Chapter 1

Introduction

1.1 Background of the Study

Since the early 1980s, the liberalisation of domestic markets and their integration into the global economy have become an important development strategy for developing countries. The programme has been pursued in various ways, including reductions in quantitative restrictions, tariff reductions, and simplification of tariff structures. While some of these reforms have been implemented unilaterally, most have been initiated through the structural adjustment reform programmes of the World Bank and the IMF, and regional trade agreements. The insistence of the IMF and the World Bank on trade reform is based on the belief that liberalisation will bring important welfare gains to these countries.

It has long been recognised that, as well as affecting aggregate income, trade policies have strong redistributive effects. For example, by influencing the allocation of resources and switching the production from non-tradable and inefficient import substitutes to efficient exportables, trade liberalisation increases the demand for unskilled labour in labour-abundant countries. More generally, equalisation of factor prices tends to occur across nations. In addition, capital account liberalisation is expected to raise employment, investment, labour productivity and hence growth in poor countries.

In recent years however, concern has been growing about how to protect the most vulnerable in society and how to ensure that their well-being improves over time. Some argue that trade liberalisation is beneficial to the poor in developing countries, while critics of globalisation claim that developing countries joining with the world economy make the rich get richer and the poor poorer in develping countries. Critics of globalisation also argue that the World Trade Organisation (WTO), which rules over 90 per cent of international trade and where about 75 per cent of members are from developing countries, reinforces the asymmetry of economic and political power among nations, despite a quarter of its membership coming from developing countries. Public protestations during recent WTO, IMF, World Bank and World Economic Forum (WEF) meetings have drawn attention to the current uneven character of the global trade regime. Acknowledging the unequal nature of global trade, the Doha Round of WTO was named "Development Round", with the aim of reforming the global trading system in favour of the development of the poor countries. However, after five years of continued negotiations, the suspension of the Doha Round in 2006 again proved that in the world trade regime, the interests of the poorer countries were not being satisfied.

Within this context, and accepting the importance of the "Millennium Development Goals", which seek to halve world poverty by 2015, the IMF and the World Bank are now imposing poverty reduction policies as a condition of their funding to developing countries[1]. To meet World Bank funding conditions, a developing country needs to prepare a Poverty Reduction Strategy Paper (PRSP) in assessing the impacts of its economic policies on the poor.

However, there is considerable debate in the empirical literature about trade liberalisation and its impact on poverty and inequality. The majority of the recent empirical literature simulating the impact of trade liberalisation has concluded that trade liberalisation has a positive impact on poverty reduction (for example, Ben-David (1999); Cline (2004); Collier and Dollar (2001); McCulloch, Winters, and Cirera (2001); Oxfam (2002); Winters (2002); and Winters, McCulloch, and McKay (2004)). On the other hand, critics of globalisation and trade liberalisation (for example, Cornia (2002); and Gunter and van der Hoeven (2004)) contend that in most cases trade liberalisation has worsened inequality. Most studies have tried to correlate trade liberalisation and poverty via growth in the economy. For example, Cline (2004); World Bank (2004); Hertel and Reimer (2005); Rajan and Bird (2002) have emphasised long term growth as the primary vehicle for poverty reduction. Dollar and Kraay (2002) and Dollar and Kraay (2001) used a cross-country regression approach to examine growth performance in relation to trade policy and found no general trend in inequality among countries known as "globalisers". Sachs and Warner (1995) and Frankel and Romer (1999) found a positive relationship between poverty and growth by using a cross-country regression. However, Rodrigues and Rodrik (2000) obtained negative results using the same method.

[1] The Millennium Development Goals (MDGs) are the eight goals in the Millennium Declaration that was adopted by 189 nations and signed by 147 heads of states and governments during the UN Millennium summit in September 2000.The goals are: 1) to eradicate extreme poverty and hunger; 2) to achieve universal primary education; 3) to promote gender equality and empower women; 4) to reduce child mortality; 5) to improve maternal health; 6) to combat HIV/AIDS, Malaria, TB and other diseases; 7) to ensure environmental sustainability; and 8) to promote a global partnership for development. The member countries have agreed to achieve these goals by the year 2015.

Again, findings on global income distribution vary noticeably depending on the analytical approach used[2]. Some analysts, using cross-country observations, found economic growth to have a neutral effect on income distribution (for example, Dollar and Kraay (2002); Li, Squire, and Zou (1998); and Sala-i-Martin (2002)). However, Milanovic (2002), using household surveys which covered about 84 per cent of world population and 93 per cent of world GDP, found world inequality increased between 1988 and 1993[3], as indicated by a rise in the Gini coefficient from 0.62 to 0.66. He argued that it is the difference in between-country inequality that drove overall inequality up.

Further, a number of authors such as Berry, Bourgguignon, and Morrison (1983), Korzeniewicz and Moran (1997) and Schultz (1998) have also found that by the middle of the twentieth century, income inequality between nations had become the primary source of inequality in the world distribution of income. According to the United Nations Development Program (UNDP, 1999a) and the World Bank (2000/01), the ratio of per capita incomes between rich and the poor countries has doubled since 1960 (Svedberg, 2004), while according to other studies such as Firebaugh (1999), and Radetzki and Jonsson (2001), inter-country distribution has remained unaltered or improved during the period 1960-1995, when measured by the Gini coefficient.

The conflicting results of various researchers originate from different methods used for estimating per capita income and measuring income distribution and poverty, and differences in time periods, the selection of countries and population weights. Yet despite such ambiguities some conclusions can be drawn about the general trends in poverty and inequality in the developing world from Table 1.1 and Figure 1.1.

Table 1.1 shows the share of population living on less than US$1 a day in developing countries during the period 1981-2004. It can be seen that except for Europe and Central Asia, poverty has fallen for all regions in the world during the last two decades. The greatest reduction in poverty occurred in East Asia and the Pacific, where the proportion of people

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[2] Global income distribution is the distribution of per capita income among the citizens of the world. It can be decomposed into the between-country distribution of income (the distribution of average income per capita between countries) and the within-country distribution of income (the distribution of income per capita within countries). In global income distribution, between-countries income differences explain about 60-90 per cent of the total income variation among the citizens of the world, while within-country distribution of income explains the remaining 10-40 per cent (Cornia, 2002).

[3] The definition of the Gini coefficient is provided in Chapter 3.

living on less than US$1 a day has decreased from 57.7 per cent to 12.3 per cent. Sub-Saharan Africa had an increasing trend until 1999, but thereafter the proportion declined to 41.1 per cent in 2004. South Asia recorded a strong performance in reducing the share of the poor in total population however this region is still deemed to be the second poorest region in the developing world after Sub-Saharan Africa.

Despite this decreasing trend of poverty in various regions in the world, about 2.8 billion people, i.e. almost half the world's population, live on less than US$2 a day and about 1.2 billion people , i.e. one-fifth of the world's population, live on less than US$1 a day. Among these, about 44 per cent live in South Asia (WDR, 2000/01). In an increasingly inter-dependent world, the high prevalence of poverty in developing countries has implications for all countries. Another alarming aspect is that poverty reduction has been accompanied by rising inequality.

Table 1.1: Proportion of people living on less than US$1 a day (per cent), 1981-2004

Region	1981	1987	1993	1999	2004
East Asia and the Pacific	57.7	28.2	25.2	15.5	12.3
China	63.8	28.6	28.4	17.8	9.9
Europe and Central Asia	0.7	0.4	3.6	3.8	0.9
Middle East and North Africa	5.1	3.1	1.9	2.1	1.5
South Asia	51.6	44.9	37.1	35.8	32.0
Sub-Saharan Africa	42.3	47.2	45.5	45.8	41.1
Latin America and Caribbean	10.8	12.1	8.4	9.7	8.6
Total	40.6	28.7	25.6	22.3	18.4

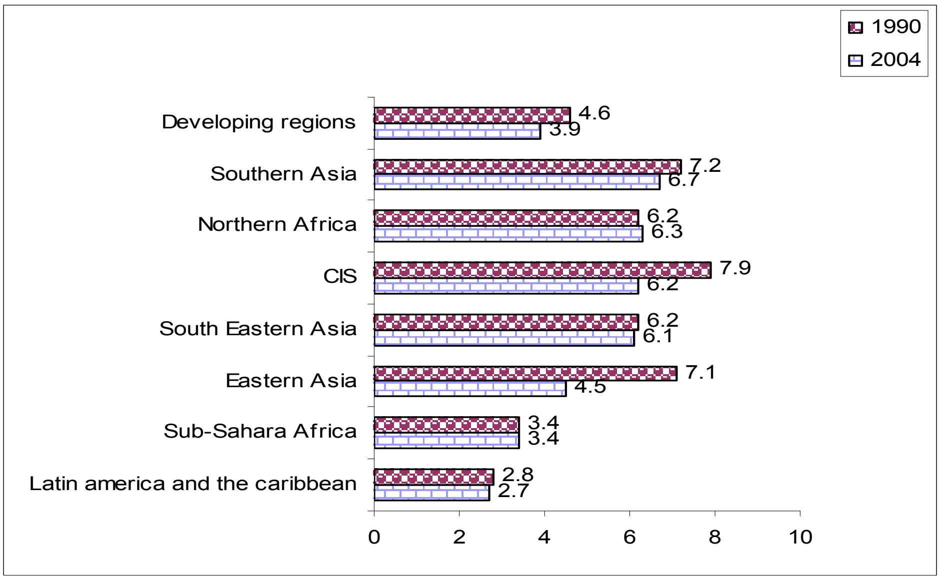
Note: Figures for 2004 show preliminary estimates.

Source: World Bank (2007b).

Figure 1.1 shows that the share of national consumption by the poorest fifth of the population in developing regions decreased from 4.6 per cent to 3.9 per cent between 1990 and 2004. In Eastern Asia, the share of consumption of the poorest people fell from 6.2 per cent in 1990 to 4.5 per cent in 2004. In the CIS (Commonwealth of Independent States), the share of consumption among the poorest people fell from 7.9 per cent in 1990 to 7.1 per cent in 2004. Figure 1.1 also shows that the shares were lowest in Sub-Saharan countries and in Latin America, where the poorest fifth of the people accounted for about 3 per cent of national consumption.

According to the Human Development Report (2005), income is distributed very unequally across the world's people. The world's richest 500 individuals have a combined income greater than that of the poorest 416 million, whereas the richest ten per cent, almost all of whom live in high-income countries, account for fifty four per cent of total income (UNDP, 2005a). Further, within-country inequality is also high in many developing countries. According to UNDP (1999b) inequality has been rising in many countries since the early 1980s. In China, disparities are widening between the export-oriented regions, with a Human Poverty Index (HPI) of 20 per cent, and the interior, with an HPI of 50 per cent. Even in OECD countries, income inequality increased after the 1980s, especially in Sweden, the UK and the USA (UNDP, 2005a).

Figure 1.1: Share of poorest quintile in national consumption in the World, 1990 and 2004 (percentage)



Source: United Nations (2007)

In an increasingly interdependent world, the high prevalence of poverty and increased inequality in developing countries demonstrate that the benefit of global growth does not necessarily spread to the poorest people in the world. Now the question is, to what extent has trade liberalisation contributed to these observed trends in poverty and inequality? Because of the absence of a widely accepted methodology, country case studies with an analytical framework such as a general equilibrium model would seem to be the best approach to addressing the problem.

In this study, Bangladesh has been used as a case study, as it was among the first of 35 countries that adopted Bretton Woods Institution-sponsored Structural Adjustment Program. As a contracting party to the GATT since 1972, and as an original member of the WTO, Bangladesh has initiated various policy reforms in order to integrate with the world economy. In the South Asian region, it was the second country to open up its economy in the 1980s after Sri Lanka. In addition, Bangladesh is party to many regional trade agreements such as the South Asian Preferential Trade Agreement (SAPTA), the South Asian Free Trade Area (SAFTA), the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)[4] and the Asia-Pacific Trade Agreement (APTA)[5] also known as the Bangkok Agreement. However, despite the implementation of various international programmes and individual government efforts, poverty remains widespread, especially in rural areas. According to the World Bank (2002b), Bangladesh has the highest incidence of poverty in South Asia, the third highest absolute number of poor in the world after India and China, and one of the lowest per capita GDP figures (US$366 per annum in 2000) in the world. Further, about 36 per cent of the population lives on less than US$1 per day (in 2000) and about 82.8 per cent lives on less than US$2 per day. Also, income distribution is highly skewed, with the Gini coefficient rising from 0.39 in 1981, to 0.47 in 2005 (GOB, 2006).

1.2 Trade Liberalisation and the Bangladesh Economy

Bangladesh introduced a restricted trade regime following its independence in 1971[6]. This highly protectionist trade policy regime was regulated through quantitative controls on imports and exceptionally high tariff rates on imports. In addition, there were strict exchange control measures. This inward-looking development strategy led to serious macroeconomic, trade and fiscal imbalances and increased dependence on external sources.

A major change in policy direction occurred in the early 1980s with the adoption of market-oriented liberalising policy reforms under the guidelines of the IMF and the World Bank. Reforms, launched in the 1980s, were aimed mainly at privatisation of state-owned

[4] BIMSTEC, which came into effect in July 2006, offers co-operation in six areas: trade and investment, technology, transport and communication, energy, tourism and fisheries. The member countries are Bangladesh, India, Sri Lanka, Thailand, Mayanmar, Nepal and Bhutan.

[5] Member countries are Bangladesh, India, Laos Peoples Democratic Republic, the Republic of Korea, Sri Lanka, Philippines, Thailand and China (came into effect from July, 2006).

[6] Before 1971, Bangladesh was the eastern part of Pakistan. After a war of liberation in 1971 against west Pakintan, Bangladesh found itself as an independent nation.

enterprises, withdrawal of quantitative import restrictions, financial liberalisation and some downward adjustment of tariffs and QRs (Quantitative Restrictions). Major progress in trade policy reform occurred in the 1990s with a substantial scaling down and rationalisation of tariffs, removal of trade–related QRs, elimination of import licensing, unification of exchange rates and the move to a more flexible exchange rate system (Ahmed and Sattar, 2004). The specific measures of trade liberalisation that Bangladesh adopted were as follows[7]. The unweighted average protection rate[8] declined from 73.6 per cent in 1991-92 to 24.3 per cent in 2006-07, while the weighted average rate of protection fell from 23.1 per cent in 1992-93 to 9.6 per cent in 2004-05 (World Bank, 2006b). The maximum tariff (custom duty) rate was reduced from 350 per cent in the fiscal year 1991 to 37.5 per cent in 2000. Most favoured-nation (MFN) tariffs fell from an average of 58 per cent to 22 per cent during the period 1991-2000, and then to 15.5 per cent in 2005-06 (WTO, 2006). The number of tariff bands had been reduced to 5 in 2004-05 (0 percent, 7.5 per cent, 15 per cent, 22.5 per cent and 30 per cent) from 15 in 1992-93. There was also a significant reduction in the number of imported commodities subject to quantitative restrictions.

On the export side, greater efforts were made to diversify the export base, improve the quality of exports and stimulate higher-value added exports of machinery and intermediate inputs. Duty drawbacks and certain other tax exemptions, such as income tax rebates, lower interest rates on bank loans, tax holidays and other incentives were introduced. In its exchange rate regime, Bangladesh introduced a flexible exchange rate in 2003 in place of the fixed exchange rate system dating from 1972.

Even though the initial response of the economy to the reforms was not promising, dramatic changes occurred during the 1990s[9]. Openness, measured by the rates of trade (exports plus imports) to GDP, increased from 18.0 per cent in the 1980s to 22.9 per cent in the 1990s and 30.4 per cent during the period 2000-05 (IFS). The growth of GDP, which had averaged 3.7 per cent annually during the 1980s, increased to 5.1 per cent in 2000-05. Per capita real GDP accelerated from 1.3 per cent per annum in the 1980s to 3.3 per cent in 2000-05 (IFS). Besides these successes, other major macroeconomic indicators showed positive trends. For

[7] The nature and extent of economic reforms in Bangladesh are discussed in detail in Chapter 2.
[8] In addition to custom duties, the protection rate incorporates the protection provided by all other import duties, i.e. surcharge and fees. Supplementary duty and VAT are also levied on imports.
[9] Details on Bangladesh's post 1990 economic performance are to be found in Chapters 2 and 3 of this study. See also Hossain (2006), and Mujeri and Khondker (2002).

example, the average annual rate of inflation fell from 10.8 per cent during the first half of the 1980s, to 3.4 per cent during the period 2000-05. Both Investment-GDP and Saving-GDP ratios increased from 15.9 per cent and 3.4 per cent in the 1980s to 17.8 per cent and 8.3 per cent respectively by the end of the 1990s. There was also a notable improvement in the government's budgetary position. The budget deficit as a percentage of GDP fell from 9.3 per cent in the 1980s to 4.5 per cent in 2000-05. Further, in the external sector, the export growth rate increased from around 6 per cent of GDP in 1973-74 to 12 per cent in 2003-04. Clearly, Bangladesh's more liberal trade policies have coincided with greater stability and faster economic growth.

1.3 Research Problem

The acceleration in the growth of per capita income in Bangladesh in the 1990s was accompanied by considerable progress between 1991-92 and 2005 in poverty reduction. The overall incidence of poverty fell from 58.8 per cent in 1991-92 to about 50 per cent in 2000 and to about 40 per cent in 2005. The depth of poverty in the population (poverty gap) fell from 17.2 per cent to 12.9 per cent in 2000 and to about 9 per cent in 2005, whereas the severity of the poverty (squared poverty gap) fell from 6.8 to 4.6 per cent in 2000 and to about 2.9 per cent in 2005 (BBS, 2006).

Notwithstanding this poverty reduction, the faster rate of growth in incomes in Bangladesh during the 1990s was also accompanied by some increase in income inequality. The income-based Gini coefficient reveals only a gradual increase in inequality from 0.36 in 1983 to 0.38 (towards the end of the pre-liberalisation period) in 1988 at the national level, but thereafter it rose steeply to 0.47 in 2005. In the case of the urban areas, the Gini coefficient, after declining during the period 1983-1988, rose sharply from 0.40 in 1991 to 0.50 in 2005. In the case of the rural areas, an upward trend occurred throughout the 1980s and the 1990s.

Table 1.2 shows how unevenly income has been shared between the lowest and highest quintiles in Bangladesh during the period 1981 to 2004. It can be seen that during the period 1981-82 to 1991-92, the ratio of the highest quintile to the lowest quintile fluctuated between 6.0 to 7.0 but thereafter it trended upwards.

Table 1.2: Income disparities between the lowest and highest quintile in Bangladesh, 1981-2004

Year	1981-82	1983-84	1985-86	1988-89	1991-92	1995-96	2000	2004
Ratio of top 20% to lowest 20%	6.8	6.0	6.0	7.0	6.9	8.8	11.0	11.1

Source: Household Income and Expenditure Surveys and BBS (2004).

The combination of a faster economic growth rate and increasing income inequality suggests that the benefits of growth have not been shared equally between the rich and the poor. The present study is motivated by these considerations and hence it attempts to develop an analytical framework which takes into account both direct and indirect effects of policy changes on poverty and inequality, as well as macroeconomic performance and economic structure.

Much research has been conducted on Bangladesh concerning the benefits of trade liberalisation. Some studies (for example, Hossain (1989); Chowdhury (1990); Ahammad (1995); World Bank, (1999a); Ahmed (2001); Hossain (2003); Ahmed and Sattar (2004); and Hoque (2006)) found that trade liberalisation had positive impacts on the economy. However, most of these studies took a macroeconomic perspective with limited consideration of distributional impacts. Although in recent years there have been some studies into the welfare and poverty impacts of liberalisation, these have produced conflicting results. For example, according to Khondker and Raihan (2004) trade liberalisation produced a welfare loss for all representative household groups, measured by the compensating variation (CV) and equivalent variation (EV). In addition, they found that poverty deteriorated in both urban and rural areas. Annabi *et al,*. (2005) also found negative implications for overall poverty and welfare for households. In contrast, Mujeri and Khondker (2002) found that the welfare gains emanating from globalisation efforts are generally pro-poor even though they accrue more to well-off household groups than less well-off groups. These contradictory results call for further examination of the issue. Moreover, to date very few studies have paid attention to the public revenue consequences. In defining a complete trade liberalisation scenario, it is also important to define how the government adjusts for any loss in tariff revenues and its projected effects. This issue needs to be taken into account in any comprehensive assessment of the relationship between trade liberalisation and its impact on poverty and inequality.

1.4 Objectives of the Study

The main objective of this study is to use quantitative methods to examine the impacts of trade policy changes on household poverty and income distribution in Bangladesh, in both the short run and the long run. In addition, this study hopes to gain insight into how the reduction in tariffs affects various macroeconomic indicators, output and employment at the level of individual industries, and households' welfare. Specifically, this study seeks to answer the following questions:

- What will be the impact of reducing the nominal rate of protection on the allocation of resources and the distribution of income?

- Which sectors will be most affected by tariff reductions?

- How will various socio-economic groups be affected by trade liberalisation? and

- How will various macroeconomic variables such as GDP, aggregate employment, exports, and imports be affected by significant tariff cuts.

In line with the above mentioned questions, the specific objectives of the present study are:

1) to provide an overview of trade liberalisation policies in Bangladesh and their accompanying developments in macroeconomic performance, on poverty, inequality and the labour market situation;

2) to develop a multi-sectoral, multi-factor and multi-household computable general equilibrium (CGE) model for Bangladesh, that incorporates all the attributes of the economy and an endogenous poverty line that can be used to evaluate the poverty effects of trade policies;

3) to link the CGE model to Household Income and Expenditure Survey data using a top-down representative household approach to assess the income inequality and poverty implications of trade policies for each household group; and

4) to analyse the impacts of across the board tariff reductions (both with and without a compensatory change in consumption tax) on domestic output, employment, trade balance, terms of trade and the distribution of income and poverty.

1.5 Methodology

The focus of this study is to analyse the short and long run effects of tariff adjustment in general and the poverty and income distribution impacts in particular in Bangladesh. To do this, we need an economy-wide framework that considers details of households' incomes and also considers the impact of shocks on the distribution of incomes across disaggregated factors. As examples, we need to examine capital disaggregated by type, and labour by education, sex, skill and region. Moreover, the framework must also include the mapping of factors that affect household income including its size distribution. A computable general equilibrium model (CGE) is best suited for this purpose, as it takes into account all the economic linkages and interactions within the economy. As Lofgren, Robinson, and El-Said (2003a, p. 326) argue, "this class of models explicitly incorporates markets for factors and commodities and their links to the rest of the economy, providing a natural framework for generating the extending functional distributions as well as data on employment, wages and commodity prices". By allowing interactions of all agents in the economy, CGE model captures the general equilibrium adjustments and thus able to estimate the consequences of both the micro and macroeconomic policies.

In this study, a static multi-household, multi-sector computable general equilibrium model is developed to assess the economic impacts of tariff liberalisation in Bangladesh. The model follows Horridge *et al.,* (1995) IDC-GEM, a SAM-based computable general equilibrium model of the South African Economy. IDC-GEM is, in turn, based on the Australian ORANI-F model (Horridge, Parmenter, and Pearson, 1993), which closely follows ORANI, a multisectoral CGE model for the Australian Economy (Dixon *et al.*, 1997). Following the approach proposed by Decaluwe *et al.*, (1999), poverty analysis is performed with income variations in combination with an endogenously-determined poverty line in a representative household approach. By using a non-parametric representative household approach, income distribution functions are empirically estimated for each group of households from household survey data and are linked to the CGE model in a top-down fashion to estimate absolute and relative poverty.

The Foster-Greer-Thorbecke (FGT) measure of poverty is used to quantify household poverty levels, which allows us to compare three measures of poverty: the head count ratio, poverty gap index and squared poverty gap index.

1.6 Outline of the Study

The remainder of this thesis is structured as follows. Chapter 2 presents an overview of trade liberalisation policies in Bangladesh and accompanying macroeconomic developments. Chapter 3 examines trends in poverty, inequality and labour market conditions in Bangladesh. Chapter 4 explores the theoretical and empirical linkages between trade policy, inequality and poverty. In addressing the empirical linkages, this chapter highlights the existing CGE literature focused on poverty and income inequality. In addition, Chapter 4 surveys CGE models that have been used for analysing policies in Bangladesh. Chapter 5 develops a static multi-sectoral, multi-household CGE model for the Bangladesh economy. Chapter 6 describes the construction of a database for the Bangladesh model and the construction of a Social Accounting Matrix (SAM) that is needed to implement the income distribution part of the model. Chapter 7 presents the model closures, and the key results of alternative trade policy simulations. Results of the simulations are provided for some macroeconomic variables, sectoral level variables and household level variables. An analysis of the effects on poverty and income distribution in Bangladesh under trade policy simulations is presented in Chapter 8. Finally, Chapter 9 summarises the main findings of the study and their policy implications. This chapter concludes with a discussion of the limitations of the study and suggestions for future research.

Chapter 2

The Bangladesh Economy: Policies and Performance

2.1 Introduction

Since gaining political independence from Pakistan in 1971, the Bangladesh economy has undergone numerous shifts in trade, fiscal, industrial and financial policies. Immediately after independence Bangladesh adopted a protectionist inward-oriented policy regime with rigid trade and exchange controls. In the 1980s and 1990s, the country experienced a radical shift to a more liberal policy regime under the structural adjustment programs (SAP)[10] suggested by the World Bank and the International Monetary Fund (IMF). The biggest challenge within Bangladesh's economic reform program has been the liberalising of its trade sector. Other policy measures include reforms in the fiscal, financial and the industrial sectors.

The main objective of the present study is to assess the impact of the major trade reforms on the distribution of income and on the incidence of poverty in Bangladesh. This chapter presents an overview of trade liberalisation policies in Bangladesh and accompanying macroeconomic developments. After a brief background, section 2.2 provides the historical context from which the trade policy reforms emerged. Section 2.3 describes their nature and extent and highlights the implementation of various import liberalisation and export promotion policies in Bangladesh. It also examines financial sector reforms including foreign exchange, and fiscal reforms. Section 2.4 measures the degree of progress towards trade liberalisation in Bangladesh by using a variety of indexes: the export orientation ratio; the import penetration ratio; the ratio of trade to GDP; and anti-export bias rates. Section 2.5 evaluates the performance of the Bangladesh economy with section 2.6 offering some concluding remarks.

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[10] Structural Adjustment Program (SAP) means the policy changes implemented by IMF and the World Bank in developing countries. These policy changes are conditions for getting new loans from the IMF or the World Bank. This program is implemented through a Structural Adjustment Facility (SAF), Enhanced Structural Adjustment Facility (ESAF), Structural Adjustment Loans (SALs), and Sectoral Adjustment Loans (SECALs). See Rashid (2000).

2.2 Structural Conditions in the 1970s

Bangladesh had a war-ravaged economic structure in 1971. Domestic and foreign resources were not sufficient to match the investment requirements of rehabilitation, so the government had to resort deficit financing. As a result, the money supply increased rapidly leading to high inflation. In the face of a rising import bill and decreased exports, the balance of payments deteriorated severely and foreign exchange reserves fell to a very low level. There was a chronic deficit in the current account of the balance of payments and the merchandise trade deficit increased to 10.4 percent of GDP by the fiscal year 1980 (Rashid, 2000).

Over the same period, the economy pursued a highly restricted tariff regime. The tariff structure was characterised by a very high tariffs on final goods and lower tariffs on intermediate and primary products. Extensive quantitative restrictions (QRs) banned the import of luxury and non-essential commodities. The export base, on the other hand was very narrow, with raw jute and jute products accounting for about 87 per cent of all exports. Private investment was also highly restricted during the early 1970s, with priority given to public investment. The exchange rate regime was a fixed exchange rate system under which the currency was highly overvalued.

This highly restrictive import substituting development policy had dismal macroeconomic consequences. Between the fiscal years 1980 to 1985, the average annual growth rate of GDP reduced to 3.5 per cent, from 5 per cent in the 1970s. In the fiscal year 1981, real manufacturing growth rate was 5.4 per cent which recorded a negative growth of 0.16 per cent in the fiscal year 1983. Total export growth declined to an average of 4.5 per cent during the fiscal year 1982-83. The current account deficit to GDP ratio climbed from 10 per cent in the fiscal year 1981 to 12 per cent in the following year, but subsequently fell to 8.2 per cent in the fiscal year 1985 (Rashid, 2000).

A major change in policy direction occurred in the early 1980s with the adoption of market oriented liberalising policy reforms. In fact, Bangladesh was among the first of 35 countries which adopted the World Bank/IMF sponsored Structural Adjustment Program. This program included export promotion schemes, reform and privatisation of state owned enterprises, exchange rate liberalisation, removal of price controls and subsidies, and tax reforms. It should be noted here that although outward orientation began in Bangladesh in the early

1980s, the pace and extent of liberalisation accelerated during the late eighties and the early nineties, when more comprehensive programs of stabilisation and economic reforms were put in place under the structural adjustment programs prescribed by the World Bank and the IMF (Khondker and Raihan, 2004). The latter decade saw liberalisation of imports through removal of quantitative restrictions (QRs), reductions in nominal and effective tariff rates and adoption of a unified and moderately flexible exchange rate regime (Ahmed and Sattar, 2004).

2.3 Nature and Extent of Economic Reforms in Bangladesh

Economic liberalisation in Bangladesh can be divided into three phases: phase I (FY 1982-FY 1986), phase II (FY 1987-FY 1991) and phase III (FY 1992-onwards) (Bayes & Muhammad, 1998). The first reform measures were made during the fiscal years 1982-86, which coincided with the introduction of the New Industrial Policy of 1982, providing for denationalisation of public enterprises, simplification of investment sanctioning procedures, and similar measures. This policy was followed by some downward adjustment of tariffs and QRs. The second phase of trade reforms coincided with the introduction of the Revised Industrial Policy of 1986 which was aimed at promoting private enterprise and providing incentives and opportunities for private investment.

The third phase of trade reforms brought a significant intensification of the trade liberalisation program. The Industrial Policy of 1991 (revised in 1992) was based on the philosophy of market economy[11]. Under this policy greater incentives for private investment were provided through various provisions such as tariff rationalisation, tax holidays, and accelerated depreciation allowances. The following sections will discuss these changes briefly.

2.3.1 Import Policy Changes

On the import side, from the very beginning government strategy was to face the increasing competition around the globe by gradually reducing duty rates. Bangladesh pursued one-year export and import policies in the eighties and then two-year policies in the first half of the nineties, after which five-year export and import policies were formulated and implemented. More recently the government has announced three-year export-import policies (2003-2006) (GOB, 2005). Whereas the earlier import policies were directed at decreasing tariff levels, rationalising the tariff structure, phasing out the quantitative restrictions (QRs) and

[11] See Ahmed (2001).

simplifying trade procedures, the new import policies have been introduced in response to the rapid changes and expansion of world trade. At the same time they have been made consistent with various industrial policies mentioned earlier. The important objectives of the new import policies are:

a) Further simplification of the import regime in the light of the changes due to globalisation and the gradual development of a free market economy under WTO agreements;

b) Strengthening the provisions for technology import to promote widespread diffusion of modern technology;

c) Provision of import facilities for export oriented-industries to build a strong export base; and

d) Gradual removal of import protections to make available cheaper industrial raw materials, and thus enhance competitiveness and efficiency.

The important changes in the overall structure of tariffs are discussed below:

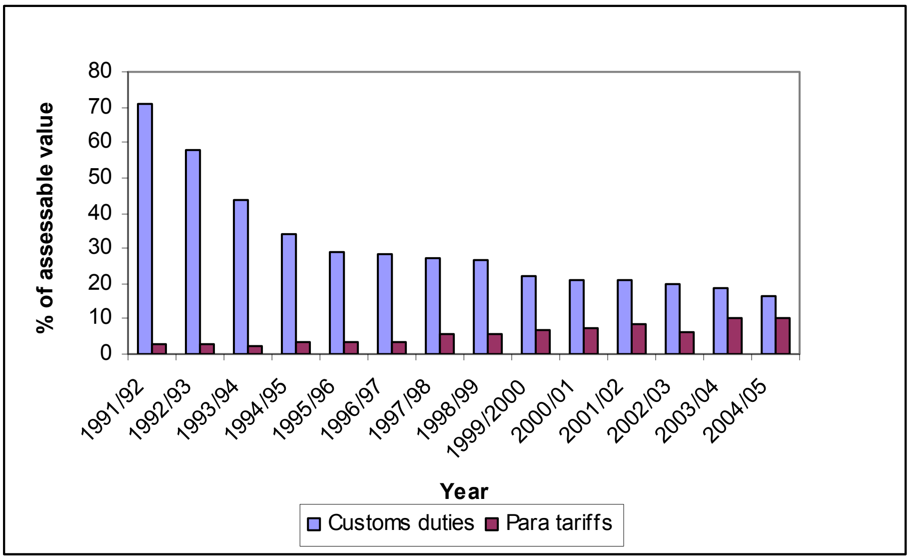
2.3.1.1 Reforming the tariff structure

During the 1980s, several attempts were made to reform the tariff structure by reducing the variance of tariffs. In 1986, the number of statutory rates was reduced from 24 to 11, and then in 1988, the government adopted a phased three-year program to reduce maximum tariffs: 1) for most final goods imports from over 200 per cent to 100 per cent; 2) for raw materials to 20 percent; and 3) for intermediate products to 75 per cent (Ahammad, 1995, pp. 23-24). However, the situation did not improve much. Since the 1990s, Bangladesh has steadily reduced its import duties (Figure 2.1, 2.2 and 2.3). The tariff regime has been simplified by equalising operative tariff rates with statutory tariff rates and also by reducing tariff barriers and tariff bands. The number of tariff bands was gradually reduced from 15 in 1992-93 to 5 (0 per cent, 7.5 per cent, 15 per cent, 22.5 per cent and 30 per cent) in 2004-05.

Furthermore, the maximum tariff rate was lowered from 300 per cent to 37.5 per cent, and most favoured-nation (MFN) tariffs fell by more than half, from an average of 58 per cent to

22 per cent over the same period (WTO, 2006). The share of bound duties remained unchanged between 1997 and 2003, at 13.2 per cent, while the share of duty-free tariff lines increased from 4 per cent in 1992 to 30 per cent in 2003. The average weighted import customs duty fell from 23 per cent to 12 per cent between 1991-92 and 2004-05. During the same period, the unweighted average protective rate[12] of all tariff lines fell from 73.6 per cent in 1991-92 to 32 per cent in 1995-96 (Figure 2.1). After 1995-96, the liberalisation process stagnated so that during the period 1995 to 2006 the unweighted average tariff declined only slightly (Figure 2.1), from 31.96 per cent to 24.32 per cent. In the case of the industrial tariff line the average tariff came down from 32 per cent to 25 per cent (Figure 2.2) while for agricultural goods it remained virtually unchanged from 1995-96 to 2004-05 (World Bank, 2006b). The reason for this slow reduction in tariff levels was the associated increased use of para-tariffs. Therefore, although average custom duties declined sufficiently during 1995-96 to 2004-05, this was almost entirely offset by increases in para-tariffs, which went up from an average of 3.3 per cent to 6.3 per cent over the same period.

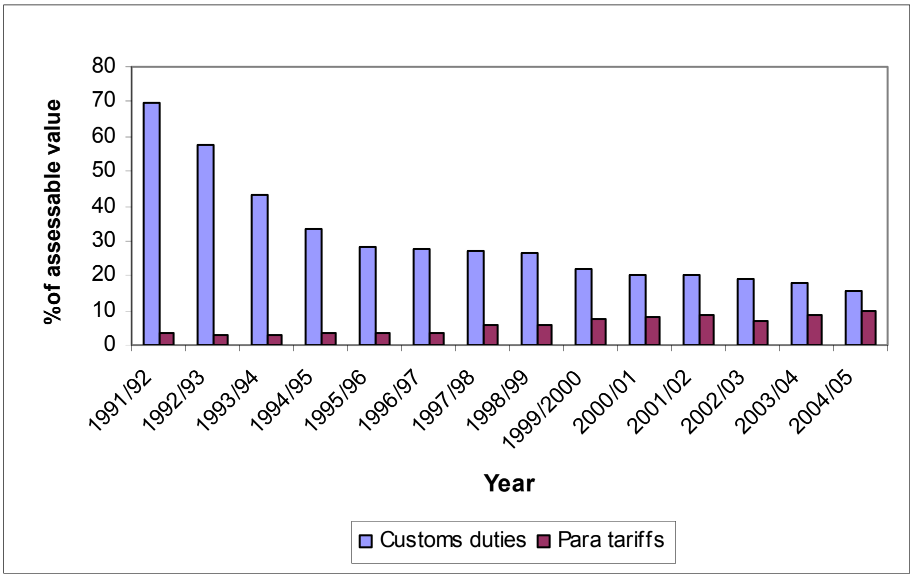
Figure 2.1: Bangladesh 1991/92-2004/05: All tariff lines, unweighted average protective import duties



Source: World Bank (2006b)

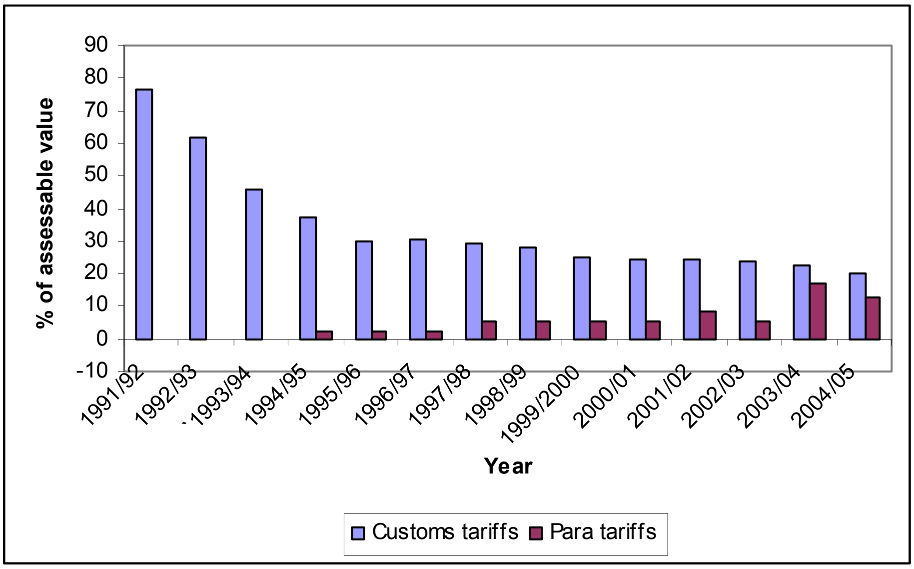
[12] Protective rate includes customs duties and some important taxes which have protective effects known as 'para-tariffs'. Since the early 1990s five different para-tariffs which have been used to raise revenue as well as provide extra protection for selected import competing industries. They are Infra-structure Development Surcharge (IDSC), Supplementary Duties (SD), Regulatory Duties, VAT (Value Added Tax) and License Fee. See World Bank (2006b) for details.

Figure 2.2: Bangladesh1991/92-2004/05: Industrial tariff lines, unweighted average protective import duties



Source: World Bank (2006b)

Figure 2.3: Bangladesh 1991/92-2004/05: Agriculture tariff lines, unweighted average protective import duties

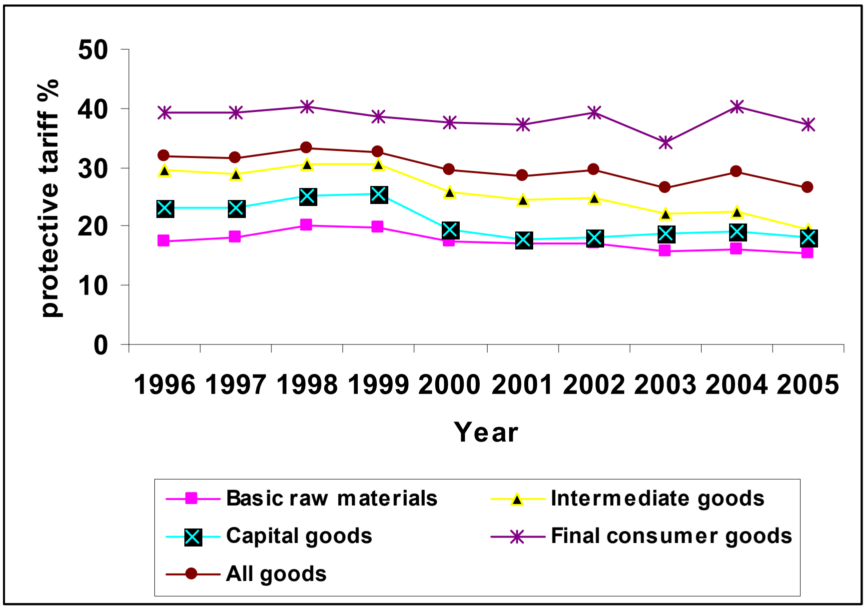


Source: World Bank (2006b)

According to the World Bank (2006b), in 2003-04, para-tariffs accounted for 35 per cent of the average protection rate for all tariff lines, 33 per cent of the protection rate for all industrial products and 43 per cent of the average protection for agricultural, fisheries, livestock and processed food products. So, in spite of drastic reductions in maximum tariffs, retention of these para-tariffs held the top tariff rate at a fairly high rate, which points to the existence of tariff escalation as indicated in Figure 2.4.

As shown in Figure 2.4 between 1995-96 and 2004-05 the average final consumer goods protection rate did not show any downturn trend although there was a significant reduction in custom duties. By contrast, average protection rates on raw materials, intermediate goods and capital goods were much lower.

Figure 2.4: Bangladesh FY 1996-FY2005: Average protective tariffs by type of goods



Source: World Bank (2006b)

During 2004-05, in the average protection rate of final goods para-tariffs comprised 12.75 percentage points whereas for raw materials, intermediate goods and capital goods these rates were 0.87, 1.30 and 3.06 percentage points respectively (World Bank, 2006b)[13]. This escalation in the tariff system was a major source of distortion as it created big differences in effective rates of protection (ERPs)[14] both within the import substitution sector and between import substitution activities and export activities. A recent estimate of industry wide ERPs

[13] This much lower incidence of the selective para-tariffs among raw materials, intermediate goods and capital goods is to provide very high protection levels to a wide range of import substitution industries while reducing the tariffs on their intermediate inputs (World Bank 2006b).
[14] The effective rate of protection is defined as the percentage change in the value added per unit of output in an industry because of the imposition of tariffs.

by the Bangladesh Tariff Commission, using the 1992-93 Bangladesh Input-Output table, indicates a gradual decline in average levels of effective rates of protection from 76 per cent in FY1992 to 29 per cent in FY1998. However, ERPs varied widely across sectors with the export-oriented textiles and clothing sectors together with processed food and tobacco products receiving high levels of effective protection (Appendix Table A 2.1).

2.3.1.2 Elimination of quantitative restrictions (QRs)

In the 1980s Bangladesh had a very restricted import regime characterised by QRs under which imports of many products were effectively banned; only commodities included in the 'positive list' were allowed to be imported. Subsequently, the 'positive list' was replaced by the 'negative list' which listed all banned items and the 'restricted list' which listed items that were allowed to be imported under certain conditions. Items not included in these two lists could be imported freely. During the 1990s there were significant reductions in the number of commodities subject to quantitative restrictions. The first relaxation of QRs took place under the Import Policy Order (IPO) 1991-93, which reduced the number of items on the import control list from 325 to 193. Eventually, the Import Policy Order for 2003-2006 reduced the number to 63 of which only 24 were for protective purposes (Table 2.1).

Table 2.1: Evolution of import restrictions

	IPO 1991-93	IPO 1993-95	IPO 1995-97	IPO 1997-02	IPO 2003-06
Number of items in the control list at the HS-4 digit level	193 (15.65%)	111 (9.0%)	120 (9.7%)	122 (9.8%)	63 (5.1%)
Number of trade related items in the control list at the HS-4 digit level	79 (6.45%)	19 (1.5%)	27 (1.9%)	28 (2.2%)	24 (1.9%)

Source: Ahmed and Sattar (2004)

According to Ahmed and Sattar (2004), whereas in 1990 about 26 per cent of all HS[15]-4 digit codes were subject to QRs, by 2002 only 122 items (or 10 per cent of items) covering about 2 per cent of imports remained restricted for trade and non-trade reasons. Furthermore, the

[15] The Harmonized System (HS) is an internationally accepted system of classification of imports. The greater the level of digit will be, the greater the level of detail in the description of the commodity.

number of banned items was sharply reduced from 135 in the fiscal year 1990 to only 5 in 2000 (Rashid, 2000). Under IPO 2003-06, trade related restrictions were limited to agricultural products, packaging materials and textile products. Nearly 40 per cent of all QRs were applied to textile products that enjoyed the heaviest protection. However this protection was removed in January 2005 (World Bank, 2006b) with some restrictions on the import of goods related to health, safety, and the environment and other groups still in place.

2.3.1.3 Simplifying import procedures

Immediately after liberation, one of the government's import procedures was the provision of import licensing. However, in 1983-84, the licensing system was eliminated and replaced by a simple Letter of Credit (L/C) procedure. Furthermore, the liberalisation process in 1985 replaced the positive lists with lists containing goods subject to some form of restriction and ultimately to a single country list. In subsequent years, the coverage of the control list was gradually reduced (World Bank, 1995). Among other measures, the introduction of a trade-neutral value added tax (VAT) in 1994 and a Voluntary Pre-Shipment Inspection (PSI) scheme in the 1993-94 budget were important. The trade regime was also simplified by equalising the operative tariffs with statutory tariffs and also by reducing tariff bands.

2.3.2 Export Promotion Policies[16]

Bangladesh's post-independence trade policies were characterised by severe import restrictions which caused high effective rates of protection for the domestic import-competing industries, resulting in an anti-export bias. Subsequently, Bangladesh embarked on an export-led industrialisation strategy to take advantage of freer trade. In both the New Industrial Policy (NIP) (1982) and the Revised Industrial Policy (RIP) (1986), export diversification and import liberalisation policies were given priority. Industrial policy in 1991 was also designed with the explicit goal of enhancing the environment for the growth of Bangladesh's export industries. To promote export growth and narrow the gap between import payments and export earnings, the government initiated various export policies after the 1980s. After the

[16] Detailed the Export Policies of Bangladesh will be found at Export Promotion Bureau of Bangladesh, Ministry of Commerce, Government of the People's Republic of Bangladesh also available at http://www.epb.gov.bd/the_organization.php.

completion of the 1997-2002 export policy, the government formulated and implemented an export policy covering 2003-06 with the main objectives[17] :

1) to develop marketability of exportables through product diversification and quality improvements;

2) to establish backward linkages from the export-oriented industry and service sectors;

3) to attract increased numbers of entrepreneurs into export-oriented industries;

4) to expand existing markets and also develop new markets for Bangladeshi exports.

The strategies devised and implemented to reach the above objectives were:

1) remove regulatory and procedural bottlenecks;

2) provide policy support to Bangladeshi exporters;

3) development of infrastructure;

4) formulate an export development program to broaden and diversify the range of exportable products through backward linkages; and

5) formulate policy for quality improvement and encourage export enterprises to adopt international standards.

In line with the above objectives an incentives package including fiscal and financial incentives and general facilities was implemented. It can be summarised as follows.

[17] Source: GOB (1998).

A. Fiscal incentives**:**

1) Income tax rebate on export earnings: Until 1995-96, exporters were eligible for income tax rebates of up to 50 per cent of the tax attributable to income from exports. However after 1995-96, 50 per cent of income from exports became tax-free.

2) Special bonded warehouse scheme: This was first introduced for the ready-made garment industry in 1978, when firms producing exclusively for export were allowed to import and stock duty free imports. Until 1993, this facility was available only for 100 per cent exporters in the garment industry using a back-to-back letter of credit (L/C) and to suppliers that sold 100 per cent of their output to garment exporters (Ahmed, 2001). After 1993, the special bonded warehouse facility was extended to all 100 exporters and "deemed exporters"[18].

3) Back-to-back L/C system: Under this scheme, exporters of certain products such as ready-made garments and specialised textiles could open letters of credit on a back-to-back basis for the importation of raw materials through commercial dealers without prior permission of the Central Bank. Exporters could open an L/C up to 75 per cent of the net Free on Board (f.o.b)[19] value of the export letter of credit and import raw materials on a deferred payment basis, payment being made from the proceeds of their exports. After 1986-87, this facility was extended to a broad range of export industries.

4) Export performance licensing (XPL)/export performance benefit scheme: Under this provision, the exporters of non-traditional products obtained Import Entitlement Certificates equal in value to a certain percentage of their gross f.o.b export earnings. In 1986, the XPL scheme was replaced by the Export Performance Benefit Scheme (XPB) and the entitlement rates were raised to 40 per cent and 100 per cent of the f.o.b value of exports (Ahmed, 2001).

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[18] The local raw materials used for producing exportable and local products and raw materials used in industries with foreign investment were deemed to be exports.

[19] "Free on Board" (f.o.b) is a trade term used to mean that a seller will deliver goods on a railroad car or vessel without any expense to the purchaser. The buyer has to bear all costs and risk of loss to the goods from that point.

5) Payment of duty drawback through commercial banks: Under this system, exporters obtained a full or partial refund of the value of customs duties or sales taxes already paid on the importation of raw materials used in the production of export products. From 1980 a flat rate draw back scheme was introduced, under which it was paid on the basis of a rate determined on the f.o.b value of export products according to input-output coefficients.

6) Tax holidays: Exporters were granted tax holidays of 5-7 years or accelerated depreciation allowance at the rate of 80-100 per cent. This facility was open especially for new export oriented units, new industrial companies, agro-processing units, and ICT businesses including computer software.

B. Financial incentives:

1) Cash compensation scheme: The scheme was created especially for the ready-made garments, hosiery and specialised textile units which were not covered by bonded warehouse and duty draw back facilities. It granted a compensatory benefit at a rate of 15 per cent of the f.o.b value of exports to cover possible taxes paid on imported and locally purchased inputs used in the export products.

2) Export Credit Guarantee Scheme: To provide insurance against possible risks there were actually four schemes: (i) export credit guarantee (pre-shipment); (ii) export credit guarantee (post-shipment); (iii) export payment risk policy; and (iv) a whole turnover pre-shipment finance guarantee.

3) Use of foreign currency: Exporters were entitled to retain either 40 per cent or a specified rate fixed by the government of their f.o.b earnings in their foreign currency accounts for real business needs.

4) Export Development Fund: This fund helped exporters with venture capital on easy terms and at a lower rate of interest. It also assisted exporters in obtaining foreign technology and consultancy for product development and diversification.

5) Export Processing Zones (EPZs): To provide a secure environment for foreign investors, the Bangladesh government established EPZs where local investors were permitted to invest in export industries. These producers could import raw materials, supplies and capital goods free of duty, retain foreign currency earnings, operate in a labour market free of unions and were exempt from income tax for ten years after establishment.

As a result of the above mentioned incentives and various other initiatives, Bangladesh has experienced impressive export growth over the last three decades. Export earnings in 2004-05 were US$8,654.82 million which was 13.83 per cent higher than the previous year (World Bank, 2006a).

2.3.3 Financial Sector Reform Policies

Bangladesh inherited a suppressed financial sector from Pakistan. Until the early 1980s the sector was characterised by excessive controls over interest rates, directed credit, complex rules for money and capital markets and an overvalued exchange rate (Chowdhury, 2001). The situation was exacerbated by the nationalisation of all commercial banks and other financial institutions. In 1976, the government of Bangladesh began the liberalisation process with the privatisation of state owned enterprises along with the reform of the financial sector. This led to the denationalisation of the two commercial banks (NCBs) and establishment of a number of new private commercial banks (PCBs) to operate. In addition, the interest rate on deposits was raised to afford a positive real return on deposits. The main aim of the government was to create competitive conditions in the banking sector.

In 1984, the government appointed the National Commission on Money, Banking and Credit (NCMBC) to investigate problems in the banking sector. In response to the commission's report the government commenced the first phase of a Financial Sector Reform Programme (FSRP) in 1990, which was supported by Financial Sector Adjustment Credit (FSAC) provided by the World Bank. After finishing the FSRP in 1996, the government formed a Bank Reform Committee (BRC) which submitted its recommendations in 1999. These included deregulation of interest rates, strengthening of capital markets and improvements in debt recovery (Bhattacharya and Chowdhury, 2003). In considering the above mentioned recommendations, the Bangladesh government took several reform measures which are summarised below:

1) Interest rates**:** Under the financial sector reforms the government allowed the private sector banks to set their own interest rates within prescribed bands. Interest rate bands were prescribed for different categories of loans, advances and deposits within which banks were free to fix their rates. Previously the Bangladesh Bank (the Central Bank) determined the interest rate. Under this new policy, lending rate bands were determined on the basis of shadow rates and deposit rate bands were determined taking into consideration the expected rate of inflation (Chowdhury, 2000). However in 1992, except for the three sectors - agriculture, small industries and cottage industries, the interest rate bands were abolished for all sectors. Interest rate bands on deposits were also eliminated. The government encouraged banks and non-bank institutions to rationalise the interest rate on loans. Furthermore, to provide an adequate flow of finance, the Bangladesh Bank also reduced the bank rate from 8 per cent to 5 per cent in 2003-04 (GOB, 2005).

2) Cash reserve ratio requirement**:** To increase investible funds with the banks, the minimum cash reserve requirement was reduced.

3) Measures for loan recovery**:** One of the biggest problems of the financial sector in Bangladesh was loan defaults. The government undertook various measures to recover large loans. The Ministry of Finance along with Bangladesh Bank, NCBs and Development Financial Institutions (DFIs) initiated a move to set guide lines to write-off bad loans of the banking system. In addition, the "Money Loan Court" was initiated in 2003. As a result of these initiatives the level of bad loans gradually declined.

2.3.3.1 Reforms in foreign exchange regime

Immediately after independence in 1971, Bangladesh's currency, the taka (TK), was pegged to the British pound sterling at £1=TK.18.97[20]. However, due to existing expansionary

[20] In a pegged or fixed exchange rate the government (or the central bank) sets a fixed price for the domestic currency in terms of another country, such as the U.S. dollar, the Euro or the Yen, or a basket of currencies. To

monetary and fiscal policies, this system led to a crisis in the balance of payments (Hossain, 2000). The exchange rate was devalued against the pound by 58 per cent immediately after independence in 1971 and by 85 per cent in 1975 with respect to the pound sterling (Bhuyan and Rashid, 1993).

In 1979, the taka was pegged to a trade-weighted basket of the currencies of Bangladesh's major trading partners, but allowed to fluctuate within margins of 2.5 per cent on either side of the peg. In 1983, the intervention currency was changed to the US dollar as the United States had the highest trade relative weight with Bangladesh. Until then Bangladesh had practised a multiple exchange rate regime involving the official pegged rate and a secondary foreign exchange rate associated with the introduction of the Wage Earner's Scheme[21]. Because of the increasing inflow of remittances, the Wage Earner's Scheme latter became an important medium for import liberalisation. It enabled importers to avoid the cumbersome and time-consuming process of import licensing (Bhuyan and Rashid, 1993). The percentage difference between the official exchange rate and the secondary foreign exchange rate (known as the exchange rate premium) narrowed as more imports were shifted to the secondary market from the official market. Between 1983 and 1990, the percentage of total imports financed through the secondary market increased from 21 to 47 per cent. This in turn encouraged the growth of black markets for foreign exchange to develop and made the foreign exchange system cumbersome. Ultimately in 1992, under a reform program the government unified the two exchange rates.

To offset differences in the domestic and foreign inflation rates and thus keep the real exchange rate constant, Bangladesh maintained a policy of frequent adjustment of the official nominal exchange rate after 1985, and adjustments in nominal exchange rates were made by considering trends in the Real Effective Exchange Rate (REER) index based on a trade weighted basket of currencies of major trading partners of Bangladesh and the rate of inflation.

In 1994, Bangladesh accepted the Article VIII obligations of the IMF and thus committed to make the taka fully convertible on the current account. Under this obligation, authorised

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maintain the fixed exchange rate, the central bank buys and sells its own currency on the foreign exchange market in return for the currency to which it is fixed.

[21] The Wage earner's scheme aimed at conversion of remittances of the Bangladeshi workers at the open market rate. Importers facing shortage of foreign exchange allocations used to buy foreign exchange from this market.

foreign exchange dealers were allowed to convert taka into foreign exchange without any restrictions for all trade and other current account transactions. The objectives of this measure were: i) to create confidence in the Bangladesh currency and thus in the management of the economy; ii) to facilitate international trade and support for the process of trade liberalisation; and iii) to link the economy with international markets, particularly financial markets (Alam, 1995).

A bold exchange liberalisation step took place in May 2003 when Bangladesh introduced a fully market based exchange rate. Under this system, the Bangladesh Bank did not interfere in the determination of the exchange rate, which was now to be determined by the demand and supply of foreign currencies. However, to keep this exchange rate market stable, the Bangladesh Bank occasionally intervened directly through the sale and purchase of foreign exchange if needed (Younus and Chowdhury, 2006). Since the introduction of this floating exchange system in 2003 meant there have been no large fluctuations in the TK/USD exchange rate (Table 2.2). An estimate of WTO (2006) states that between 1999-00 and 2004-05 the taka depreciated by 22 per cent against the US dollar.

Table 2.2: Average exchange rate (taka per US$)

Fiscal Year	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Average exchange rate	42.70	45.46	48.00	50.31	53.96	57.43	57.90	58.94	61.39

Source: GOB (2005)

2.3.4 Fiscal Policy Changes

The tax structure of Bangladesh can be divided into direct taxes and indirect taxes. Direct taxes include taxes on the income of individuals and corporations, and taxes on land and gifts. Indirect taxes include customs duty, VAT, taxes on motor vehicles, travel, electricity and turnover. In Bangladesh, over the entire period covering the 1990s and early twenty first century, indirect taxes accounted for about 75 per cent of total taxes and around 50 per cent of the total indirect tax revenue collected from imports in the form of custom duty, sales tax, development surcharge, license fees and regulatory duty (Chowdhury, 2005).

As part of the structural adjustment program, the government initiated a major reform of the tax system. The objective was to reduce its heavy dependence on trade taxes and to move more towards domestic taxes. Various steps have been taken in this direction. In 1991, the government introduced a VAT in place of the sales tax at import stage and excise duty on domestically produced goods. The VAT was introduced at a uniform rate of 15 per cent at the manufacturer-cum-import level[22]. However an Advanced Value Added Tax (AVAT) was introduced in 2004, at a rate of 1.5 per cent and it was calculated assuming a minimum 10 per cent value addition at the wholesale and retail level (WTO, 2006).

With these reforms, total revenue of the government rose significantly. Table 2.3 shows the trends in revenue, expenditure and the budget deficit during the period 1980-2005. Revenue, which was around 9 per cent of GDP during the period 1980-85, grew to an average of 10.74 per cent during the period 1990-95 and to 10.29 per cent over the period 2000-05. Tax revenue increased from an average of 7.2 per cent in 1980-85 to 8.22 per cent in 2000-05. Over 30 per cent of the total tax revenue comes from customs duties and with the inclusion of VAT collected, import tax continues to be the principal source of indirect tax revenue. From Table 2.3 it is seen that government total expenditure decreased from 18 per cent of GDP on average in 1980-85 to about 15 per cent in the 2000-05 period. This was a result of the government's better control of current expenditures. One notable point regarding fiscal policy has been the decline of the budget deficit as a ratio of GDP since the 1980s. Starting from 9.3 per cent of GDP in the 1980s, it came down to 4.5 per cent during the period 2000-05. Another notable development in the fiscal sector during this period was the increased dependence on domestic sources for financing budget deficit.

Table 2.3 also shows the financing of the budget from net foreign financing decreased from an average of 3.88 per cent during the period 1990-95 to 2.34 per cent in 2000-05, while financing from domestic sources rose from 1.48 per cent on average in 1990-95 to 2.14 per cent in 2000-05. The overall balance during FY 2004 equalled (-) 3.4 per cent of GDP, of which foreign financing contributed 41 per cent and the remaining 59 per cent was derived from domestic sources (Centre for Policy Dialogue, 2004).

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[22] At the initial stage textiles, fertilizer, medicine, books, the output of cottage industries, capital goods, hand-made cigarettes, bank services and other agricultural inputs were exempted from the VAT (World Bank, 1995).

Table 2.3: Trends in fiscal account, 1980-2005 (as percentage of GDP)

	1980-85	1985-90	1990-95	1995-00	2000-05
Total revenue	8.9	9.0	10.74	9.16	10.29
Tax revenue	7.2	7.2	8.64	7.40	8.22
Total expenditure	18.4	16.6	17	13.64	14.82
Overall budget deficit	9.3	7.5	6.56	4.5	4.54
Net foreign financing	-	-	3.88	2.42	2.34
Net domestic financing	-	-	1.48	2.12	2.14

Sources: World Bank (1995), GOB (2003a) and GOB (2006)

2.4 Measuring the Degree of Openness of the Bangladesh Economy

With the initiation of the reform and liberalisation measures, Bangladesh has become increasingly open to international market forces. This section examines the degree of openness of the Bangladesh economy. However, before measuring Bangladesh's degree of economic openness it is important to discuss the various measurement techniques found in the empirical literature.

2.4.1 A Brief History of the Measurement of Openness

A wide variety of measures of trade openness have been used by researchers. According to Baldwin (1989), measures of openness can either be based on outcome or incidence. Outcome-based measures assess the deviation of the observed outcome from the outcome without trade restrictions. These measures may be either price based or trade flow based. Incidence based measures take into account the frequency of occurrences of the various types of non-tariff barriers. The most used outcome based indicator of openness is the ratio of trade (imports + exports) to total output. However this estimate underestimates the true degree of openness of the economy because many potentially tradable goods never actually pass through frontiers. So an adequate measure of openness needs to determine the relative importance of tradable and nontradable products (Ahmed, 2001). Pritchett (1991) suggested correcting the ratio of trade to total output by taking into consideration factors such as level of per capita GDP, size (both area and population), transport costs and obvious resource endowment characteristics.

A theoretically more sophisticated trade intensity measure was constructed by Leamer (1988). Leamer used factor endowments (land, labour, capital, oil production and minerals) along with distance and the trade balance to predict net exports within a product category for each country. Net exports within a product category are regressed on factor endowments for a cross section of countries (Santos-Paulino, 2005). Then summing up the deviations of the actual from predicted levels of net exports for all commodities, the openness measure is computed. However one criticism with this measure is its assumption that each country adopts the world's average level of protection. In this sense it captures only a country's deviation from the cross-country average level of trade restrictions.

Another outcome-based measure of openness is the import penetration ratio. This index can be defined in two ways, as the ratio of imports to GDP and as the ratio of imports to aggregate consumption. According to Andriamananjara and Nash (1997), the latter is a more reliable indicator of restrictive trade policy since in almost all developing countries imports of consumption goods are strictly restricted. Romer (1993) used import/GDP as a measure of openness.

The ratio of exports to GDP is a further example of an outcome-based measure of openness which is called an export orientation ratio, as it is a comparison of domestic and border prices of similar products. However, as Andriamananjara and Nash (1997) commented, with the latter kind of index, trade restrictions will be underestimated in a country with a trade policy that taxes both imports and exports. The prices of importables are raised above world levels while those of exportables are depressed. As a result, an average index number will be low enough even though distortions are quite high. According to Andriamananjara and Nash (1997) movement in the real exchange rate is also an outcome based measure of trade openness. While trade restrictions appreciate this rate, trade liberalisation depreciates it which can be used to infer liberalisation.

Krueger (1978) and Bhagwati (1988) measured trade orientation by the degree to which the structure of protection and incentives in a country is biased against exports. According to Krueger and Bhagwati, the degree of bias of a trade regime can be described as follows:

$$B = {EER_m}/{EER_x} = {E_m(1+t+n+P_r)}/{E_x(1+s+r)}$$

where the effective exchange rate for imports (EER_m) is the nominal exchange rate for imports corrected by the average effective import tariff (t), import charges (n) and the premium associated with quantitative restriction (P_r). On the other hand, the effective exchange rate for exports (EER_x) is the nominal exchange rate for exports (E_x) corrected by export subsidies (s) and other incentives to export (r). If *B*>1, it implies an anti-export trade regime whereas a value of *B*<1 indicates an export promotion strategy. A value of *B*=1 implies a neutral trade regime.

Michaely *et al.,* (1991) constructed a subjective index of trade liberalisation from their 19 countries cross-country regression. The index varies from the value of 1 to 20, where 1 indicates the most reserved external sector and a value of 20 indicates complete liberalisation. However, according to Greenaway (1993), this index is not appropriate for cross-country comparison as it relies on dummy variables to classify trade regimes.

The World Bank (1987b) constructed an 'outward orientation' index for 41 countries at two points in time, 1963-1973 and 1973-1985, based on the following indicators: i) the effective rate of protection; ii) the use of direct controls like quotas and import-licensing schemes; iii) the use of export incentives; and iv) the degree of exchange rate overvaluation[23]. However, these classifications were criticised as biased by Edwards (1998).

Dollar (1992) constructed a cross-country measure of outward orientation of the economy, based on the international comparisons of price levels collected for 121 countries by Summers and Heston (1988): $RPL_i = 100 * {eP_i}/{P_{us}}$

where RPL is the relative price level index, *e* is the exchange rate between country *i* and U.S., P_i and P_{us} are the consumption price index for country *i* and the U.S. Variation in this index value is interpreted as a measure of difference in the restrictiveness of trade policy across countries. However, its main limitation is that it does not consider tariffs, export duties and taxes, export subsidies and other non-tariff barriers. Sachs and Warner (1995) constructed a composite indicator of openness by using a series of trade related indicators such as tariffs,

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[23] The classification of the countries was: 1) strongly inward-oriented; 2) moderately inward-oriented; 3) moderately outward-oriented; and 4) strongly outward-oriented.

quotas coverage, black market premia, social organisation and the existence of export marketing boards. Edwards (1998) criticised Dollars measure on the basis that "although this index is an improvement over previous attempts, it provides only a binary classification - a country is either open or closed. Furthermore, most of the data used to construct this index are available only at one point in time".

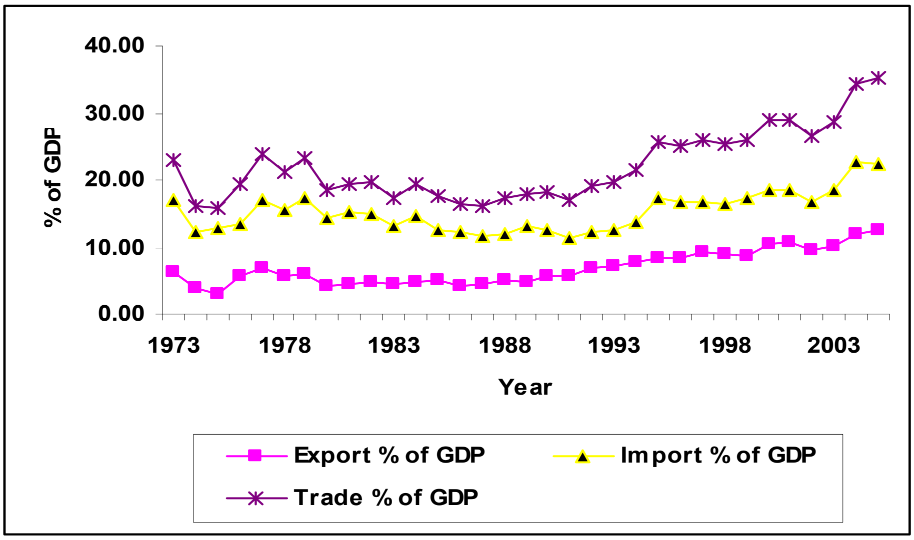
As shown above, there is a wide variety of measures of trade openness and the lack of an agreed- upon definition prompted some researchers such as Dean *et al.* (1994) and Andriamananjara and Nash (1997) to use observed values of variables associated with trade restrictiveness as indicators of openness. Among these, import tariffs, quantitative restrictions on imports, export incentives, the black-market premium, degree of exchange rate misalignment and the average collection rate are notable.

2.4.2 Bangladesh Perspective

To assess the degree of openness of the Bangladesh economy, this section will consider some of the above-mentioned measures: i) import penetration ratio; ii) export orientation ratio; iii) trade-GDP ratio; and v) anti-export bias ratio. All of these measures suggest that Bangladesh has become increasingly open to the world since the reform policies were pioneered.

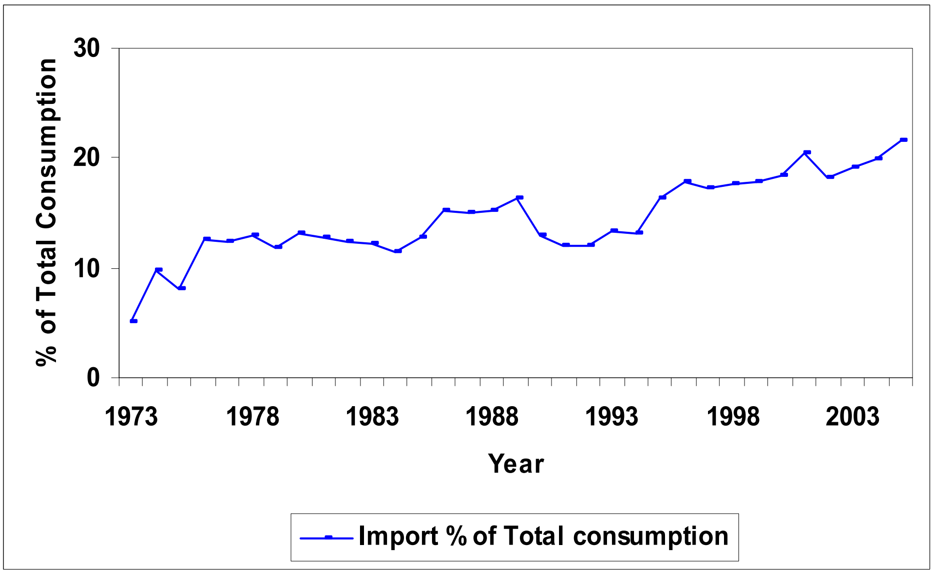
Figure 2.5 shows the import penetration ratio, export orientation ratio and trade-GDP ratio for Bangladesh over the period 1973-2003. All of these indicators rose over time indicating greater openness. Starting from 6 per cent of GDP in 1973, the ratio of exports of goods and services rose to about 12 per cent in 2003; the ratios of imports of goods and services rose from 17 per cent to 22 per cent; and the ratio of trade (exports + imports) to GDP increased from 23 per cent to 35 per cent.

Figure 2.5: Import orientation, export orientation and trade–GDP ratios in Bangladesh, 1973-2000



Source: Drawn from *International Financial Statistics Year Book* (various issues)

Figure 2.6: Import penetration ratio in Bangladesh, 1973-2003



Source: Drawn from *International Financial Statistics Year Book* (various issues).

Figure 2.6 reveals that the import penetration ratio (expressed as a percentage of total consumption) also rose, from nearly 6 per cent in 1973 to 20 per cent in 2003. Furthermore, all the above measures show larger increases during the extensive trade liberalisation period (1992-onward) than in the initial phases of reforms (1976-1991).

The World Bank has estimated the anti-export bias ratios for Bangladesh for the period 1991/92-19997/98. In that study, the real effective exchange rate for imports (REERm) was derived by adjusting the nominal exchange rate for import taxes and the scarcity premium that controls may generate, while the real effective exchange rate for exports (REERx) has been derived by adjusting the nominal rate for export promotion schemes. Thus REERm represents the domestic currency value of imports worth one US$, while REERx denotes the domestic currency equivalent of income from exports worth one US$. It is evident from Table 2.4 that the real exchange rate for imports shows a declining trend over time, while the real effective exchange rate for exports shows an upward trend, with a resulting reduction in anti-export bias of 1.657 in 1991-92 to 1.263 in 1997-98.

Table 2.4: Annual exchange rates (TK per US$) and trade policy bias in Bangladesh, 1991-1998

Fiscal Year	Nominal exchange rate	REERm	REERx	REERm/REERx
1991-92	38.15	63.84	38.53	1.657
1992-93	39.14	60.81	39.72	1.531
1993-94	40.00	56.97	40.48	1.407
1994-95	40.20	52.79	40.53	1.302
1995-96	40.84	51.91	41.25	1.258
1996-97	42.70	54.16	43.22	1.253
1997-98	45.46	58.44	46.25	1.263

Source: World Bank (1999a).

Therefore, according to the above measures of openness, Bangladesh is a more open economy today than it was in the 1980s. A cross country comparison with regard to trade liberalisation also reveals that the speed of liberalisation has been faster in Bangladesh compared with other South Asian countries except for Sri Lanka and Nepal. Table 2.5 shows that in 1991, Bangladesh had the highest average tariff rate among South Asian countries of 88.6 per cent, however, during the period 2002-03 it declined to 17 per cent which was the lowest tariff rate except for in Nepal.

Table 2.5: Trends in unweighted average tariff rates in South Asia (per cent)

Countries	1986	1991	1995	1999	2002-03
Bangladesh	81.8	88.6	42.0	22.2	17.0
India	100.0	79.2	41.0	30.0	20.0
Nepal	21.0	22.6	11.0	16.3	14.7
Pakistan	66.0	66.0	51.0	41.7	20.6
Sri Lanka	27.3	26.9	20.0	20.0	-

Source: RIS (2004)

2.5 Macroeconomic Performance of Bangladesh

The aim of this section is to present a brief overview of macroeconomic performance in Bangladesh. For this purpose, some basic macroeconomic indicators will be compared mainly with respect to two time phases. One is the extensive policy reform period (1992-onwards) and the other is the initial stages of reform period (1976-1991). Table 2.6 represents the annual growth rates of some basic macroeconomic indicators of Bangladesh during the period 1973-2005. It can be seen that there was an improvement in GDP growth performance during the 1990s compared to the 1980s. However, one notable feature of Table 2.6 is that in the 1970s the economy experienced high real GDP growth at 5.6 per cent, which slowed down to an average of only 3.5 per cent per annum in the 1980s. The high figure was in part due to a low war-devastated production base; hence a small change in GDP resulted in apparently a high rate of growth (Hossain (2003), Ahmed, (2001)). This is also true for some other indicators.

As stated earlier, even though various market oriented reform measures were introduced in Bangladesh during the early 1980s, it was only in the early 1990s that the economy started to grow at a steady pace. From Table 2.6 it is clear that GDP growth rate shows a modest improvement during the extensive liberalisation period (1995-2000) at about 5.06 per cent and then increased marginally during the period (2000-05). In the 1980s, per capita GDP grew slowly, however, during the 1990s, the growth rate accelerated (Table 2.6). A slowdown in the population growth rate and a sustained jump in the rate of GDP growth was the cause for the acceleration in the growth of per capita income.

All three broad economic sectors (agriculture, industry and services) contributed to the acceleration of the growth performance in the 1990s. However, they performed differently during the time periods. The annual growth rate of agricultural output remained constant at 2.06 per cent until 1985-90, but then increased modestly to 4.07 per cent in the period 1995-2000. After the great flood of 1998, favourable weather conditions, improvements in the quality and availability of inputs in response to the government's agricultural policies have contributed to higher growth (IMF, 2003).

Table 2.6: Bangladesh: Basic macroeconomic indicators, 1973-2005

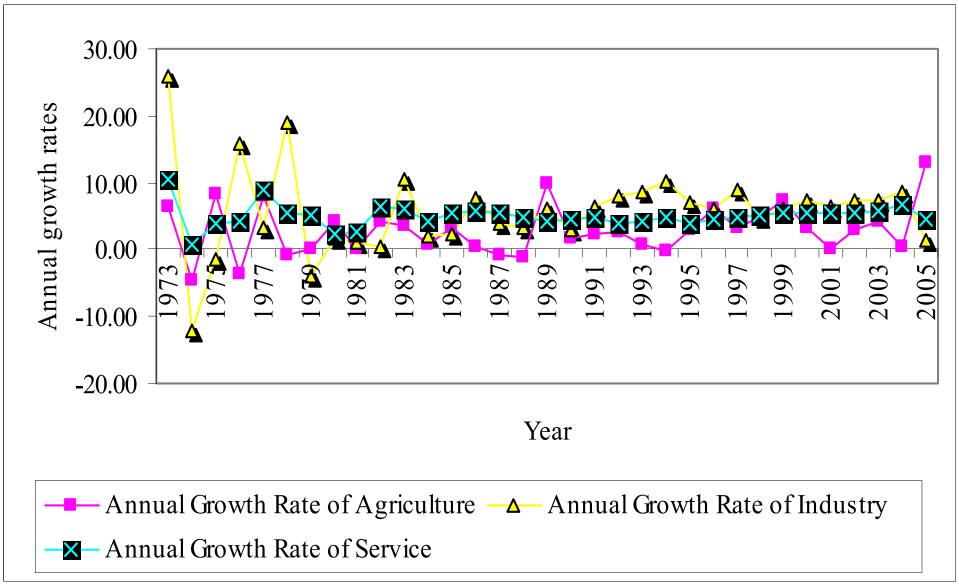
Indicators	1973-80	1980-85	1985-90	1990-95	1995-2000	2000-05
Real GDP growth rate	5.61	3.50	3.81	4.34	5.06	5.17
Per capita real GDP growth rate	3.28	1.06	1.53	2.08	3.03	3.26
Population growth rate	2.32	2.43	2.28	2.25	2.03	1.91
Trade balance–GDP ratio	-8.37	-8.46	-6.43	-4.76	-4.79	-4.63
Inflation rate	19.3	10.8	8.3	4.2	3.8	3.4
Budget deficit-GDP ratio	-	-9.3	-7.5	-6.65	-4.5	-4.54
Domestic saving-GDP ratio	-	1.68	2.45	6.67	8.26	-
Investment-GDP ratio	-	13.6	11.72	14.48	17.8	-
Current account-GDP ratio	-4.56	-3.18	-2.18	-0.18	-1.18	-0.14
Agricultural output growth rate	2.02	2.06	2.06	2.39	4.07	4.12**
Industrial output growth rate	5.44	4.01	5.06	7.68	6.16	5.16
Service sector output growth rate	4.84	5.10	4.89	4.39	5.23	5.56
Annual average growth rate of exports	24.28*	18.54	16.95	20.81	15.48	16.39
Annual average growth rate of imports	29.41*	16.50	9.90	14.96	15.93	14.59

Notes: '-'means data is not available for that period.
For the first three indicators compound growth rate has been calculated.
For the rest of the indicators average annual growth rate has been calculated.
Real values have been calculated at the base of the year 1995
'*' denotes average annual growth rate for the period 1974-80.
'**' denotes annual average growth rate for the period 2000-04.
For savings and investment data, new data series has been converted to old series by Spliced Index method.

Sources: Author's own calculation based on *International Financial Statistics* (various issues), *Statistical Yearbook* (various issues), Bangladesh Bureau of Statistics, *Economic Trends* (various issues), Bangladesh Bank.

On the other hand, the growth of industrial output increased to 7.68 per cent in the post liberalisation period (1990-95) from 4.01 per cent in 1980-85, however it subsided a little during the period 1995-2005. Compared to agriculture, industry output grew at a faster rate in the extensive liberalisation period than in the pre-liberalisation period. Within the broad group of industry, an important sub-sector was manufacturing where growth mainly originated from the ready-made garments and knitwear industry. The export share of ready-made garments and knitwear grew from about 40 per cent at the close of the 1980s to nearly 75 per cent at the close of the 1990s. Another issue of this growth pattern was the relative role of non-tradable sectors such as construction and small-scale industry in the process of growth acceleration. According to Osmani *et al,*. (2003), at least two-thirds to three-quarters of the incremental growth in the 1990s originated from the non-tradable sectors. In the case of services, the growth rate continued to accelerate throughout the period (1990-2005) even though compared to industry its growth rate remained low.

Figure 2.7: Annual growth rates of agriculture, industry and service, 1973-2005

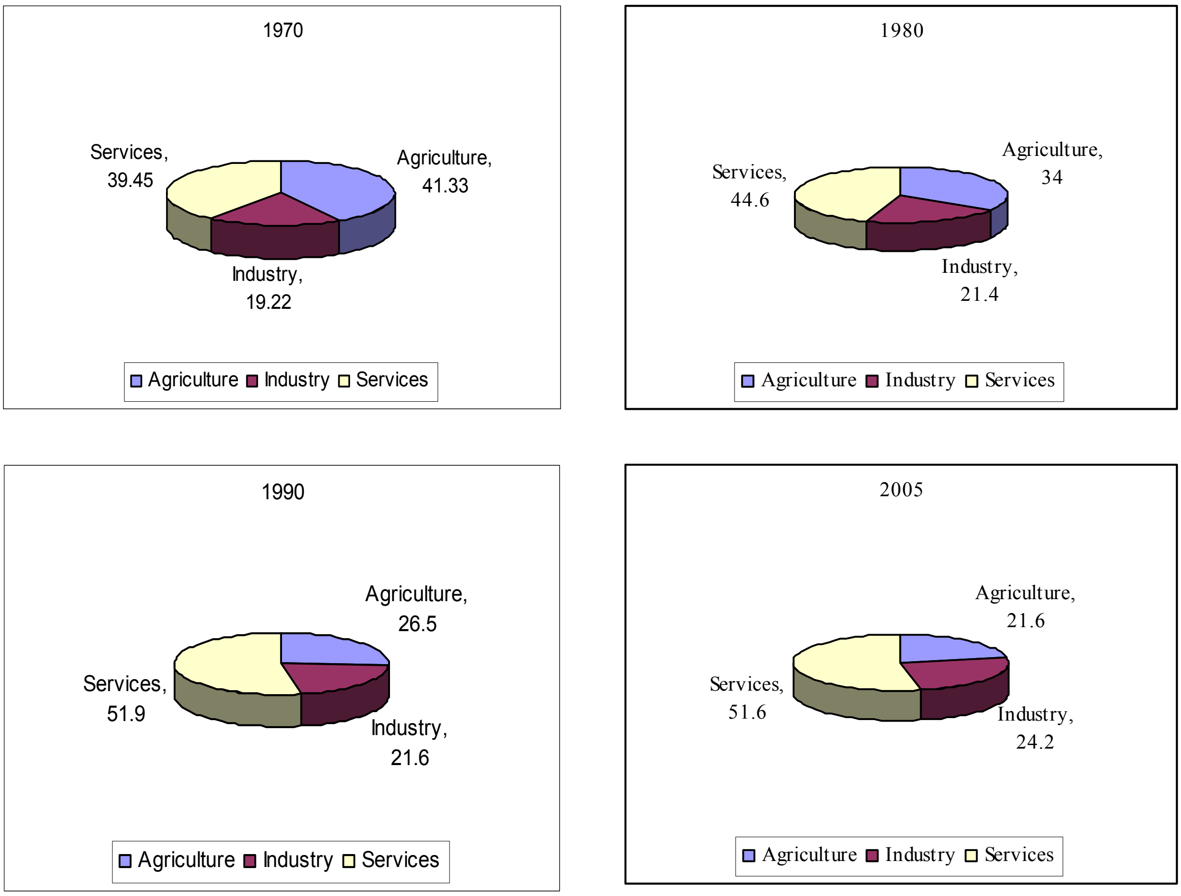


Source: Based on IMF, *International Financial Statistics* (various issues).

Growth performance during the post-liberalisation period was accompanied by a significant structural change in the economy in favour of the non-agricultural sector (Hossain, 2006). The relative contribution of agriculture to GDP which was traditionally highest, decreased, while the contributions of industry and services increased (Figure 2.8 (a), 2.8 (b), 2.8 (c) and 2.8

(d)). Agriculture, which constituted 41.33 per cent of real GDP in 1970 declined to about 34 per cent in 1980, 26.5 per cent in 1990 and 22 per cent in 2005.

Figure 2.8 (a, b, c, d): Contribution of broad sectors in GDP, 1970-2005



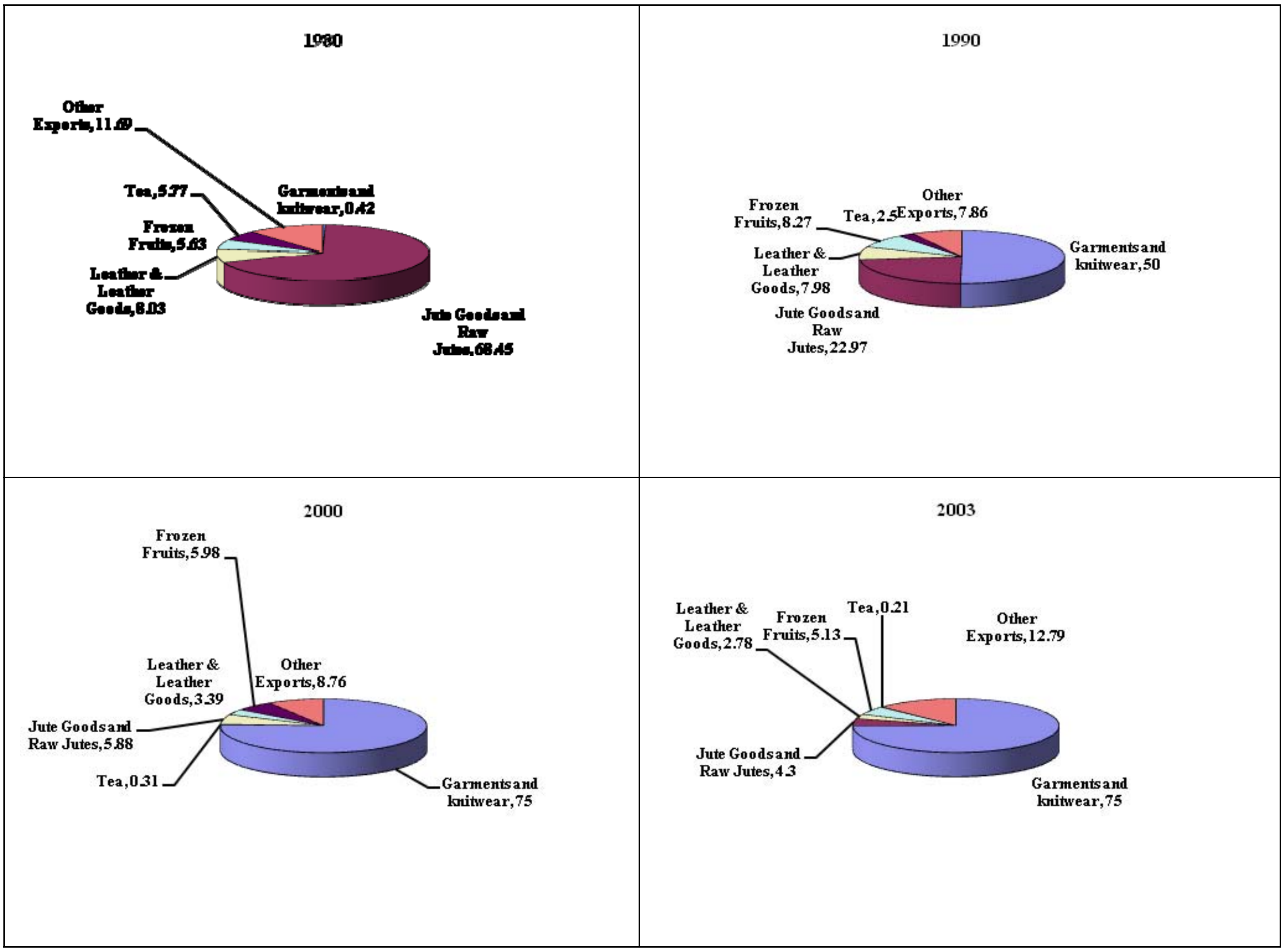
Source: The periodical sectoral value added has been calculated by taking data from the IMF, *International Financial Statistics* (various issues).

In 1970, the contribution of agriculture in GDP was about 41 per cent while the contribution of the industrial sector was small, less than 20 per cent of GDP whereas the services sector including transportation and power accounted for the rest of the GDP. The share of the industrial sector stagnated until the mid 1980s, but due to remarkable growth in the ready-made garments industry its contribution increased to 24.2 per cent in mid 2005. During the 1990s, medium and large scale manufacturing as a whole grew at about 7 per cent annually, but at only about 4 per cent excluding the ready-made garments industry (Mahmud, Ahmed, and Mahajan, 2008).

The service sector became the largest contributor to GDP by 1980, and this share increased to 54.2 per cent in 2005 (Figure 2.8d). Therefore, over the long term there has been a shift in the sectoral composition of GDP away from agriculture towards industry and services. Nevertheless, given its position as the predominant economic activity, agriculture was still the single largest employer. Until the 1960s, agriculture directly employed about 80 per cent of the labour force (Hossain, 1995, p. 13) which declined to the level of about 60 per cent in the 1990s (Hossain, 2006, p. 11). According to the Bangladesh Labour Force Survey of 2002-03, 51.69 per cent of the labour force was employed in agriculture, whereas in the industry and service sectors these shares were 13.56 per cent and 34.75 per cent respectively. In 1999-2000, these figures were 62.30 per cent, 8.30 per cent and 29.40 per cent respectively (GOB, 2004). Thus, over the years there has been a shift of the labour force away from agriculture to the rural non-farm sector largely in services, including construction, trade transport, hotels and restaurants and community and personal services.

Table 2.6 shows the growth rates of total exports showing an upward trend during 1990-95 compared to 1980-90. Total export growth was 18.54 per cent during the period 1980-85, decreasing to 16.95 per cent in 1985-90, and in the period 1990-95 growing at a rate of 20.81 per cent. In fact, in manufacturing exports since the mid 1980s, the textile and ready-made garments grew at a much faster rate in each period and as a result there has been a structural change in the composition of total exports (Hossain, 2003). In Bangladesh, traditional exports were comprised of jute manufacturing, tea, leather and leather products, whereas non-traditional commodities were comprised of frozen shrimps, frog legs, fish, chemical products, woven garments, knitwear and other manufactured goods. A significant feature of Bangladeshi exports over time has been the gradual change from traditional commodities to non-traditional commodities. In the early 1980s traditional commodities constituted nearly 94 per cent of total exports, which falling to 41 per cent in the 1990s and to 20 per cent in 2003-04 (Figure 2.9a, 2.9b, 2.9c and 2.9d).

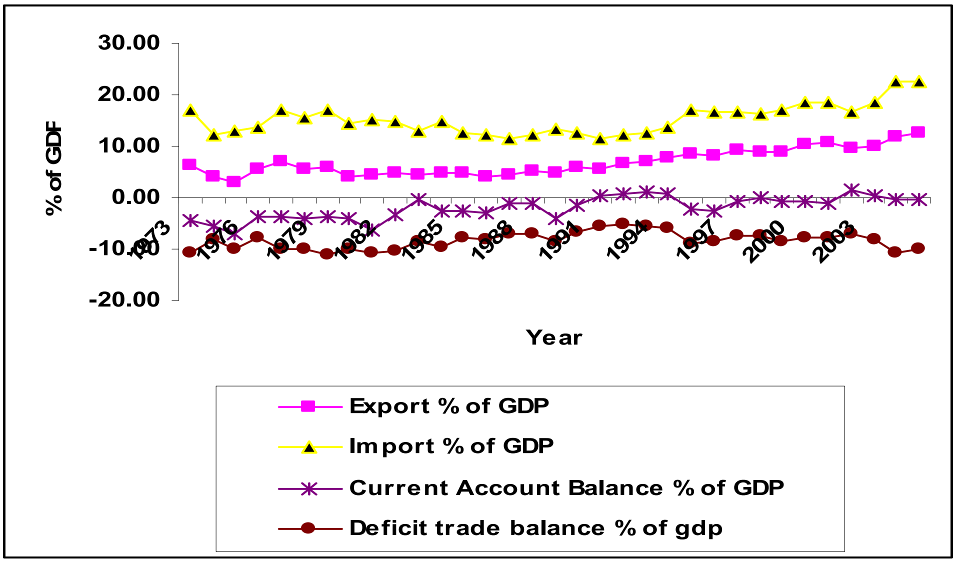
Figure 2.9 (a, b, c, d): Changing structure of exports in Bangladesh, 1980-2003



Source: Drawn from Ahmed (2005)

In the 1980s, ready-made garments and knitwear contributed only 42 per cent of total exports. This share rose to 50 per cent in 1990 and to 75 per cent in 2000 and remained at this level up to 2003 (Figure 2.9 a, b, c, d). By contrast, the share of the traditional exports of jute and jute products fell from 68 per cent of total exports in 1980 to 23 per cent in 1990 and 6 per cent in 2000, and only 4 per cent in 2003.

Figure 2.10: Growth rate of exports, imports, trade balance and current account balance in Bangladesh, 1973-2003



Source: IMF, *International Financial Statistics* (various issues).

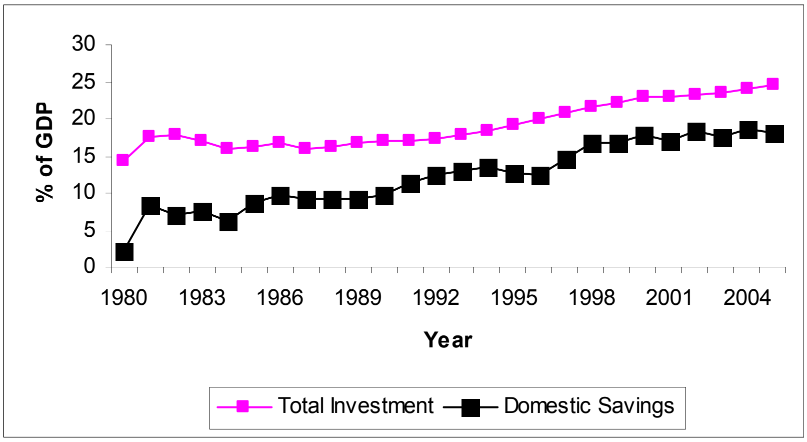
Growth in imports was 15.9 per cent during the period 1995-2000 compared with 16.5 per cent in 1980-85 and 9.9 per cent in 1985-90. However there has been no remarkable structural change in the commodity composition of total imports. Bangladesh's imports mainly consist of capital goods, raw materials and intermediate goods for export-oriented products and final consumer goods.

One notable phenomenon is the coverage of imports by exports. In 1999-2000, merchandise exports financed about 69 per cent of imports compared to 35.37 per cent in the early 1980s (BBS, 2004a). However, despite a massive increase in export growth, the balance of trade has been always in deficit (Table 2.6 and Figure 2.10). In the case of the current account balance, the absolute magnitude decreased in the post-liberalisation period compared with the pre-liberalisation period and it was always lower than that of the trade balance. The reason for this is the rising inflow of remittances (Figure 2.10).

There was remarkable success in keeping inflation under control. The rate of inflation declined from nearly 20 per cent in the 1970s to a single digit rate in the late 1980s, and continued to decline thereafter (Table 2.6). The average annual inflation rate for 2000-04 was 4.9 per cent, which was lower than in India and Pakistan where the rates were 7.7 per cent and 7.9 per cent respectively. Even in Sri Lanka the rate was 10.4 per cent (World Bank, 2006a).

There were also some improvements in both the domestic Saving-GDP ratio and Investment-GDP ratio. The former was extremely low during fiscal year (FY) 1980-81, but increased from 6.24 per cent in FY1984-85 to 9.64 per cent in 1990-91 and had since gradually increased to 18.67 per cent in FY 2004-05. The investment-GDP ratio also increased from 14.44 per cent in FY 1980-81 to 17.31 in FY 1990-91 and to 18.67 per cent in FY 2004-05. Here it is important to note that as a result of the private sector-oriented reforms in the economy and particularly vast export and investment incentives, local and foreign direct investment rose in the 1990s, as reflected in the gradual increase in the investment rate. The budget deficit[24] as a percentage of GDP fell steadily from the early 1980s to the late 1990s, as the government put more emphasis on revenue raising measures including the introduction of VAT.

Figure 2.11: Annual growth rates of domestic savings and total investment, 1980-2004



Source: World Development Indicators (on line Database)

Another important feature of trade liberalisation was the increasing inflow of foreign investment. At the time of independence, the total volume of FDI (foreign direct investment) in Bangladesh was only US$27 million. In the last phase of the 1980s, due to the governments privatisation policy and implementation of liberal trade policies there was a significant increase in FDI. Starting from a trickle in the 1980s, the inflow of foreign direct investment in Bangladesh rose to nearly US$400 million in the fiscal year 1997-98 (World Bank, 1999b). In 2004, FDI in Bangladesh increased to about US$660.8 million (BOI, 2005). Across this foreign direct investment, the bulk went into the gas, garment and textile sectors. Trade and

[24] Budget deficit has been defined as the difference between total public revenue earnings (i.e. sum of tax and non-tax revenues) and the total public expenditure (sum of revenue and development expenditure).

exchange rate liberalisation, liberalisation of the investment regimes and current account convertibility have helped to bring about this increased trend.

2.6 Concluding Remarks

This chapter has described Bangladesh's reform policies and provided an overview of macroeconomic developments during the last three decades. It can be seen that since the 1980s, the government has undertaken a number of bold steps, including liberalisation of the trade and foreign investment regime, strengthening of the financial sector, either closing or privatising some loss-making state-owned enterprises, and broadening the tax base by introducing a VAT. In respect to trade liberalisation, export diversification and import liberalisation received the highest priority. Comparisons of macroeconomics indicators for the 1980s and 1990s suggest a positive relationship between the reform policies and economic performance. However, to reach the target of Millennium Development Goal (MDG) of United Nations of halving the proportion of the world poor by the year 2015, even faster economic growth of 6-8 per cent is required (World Bank, 2002b)

Liberalisation brought crucial changes in the external sector. Both export and import growth rates increased as the country gradually transformed itself from traditional commodity exporters to non-traditional commodity exporters. Other macroeconomic indicators such as the inflation rate, budget deficit, trade balance and current account balance all show favourable performances during the period of extensive liberalisation (1990-onward) compared to pre- liberalisation (1975-1990).

Thus it can be concluded that Bangladesh's overall economic performance was stronger in the 1990s and early 2000s than in the 1980s, even if a direct causal relation between trade liberalisation and economic performance is difficult to quantify. However, economic policies have to be judged not only in aggregate terms but by their impact on poverty reduction. Therefore, it is time to see how this growth performance has influenced the level of poverty and income inequality in Bangladesh. The next chapter will provide a brief overview of the poverty and income distribution situation in Bangladesh in the face of trade liberalisation.

Chapter 3

An Overview of Poverty, Inequality and the Labour Market in Bangladesh

3.1 Introduction

As outlined in Chapter 2, the Bangladesh economy has performed well with respect to GDP growth, agricultural output, the services and industrial sector and export earnings during the post-liberalisations period. However, whether this growth performance has translated into a reduction in poverty and inequality is a matter of concern. Available estimates indicate that during the 1990s Bangladesh succeeded in reducing poverty on average by 1 percent per annum (IMF, 2005). A World Bank estimate also suggests that the poverty head count index declined from 88.15 per cent in 1972-73 to 49.8 per cent in 2000. Yet in spite of this apparent success, Bangladesh still has the highest incidence of poverty in South Asia, the third highest absolute number of poor in the world after India and China, and its per capita GDP ($480 in 2006 at Purchasing Power Parity) is one of the lowest in the world (World Bank, 2007a). Furthermore, inequality in Bangladesh as a whole increased throughout the entire decade, the overall Gini ratio increased from 0.30 in 1991-92 to 0.41 in 2000. This large increase in the Gini ratio reflected a sharp rise in urban-rural inequality over the same period (Khan, 2006). The concurrent presence of trade liberalsation, inequality and poverty has raised alarm that trade policies may have worked against the large poor majority of the country. It is also suspected that trade liberalisation has failed to align employment with growth.

Through this perspective, the present chapter provides a historical overview of trade liberalisation, poverty, inequality and labour market developments in Bangladesh. In doing so, section 3.2 provides a poverty profile of Bangladesh. It briefly examines early controversies about the extent of poverty before examining more recent estimates of the various dimensions of poverty in Bangladesh. Section 3.3 presents trends in income inequality in Bangladesh and includes an examination of the structure of and changes in income distribution in Bangladesh. Section 3.4 provides a description of labour force trends and structural changes in employment and section 3.5 offers some concluding comments.

3.2 A Poverty Profile of Bangladesh

3.2.1 Trends in Poverty Incidence in Bangladesh

In Bangladesh, numerous studies have been conducted concerning the incidence of poverty. Some of these studies relate trade liberalisation to poverty incidence and conclude that globalisation has contributed positively to poverty reduction even though most of them question the uneven distribution across different households and urban/rural differences. Some of these studies include Osmani (2005), Mujeri and Khondker (2002), Roy (1996), World Bank (1998), Osmani *et al.,* (2003), Sen *et al.,* (2004) and Annabi *et al.,* (2005). Other studies have measured the trends and determinants of the current status of poverty in Bangladesh (for example, Hossain and Sen (1992), Khundker *et al.,* (1994), Khan (1990), Osmani (1990), Wodon (1999) and others). Even though all of the studies used data provided by the Household Expenditure Surveys (HES) conducted by the Bangladesh Bureau of Statistics (BBS), there remains much controversy about the extent of poverty, particularly in the 1970s and 1980s (Ravallion and Sen, 1996).

Most studies have used the head count ratio[25] as a measure of poverty; however there are discrepancies among the head count estimates because of differences in underlying assumptions. According to Ravallion and Sen (1996), the main ingredients of poverty measures, i.e. calorie requirements and allowances for non-food goods, require judgements. Also, the set of prices used for costing the minimum calorie bundle[26] in setting the food poverty line within the Cost of Basic Needs (CBN)[27] method constituted a major source of discrepancy amongst various head count estimates. Further, in the case of non-food basic needs, a similar discrepancy arises.

Table 3.1 presents estimates of the head count index of poverty for various years in the 1970s and 1980s in Bangladesh. Even though each study used the same primary data source and the same food energy requirement method, the results differed. For example, for urban areas for

[25] Head count ratio is the most common measure of poverty, and is the proportion of the poor in the total population.

[26] Minimum consumption bundle estimated for an average Bangladeshi population contains 832 gm of food consisting of 437 gm of cereals, 175gm of vegetables, 40gm of pulses, 58gm of milk, 48gm of fish and 12gm of meat. It corresponds to an average per capita daily intake of 2,112 calories and 58gm of protein.

[27] With the CBN method, any household with per capita expenditure below a given poverty line is considered as poor. The poverty lines are set by computing the cost of a food basket enabling households to meet the requirement and adding to this cost an allowance for non-food consumption. See Ravallion (1994), Ravallion and Bidani (1994) and Ravallion and Sen (1996).

the year 1981-82, the head count ratio varies from 48.4 per cent to 66.0 per cent, similarly, for 1985-86, it ranges between 29.1 per cent and 56.0 per cent. For rural areas for 1973-74 the proportion of poor people varies from 47.7 per cent to 82.9 per cent. In spite of differences among the estimates for the various sub periods, all studies except one (Ahmed, Khan, and Sampath, 1991) suggest that urban poverty fell during the 1980s. Similarly for rural areas, all studies show poverty incidence decreased during the 1970s and 1980s, except in the study of Islam and Khan (1986).

Methodological differences may contribute to these observed differences. For example, by using a fixed consumption bundle, Rahman and Haque (1988) have shown that rural poverty rose in the first period and then fell in the second period. In contrast, Hossain and Sen (1992), using the same minimum consumption bundle, have shown that while head count ratios decreased in the earlier 1980s, they worsened after the mid 1980s. Khundker *et al.,* (1994) obtained the same result for urban areas. Using a different methodology, the World Bank (1987a) and BBS (1988) also have shown that poverty has fallen over all periods for both urban and rural areas. In fact, the World Bank (WB) and BBS constructed a poverty income line by estimating a relationship between income and consumption of calories in a given year. Table 3.1 also reveals that for 1985-86 the Ahmed *et al.,* (1991) study and the WB/BBS study both show a higher poverty rates in urban areas than in rural areas. According to Ravallion and Sen (1996), this result was due to differences in the real value of the urban and rural poverty lines generated by the FEI[28] (Food-Energy-Intake) method of setting poverty lines. In fact, the FEI method has deficiencies when used for poverty comparison because the poverty lines it generates do not represent identical purchasing power in real terms over time or across sectors or groups (World Bank, 1998). For example, people in better-off regions (urban) buy more expensive calories and reach their food energy requirement at higher level of total spending (Ravallion and Sen, 1996) than their rural counterparts. Thus the poverty line of better-off regions will be higher than the worse-off regions (rural) poverty line.

[28] By this method, poverty lines are set by computing the level of consumption or income at which households are expected to satisfy the normative nutritional requirement (Wodon, 1997).

Table 3.1: Poverty measures: Head count indices in various studies for Bangladesh

Year	Ahmed and Hossain (1984)	Islam and Khan (1986)	Rahman and Haque (1988)	Ahmed *et al.* (1991)	Hossain and Sen (1992)	Official Estimates of BBS/ WB (1987/88)	Ravallion and Sen (1996)	Khuunker *et al.* (1994)
Urban								
1973/74	-	-	-	-	-	-	-	63.2
1976/77	-	-	-	-	-	-	-	-
1981/82	-	-	50.7	65.3	-	66.0	-	48.4
1983/84	-	-	39.5	-	-	66.0	40.9	42.6
1985/86	-	-	29.1	66.8	-	56.0	30.8	30.6
1988/89	-	-	-	-	-	44.0	35.9	33.4
1991/92	-	-	-	-	-	-	33.6	-
Rural								
1973/74	55.7	47.7	65.3	-	71.3	82.9	-	-
1976/77	61.1	62.3	-	-	-	-	-	-
1981/82	-	-	79.1	71.8	65.3	73.8	-	-
1983/84	-	-	49.8	-	50.0	57.0	53.8	-
1985/86	-	-	47.1	51.6	41.3	51.0	45.9	-
1988/89	-	-	-	-	43.8	-	49.7	-
1991/92	-	-	-	-	-	-	52.9	-

Sources: Ravallion and Sen (1996), Hossain and Sen (1992)

Because of these observed problems with the FEI method, the CBN method is considered the standard method for estimating the incidence of poverty. In late 1994, the World Bank in a joint capacity building effort with BBS improved the official methodology for measuring poverty. By dropping the FEI method, World Bank (WB) and BBS adopted the cost of basic needs method.

Three steps were followed in estimating this cost. First, a representative, fixed food bundle was estimated which provided minimal nutritional requirements of 2,122 kcal. per day per person. Then by multiplying the price of each item in the bundle with the quantities in the food bundle, the food poverty line is estimated. In the second step, allowances for non-food consumption were estimated. In order to capture geographical differences in the costs of non-food goods, 'lower' and 'upper' allowances for non-food basic needs were computed for each area based on representative households' actual nonfood expenditures[29]. Third, simply adding

[29] 'Lower non-food allowance' was estimated by taking the median amount spent for non-food items by a group of households whose per capita total expenditure was close to the food poverty line. Similarly, the 'Upper non-food allowance' was obtained by taking the median amount spent on non-food items by a group of households whose per capita food expenditure is close to the food poverty line (BBS, 2006).

the food poverty lines with the 'lower' and 'upper' nonfood allowances yielded the total lower and upper poverty lines for each geographical area.

BBS calculated the incidence of poverty by using primary data from the HES (Household Expenditure Survey) between 1983 and 1996, which is shown in Table 3.2[30]. This table has several notable features.

Table 3.2: Head count indices of poverty using the Cost of Basic Need Method, 1983/84-2005 (percentage of population below the poverty line)

Year	% of population under lower poverty line			% of population under upper poverty line		
	Rural	Urban	National	Rural	Urban	National
1983/84	42.62	28.03	40.91	59.61	50.15	58.50
1985/86	36.01	19.90	33.77	53.14	42.92	51.73
1988/89	44.30	21.99	41.32	59.18	43.88	57.13
1991/92	45.95	23.29	42.69	61.19	44.87	58.84
1995/96	39.76	14.32	35.55	56.65	35.04	53.08
2000	37.90*	19.90*	34.3*	52.30*	35.2*	48.9*
2005	28.6*	14.60*	25.1*	43.8*	28.4*	40.0*

Note: "*" estimates are taken from the Preliminary Report on Household Income and Expenditure Survey-2005, BBS.

Source: World Bank (1998).

First, it shows that the national incidence of poverty declined between 1983-84 and 2005, as measured both by lower and upper poverty lines. In 1983-84, 58.50 per cent of Bangladesh's population was poor (per capita consumption below the upper poverty line) as compared to 40 per cent in 2005, while 40.91 per cent of the population was extremely poor (per capita consumption is below the lower poverty line) in 1983-84 as compared to 25.1 per cent in 2005. Thus the long-term poverty trends (Figures 3.1 and 3.2) show a significant decline over the period 1983-2005 as a whole.[31] Economic growth with concomitant human development

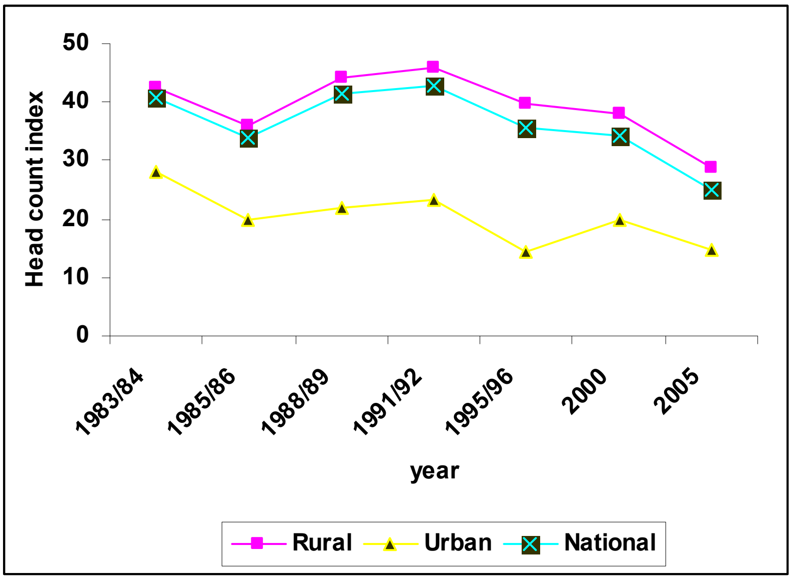
[30] Concurrently there are other poverty measures (for example, Osmani *et al.* (2003) and Sen *et al.* (2004)). However, this paper has reported the WB/BBS results.

[31] The latest Poverty Monitoring Survey (PMS) 2004 Report of the Bangladesh Bureau of Statistics has also shown a declining trend of income poverty during 1999-2004. However, to measure the incidence of poverty they have used the Direct Calorie Intake (DCI) method.

along with a number of employment and income generating programs both at government and non-government level helped alleviating the poverty situation.

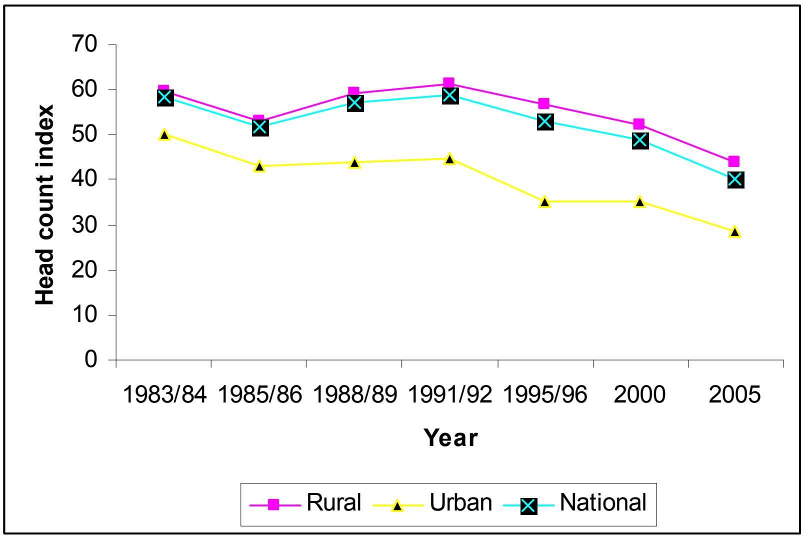
Second, there was a substantial variation in poverty incidence over different sub periods and between urban and rural areas. For example, under both poverty lines, the national head count ratio declined between 1983-84 and 1985-86 but increased in the years 1988-89 and 1991-92, before again declining in later years. Nearly the same pattern is observable for both rural and urban areas. According to Sen *et al.,* (2004), much of these fluctuations were related to the damaging effects of floods in 1987 and 1988 on agricultural output.

Figure 3.1 : Poverty incidence: The very poor, 1983-2005



Source: Table 3.2

Figure 3.2 : Poverty incidence: The poor, 1983-2005



Source: Table 3.2

Third, by considering 1983-1992 as the initial phase of reform and 1992-2005 as the post-reform period, it can be concluded that there was a faster rate of poverty reduction in the post-reform period than in the initial phase (Tables 3.3 & 3.4). Using the upper poverty line, Table 3.4 shows that the national poverty incidence increased by 0.06 per cent annually during 1983-1992 because increasing poverty in rural areas outweighed falling poverty in urban areas. On the other hand, in the period 1992-2005, the national poverty incidence declined at an annual rate of 2.29 per cent, with both urban and rural poverty incidence also declining by 2.62 and 2.03 per cent respectively.

Table 3.3: Poverty reduction rates during pre- and post- reform era (using lower poverty line)

	1983-1992	1992-2005	1983-2005
National	0.44	-2.94	-1.68
Urban	-2.04	-2.67	-2.08
Rural	0.78	-2.69	-1.43

Source: Author's own calculation from Table 3.2

Table 3.4: Poverty reduction rates during pre- and post- reform era (using upper poverty line)

	1983-1992	1992-2005	1983-2005
National	0.06	-2.29	-1.37
Urban	-1.18	-2.62	-1.89
Rural	0.27	-2.03	-1.15

Source: Author's own calculation from Table 3.2

The overall scenario is not inconsistent with the hypothesis that trade liberalisation reduced the incidence of poverty in Bangladesh. This reduced incidence is also not inconsistent with the evidence of per capita consumption expenditure growth at the national level. Per capita HIES (Household Income and Expenditure Survey) consumption expenditure grew at an annual rate of 0.6 per cent between 1983-84 and 1991-92. This increased to 2.7 per cent between 1991-92 and 2000 (Sen and Hulme, 2006).

A fourth notable feature in Table 3.2 is that the rate of declining poverty incidence from 1983 to 2005 was larger in urban areas than in rural areas. As a result, in terms of the lower poverty line, the ratio of the rural poverty index to the urban poverty index was considerably higher at the end of the period than it had been at the beginning. The same is true for the upper poverty line.

Apart from the tendency of urban households to be better off than rural households (in terms of poverty incidence), there was considerable difference in poverty incidence across regions. For example Table 3.5 reveals that during the 1990s, Rajshahi division had the highest incidence of poverty (71.9 per cent) followed by Khulna division with an incidence of 59.6 per cent and Dhaka division with 59.3 per cent. On the other hand, Chittagong division recorded the lowest incidence of poverty at 46.6 per cent. However, during 2000, there was notable progress in the poverty reduction across all the divisions, even though the progress was uneven. Dhaka division recorded a rapid reduction whereas an almost stagnant situation was observed for the Chittagong division (Table 3.5).

Table 3.5: Regional trends in poverty (head-count ratio), 1991-2005 (using the upper poverty line)

Division	1991-92	2000	2005
Chittagong	46.6	47.7	34.0
Dhaka	59.3	44.8	32.0
Khulna*	59.6	47.0	45.7
Rajshahi	71.9	61.0	51.2
Sylhet	-	42.4	33.8
All Divisions	58.8	49.8	40

Note:* including Barisal division, data source for Sylhet is from Preliminary Report on Household Income and Expenditure Survey, 2005.

Source: World Bank (2002b)

The incidence of poverty fell most rapidly in Dhaka division between 2000 and 2005 at an annual rate of 4.76 per cent. The situation also improved for all divisions in 2005 compared to 2000. Table 3.5 also reveals that in spite of a tendency towards reduction of the incidence of poverty in Rajshahi district, it is the most vulnerable area to poverty.

3.2.2 Incidence of Poverty by Labour Force Status of Head of Household

Table 3.6 shows that in both rural and urban areas the incidence of poverty is significantly higher, respectively at 75 per cent and 67 per cent for household, whose heads work as casual wage labour. Among the total number of poor people, about 46 per cent in the rural areas and about 36 per cent in urban areas are included in this category. Among other workers, the self-employed in agriculture in urban areas have the next highest incidence of poverty, followed by those self employed in the non-agricultural sector in rural areas.

Table 3.6: Poverty incidence by labour force status of household head, 2000 (using the upper poverty line)

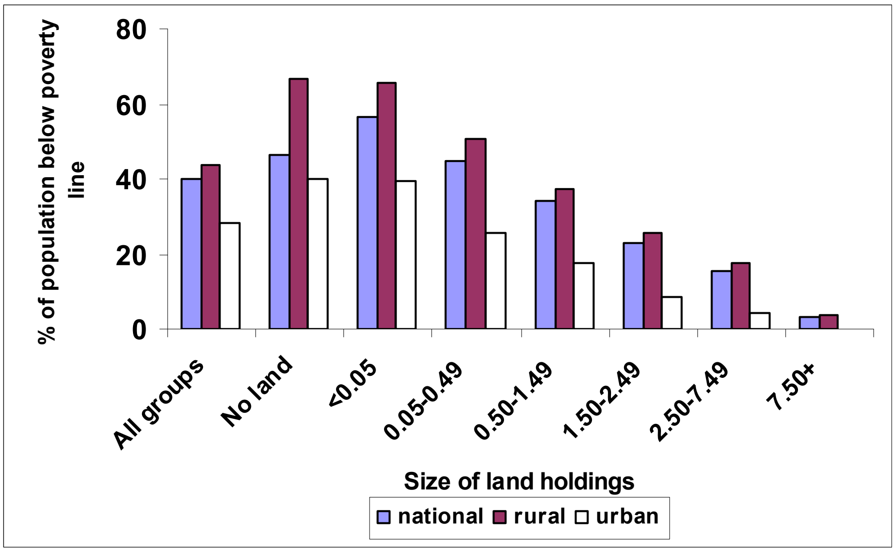
Labour force status	Rural			Urban		
	Head count index (%)	Percent of		Head count index (%)	Percent of	
		Population	Poor		Population	Poor
Casual wage labour	74.9	33	46	66.9	20	36
Salaried employment	35.1	9	6	24.1	30	20
Self-employment: Non-agriculture	44.6	18	15	32.2	32	28
Self-employment: Agriculture	43.3	31	25	47.9	5	7
Unemployed/not working	42.9	10	8	25.9	13	9
Total	53.0	100	100	36.6	100	100

Source: ADB and Government of Japan (2004)

3.2.3 Poverty and Landownership

Figure 3.3 reveals that poverty incidence increases with the decreasing size of land holdings owned by the rural poor. The number of households owning less than 0.05 acres of land is badly affected by the curse of poverty (56.4 per cent). In Bangladesh, where about 80 per cent of the population lives in rural areas and around 50 per cent of people still depend on agriculture, land ownership is a key determinant of poverty. According to World Bank (1998) estimates, among the landless in rural areas, six out of ten were very poor and seven out of ten were poor, while among marginal landowners, six out of ten were very poor and eight out of ten were poor.

Figure 3.3: Head count index by acres of land owned, 2005 (using the upper poverty line)

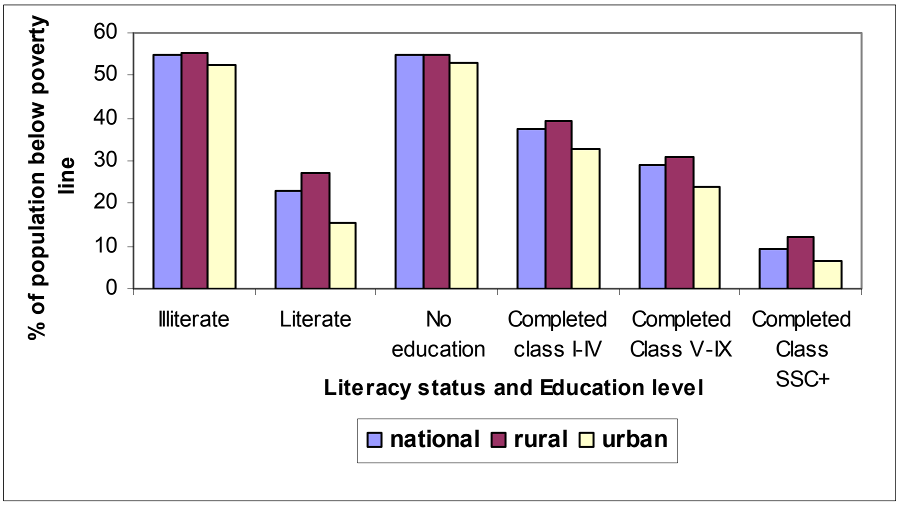


Source: BBS (2006)

3.2.4 Poverty and Educational Attainment

Figure 3.4 reveals that households whose heads did not have any education had the highest probability (54.7 per cent) of being poor in 2005. The comparable figure for the literate was 31.7 percentage points lower. Figure 3.4 also shows that poverty declines as heads of households become more educated. Another notable feature is that with increasing education levels, urban poverty falls faster than rural poverty.

Figure 3.4: Incidence of poverty by educational statistics, 2005 (using the upper poverty line)



Source: BBS (2006)

3.2.5 Human Development Index (HDI)

Since poverty is multidimensional (World Bank, 2002b), it is important to define poverty in Bangladesh not only in terms of income or consumption but also in terms of the wider Human Development Index[32]. Bangladesh has made greater progress in terms of the Human Development Index than in terms of income growth and poverty reduction. Indeed, its progress measured by the HDI compares favourably with most low-income countries. In 2004, it ranked 137 among 175 member countries, with an HDI of 0.51, a large improvement on its 0.347 in 1975 (Table 3.7). Bangladesh is one of the few countries amongst the least developed countries that has increased its HDI score by 20 per cent since 1990 (UNDP, 2006).

Table 3.7: Trends of HDI in Bangladesh, 1975-2004

Year	1975	1980	1985	1990	2000	2004	HDI rank in 2004
HDI	0.347	0.366	0.391	0.422	0.454	0.510	137

Source: UNDP (2006)

Bangladesh has been successful in many components of human development. For example, from low base levels, it has achieved a sharp decline in the birth rate, an increase in average life expectancy, a reduction in the population growth rate, increased access to safe drinking water and achieved an increase in the literacy rate. After committing in 2000 to attaining the Millennium Development Goals (MDGs), Bangladesh's achievements in human development are remarkable[33] as some of the targets embodied in the millennium declaration are similar to the United Nations human development Index, such as achieving universal primary education, reducing the infant and child mortality rate and easing of access to safe water.

[32] The Human Development Index (HDI) is a composite index that measures the average achievements in a country in four basic dimensions of human development, such as life expectancy at birth, adult literacy rate, the combined gross enrolment ratio for primary, secondary and tertiary schools, and gross domestic product per capita measured in terms of purchasing power parity.

[33] As a member of the United Nations, Bangladesh also committed in 2000 to achieve the millennium development goals and has taken a comprehensive approach to achieve those goals. Bangladesh at the end of the 1990s appears to be "on track" for most MDGs targets including infant mortality, expansion of universal primary and secondary education, supply of safe drinking water and sanitation (Sen and Hulme, 2006). The country is putting its best effort and on track to achieve other MDGs by 2015. To achieve these targets, Bangladesh government has prepared Poverty Reduction Strategy Paper (PRSP) titled 'Unlocking the Potential: National Strategy for Accelerated Poverty Reduction' (for the period of FY 2004-05 to 2006-07) (GOB, 2008). This document has outlined a number of policy measures to achieve the MDGs.

Table 3.8 compares the record of Bangladesh in human development with those of its South Asian neighbours and all developing countries. During the period 1970-2000, Bangladesh's annual per capita GNP growth rate was 1.7 per cent, the lowest among South Asian countries and lower than the average for all developing countries. During the same period, India had the highest per capita growth, two times the income per capita of Bangladesh. In terms of the Human Development Index, Bangladesh achieved progress in life expectancy at birth, even though its present status is still lower than other South Asian countries except Nepal and the average for all developing countries. The life expectancy at birth increased from 45.2 years to 62.6 years during the period 1970-75 to 2000-05, an annual average increase of 1.28 per cent.

In terms of infant mortality rate, Bangladesh's position is better in comparison with South Asian countries except Sri Lanka and even the average for all developing countries. The infant mortality rate declined from 145 infant deaths per 1,000 live births to 56 deaths during the period 1970-2004, an average annual rate of decline of 1.75 per cent. The average annual under five mortality rate was nearly 2 per cent for Bangladesh during the period 1970-2004 whereas in the case of South Asia and the average for developing countries the rates were 1.54 per cent and 1.36 per cent respectively. Although Bangladesh has made progress with regard to the adult literacy rate, it seems that in comparison to South Asia and the average for developing countries it has lagged behind. Bangladesh has achieved rapid progress in schooling during the last two decades. The gross primary enrolment rate, which was only 61.5 per cent in 1980, increased to 72 per cent by 1990 and 96 per cent by 2000 (World Bank, 2005). Access to improved water supply is better in Bangladesh than other South Asian neighbouring countries and the average for developing countries. However, this success is being threatened by the problem of arsenic contamination of ground water (ADB, 2002).

Table 3.8: Human development: An international comparison

	Bangladesh	India	Pakistan	Nepal	Sri Lanka	South Asia	Developing Countries
Per capita GNP growth,1970-2000	1.7	3.4	2.9	2.0	3.3	2.5	2.4
Life expectancy at birth (years)							
1970-75	45.2	50.3	51.9	44.0	65.1	49.8	55.5
2000-05	62.6	63.1	62.9	61.4	72.6	63.3	64.7
Average annual % change (+)	1.28%	0.85%	0.71%	1.32%	0.38%	0.90%	0.55%
Infant mortality rate (per 1,000 live births)							
1970	145	127	120	165	65	129	108
2004	56	62	80	59	17[a]	69	61
Average annual % change (-)	1.75%	1.46%	0.95%	1.84%	2.11%	1.33%	1.24%
Under five mortality rate (per 1,000 live births)							
1970	239	202	181	250	100	206	166
2004	77	85	101	76	19[b]	95	89
Average annual % change (-)	1.94%	1.65%	1.26%	1.98%	2.31%	1.54%	1.33%
Total fertility rate (%)							
1970-75	6.2	5.4	6.3	5.8	4.1	5.6	5.4
2000-05	3.5	3.0	5.1	4.3	2.0	3.3	2.9
Average annual % change (-)	1.45%	1.48%	0.63%	0.86%	1.71%	1.37%	1.54%
Adult literacy rate (%)							
1990	34.2	49.3	35.4	30.4	88.7	49.1	68.8
2004	53[c]	61.0	49.9	48.6	90.7	60.9	78.9
Average annual % change (+)	3.66%	1.58%	2.73%	3.99%	0.15%	1.60%	0.98%
Primary school enrolment (%)							
1991	61.5[d]				-	-	-
2004			33				
Average annual % change	75[e]	90	66	78			
Secondary school enrolment (%)							
1975-77	14	-	-	-	-	-	-
1996-97	29	49	30	42	75	44	50
Access to safe water (%)							
1990	94	68	83	67	68	72	-
2000	97	84	90	88	77	85	78
Average annual % change (+)	0.29	2.13	0.77	2.88	1.20	1.64	
Human Poverty Index (%)	44.2	38.1	36.3	31.3	17.7	-	-

Note: 'a' the number is for the year 2002

'b' " " " " 2002

'c' " " " " 1999

'd' " " " " 1991(source: (World Bank, 2005)

'e' " " ' " 2000(source: (World Bank, 2005)

'-'means not available

Source: Author's own calculation from various Human Development Reports, UNDP.

3.3 Trends in Income Inequality in Bangladesh

As stated in the previous section, Bangladesh has achieved poverty reduction over the last decade. Nevertheless the country has the highest incidence of poverty in South Asia. About 36 per cent of the population lives below US$1 per day (in 2000) and about 82.8 per cent lives under US$2 per day (World Bank, 2002a). According to Khan (2006), Osmani *et al.,* (2003), Sen *et al.,* (2004), World Bank (2002b) and Wodon (1999), the growing income disparity has offset the potential poverty reducing effect of growth. For instance, according to World Bank (2002b) estimates, had the observed rate of growth during the period between 1991-92 and 2000 been distribution-neutral, poverty would have fallen by 17 percentage points, or almost twice the actual observed rate. The extent of income inequality in Bangladesh can best be understood by Table 3.9. This shows the income shares of segments of the population ranked in ascending order of income per household for the years 1973, 1983, 1991, 1995 and 2005. By observing the income shares of different income quintiles it is clear that income distribution is skewed towards the high income categories and that this skewedness has been widening overtime.

Table 3.9 reveals a clear tendency for the shares of income of the first four quintiles to decline. For instant, starting from 1983, the income shares of the 1st and 2nd quintile declined steadily until 2005. The decrease in the percentage share of income is 1.74 percentage points for the first quintile, and 2.2 for the second. In the case of the third quintile, the percentage share increased by 4.59 in 1991 from the year 1983, but after that it declined by 2.4 percentage points between the year 1991 and 2005. The fourth quintile also showed the declining trend over the period 1973-2005. The most striking change is in the fifth quintile class, where the share of income increased between 1983 to 2005 by the rate of 9.33 percentage points. In the year 2005, the share of the highest income quintile in total income was 52.71 per cent which was nearly 10 times higher than the share of the lowest income quintile (Table 3.9).

Another notable feature is that in 1983, income accruing to the top 5 per cent of households increased from 18.30 per cent to 26.93 per cent in 2005, a 47 per cent increase. On the other hand, the share of the lowest 5 per cent declined from 1.17 per cent in 1983 to 0.77 per cent in 2005, a 34 per cent decrease. In 2005, the income share of the highest 5 per cent was thirty five times higher than the share of the lowest 5 per cent. Table 3.9 also reveals that in 2005, the lowest 40 per cent shared only 14.36 per cent of total income. Clearly showing that overtime, the rich section of the population became richer while the poor got poorer, as far as income shares are concerned.

Broadly similar patterns are observed in both rural and urban areas although inequality was higher in urban areas than in rural areas. In urban and rural areas the shares of income of the first four quintiles declined gradually from 1983, but the rate of decrease was higher in urban areas compared to rural areas. For instance, in urban areas between the period 1983 and 2005, the share of income decreased by 2.1 percentage points or about 30 per cent for the first quintile, whereas in rural areas the decline was only 20 per cent between the years 1983-2005. The corresponding figures for second, third and fourth quintiles were 2.47, 2.69 and 3.86 percentage points for urban areas and 1.96, 2.14 and 1.1 for rural areas respectively. Furthermore, in rural areas, the richest/poorest ratio in 2005 was 26.17 compared to 15.24 in 1983. In urban areas this ratio increased to 45.33 in 2005 from 14.35 in 1983. Furthermore, whereas in 1983, the richest quintile's income share was about 2.47 times higher than the poorest 40 percent's income share in urban areas, it went up to 4.18 times in 2005. The corresponding figures for the rural areas were 2.22 and 3.12 respectively. A clearer picture of increased inequality is obtained from the Gini coefficient[34]. Figure 3.5 shows, starting from 1973, the national Gini coefficient increased to 0.39 in 1981 indicating a move towards greater income inequality. However in 1983, it fell to 0.36 which indicates a reducetion in inequality.

[34] The Gini coefficient measures the extent to which the distribution of income or consumption expenditures among individuals or households within an economy deviates from a perfectly equal distribution. It ranges from 0 (perfect equality) to 1 (all income accrues to one household).

Table 3.9: Income distribution in Bangladesh (percentage share of income of households by quintile groups), 1973-2005

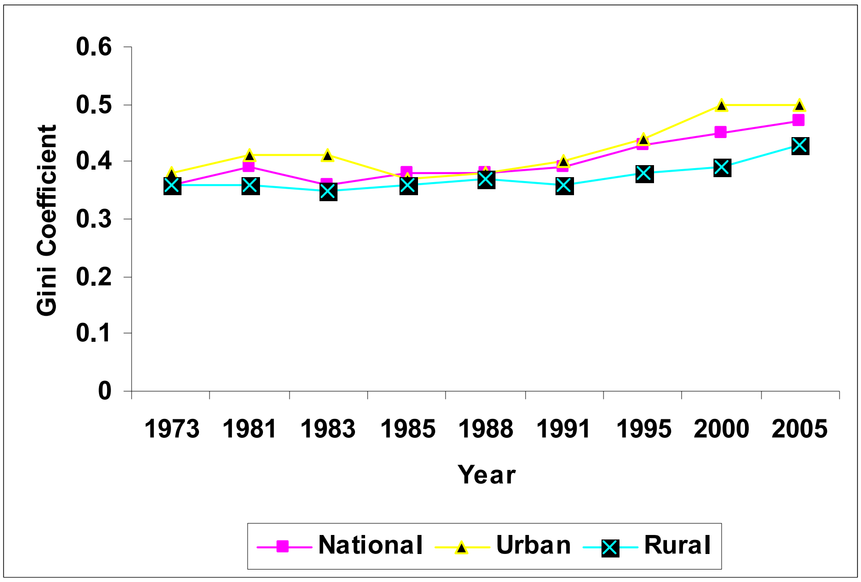
Group	National					Urban					Rural				
	1973	**1983**	**1991**	**1995**	**2005**	**1973**	**1983**	**1991**	**1995**	**2005**	**1973**	**1983**	**1991**	**1995**	**2005**
1st Quintile	7.0	7.2 6	6.52	5.71	5.26	6.8	6.92	6.7	5.12	4.82	7.2	7.32	6.74	6.49	5.88
2nd Quintile	11.3	11.75	10.89	9.83	9.1	11	10.95	10.89	9.04	8.48	11.9	11.92	11.15	10.94	9.96
3rd Quintile	15.1	10.94	15.53	13.88	13.13	16	15.34	14.91	14.17	12.44	15.1	16.2	15.78	15.14	14.06
4th Quintile	22.8	21.73	22.1	20.5	19.79	22	22.57	21.43	20.33	18.71	23.3	21.86	22.58	21.62	20.76
5th Quintile	44.8	43.38	44.87	50.08	52.71	45.2	44.22	46.07	52.34	55.56	42.5	42.7	43.75	45.81	49.35
Gini Coefficient	**0.36**	**0.36**	**0.39**	**0.43**	**0.47**	**0.38**	**0.41**	**0.40**	**0.44**	**0.50**	**0.36**	**0.35**	**0.36**	**0.38**	**0.43**
Poorest 5%	1.20*	1.17*	1.03*	0.88	0.77	-	1.18	1.09	0.74	0.67	-	1.19	1.07	1.00	0.88
Richest 5%	17.2	18.30	18.85	23.62	26.93	18.6	16.93	19.42	24.30	30.37	16	18.14	17.80	19.73	23.03
Poorest 40%	18.3	18.95	17.41	15.54	14.36	17.80	17.87	17.59	14.16	13.30	19.1	19.24	17.89	17.43	15.84
Ratio of top 5% to lowest 5%	14.33	15.64	18.30	26.84	34.97	-	14.35	17.82	32.84	45.33	-	15.24	16.64	19.73	26.17

Note:* mean data for the year 1974 is taken from (Hossain, 2003).

Source: Khan and Hossain (1989), Report for the Household Income & Expenditure Survey 2000, and Preliminary Report on Household Income & Expenditure Survey 2005.

During the years 1985 and 1988, income distribution did not vary or remained stable but the situation has changed in a major way since the early nineties. The Gini coefficient increased to 0.47 in 2005, from 0.39 in 1991. In the case of urban areas, the Gini coefficient rose from 0.38 in 1973 to 0.41 in 1981 and remained stable until 1983 and declined thereafter, showing an obvious improvement in income distribution during the last phase of the 1980s. However, this ratio rose sharply from 0.40 in 1991 to 0.44 in 1995 and to 0.50 in 2000 where it remained until 2005. In the case of the rural areas income inequality remained more or less stable until the year 1991. However, from the year 1995 it increased through to 2005, when it reached 0.43 compared with 0.36 in 1991.

Figure 3.5: Long-term trends in inequality in Bangladesh, 1973-2005



Source: Drawn from Table 3.9

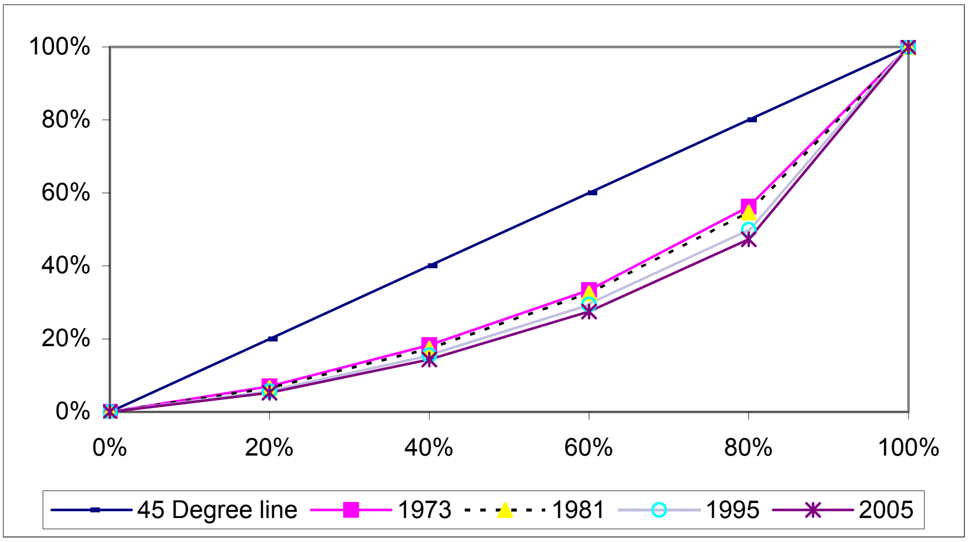
A further perspective on income inequality is provided by the Lorenz curve[35] for the years 1973, 1981, 1995 and 2005 for national, rural and urban areas (Figure 3.6, 3.7 and 3.8). In these figures, the 45^{o} line indicates perfect equality in income distribution. The degree of inequality is measured by how far the Lorenz curve is bowed out from the 45^{o} line. The more the Lorenz curve bends away from the 45^{o} line of equality, the less equal is the distribution of

[35] The Lorenz curve is a graphical representation of the cumulative distribution function. By plotting the cumulative percentage of population on the horizontal axis whilst plotting the cumulative percentage of income along the vertical axis, the Lorenz curve is drawn. It is compared with the perfect equality line that is at an angle of 45 degrees. The further the Lorenz curve lies below the line of equality, the more unequal is the distribution of income.

income. Thus, from the figures we observe growing inequality across the observable periods. The deterioration in income equality is greater noticeable during the post-liberalisation period compared to the initial phase of trade policy reform. In addition, this trend is greater in urban areas in comparison to rural areas.

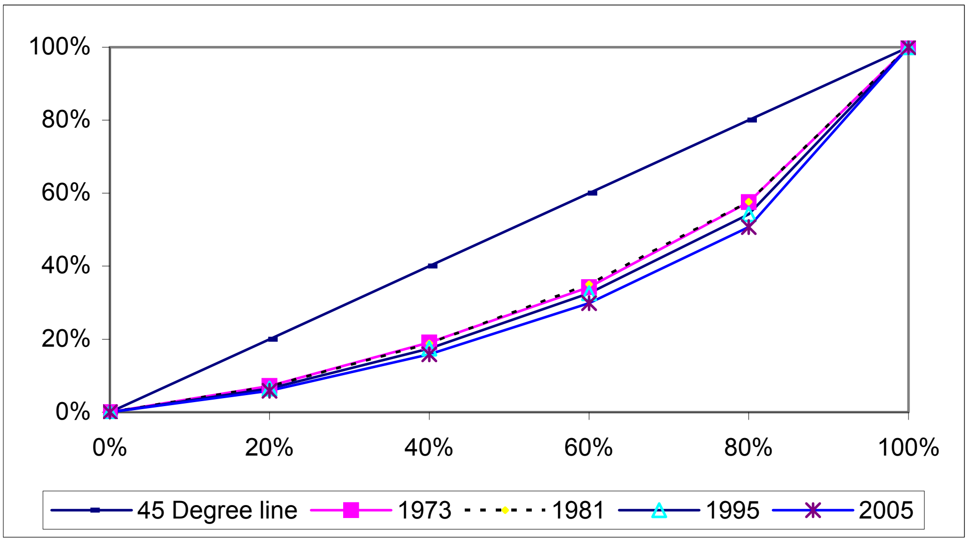
From the above analysis it is clear that in Bangladesh, inequality worsened during the period of policy reform implementation. Taking the year 1983 as the starting point of trade liberalisation, Table 3.9 shows that income received by the first, second quintiles and the poorest 40 per cent increased in 1983 compared to 1973, while income received by the richest 20 per cent and 5 per cent of the economy declined over the same period. However, with the beginning of the new globalisation process in 1981-82 the income shares of the poorest 5 per cent, 20 per cent, and 40 per cent started to decline.

Figure 3.6: National Lorenz income inequality curves for the years 1973, 1981, 1995 and 2005



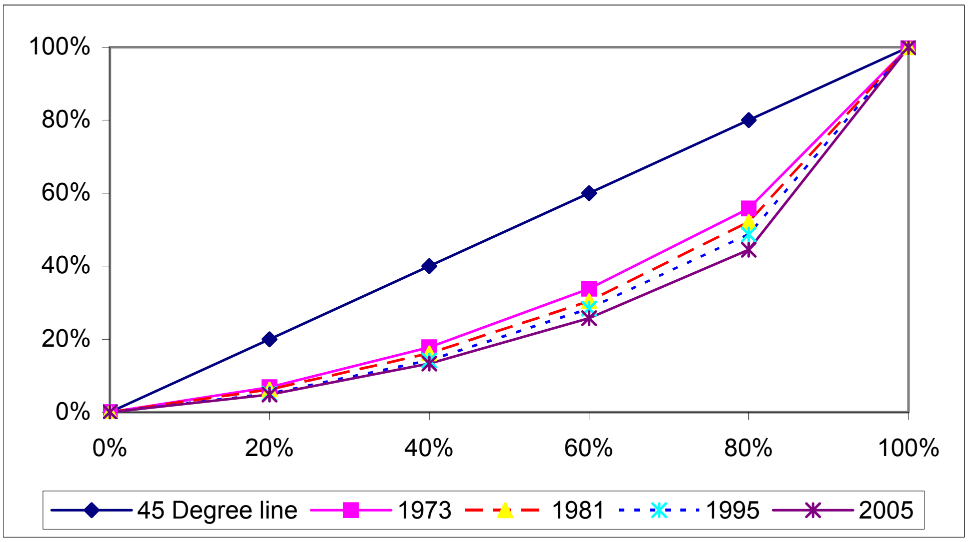
Source: Drawn from Table 3.9

Figure 3.7: Lorenz income inequality curves for rural areas for the years 1973, 1981, 1995 and 2005



Drawn from Table 3.9

Figure 3.8: Lorenz income inequality curves for urban areas for the years 1973, 1981, 1995 and 2005



Drawn from Table 3.9

On the other hand, the income share of the richest 5 per cent, and 20 per cent started to increase and reached a peak during the same time period (Table 3.9). As a result, there emerged a large gap between the highest and lowest income groups. In 1983, the income accruing to the top 5 per cent of households was 18.30 per cent while the income share of the lowest 5 per cent was 1.17 per cent implying an income differential of 14.41. By 2005, this differential had increased to 35 (26.93:0.77). The situation was more severe in urban areas than in rural areas. In rural areas, the richest-poorest ratio in 2005 was 26.17 compared with 15.24 in 1983. In urban areas this ratio increased to 45.33 in 2005 from 14.35 in 1983 (Table 3.9). Thus it is clear that trade liberalisation in Bangladesh did not bring any reduction in income inequality. Rather it was accompanied by increased inequality controlling for other variables.

3.4 Labour Market Development in Bangladesh

As discussed in Chapter 2, after the initiation of trade liberalisation in Bangladesh, there were significant improvements in the overall macroeconomic indicators. Whether these improvements brought any changes in the creation of new employment is a matter of concern as employment provides the major link between economic growth and a reduction in poverty. A country which attains high rates of employment growth alongside high rates of economic growth is also successful in reducing poverty (Islam, 2004). Theory suggests that by providing productive and gainful employment opportunities for the labour force in the formal sector, trade liberalisation initiates positive gains for labourers. This section discusses overall trends in the labour market and the employment situation in Bangladesh for the last three decades.

3.4.1 Demographic Changes and the Labour Market

Table 3.10 shows the growth rate of population, labour force and employment during the period 1981-2000. It is evident that in Bangladesh the labour force grew at a much faster rate than the population. For example, during the period 1981-2000, the civilian labour force increased from 25.9 million to 45.05 million at an annual average rate of 3.69 per cent, while the total population grew from 89.9 million to 126.6 million at an annual average rate of 2.04 per cent (Table 3.10). By disaggregating the figures for various sub-periods, it can be seen that during the periods 1981-85, 1985-90 and 1990-95 population growth rates were more or less stable at 1.67 per cent, 1.92 per cent and at 1.64 per cent respectively, even though during the last phase of the 1990s the rate decreased. In contrast, the civilian labour force grew at the rate of 3.18 per cent and 2.75 per cent during the first and second half of the 1980s; however, during the first and second phase of the 1990s the rate decreased. The size of the employed population also registered an increase of by 69 per cent for the period 1981-2000 which was much less than the increase in civilian labour force by 73 per cent for the same period.

Table 3.10: Size and structure of the labour force in Bangladesh, 1981-2000

Year (mid)	Population (million)	Civillian labour force (million)	Employed population (million)		
			Male	Female	Total
1981	89.9	25.9	23.9	1.4	25.3
1983	93.3	29	25.55	2.43	27.98
1984	95.3	29.5	26.43	2.55	28.98
1985	97.4	30.80	-	-	-
1989	106.2	33.40	29.40	3.30	32.40
1990	108.6	35.9	30.44	4.47	34.91
1995	119.3	41.73	33.16	7.15	40.31
2000	126.6	45.05	33.67	9.15	42.82

Sources: Khan and Hossain (1989), Mujeri (2004)

With regard to the total number of unemployed, this figure increased from 0.6 million in 1981 to 2.2 million in 2000, representing an increase in the unemployment rate from 2.31 per cent in 1981 to 4.95 per cent in the year 2000. An important change in the structure of employment was the rapid rate of growth in female employment. Male employment grew from 23.9 million in 1981 to 31.1 million in 1990-2000 at an annual average rate of 3.88 per cent. Over the same period female employment grew at an average annual rate of 8.26 per cent (Table 3.10).

3.4.2 Sectoral Distribution of Employment

As discussed in Chapter 2, there were some shifts in the sectoral contributions to GDP after trade liberalisation. For example, agriculture’s share declined from 34 per cent to 26.5 per cent during the period 1980-2005, while industry’s share increased marginally from 21.4 per cent to 24.2 per cent and the service sector’s share increased from 44.6 per cent to 54.2 per cent during the same time frame. However, these changes were not closely reflected in the changes in the sectoral distribution of employment.

Table 3.11 shows the sectoral distribution of employment during the period 1981-2000. From Table 3.11 it is evident that even though the share of employment in agriculture has decreased from 70.1 per cent in 1981 to 62.1 per cent in 2000, it still employs more people than all the other sectors combined. On the other hand, the share of employment in manufacturing declined from 19.6 per cent to 10.3 per cent in contrast to its increasing share in GDP. According to Rashid (2000), this is a result of trade liberalisation adversely affecing several competing large and medium import industries. In addition, the government's de-nationalisation policy in the 1980s led to the collapse of many state owned enterprises which all contributed to the decline in employment growth. Table 3.11 also shows that the service sector, which contributes about 50 per cent of GDP, accounted for only 25 per cent of the labour force in 2000. One important feature of the emerging trends in the labour market during the 1990s was the shifting of labour from agriculture to the economy's large informal sector. According to the Labour Force Survey of 1999-2000, about three-quarters of non-agricultural labour force belonged to the informal sector, the rest being employed in the organised sector, public and private combined (Mahmud, 2006).

In Bangladesh, a large part of the informal sector employed in rural areas and rural non-farm (RNF) activities accounts for over 40 per cent of rural employment[36] (Hossain, 2003). In 1983-84, about 34 per cent of the rural labour force was employed in non-farm activities whereas by the year 2000 this figure stood at 39 per cent (Mahmud, 2006). In the 1980s, the RNF sector was in the form of low-earning self-employment and unpaid family work. By the 1990s, it was engaged in the larger scale enterprises that created greater wage differentials between skilled and unskilled workers and larger profits for more prosperous entrepreneurs. According to Khan (2006), these disequalising components of income (income from non-farm enterprise, salary from non-farm employment) are responsible for inequality in the distribution of rural income during the period 1990-2000.

Another obstacle was strong entry barriers for the poor into the formal sector, i.e. in salaried or permanent wage employment which prevented the poor from generating sufficient income to move out of poverty.

[36] According to Hossain (2003), RNF activities are classified into three categories: 1) manual labour based – includes self-employed subsistence oriented cottage industries, wage employment in rural business enterprise, transport operation and construction labour; 2) human capital based occupation-includes salaried service in public and private organisations, teachers and various types of personal services; and 3) physical and human capital intensive activities-includes commercial type rural industries, for example, agro-processing, shop-keeping, peddling, petty trading and contractor services.

Table 3.11: Sources of employment: Changes in sectoral distribution

Year	Agriculture	Manufacturing	Service	HH Work
1981	70.1	19.6	8.7	1.6
1984	58.8	9.0	26.2	6.0
1985	57.7	9.3	28.2	4.8
1986	57.4	11.8	26.6	4.3
1989	65.0	15.5	14.8	4.8
1991	66.3	12.7	16.1	4.6
1996	63.2	9.5	25.1	2.2
2000	62.1	10.3	24.8	2.8

Note: 'HH' means Household

Source: Rahman and Islam (2003).

3.4.3 Trends in Wages in Bangladesh, 1990-2000

In a labour abundant country like Bangladesh, trade liberalisation should initiate expanding employment opportunities, especially for low-skilled workers which in turn will push up wage rates. However, the evidence shows that in Bangladesh during the late 1990s real wage indices in manufacturing and agriculture stagnated. As a result, the increase in the GDP growth rate was unable to reduce the poverty targets during the late 1990s.

Table 3.12 shows the real wage rate indices in different sectors in Bangladesh for the period 1990 to 2000 and that there were considerable variations in the movement in real wages across the major sectors. For example, the agricultural real wage increased at an annual average rate of 2.16 per cent per year from 1990-91 to 1993-94. Then it started declining steadily. During the period 1993-94 to 1999-2000, real wages declined by 1.61 per cent annually. In the case of the organised manufacturing sector there was a steady increase in the real wages from 1990-91 to 1999-2000 with few exceptions. The construction sector, which is representative of the non-farm informal sector shows a decreasing trend until the year 1991-92, after which it tends to decline steadily.

Table 3.12: Trends in real wages, 1990-2000 (base 1985-86=100)

Year	Manufacturing	Construction	Agriculture
1990/91	99	93.1	98
1991/92	98	90.5	101.1
1992/93	103	92.0	105.1
1993/94	105	90.2	106.5
1994/95	105	83.6	101.5
1995/96	107	85.2	100.1
1996/97	113	87.6	101.3
1997/98	119	88.2	98.1
1998/99	114	88.0	94.0
1999/2000	119	89.5	94.5

Source: Rahman and Islam (2003).

During the period 1990-91 to 1999-2000, the real wage index for construction declined by 0.38 per cent. Thus, the trends in real wages in the agriculture and construction sectors imply that acceleration in GDP growth of these sectors did not contribute much to raising real wages[37].

3.5 Concluding Remarks

This chapter provided an overview of the relationship between trade liberalisation, poverty, inequality and labour market developments in Bangladesh during the last few decades. It has been found that in Bangladesh the incidence of poverty declined, measured both by lower and upper poverty lines and the rate of reduction was faster in the post-reform period compared to the pre/initial-reform period. However, the decrease in poverty was greater in urban areas than in rural areas. In recent periods, rural poverty was found to be about twice as much higher than in urban areas. People working in agriculture and with no land or less than 0.05 acres of land were found to have the highest incidence of poverty. Nevertheless, Bangladesh made progress in terms of Human Development Indicators and in this respect Bangladesh compares favourably with most low-income countries.

[37] There is substantial discrepancy in the results for the trends in real wages. The reason lies in the use of different deflators in calculation. See Salmon (2002), Sen and Hulme (2006), and Ahmed and Sattar (2004) for comparison.

Income inequality was measured in terms of quintile shares of income, Gini coefficients and Lorenz curves and all indicate increases in income inequality in Bangladesh. It was observed that existing inequality was aggravated during the policy reform implementation period. In addition, deterioration in the income inequality situation was found to be more severe in urban areas. An analysis of labour force trends and the distribution of employment by sectors show that during the extensive trade liberalisation period (in the 1990s) there was a deceleration in the rates of employment in both the agriculture and manufacturing sectors. However, the bulk of employment generation during the 1990s was in the informal sector. Increases in real wages also did not match with the growth performance of major sectors. These observed phenomenons in terms of poverty, inequality, and the labour market in Bangladesh has led to a surge in studies that directly assess the impact on poor household groups of trade liberalisation policies. Understanding these linkages is essential in predicting whether these changes will help or hurt the poor. The following chapter provides an analysis of the theoretical, methodological and empirical findings on the link between trade policy, poverty and income inequality.

Chapter 4

A Review of Literature on Income Distribution, Poverty and Trade Policy

4.1 Introduction

The present chapter offers a survey of theoretical and methodological studies that analyse how trade policies affect the incidence of poverty and inequality. The focus is mainly on the studies that use a general equilibrium framework, as this approach can capture both the direct and indirect effects of trade policies within a constrained optimisation framework. The chapter is organised as follows. Section 4.2 provides a brief overview of the theoretical considerations relating to trade liberalisation, poverty and inequality. Section 4.3 reviews empirical research into the links between trade, poverty and income inequality. This section mainly highlights different methodological aspects of the computable general equilibrium models (CGE) that have been used in analysing trade policies within both developed and developing countries. Section 4.4 discusses the application of CGE models to the Bangladesh economy. Section 4.5 provides some concluding comments.

4.2 Theoretical Approaches

In the historical development of international trade and development economics, the effects of economic policy on the distribution of welfare among individuals and households were often neglected. As Corden (1997) stated:

"Many economic theorists have tended to be either blind or nihilistic about the income distribution implications of economic policies. A vast amount of normative economic theory ignores income distribution by concentrating on Pareto-optimality".

A policy was justifiable if sufficient compensation could be given to maintain the utility of those adversely affected by the policy. Both the classical theory of international trade and its neo-classical refinements showed how a country tends to benefit from specialisation and trade, but they neglected to show how the gains of real income within each country were divided among labour, capital and land (Metzler, 1949). Heckscher and Ohlin were the first to analyse the influence of international trade on the distribution of national income. They argued that international trade, by increasing the demand for each country's abundant factors of production, tends to equalise the relative returns to the factors of production in different countries (Metzler, 1949). In an extension of Heckscher and Ohlin's work, Stolper and Samuelson (1941) provided a rigorous analysis of the income distribution effects of a tariff in a general equilibrium model (see below).

In development economics, the early theorising of the 1950s and 1960s was dominated by an aggregate growth point of view, with little concern for distribution. As Bourguignon *et al.,* (2006) stated:

"the social impact of macro policies was analysed as a by-product of GDP growth with little or no effect of growth itself on the income distribution across individuals of a population….with poverty defined by some fixed level of real income, growth would eventually reduce poverty through a trickle-down effect".

It was assumed that growth would affect the poorest sections of developing countries in much the same way as it affected the relatively poor in developed countries. There was extensive support for the 'Kuznets U' hypothesis that the relative distribution of income would become more unequal in the early stages of economic development, before becoming more equal in the later stages. However, towards the end of the 1960s, this relatively optimistic view was increasingly questioned when rapid aggregate growth was accompanied by deteriorating employment opportunities. Empirical work by Adelman and Morris (1973), Paukert (1973), and Ahluwalia (1976) showed that for most developing countries, the distribution of income deteriorated as a consequence of growth. These findings increased concerns about distributional issues towards the end of the 1970s.

In the literature, there are three approaches to income distribution: 1) the functional distribution of income; 2) the extended functional distribution of income; and 3) the size distribution of income[38]. The functional distribution of income refers to the shares of the national income accruing to the primary factors of production, viz land, labour and capital. The extended functional distribution disaggregates the functional distribution by sectors and

[38] See Adelman and Robinson (1989) for a detailed discussion of these concepts with their applications.

mode of production (Adelman and Robinson, 1989). It refers to the distribution of income among disaggregated factors as for example, labour differentiated by skills and education, capital by type or sector and land by region or type. The size distribution of income refers to the size distribution of income among households. Such a distribution distinguishes between low and high income groups. The determinants of the size distribution include social, political and cultural factors in addition to economic factors. Champernowne (1953) and Meade (1964) made early contributions to the theory of size distribution. They included the market value of services from human and non-human capital in the definition of personal income.

According to Adelman and Robinson (1989), the extended functional distribution and the size distribution of income are the most relevant approaches for welfare analysis. However, in empirical trade policy analyses, assessments of the effects on the size distribution of income are limited, even though in the general equilibrium literature there has been extensive modelling of the extended functional distribution and the size distribution. A number of trade models evaluate how functional income distribution changes as a result of policy shocks. The well-known Stolper-Samuelson theorem and Ricardo-Viner's specific factor model provide analyses of how the returns on capital and labour are altered when the prices of tradable goods change. In its restrictive form, the Stolper and Samuelson (1941) theorem states that when trade barriers are removed, the real return to the factor with which the country is abundantly endowed increases, and the real return for the scarce factor decreases as the relative product prices move favourably to the abundant factors. Critics argued that Stolper-Samuleson's analysis of the income distribution effects of a tariff were based on a very special framework and on many restrictive assumptions. However, subsequent analyses and refinements of this theorem by Metzler (1949), Bhagwati (1959), Jones (1965), Chipman (1969), Either (1974), Jones and Scheinkman (1977) have shown that the essential features of the theorem hold much more generally[39].

In its original setting, the Stoleper-Samuelson theorem can be described as follows. Suppose an economy consists of only two sectors and there are two homogenous factors of production ('capital' and 'labour'). Each factor is in fixed supply to the economy and is always employed in both sectors. It is also assumed that both capital and labour are freely mobile between the

[39] See Deardorff and Stern (1994) for an overview of the Stolper-Samuelson theorem with its extensions, verifications and refinements.

two sectors[40]; one sector produces exportable commodities while the other sector produces goods which compete directly with imports. Further, suppose the import competing sector is labour intensive and the exportable sector is capital intensive, i.e. the import competing sector employs a higher ratio of labour to capital than the other sector. In each sector, the real factor price will be equal to the marginal product of the factor in that sector and there are constant returns to scale.

With these assumptions, an increase in a tariff, or any other changes that raise the relative price of the import competing sector's output, encourages an expansion of this sector. Under the assumption of full employment, this increase in the import competing sector initiates a contraction in the exportable sector, which in turn increases the aggregate demand for labour compared to capital. Thus, there is an upward pressure on the price of labour and, with the export price kept constant, the return to capital must fall. In fact, the rise in the real wage will be proportionately greater than the rise in the domestic price of importables induced by the tariff (Corden, 1997) which is termed the 'magnification effect'[41]. The general conclusion is that a country's scarce factor gains from protection while a country's abundant factor loses.

Many criticisms were levelled at the Stolper-Samuelson theorem on the grounds that it is based on many restrictive assumptions. Metzler (1949) pointed out that the study by Stolper and Samuelson made no allowance for the terms of trade. By abandoning the small country assumption and allowing for the terms of trade impact, Metzler (1949) showed that a country, by its protectionist policy, might not succeed in raising the relative domestic price of its import competing products. At the initial world price, the tariff reduces the price of importables. With sufficiently low elasticity of demand in the world market, the tariff might improve the home country's terms of trade by more than the amount of the tariff (Jones, 2006). This implies violation of the Stolper-Samuelson result whereby a country's labour intensive importable sector's return would rise because of a tariff.

Relaxing assumptions of free mobility of all factors and allowing many factors produces the Specific Factor model, which may also produce contrasting results. The Specific Factor model, originally discussed by Viner, was a variant of Ricardian. The formal clarification in mathematical terms was carried out by Jones (1971). According to this model, a country

[40] This characteristic corresponds to long-run phenomena.
[41] 'Magnification effect' refers to the effect of a given change in commodity prices on factor prices. This concept was first introduced by Jones (1965).

produces two goods, one importable and another exportable in two separate industries, by using two factors of production, capital and labour. Further, it is assumed that at least one of these factors is mobile (for example, labour) across sectors but the other is sector specific. The distributional result is that the removal of trade barriers benefits the owners of the specific capital in the exportable sector, while the factor specific to the importable sectors loses. However, the welfare effects on the mobile factors are ambiguous as this depends on the consumption pattern of labourers. Thus, it is necessary to know labourers' consumption preferences or the relative budget shares of various products before calculating real returns on the mobile factor.

Winters (2000) thus argued that the Stolper-Samuelson theorem is incapable of answering the questions of trade and poverty in the real world as it relies on many restrictive assumptions and it needs to be supplemented by further analysis to derive concrete conclusions. Winters (2000) provided a conceptual framework in linking trade reforms with poverty through a number of channels[42]: 1) the price and availability of goods; 2) factor income, prices and employment; 3) changes in government revenue and expenditure; 4) changing incentives for investment and innovation which affect economic growth; and 5) negative external shocks, e.g. changes in terms of trade that affect poverty.

A detailed discussion of each channel indicates the way in which trade liberalisation affects poverty. By lowering the prices of imported goods and raising the prices of exportables, trade liberalisation affects the poor. Consumers benefit from the falling prices, whereas the producers of exports benefit from rising prices. The effect of a price change on a household's welfare thus depends on whether the household is a net supplier or a net demander of the good or service in question. If the household comprises of poor consumers, lowering the prices of imports help them and if the poor are producers of the export goods, then the price rise will benefit them.

The second channel through which trade liberalisation affects poverty is changes in wages and employment. As mentioned previously, the Stolper-Samuelson theorem predicts that a rise in the relative price of a commodity leads to a rise in the real return to the factor used intensively in producing that commodity (Bannister and Thugge, 2001). However, as the theorem has

[42] See Bannister and Thugge (2001) and Ben-David, Nordstrom, and Winters (1999) for a detailed discussion on these linkages.

little applicability where there are many factors of production, following Bannister and Thugge (2001), the following conclusions are drawn. Firstly, the effect of trade reform on employment and wages depends on the flexibility of labour markets. Since in developing countries, labour markets have a higher degree of flexibility and a high elasticity of supply of labour, changes in employment are more likely than changes in wages. Secondly, the effects on employment and wages depend on the speed of firms' adjustments. If firms react swiftly and the right economic environment exists, then investment and higher productivity protect the firms and labourers from the negative effects of liberalisation.

Trade reforms have impacts on government revenue and expenditure. Lower tariffs reduce government revenue, which in turn affects the poor if public services on which they depend are cut back as a result of the fall in revenue. Bannister and Thugge (2001) argue that government revenue can increase in some instances (in case of high previous tariffs) through increased trade flows, reduced incentives for smuggling and corruption, simplifying of the tariff regimes and sound macroeconomic and exchange rate policies.

Moreover, there is a general consensus that trade liberalisation may contribute to growth of an economy through improved incentives for investment and innovation, higher flows of foreign direct investment, technology transfers and new business practices that increase overall productivity and growth (Bannister and Thugge, 2001). Finally, there is a concern that even though trade liberalisation helps countries to diversify their import and export markets, greater openness sometimes increases vulnerability in terms of trade shocks, which in turn may have a greater impact on the poor. There is ample evidence of more open economies suffering from greater macro economic volatility. According to Bannister and Thugge (2001), countries should use exchange rate management policy as a complement to demand management policy to deal with external trade shocks.

Because of the complexity of the relationships between trade, poverty and inequality, researchers have adopted a number of approaches in attempting to establish the linkages between them. The next section is devoted to a review of empirical studies on the relationships between trade, poverty and income distribution.

4.3 Empirical Analysis: Methods to Investigate the Links between Trade, Poverty and Income Distribution in Developing Countries

The assessment of how different groups in society are affected by various adjustment policies needs to link aggregate macro variables with the distribution of income at the micro level. In the literature, there exists a variety of methodologies, ranging from case studies to macro econometrics, to partial equilibrium analysis, to social accounting matrix multipliers, and to the general equilibrium analysis with different variants in each category to link up these relations. Data availability in different countries has necessitated different approaches[43]. However, despite the methodological diversity, there emerges an increasing recognition that any analysis of poverty and trade should include factor markets as the most important linkage. This issue gains importance as households are much more specialised in factor earnings than in consumption (Hertel and Reimer, 2005). Hertel and Reimer (2005) classified the literature into four broad methodological categories; for example, cross-country regression, partial equilibrium or cost-of-living analysis, general equilibrium simulation and micro-macro synthesis.

4.3.1 Cross-Country Regression Analysis

This approach tests for correlations among trade, growth, poverty and income inequality variables observed at the national level (Reimer, 2002). In this approach, data on trade openness and other control variables are combined with levels of inequality/poverty or over-time changes in these variables. Dollar and Kraay (2002) classified countries into globalisers and non-globalisers in accordance with their growth performance in relation to trade policy and found no general trend of income inequality among globalised countries. By undertaking cross-country regression analysis, Dollar and Kraay (2002) found no systematic relationship between changes in trade volumes and changes in the income share of the poorest. However, Rodriguez and Rodrik (2000) criticise their results in terms of methodological problems and with the empirical strategies employed by Dollar and Kraay (2002). Moreover, this approach does not consider the diverse nature of the economies in terms of their socio-economic characteristics, policies and institutions, and hence is unable to identify country specific parameters in terms of trade, poverty and growth. Despite various disadvantages, cross-

[43] See Davies (2004), Bannister and Thugge (2001), Essama-Nssah (2005), Maasland (1990) and Gunter, Cohen, and Lofgren (2005) for a good summary of the modelling approach in evaluating poverty and distribution impact of trade shocks.

country regression analyses have a number of advantages in linking trade and poverty (Reimer, 2002). For example, the regression results are much more general than the country specific results and are able to take into account some dynamic aspects of trade reforms.

The following section describes some studies of the impact of trade reforms that used partial equilibrium analysis.

4.3.2 Partial Equilibrium Analysis/Cost-of-living analysis

In this approach the welfare impacts of direct price changes due to trade liberalisation are estimated at the household level. First, a process is used that generates the new prices resulting from trade liberalisation (actual changes or simulated). Second, the impact of the price changes on poverty and income distribution are assessed, using a household expenditure survey. This approach generally emphasises one or a limited number of (commodity) markets. It assumes that that the markets under investigation do not have important linkages with other sectors of the economy. This approach is also termed cost-of-living analysis as it focuses on the impact of commodity price changes on household expenditure and thus on poverty.

Case (1998) used a 1993 South African Living Standards Survey (SALSS) to quantify the effects of trade reform on household wellbeing. By using household budget shares together with estimates of the demand system from a linear expenditure system and estimates of the changes in consumer prices expected from tariff reforms, Case (1998) estimated the changes in welfare for Africans and Whites. By comparing households' expenditures for the initial level of utility at the new (lower) prices after trade to the cost at the original price, and expressing it as a fraction of average pre-reform total household expenditure, Case (1998) estimated the welfare gain of households. Her results show that a 75 per cent reduction in tariffs reduces the cost of reaching the household's initial level of utility by about 2 per cent for African households and by 1 per cent for White households. However, her method ignores the effects on factor earnings. Reimer (2002) pointed out: "despite the availability of employment and income information in the household survey, potential factor earnings do not enter into Case's study".

Levinsohn *et al.,* (1999) investigated the impact of the Asian financial crisis on the Indonesian poor, using the consumption data from the 1993 SUSENAS (National Economic Survey of Indonesia) of 58,100 households. They computed a Lespeyres cost-of-living index for each household by combining the SUSENAS consumption data with price changes due to the 1997-98 crisis, which was then used to measure the impact of the crisis on households. Their simulation results showed that very low income households experienced larger cost-of-living increases from the international shocks irrespective of being urban or rural. Their simulation results also showed that among all households, the urban poor were most adversely impacted by the crisis. One important drawback of their approach is that the paper considered only the variation in the changes in nominal prices without considering the changes in income that are also needed to make a full adjustment of the real effects of that crisis.

Following Levinsohn *et al.,* (1999), Ianchovichina and Martin (2002) assessed the re-distributional impact of trade on poverty and inequality in Mexico, using household survey data for 1996. However, their model differs from previous models in the choice of methodology for the price generator. Whereas Levinsohn *et al.,* (1999) used actual price changes, Ianchovichina *et al.,* (2002) use the GTAP model as the price generator. A 'two-step' structure was used, where the first step is to generate new prices (simulated or actual changes) and the second step, using a household survey to assess poverty and inequality effects, To calculate the impact of the policy simulation on the expenditure and income of the household, Ianchovichina *et al.,* (2002) also used various price indexes. Finally, by applying both the expenditure and income sides of the simulations the changes in welfare were measured. Simulation results show that the impact of trade liberalisation on welfare is positive in general for all income deciles, however, the poor benefited proportionately more than the rich.

Minot and Goletti (2000) examined how liberalisation of both internal and external rice market affects food security and poverty in Vietnam. They developed an agricultural spatial equilibrium model with four staple food markets (rice, maize, sweet potatoes and cassava) in seven regions, where the supply of each crop in each region is a function of producers' prices of all commodities and own price. Demand is a function of per capita expenditure, consumer prices and a Stone's price index. The demand system was approximated by an Almost Ideal Demand System (AIDS). The model was simulated for: 1) removal of the rice export quota; 2) changing the quota level; 3) replacing the quota with tax; and 4) removal of restrictions on the internal movement of food. The effects on rice prices, production, consumption and income were then combined with the household survey to examine the impact on real income and poverty among the regions. The results showed that export liberalisation would raise the rice price and be unfavourable for the urban poor and the rice-deficit regions. At the same time, higher prices would create positive effects for rural farmers, especially in rice exporting regions. Overall, there would be a slight decline in poverty incidence.

Porto (2003) estimated the poverty impacts of national and foreign trade reforms in Argentina using the following three steps. First, an assessment was made of the changes in the domestic prices of traded goods as induced by the trade shock. Second, wage-price elasticities were estimated for the responses of wages to traded good prices. Finally, the resulting changes in household labour income were used to estimate the changes in poverty. It was found that the increases in the prices of exportable goods (agricultural or industrial) affect wages positively, while higher import prices for consumer goods affect it negatively. In terms of poverty, the results showed that while both national and foreign trade reforms significantly alleviated poverty in Argentina, foreign reforms were more important.

Nicita (2004) studied the effects of trade liberalisation in Mexico during the 1990s using a farm-household model in which the effects of trade liberalisation on household welfare operated through the movement of the prices of goods and factors of production. According to Nicita (2004), the change in the domestic price of an imported good is determined by the change in the tariff rate multiplied by the price of the imported good adjusted by changes in the exporter mark-up. Thus, in his pass-through equation, domestic prices for imported goods in a region were a function of the international price, exchange rate, and the tariff and trade costs.

Following Porto (2003), Nicita's labour earning equation was dependent on goods prices, household characteristics, and individual characteristics. Econometric estimation resulted in pass-through elasticities and price-wage elasticities which were then inserted into a household welfare function (a measure of the percentage change in money metric utility). The findings of the study were that trade liberalisation produced different outcomes for different household groups as domestic prices and labour income across the country and income groups changed differently. Even though trade liberalisation benefited all income groups, richer households gained more than poorer households. In terms of geographic distribution, states closest to the US border gained threefold more relative to the less developed states in the south. Thus, trade liberalisation enhanced inequality.

The partial equilibrium models discussed above mainly focused on the expenditure (consumption) side. However, neglect of the factor market effects of trade liberalisation and inter- and intra- sectoral linkages severely limits the usefulness of these studies. General equilibrium analysis offers a more comprehensive way of modelling the overall impact of policy shocks on the economy. It can produce disaggregated results at the microeconomic level as well as providing a consistency check on macroeconomic results (Hertel and Reimer, 2005). General equilibrium analysis is the only method which can capture the repercussions and flow-through effects of any distortion in an economic system. It also can capture any change in relative factor prices. The following section describes the uses of Computable General Equilibrium (CGE) models in poverty and income distribution analysis.

4.3.3 Computable General Equilibrium Models

Analysis of the impact of any policy shock on poverty and income inequality needs an overall economy-wide framework which captures extensive details of households' income and spending patterns. It also needs to capture the impacts of policy shocks on the "extended" functional distribution of income and the mapping from the functional distribution of income to size distribution of income among households (Lofgren, Robinson, and El-Said, 2003b). Because it meets these requirements, in estimating poverty and income distribution effects, the CGE model is the most widely used methodology[44].

In addition, the CGE approach has the advantage of performing counterfactual analysis, which facilitates understanding the links between a specific shock and the level of poverty while keeping other factors constant (Hertel and Reimer, 2005). As Francois and Shiells (1994) argued, it is the dominant methodology for the ex ante analysis of the economic consequences of comprehensive trade agreements, whether multilateral or bilateral in nature. Hertel and Winters (2006, p. 7) state that 'no other approach offers the same flexibility for looking at prospective changes in trade policy while respecting the fundamental economy wide consistency requirements, such as balance of payments equilibrium and labour and capital market constraint, that are so important in determining the consequences of comprehensive trade reforms'.

[44] Cloutier *et al.*, (2008) provide comprehensive reviews of CGE literature on welfare, poverty and income distributional impacts of trade liberalisation.

In recent years an increasing number of applied general equilibrium models have been used to analyse a wide range of policy issues (for example, trade policies, structural adjustment policies, and poverty and income distribution) in both developed and developing countries[45]. In particular, the availability of Social Accounting Matrices (SAMs) in many developing countries and advances in computational technology and software have led to many modellers using this methodology for macro-poverty analysis.

In CGE modelling, income distribution analysis was first developed in the early 1980s, beginning with the pioneering work of Adelman and Robinson (1978) on Korea. This was followed by Dervis, Melo, and Robinson (1982) also on Korea. In the early 1990s there was another wave of income distribution analysis mainly sponsored by the OECD: Thorbecke (1991) on Indonesia, de Janvry *et al.,* (1991) for Ecuador, Morrison (1991) for Morocco, Bourguignon *et al.,* (1991) for two archetype Economies, Chia *et al.,* (1994) for Cote d' Ivoire, and Lambert *et al.,* (1991) for Cote d'Ivoire. In the 1990s, other traditional SAM-based CGE models examined how a policy shock affects household's welfare by categorising household groups in SAMs to various ranges[46]. Examples are Dorosh *et al.,* (1994) for Niger, Horridge *et al.,* (1995) for South Africa, Chan *et al.,* (1998) for Vietnam, Harris (1999) for Mexico, Bautista and Thomas (1997) for the Philippines, Dorosh and Sahn (2000) for Africa, and Kemal *et al.,* (2001) for Pakistan.

These models focused on the impact of counterfactual policy scenarios on income distribution and welfare issues, using a representative household assumption. No information on poverty was used. In measuring the distribution of income among household groups, each of these studies developed a comprehensive SAM for each respective economy, which includes a detailed disaggregation of households, factors, activities, and commodities that are important in supporting poverty and inequality analysis. The SAM also provided a complete mapping of value added from factors of production to households' income. Khan (2004) termed these models first and second generation models.

Decaluwe *et al.,* (1999) first established that CGE models can also be used to address poverty. Their innovation was to endogenise a poverty line based on a unique and constant basket of

[45] See Bandara (1991) for a detailed review of literature on the computable general equilibrium model used for development policy analysis in less developed countries.
[46] According to Cloutier *et al.,* (2008), commonly two criteria are used to define household categories: income level; and socio-economic group.

basic needs commodities, which can be used to estimate poverty incidences among various socioeconomic household groups. Since the poverty line changes following a variation in relative prices due to a policy shock, poverty levels in base periods were compared with the poverty levels in the after-shock period. Thus, poverty impacts became the focus, along with income distribution effects. In recent periods, a number of CGE modellers, for example Decaluwe *et al.,*(1999), Cockburn (2002), Bourguignon *et al.,* (2003), Croser (2002) and Savard (2003) following Decaluwe *et al.,* (1999) have assessed poverty impact through CGE models. Khan (2004) termed these CGE models as belonging to the 'third generation' of models of poverty analysis.

Savard (2003) classified income distribution and poverty analysis in CGE modelling into three main categories[47]: 1) CGE model with traditional representative household (CGE-RH); 2) integrated multi-households CGE analysis (CGE-IMH); and 3) micro-simulation approach. In considering them below, the second and third categories are grouped together following the practice of some authors.

4.3.3.1 Traditional representative household approach

In the traditional representative household approach, data from a household survey are classified into the categories of households contained in the model[48]. In less developed countries, these are commonly specified as rural or urban, skilled or unskilled and landed or landless, whereas in developed countries representative households are identified in terms of income and expenditure groups (Davies, 2004). Poverty analysis is performed by using the variation of the income of the representative households generated by CGE model due to a policy shock with household survey data.

Following a policy shock, the CGE model provides real growth rates of disposable income or consumption for all categories of households. By applying these growth rates to disposable income or consumption expenditure of each household in each household group in the household survey, a vector of income or consumption for each household group is calculated. Various poverty indices (for example, the head count ratio, poverty gap index and poverty severity index) are then estimated with this new vector of income or consumption. In estimating the poverty indices it is assumed that within each group, household income or

[47] For a detailed discussion of these methods, see Savard (2005) and Savard (2003).
[48] See Lofgren *et al.,* (2003b) for a brief description of this approach.

consumption is equally distributed to all its members. If, because of the policy shock, the representative household's total income falls under the poverty line, that household category is considered to have become poor.

The representative household approach has been widely used in a large number of trade and poverty studies over the past decade. According to Lofgren *et al.,* (2003b) there are two approaches to linking CGE models with representative households to a household module to estimate poverty: 1) specifying a distribution of income for each representative household type; and 2) using disaggregated household survey data where each survey observation is allocated to a representative household in the CGE model. The first approach was pioneered by Adelman and Robinson (1978) in a model of the Republic of Korea where they defined a parametrically-based representation of income for each household group denoted in the SAM, assuming that within each group, income has a log-normal distribution with an endogenous average and a fixed variance. This method is known as the parametric approach.

In this approach, a specific parametric distribution (usually a log-normal distribution) is assumed to describe the dispersion of income within each group. However, it is assumed that the mean of the income distributions changes while the variances are fixed or determined exogenously. Usually, the parameters of these distributions are estimated from household survey data. These distributions are then used to evaluate the poverty incidences within each group in a general equilibrium framework. Following a shock, e.g. trade liberalisation, the mean income of each household group changes, which in turn shifts the income distribution proportionately. For an increase in income or consumption the fitted distribution shifts to the right, (for a decrease in income or consumption it shifts to the left), without modifying the shape of the distribution.

The overall distribution of income is then estimated empirically by summing the separate within-group distributions, and overall poverty and inequality are generated from them. In the literature, different authors used different functional forms in modelling households' income distribution. Adelman and Robinson (1978), Chia *et al.,* (1994), Dervis, Melo, and Robinson (1982) used the log-normal distribution. De Janvry *et al.,* (1991) used the Pareto distribution. Later on Decaluwe *et al.,* (1999) provided further refinements on this approach. They proposed a flexible beta distribution to model the within-group income distributions in reference to a log-normal and Pareto, as beta distribution can be skewed to the right or to the left and be symmetric.

However, in the second approach of the representative households, there is a direct use of the empirical distributions from the household survey data to estimate intra group distributions, which in turn is used to estimate poverty and income distribution indices for each household group in the model. In this approach, changes in average household income are derived from the CGE model for each household category, which is then applied to all corresponding households in the household survey to estimate changes in poverty and inequality indices. This approach is known as the non-parametric approach.

Over the past few years, an extensive literature has emerged on the impact of reform policies on poverty and inequality using either the parametric or non-parametric representative agent models. Some of these studies are outlined briefly below.

Decaluwe *et al.,* (1999) used a CGE model for an archetypal African economy with four areas of activity (agriculture, industry, marketable and non-marketable services) to analyse the impact of a fall in the price of an export crop and an import tariff on income distribution and poverty. Calibrated on an African SAM, their model sought to compare the poverty incidence before and after policy shocks. After aggregating the household groups into six representative groups, an income distribution (beta distribution) was formulated for each group, each distribution corresponding to the characteristics of its group. A poverty line consisting of a basket of basic needs commodities was also endogenised in the CGE model. With each shock, households' average income level changed, so income distribution shifted proportionately. By comparing the post-shock within group income distributions with the new endogenously determined poverty line, poverty measures were calculated.

Pradhan and Sahoo (2001) developed a 23-sector, 3-factor and 9-household group computable general equilibrium model to analyse the impacts of tariff and non-tariff barriers on poverty and welfare in India. Following a SAM-based neo-classical CGE model, three policy simulations were carried out: viz, cutting down of quota restrictions, tariff reduction and combining the effects of reduction in both quotas and overall tariffs. Four rural and five urban occupational household groups were classified according to their sources of income. In measuring poverty within each social group, a log-normal distribution function was estimated which was used to evaluate the poverty incidences among groups. Model simulation results showed that trade liberalisation would promote export-led growth. Overall welfare increased more for urban household groups than rural groups.

Following the technique of Decaluwe *et al.,* (1999), Stifel and Thorbecke (2003) also examined the impact of trade liberalisation specifically on poverty and welfare for an archetypal African economy. As in Thorbecke (1997), the economy was modelled in a dual-dual framework by assuming that the backward sector was rural and agricultural while the modern sector was urban and industrial. Their model was calibrated to a SAM for an archetypal Sub-Saharan African economy with four production activities, four factors of production and nine socio-economic household groups. For income distribution and poverty analysis, a beta distribution function was formulated for each household group based on socio-economic characteristics which was then applied for estimating Foster-Greer-Thorbecke (FGT) poverty measurement. One important contribution of their model was the modelling of inter-group migration and its consequent effects on poverty.

Naranpanawa (2005) developed a poverty focused multi-household CGE model for the Sri Lankan economy where an empirically estimated beta distribution function was linked with the model in a 'top-down' fashion. The most important contribution of his study was to develop a disaggregated SAM for Sri Lanka for the year 1995. Following Decaluwe *et al.,* (1999), a money metric poverty line was endogenised in the model. Simulations experiments were carried out both in the short run and long run for 100 per cent tariff cuts in manufacturing industries, agricultural industries and the across the board case. The results showed that in the short run, trade liberalisation in the manufacturing industries would reduce poverty in low-income household groups, but in the long run it improved for all household groups. His overall model result showed that trade reforms may have the effect of greater inequality between the rich and the poor.

Unlike the studies described above, Aka (2004) quantified the poverty, inequality and welfare impacts of trade liberalisation and tax reform in Cote d'Ivoire by using the actual distributions from the household survey data. Following Ravallion and Bidani (1994), he constructed a poverty line which was then used to analyse poverty and inequality. In a CGE model in the framework of Decaluwe *et al.,*(1999) comprising four sectors, three goods and nine groups of households, Aka (2004) simulated the model with respect to the elimination of taxes on agricultural and industrial exports and imports. The results showed that poverty increased for all households; however, the poverty situation was diversified among household groups, with public employee households experiencing the highest poverty incidence followed by the self employed and coffee and cocoa farmers. Simulation results also showed that trade liberalisation reduces households' welfare as it increases agricultural and industrial domestic prices, which in turn increase taxes, with a resulting reduction in households' real disposable income.

Cororaton *et al.,* (2006) used 12 household categories based on the 1994 family Income and Expenditure Survey of Philippine households to evaluate the poverty impacts of the Doha Round of WTO negotiations. Using a non-parametric approach, poverty was found to increase slightly with the implementation of the Doha scenarios, especially among rural households and the agricultural self-employed.

Comparisons between the parametric and non-parametric representative household approach have been provided by Bussolo and Round (2002) and Boccanfuso *et al.,* (2002). Bussolo and Round (2002) developed a SAM-based model on Ghana with which they conducted simulations to compare a parametric and non-parametric approach for poverty calculations, in analysing the possible effects of a range of budget-neutral redistributive income transfers on poverty. Their simulation results produced changes in poverty indices that were the same in direction but different in magnitude. A similar test was performed by Boccanfuso *et al.,* (2002) for Cameroon. These authors compared various distribution functional forms such a log-normal, Pareto, beta distribution and Kernel non-parametric methods to evaluate poverty with the Foster-Greer-Thorbecke poverty indices. The authors found some distributions produced quite different poverty indices from other functional forms, and the results did not follow a systematic pattern. Pareto distribution produced the most different results, followed by the beta and the Kernel non-parametric.

The main drawback of the representative household approach (both parametric and non-parametric) is that following a policy shock, this representative household approach is unable to capture the within-group variation of inequality as intra-group variances are specified exogenously. This approach can only be used for inter-group inequality studies. Thus, with given heterogeneity of income sources and consumption patterns of households, the assumption of fixed variance will lead to biased results even with much disaggregated categories. It is widely recognised that endogenising the income variance within each group would produce more satisfactory results, as its contribution to total inequality is significant. This consideration later on led to the development of the micro-simulation approach. Micro-simulation resolves the problem of intra-group inequality within household categories in two ways: by integrating household surveys with the CGE model; and by linking the CGE model with a micro-simulation model in a top-down fashion. The following section describes the micro-simulation methodologies applied in literature.

4.3.3.2 Micro-simulation approach[49]

In the micro-simulation approach, the impact of any shocks is investigated at the micro level by focusing primarily on the economic behaviour of agents (usually households and firms). In doing so, all income categories of households are directly integrated to a representative household survey within the CGE model. Since this type of model captures as many agents as there are in the household survey, it provides a better reflection of household heterogeneity in terms of household income sources, consumption preferences and demographic compositions than the representative household approach. Thus, it is possible to endogenise the intra-group distribution by a micro-simulation approach. However, the main disadvantage of this approach is the difficulty of obtaining consistency between the macro and micro models. To obtain full consistency between the CGE model prediction and the micro analysis, according to Bibi and Chatti (2006), this approach needs to reconcile household data with the national data. According to Rutherford *et al.,* (2006), data reconciliation can be very problematic in this approach and a numerical solution can also be challenging (Chen and Ravallion, 2004).

Orcutt (1957) was the pioneer of the micro-simulation model. Since then, this model has been implemented in many countries to evaluate the impact of fiscal reforms, health care financing, and to study related dynamic issues, although the majority of these analyses were conducted within partial equilibrium frameworks (Cogneau and Robilliard, 2000). Meagher (1993) first incorporated general equilibrium effects by integrating an aggregate CGE model with a micro-simulation model in a sequential way. However, his study did not take into account the reactions of the agents at the micro level.

[49] See Davies (2004) for a comprehensive discussion on this approach.

Broadly, micro-simulation model, in the CGE context can be classified into three categories: integrated multi-household; sequential top-down; and iterative top-down/bottom-up approach.

4.3.3.2.1 Integrated multi-household CGE analysis (CGE-IMH)

In this approach, individual data usually found in the Household Income and Expenditure Surveys is directly integrated in the general equilibrium model according to the principles of micro-simulation. This ensures households' heterogeneity with regard to their endowment and consumption patterns. Further, by taking as many households as possible into account, the model allows the modeller to avoid a pre-judgement about grouping households into categories. In addition, unlike the representative household approach, no prior assumption about any distribution parameter is needed.

Decaluwe *et al.,* (1999) first applied this approach in comparison with the traditional form of CGE model with a large number of households and representative households with distribution function by using an artificial data set for an archetype economy. Their comparison showed that micro-simulation is superior to all other methodologies for the analysis of poverty and inequality, as it takes into account individual heterogeneity and thus produces intra group income inequalities.

Cogneau and Robilliard (2000) applied the same approach in assessing the impact of different growth strategies on poverty in Madagascar. They established an econometrically estimated household's behavioural equation model consists of 4,508 households.

Cockburn (2002) integrated all the 3,373 households from the nationally representative survey directly in a CGE model for Nepal to analyse the impact of the elimination of import tariffs. Because of full household information on income from each of the factors, and on consumption, this model simulation predicts how each individual household is affected by trade liberalisation. An existing CGE model based on a 1986 Social Accounting Matrix of Nepal was used for the analysis. It consisted of five factors of production (skilled and unskilled labour, land, agricultural and non-agricultural capital), three household groups (small, large and non-farm) and fifteen production sectors. All sectors, factors of production and households were separated into the same three regions: urban, Terai and hills/mountains. To maintain government revenue neutrality, following the elimination of import tariffs, an endogenously determined uniform consumption tax was imposed. Using a non-parametric approach, poverty and income distribution analysis was undertaken with the software DAD. Model simulation results showed that trade liberalisation in Nepal favoured urban households as opposed to Terai and hill/mountain households. Urban poverty fell and rural poverty increased. In terms of inequality, it increased as a result of trade liberalisation specifically not only in the urban areas but also in the hills and mountain areas.

Following Cockburn (2002), Cororaton *et al.,* (2006) applied this approach in examining the poverty effects of trade reforms under the Doha Round of WTO for the Philippines for the period 1994-2000. Based on a 1994 Family Income and Expenditure Survey of the Philippines of 24,797 households, actual income distribution is formulated for 12 household categories. Household categories were obtained by grouping households by region, household's head education level and occupation. The CGE model predicts the changes in average household income for each category following policy shocks. These changes were then applied to all corresponding households in the survey to estimate welfare and poverty impacts. Simulations are carried out with respect to the Doha agreement and some comprehensive trade reforms (rest of the world free trade, full domestic liberalisation with various replacement taxes). Implementation of the Doha agenda increases poverty slightly especially for rural self-employed agricultural and unemployed households, whereas the full liberalisation induces reduction of poverty in urban areas and increase in rural areas, as full liberalisation results in a contraction of the agricultural sector and favours the non agricultural sectors. Their simulation results also show that switching from the VAT to a uniform income tax as a replacement tax increases poverty incidences in the case of full liberalisation.

Annabi *et al.,* (2005) developed a sequential dynamic micro-simulation CGE model[50] for Senegal to assess the effects of trade liberalisation on production, poverty and inequality. Using an integrated micro-simulation approach, the model was calibrated to a 1996 Social Accounting Matrix and 1995 Household Survey data covering 3278 households. The study found that full tariff removal in Senegal would lead to a small increase in poverty and inequality in the short run. However, in the long run capital accumulation effects increases in welfare and decreases in poverty. Changes in poverty are then decomposed into growth and distribution components to examine whether trade liberalisation is pro-poor. The

[50] Unlike a Static model, in a dynamic model include accumulation effects, i.e. in this model capital stock is updated endogenously with a capital accumulation equation between periods.

decomposition results show that income distribution worsens, as urban dwellers and non-poor groups gained most.

The main advantage of this integrated multi-household micro-simulation approach is that it can capture intra-group income distributional changes and modellers need not pre-select household grouping or aggregation (Savard, 2003). However, this approach requires a large amount of statistical information and the data reconciliation creates difficulties because of the size of the model. Thus there is doubt about its practical application. According to Hertel and Reimer (2005), the integrated micro-simulation approach is difficult to apply especially with respect to large countries where there are many sectoral details and survey data in excess of 100,000 households. To resolve the above mentioned problems, Bourguignon *et al.,* (2003) proposed an alternative approach, top-down micro-simulation model, where a multi-sector CGE model is linked with a micro-simulation model describing real income generation behaviour of household groups. Hertel and Reimer (2005) termed this approach "micro-macro synthesis".

4.3.3.2.2 Sequential top-down/ layered micro-simulation approach

In the sequential top-down micro-simulation method, a micro-simulation model is linked with a CGE model by two sequential steps[51]. In the first step, the CGE model is simulated to generate a vector of factor and commodity prices and employment levels resulting from a policy shock. In micro-simulation model microeconomic features of the labour market, consumption and income behaviours are modelled using the household survey data. In the second step, the changes in variables in the CGE model are fed into the micro-simulation framework to analyse the income distribution and poverty impacts on household levels. The coefficients of the micro-simulation model have to be modified in such a way that it reproduces the macro numbers obtained from the CGE model, while allowing for the price and factor return changes which may affect individuals' behaviours (Herault, 2007). Thus, given any change in the macroeconomic variables predicted by the CGE model, the micro-simulation model provides an updated picture of the economy that takes into account individual heterogeneity. According to Robilliard and Robinson (2005), three conditions are needed for the consistency of the micro-simulation model with the equilibrium of the CGE model. 1) For each labour market category, changes in average earnings with respect to the

[51] See Robilliard, Bourguignon, and Robinson (2001) for a detailed discussion of this method.

benchmark in the micro-simulation module must be equal to changes in wage rates provided by the CGE model; 2) changes in agricultural and non-agricultural self-employment income in the micro-simulation module must be equal to changes in corresponding income originating in the CGE model; and, 3) changes in the number of wage workers and self-employed workers by labour market category in the micro-simulation module must equal the same changes provided by the CGE model.

The household micro-simulation model is based on econometric reduced form equations for individual earnings, household income from self-employment, and the occupational choice of all household members of working age[52]. It gives a complete description of households' real income generation mechanisms by taking into account both households' earnings and occupational choice determinants (Bourguignon *et al.*, 2003). After a policy shock, the CGE model provides values for various macro variables such as total employment, commodity prices, and wages etc. The micro-simulation model estimates changes in earnings, self-employment income, occupational choice and the price deflators by using the values of the variables generated from CGE model.

Robilliard *et al.,* (2001) linked the post-simulation outputs of a CGE model to a micro-simulation model for Indonesia, to model the effects of the 1997 financial crisis on poverty and inequality. With thirty eight sectors and fifteen factors of production, the solution of their CGE model provided required inputs for the micro-simulation model in the form of prices, wages and employment levels. Their household income micro-simulation model consisted of a log earnings equation for each household member of working age, an equation for the household's self-employment income and an equation for individual utility. These reduced form equations were estimated econometrically. After computing changes in wage rates, income and employment levels, Robilliard *et al.,* (2001) turned to the micro-simulation to determine the impacts on the size distribution of income and poverty. They found that poverty increased over the 1997-98 period because of both an El Nino drought and the financial crisis.

Robilliard and Robinson (2005) also combined a CGE model with a micro-simulation model to estimate the impact of the Doha Development Agenda on poverty reduction in Indonesia. Following a neoclassical-structuralist CGE model developed by Dervis *et al.,* (1982), the

[52] For a fuller discussion of the specification of the equations of the household income generation model, see Bourguignon, Ferreira, and Lusting (1998) and Bourguignon, Fournier, and Gurgand (2001).

impacts of policy shocks were examined under different specifications of the labour market. Their micro-simulation model was based on household and individual level 1996 data for 9,800 households covering 42,400 individuals. At the individual level, four occupational choices were made: 1) inactivity; 2) wage work; 3) self-employment; and 4) multi-activity. In the CGE model, the behavioural equations were formulated as a set of linear and non-linear equations and were linked to the micro-simulation model through a vector of prices, wages and aggregate employment variables corresponding to a given shock. The impact of trade liberalisation was examined through three simulations: 1) unilateral liberalisation by Indonesia; 2) full liberalisation excluding Indonesia; and 3) full liberalisation including Indonesia. Among these scenarios only the full liberalisation scenario produced significant poverty change results. Simulation results also showed that the impact of poverty reduction would be higher in rural areas than in urban areas. Robilliard and Robinson (2005) also examined two alternative tax replacement scenarios: 1) direct tax replacement; and 2) a VAT replacement tax. The direct tax replacement was found to be more effective in terms of efficiency gains and higher poverty reduction.

Bourguignon *et al.,* (2003) also applied the sequential top-down micro-simulation approach in analysing the impact of a change in the foreign trade balance and the resulting change in the equilibrium real exchange rate for Indonesia. A comparison with the standard representative household approach was also performed. Following a standard neoclassical specification of a CGE model, with thirty eight sectors, fourteen factors of production and ten household groups, the model was simulated firstly in terms of trade shock and secondly, for a 30 per cent drop in exogenous foreign savings. At the micro level, income changes were obtained through a complete specification of household income generation mechanisms which captured the heterogeneity of households in terms of sources of income, inheritance of human capital and preferences of consumption. The simulation results provided quite different distributional effects for the representative household approach and the micro-simulation approach. The micro-simulation approach produced devaluation due to a reduction in foreign savings that would strongly increase inequality, whereas the representative household approach predicted a slight improvement in households' real income distribution. According to Bourguignon *et al.,* (2003), the reasons for these differences are that, unlike the representative household approach, the micro-simulation approach takes into account changes in occupations, which in turn changes the distribution of income, and it also considers heterogenous consumption behaviour.

Following Robilliard *et al.,* (2001), Bussolo and Lay (2003) estimated the impacts of 1990s tariff cuts on poverty in Columbia. Their simulation results showed that in rural areas the movement of workers from the informal to formal sector, and the subsequent rise in unskilled wages, reduced poverty substantially. In comparing their micro-simulation results with representative household results for Columbia from other studies, it was found that the representative household approach (RH) underestimated rural poverty reduction, and overestimated urban poverty reduction.

Vos and Jong (2003) combined a CGE model analysis with a micro-simulation approach in a top-down fashion to analyse the effects of trade liberalisation on poverty and income distribution in Ecuador. Following the procedure of Ganuza *et al.,* (2002), their modelling technique was able to identify which types of labour market shifts had the greater impact on poverty and inequality at the household level. Based on a neoclassical structuralist tradition, the CGE model was calibrated to the 1993 Social Accounting Matrix for Ecuador. Four counterfactual policy scenarios were run: 1) a nominal increase in tariffs (a 100 per cent increase); 2) a uniform tariff reduction of 50 per cent; 3) implementation of the FTAA (Free Trade Agreement for the Americas); and 4) the elimination of all export subsidies and taxes according to WTO regulations.

In their micro-simulation approach, labour market adjustment was the central transmission mechanism through which the policy shocks affected poverty and income distribution at the household level. Unlike other micro-simulation methods such as Bourguignon *et al.,* (2001), where the full earnings distribution and its relation to labour market parameters are included, Vos and Jong (2003) considered a segmentation of the labour market and assumed that labour supply and occupation decisions are approximated at a random process. Their simulation results showed that trade reforms and trade integration with the FTAA induced slight aggregate welfare gains and overall employment growth which helped to reduce poverty. However, because of widening wage gaps between skilled and unskilled workers, inequality increased.

Herault (2007) combined a macro-oriented computable general equilibrium model with a static micro-simulation model to assess the effects of trade liberalisation on South African households following Robilliard *et al.,* (2001). However, his approach was extended by taking into consideration the changes in capital returns and transfers at the household level. With forty three sectors and four factors of production and based on the South African Income and Expenditure Survey of 2000 and the Labour Force Survey of 2000, the South African CGE model was first simulated with respect to the complete removal of import tariffs. In the second stage, the changes in prices, direct tax rates, returns from capital and labour and employment levels generated from the CGE model were transmitted to the micro-simulation model. Specifically, the coefficients of the micro-simulation model were modified so that it reproduced the results obtained from the CGE model. In the micro-simulation model, the labour market was divided into five segments: inactive, unemployed, subsistence agricultural worker, informal worker and formal worker, and a regression model were used to predict individual gross earnings in each of these labour market categories. Herault's simulation results showed that because of the expansion in formal sector employment, especially for low-skilled and skilled workers, blacks benefited most from formal job creation. Since blacks account for about 95 per cent of all poor, thus poverty incidences also decreased. In terms of racial inequality, nationally there was also a small reduction as the growth in per capita real income of the black population was higher than for other racial groups.

Bibi and Chatti (2006) used a layered CGE micro-simulation model to study the effect of trade liberalisation on poverty in Tunisia. First, they built a recursive dynamic CGE model of the Tunisian economy consisting of fourteen production sectors, and six household groups (identified by sources of income and location, i.e. rural and urban), which predicted the price and income changes for the period 1998-2015 under protection and free trade assumptions. These results were then applied to the second layer micro-simulation model to assess the effects on income of each household in the survey. Since households within the same group were not endowed with the same budgetary share for each good, the resulting real income also varied between households within the same group. The simulation results showed that although poverty reduction was small in the short run, however, it was significant in the long run.

Fekadu (2007) analysed the impact of unilateral trade liberalisation on poverty and income inequality in Ethiopia by linking a macro model to the micro-simulation model in a sequential fashion. His analysis was based on the 1999-2000 Household Income Consumption and Expenditure Survey of Ethiopia, which covered 17,332 households. His simulation results showed that a 100 per cent tariff cut would increase the welfare of farm households, while the welfare of wage earner households would decline. Poverty would increase at the national level, but there would be no significant effect on inequality.

One important aspect of this sequential top-down approach is that, like the integrated multi-household analysis, it can capture a fraction of within-group variation of inequality. In this approach there is no need for full reconciling of micro and macro data. Another advantage of this sequential top-down micro-simulation approach is that it provides a detailed picture of household behaviour. However, a major drawback of the approach is that the reactions of households to commodity and factor price change in the post-simulation analysis are not transmitted back to the general equilibrium model, i.e. the feedback effects of household behaviours are not taken into account in the CGE model, and consistency between the macro and micro model is not always assured.

4.3.3.2.3 Iterative top-down/bottom-up approach

Savard (2003) proposed another approach, the top-down/bottom-up approach which takes into account these problems. By introducing a bi-directional link between the household model and the CGE model, a convergent solution between the two models is obtained.

In this top-down/bottom-up approach, simulation results obtained from CGE model are transformed into the household micro-simulation model. In the household micro-simulation model income equations are specified, as in the CGE model, but at a disaggregated level, by introducing a demand system. This model is solved sequentially. The demand system is then used to calculate the consumption matrix. The micro-simulation model provides information about the variance of income within income groups and details of the incidence of price and wage changes in household groups, which are identified by education level and ethnic type. An aggregate consumption vector is obtained by calculating the consumption over all households. This is then fed back into the CGE model, and by a series of repeated iterations the model gives a convergent solution between the micro-simulation model and the CGE model.

Savard (2003) argued that, compared with the integrated micro-simulation approach, this method has three advantages: 1) unlike the integrated micro-simulation approach, this method does not need to scale the household data to national data. Thus, the modeller can directly use the income and expenditure data found in the household income and expenditure survey; 2) there is no limit to the level of disaggregation in terms of the number of households and the production sectors; and 3) there is more choice of functional forms to present microeconomic household behaviour than in other approaches.

Savard (2005) compared the top-down/bottom-up micro-simulation approach with the representative household approach for the case of the Philippines. Three versions of a standard CGE model were used: first, full factor mobility with the expenditure function derived from a Cobb-Douglas utility function; second, full factor mobility with a linear expenditure system; and third, fixed capital, full formal and informal labour market division and a linear expenditure system. For each of the versions, Savard (2005) presented a representative household approach (RH) and a top-down micro-simulation approach (TD/BU). In terms of the macroeconomic and sectoral levels, the RH and TD/BU approaches produced similar results; however, systematic opposite results were produced for poverty and inequality. Thus according to Savard (2005), in analysing poverty and inequality, the modelling approach is crucial.

Following Savard (2003)'s bi-directional linkage approach, Ferreira-Filho and Horridge (2005) assessed the potential effects of the Doha Round trade negotiation on poverty and income distribution in Brazil using a CGE and micro-simulation model. Based on the ORANI-G model of Australia, their static model of Brazil consists of 41 production activities, 52 commodities, 10 different types of labour and 270 different household expenditure patterns. Their model also followed the top-down regional modelling approach, with the model disaggregated into 27 regions. In the model, each activity used a mix of 10 different labour groups, thus, changes in activity levels induce changes in employment level by sector and region, which in turn cause changes in poverty and inequality levels. The simulation started with a set of trade shocks (changes in import prices and export demands) in a Global Trade Analysis Project (GTAP)[53] model, which excluded Brazil's own tariff reductions. The effects were then transmitted to the Brazilian CGE model through changes in import prices and a shift in the export demand schedule. In the next step, a Brazilian tariff shock was implemented by treating import prices and tariffs as exogenous. The resulting macro results from the CGE model were used to update the micro-simulation model, which was comprised

[53] The GTAP model is a standard global applied general equilibrium model with specific features of perfectly competitive markets, and constant returns to scale technology. See Hertel (1997) for details of the GTAP model structure and data base.

of 112,055 Brazilian households and 263,938 adults spread across the 27 regions of Brazil. First, wages and hours worked for the whole sample were updated, and then according to changes in labour demand, jobs were reallocated. The model's results suggested that the Doha development agenda would reduce inequality and poverty in Brazil but only to a small extent.

4.3.4 Multi-Country Analysis

There are several studies called multi-region CGE models, which can capture the impacts of bilateral and multilateral trade agreements on poverty and income inequality. Modelling software now exists for the global multilateral general equilibrium trade model called GTAP and a well developed data base. A great deal of work has been published in recent CGE literature to analyse the link between trade and poverty using the GTAP model.

In this approach, poverty estimates are conducted in two steps. In the first step, a global model provides the changes in prices, export volumes, and import prices in a target country as a result of the trade liberalisation policies in other countries. In the second step, these variables are considered as inputs in a specific country's national model. The national model takes these changes as exogenous and implements its own country's reform measures. In linking the two models there arises one problem: how to pass the information on world markets to the national model, as national models usually consider import prices as exogenous. In solving this problem, Hertel and Ivanic (2006) proposed to appropriately aggregate the import price changes generated in the global model and then pass these on to the national level where they would be applied as exogenous shocks. By using an export demand curve, the single country model determines the export supply behaviour. Same as with the sequential top-down micro-simulation model, poverty analysis is then incorporated by using a separate household micro-simulation model.

In recent periods, a number of studies have used multi-country CGE models and single country models to estimate the impact of unilateral and multilateral trade reforms on poverty, using survey-based micro-simulation models. However, most of these studies focus on the expenditure side of household surveys and ignore the earning side of the problem; for example, Case (1998), Levinsohn *et al.,* (1999), Friedman (2001), and Ianchovichina *et al.,* (2002). According to Hertel *et al.,* (2004), while the consumption based approach is well suited for poverty analysis, it is inadequate in terms of counterfactual analysis of poverty impacts. They propose an approach that includes the earnings side of the problem. Earnings data from household surveys are combined with international cross-section consumption results to analyse the implications of multilateral trade liberalisation.

Using this methodology, Hertel *et al.,* (2004) analysed the implications of multilateral trade liberalisation for poverty in seven developing countries (Brazil, Chile, Indonesia, Philippines, Thailand, Uganda and Zambia). First, they conducted an experiment in which the GTAP model generates regional price changes. In the next step, the price changes were linked with a model that includes household income and consumption profiles. The data were collected from national household surveys of the seven countries. To estimate the poverty impacts, they stratified the population into 5 groups identified by the primary source of income, for example: 1) households relying on transfers; 2) self-employed households specialising in agricultural products; 3) households specialising in non-agricultural enterprise; 4) households depending on wages and salaries; and 5) diversified households (all other). The differences in shares of earnings are more important in bringing changes in welfare than the differences in consumption. Then the authors determine households' factor earnings by income level and stratum and households' consumption patterns across income levels. In estimating consumer expenditure shares, they combine cross-country and within-country information to estimate consumer expenditure functions. By combining the factor earnings densities with the model for households' income and expenditure, poverty implications are estimated. Using the World Bank's definition of the absolute level of poverty (US$2 per day), Foster-Greer and Thorbecke poverty measures were calculated.

Hertel *et al.,* (2004)'s multilateral trade liberalisation scenario involved a complete elimination of merchandise tariff barriers, agricultural export subsidies and textile and apparel quotas. Their simulation results show that multilateral trade liberalisation increases aggregate measures of poverty in Brazil, Chile and Thailand, whereas it decreases for Indonesia, Philippines, Uganda and Zambia. Across strata, the largest percentage reduction in poverty occurs among agriculturally specialised households in Brazil (more than 30 per cent) and Chile (16 per cent). By contrast, poverty increases substantially for self-employed, non-agricultural households in Brazil, Chile and Thailand. For Brazil, Chile, Philippines and Thailand these figures are 9 per cent, 4.7 per cent, 0.4 per cent and 11.2 per cent respectively.

Following Hertel *et al.,* (2004), Valenzuela *et al.,* (2004) assessed the poverty effects of trade liberalisation on smallholder livestock producers in African and South East Asian developing countries (Zambia, Malawi, Uganda, Mozambique, Vietnam, Indonesia, Bangladesh and the Philippines).

Chen and Ravallion (2004) studied the welfare impacts of China's WTO accession. They combined disaggregated household survey data with trade liberalisation results obtained from the China GTAP model of Ianchovichina and Martin (2002). Price changes were estimated separately using a general equilibrium model. These were fed into national surveys for urban and rural areas of China for the year 1999. The variables in the household surveys were matched with the GTAP model for China. For example, in China's urban and rural household surveys there were 200 categories of consumption and production, which were brought down to 25 in accordance with the aggregated GTAP version of Ianchovichina and Martin (2002). Their simulation experiments were reductions in tariffs, quantitative restrictions and export subsidies.

Using a sample of over 80 thousand households classified by region and income level, the price changes (because of trade policy) were simulated from a general equilibrium model, which were then linked with China's national household survey for rural and urban areas. Results showed that WTO accession is likely to increase poverty slightly, and there is almost no impact on inequality. However, across household types and regions the impacts were diverse. For example, the north-east regions of Heilongjing, Jilin, Liaoning and Inner Mongolia experienced larger negative impacts as the households in these rural areas are dependent on feed grain production, the prices of which are expected to fall because of WTO accession. Further, rural households particularly dependent on agriculture with relatively few links to the outside economy through migration become most vulnerable.

Another study on China was conducted by Zhai and Hertel (2006) who assessed the implications of multilateral trade reform policies and the increasing spending on rural education for poverty in China by combining a global model with a national CGE model. To estimate the poverty impacts, Zhai and Hertel disaggregated urban and rural households into 60 urban and 40 rural representative households according to their primary sources of income and relative income levels. The rural households were again stratified as agriculture-specialised and diversified, whereas the urban households were classified as transfer-specialised, labour-specialised, and diversified. Zhai and Hertel (2006) developed a recursive-dynamic model to assess the impacts on China's trade pattern, consumption and production. It was calibrated to China's 1997 SAM. One important feature of the study was the modelling of the linkages between education and labour productivity as well as off-farm labour mobility which act as the main transmission of trade reform benefits to the households. To implement this link, they developed a framework through which education expenditure affects human capital and its distribution among household groups. In Zhai and Hertel (2006)'s model, education boosts labour productivity, first, by improving the skill composition of the labour force which results in an increased supply of skilled labour and, second, for each skill level, it yields a higher level of school attainment which improves labour productivity.

Four simulations were considered: 1) elimination of all import tariffs in the rest of the world (ROW-Lib); 2) unilateral trade liberalisation by China; 3) the first and second scenarios combined; and 4) the standard Doha scenario. Multilateral trade liberalisation effects were incorporated into the CGE model by exogenous shifts in import prices and export demand schedules obtained from global simulations (GTAP simulations). Using the World Bank's poverty line of US$2 per day, Zhai and Hertel's results show that multilateral trade reforms reduce poverty in China, especially in rural areas as off-farm employment opportunities increased. Econometric estimation suggests that education was the main determinant of off-farm employment. In addition, higher prices for farm products helped reduce rural poverty incidences. However, the overall urban poverty headcount increases because of higher food prices.

Cicowiez *et al.,* (2008) estimated the distributional, inequality and poverty effects of reforming agricultural trade policies in the case of Argentina. By combining a global economy-wide model (GTAP 7) with a national CGE model and a partly-econometric micro-simulation model, the authors first simulate the changes in the rest of the world's policies in the global model. The resulting variation in terms of trade and export demand is then fed into the national CGE model for Argentina as exogenous shocks. After removing the tariffs and export taxes on Argentina's agricultural products, the CGE model produces new levels of employment in each sector, new wages and the new relative prices which are then combined with a partly econometric micro-simulation model. In the micro-simulation model, the macro results produce new individual wages and employment and new poverty indices and inequality measurements. The simulation results show that elimination of import taxes and liberalisation by the rest of the world has positive effects on poverty indices which work through a reduction in unemployment. Further, unilateral elimination of import taxes and liberalisation in the rest of the world initiates small but positive effects on income inequality. However, these results turn negative when elimination of export taxes is taken into account. In terms of poverty, removal of import taxes in Argentina and liberalisation in the rest of the world produce positive but very small effects through a reduction in unemployment.

Gilbert (2008) developed a multiregional CGE model for South Asia covering Bangladesh, India, Sri Lanka, and an aggregate region covering the remaining countries, in order to assess the welfare impact of SAFTA (South Asia Free Trade Agreement). In his model, there are 16 production sectors (each producing a joint product for domestic and foreign markets), government, investment and multiple consumer households. The household consumption function is based on a Stone-Geary utility function, which results in a linear expenditure system. To capture the implications of trade reforms for intra-household income changes, the household structure was modified in the GTAP data base. The base data for production, trade, employment and aggregate consumption were obtained from the GTAP 6.0 data base, while data on sources of household income and variation in consumption across households were obtained from the SAMs of the various countries. To ensure consistency with the GTAP 6.0 data base, these data were rebalanced to match with GTAP data dimensions.

By considering a regional bilateral trade reform scenario of 20 per cent reduction in bilateral tariffs, and a unilateral reform scenario of 10 per cent reduction in all applied tariffs, and using the multiple representative household approach, the model results show that the welfare effects of trade liberalisation under SAFTA are likely to be small. The main reason is that these regions have similar export profiles. Thus, they have limited opportunities for beneficial exchange. In the case of unilateral trade reform, the model predicts the same welfare impacts to the GTAP model. However, country-wise results vary. For example, in Bangladesh, the impact was pro-poor both in a relative and an absolute sense; in India it was pro-poor only in absolute sense. In Sri Lanka, there was a positive effect on overall poverty but a negative impact on the rural poor.

4.4 CGE Modelling in Bangladesh

In Bangladesh, most of the CGE models constructed to date deal with taxation, trade policy, and agricultural policy. Recently, assessing the poverty and welfare impacts of trade liberalisation using a CGE model has become an increasingly popular practice. This is due to greater availability of household survey data and computational facilities through various new softwares. There are several CGE models constructed for Bangladesh which fall under this classification, for example, Hossain (1989); Chowdhury (1990); Mujeri and Khondker (2002); Khondker and Raihan (2004); Annabi *et al.*, (2005); Khondker *et al.,* (2006); and Hoque (2006). The following section provides a brief description of CGE models developed for Bangladesh.

4.4.1 Previous Computable General Equilibrium Modelling of the Bangladesh Economy

Keyzer (1986) conducted the first static simulation of a CGE model for the Bangladesh economy. That model was in fact a part of the Bangladesh Agricultural Model (BAM) constructed by the staff of the Centre for World Food Studies in 1983. BAM is an applied general equilibrium model that is linkable to an international model and it mainly focuses on agriculture and food. The supply component of this model describes the adjustment that takes place in the resources and how production plans are made. The exchange component shows what happens when the commodities are brought to market. There were 10 socioeconomic household groups (classified on the basis of main economic activity and location), 17 agricultural sub-sectors, one tradable non-agricultural good and one non-tradable non-agricultural good or service. The main objective of BAM was to study the impact of government policies on the nutritional status of the population in Bangladesh. Keyzer (1986) used the exchange component of BAM where three policy simulations were tested: 1) 50 per cent cut in all tariffs and subsidies without any nontariff barrier; 2) zero tariffs on import of non- agricultural products; and 3) an adjustment in the excise tax to meet the trade deficit. The policy changes were evaluated in terms of the effects on commodity prices, foreign exchange cost, tax revenue by commodity and nutritional status by social classes.

Hossain (1989) developed a multi-sectoral general equilibrium model to assess the effects of the restrictive trade policies on resource allocation and welfare in Bangladesh. Based on the Johansen linearisation technique, his static model of 12 sectors (9 traded and 3 non-traded) was calibrated to the 1976-77 Input-Output table for Bangladesh. Consisting of one aggregated household and one mobile primary factor, labour, the welfare effects were estimated by means of equivalent (EV) and compensating variations (CV)[54]. Two simulation experiments were conducted: 1) a 20 per cent reduction in the quantitative restrictions; and 2) a 20 per cent reduction in all tariffs assuming that quantitative restrictions are non existent. The results showed that the removal of trade restrictions initiated a shift in resources from the import-competing capital-intensive sectors to labour-intensive subsistence crops and export sectors. In terms of welfare effects, results of the unilateral removal of tariff and quantitative restrictions were found to be relatively small. Despite its methodological flexibility and predictive ability, the model's main limitation was the inability to expose the income distribution aspect clearly. To capture the income distribution aspect effectively, the model needed to include more representative households and a large number of factors.

Lewis (1990) developed a Johansen type CGE model of the Bangladesh economy to analyse the macroeconomic consequences of proposed trade and industrial policy reforms. Results showed tariff rationalisation would result in a decline in tariff revenues and reduce government resources. However, a moderate increase in excise tax would be sufficient to recover much of the revenue lost.

Chowdhury (1990) analysed the economic impact of various tax policies on resource allocation and income distribution in Bangladesh by constructing a multisectoral general equilibrium model. One of the main objectives of his study was to assess the equity and efficiency consequences of various proposed tax measures, while keeping government revenue constant. To assess the income distribution effects, a SAM was constructed for the Bangladesh economy for the year 1984-85. Most of the data for the SAM were collected from the base run solution of the Macro model of the Bangladesh third five-year plan. The model had seven production sectors, four household groups classified on the basis of income, and a government sector. The external sector was characterised by the presence of tariffs, exchange controls and the dual exchange rate system. In the model, households' income originates from primary factor income, remittances from abroad, transfers from government, and the premium received on remittances. The premium on remittances represents the wedge between the

[54] The equivalent variation (EV) measures, in money terms, the change in the amount of money needed by the consumer at the pre-policy change level in order to able to enjoy the post-policy level of utility. In contrast, the compensating variation (CV) measures the change in post-policy level of income that brings the consumer to the pre-policy change level of utility.

official and secondary exchange rate. Four sets of experiments were carried out for the short run: 1) experiments with excise tax; 2) tariff experiments; 3) experiments with excise, tariff and direct taxes; and 4) experiments with value-added tax. Simulation results from the model predicted that in Bangladesh, any tax reform involving a single tax instrument has little scope for improving efficiency and equity. Chowdhury (1990) suggested that a package of tax reforms which involved more progressive income taxes and less reliance on indirect taxes would be the best option.

Salma (1992) estimated the growth and distributional effects of agricultural price policy reforms in Bangladesh. A neo-classical general equilibrium model was developed for Bangladesh with the following institutional aspects; import and export premia, a two-tier foreign exchange system, and a slack labour market with constant nominal wages in the short run and constant real wages in the long run. In her CGE model there were 25 sectors (one agricultural and the rest manufacturing and services) where the agricultural sector was characterised by a multi-product sector in contrast to single output in non-agriculture. For the non-agricultural sectors, the model followed the ORANI model where the production technology exhibits constant returns to scale and is of a two-level nested form. In contrast, in modelling the agricultural sector, Salma (1992) introduced a three-level nested form which allows greater flexibility in production structure. Two sets of simulation experiments were conducted; first, policy shocks that indirectly contribute to the changes in agriculture, for example exchange rate and trade policies; and second; policy shocks that directly affect agricultural prices, such as withdrawal of fertiliser subsidies and food subsidies. Her simulation results showed that in both the short run and long run, indirect policies seemed to have much greater impact on agricultural productivity and outputs than direct policies.

Ahammad (1995) analysed the effects of foreign exchange and trade policies on the growth of industries and welfare in the Bangladesh economy. Following the standard ORANI model of the Australian economy, Ahammad (1995) developed a 19-sector neo-classical CGE model which incorporated some behavioural and institutional constraints in Bangladesh as they prevailed in that period. The model also included principal trade and industrial policies used in the Bangladesh economy, for example: external imbalances, divergence between domestic and international prices, the multiple exchange system, foreign exchange rationing, and subsidies under the export performance benefit scheme and domestic excise and sales taxes. Based on the Bangladesh National Board of Revenue (NBR) input-output table for 1989, Ahammad's model also included a skeleton monetary sector to clear the secondary exchange market. A utility index was constructed to measure the welfare impacts. The simulation experiments included an exogenous inflow of foreign aid, devaluation of the official exchange rate, an increase in money supply, an increase in nominal wages; reductions in tariffs, and a reduction in Export Performance Benefit Scheme entitlement rates. All these experiments were conducted under two labour market closures: a Keynesian closure, where nominal wages are kept constant; and a neoclassical closure where nominal wages change in response to policy changes.

Noman (2001) developed a CGE model for Bangladesh to examine the impact of international price shocks. Based on a trade-focused CGE model described in Dervis *et al.,* (1982), Noman's CGE model included 29 production sectors, 3 factors of production (labour, capital and intermediate inputs), households, government and the rest of the world. A 29-sector SAM was constructed based on the 1993-94 Bangladesh Input-Output table, and the model was solved using the General Algebraic Modelling System (GAMS) software. Simulations carried out were: 1) a 20 per cent rise in international petroleum prices; 2) a 20 per cent rise in international chemical prices; 3) a combination of scenarios 1 & 2; and 4) Scenario 3 combined with full liberalisation. The model results show that the increase in prices of petroleum and chemical products in the world market would have had severe effects on the economy, by reducing production, employment, government revenue, exports and imports. In turn, households' welfare would fall as a result of reduced consumption levels. However, the situation would improve if a full tariff liberalisation scenario were combined with the previous scenarios.

Mujeri and Khondker (2002) analysed the poverty and income distribution impacts of trade liberalisation policies in Bangladesh. The authors developed a static CGE model with 26 production sectors, 7 household groups (classified on the basis of location, land ownership, occupation and the education level), and 6 labour groups which was calibrated to the 1995-96 Social Accounting Matrix for Bangladesh. The compensating variation (CV) and the equivalent variation (EV) were used to calculate the welfare impacts. Following Decaluwe *et al.*, (1999), a Beta distribution function was formulated first for each household group (using the 1995-96 Bangladesh Household Expenditure Survey), which was then employed to assess the poverty implications. Two poverty lines (urban and rural) were defined, based on the basic needs commodities which were endogenously determined in the model. The beta distribution functions and poverty lines were used to estimate pre-simulation and post-simulation Foster-Greer and Thorbecke (FGT) poverty incidences. Two sets of simulations were conducted; first, full tariff liberalisation; and second, the base value of foreign savings was augmented to reflect the increased pattern of foreign investment flow. The results from the study revealed that in Bangladesh the globalisation efforts were generally pro-poor even though the gains were relatively small.

Khondker and Raihan (2004) assessed the poverty and welfare impacts of different policy reforms in Bangladesh, using a comparative-static CGE model based on the 1995-96 SAM of Bangladesh. In the 1995-96 SAM, there were 7 household groups (classified in urban and rural areas in accordance with land ownership, occupation type and education level), 7 factors of production (6 types of labour and 1 capital), and 26 production sectors. Equivalent variation (EV) and Foster-Greer-Thorbecke poverty measures were estimated. Following Decaluwe *et al.*, (1999)'s procedure of poverty estimation, a Beta distribution function was estimated for each representative household group. Three simulations were carried out: 1) domestic trade liberalisation with compensating production taxes; 2) a ready-made garment export shock; and 3) a remittance shock. The main observations from simulations were that, in Bangladesh, full tariff liberalisation produced losses of welfare for all household groups even though the patterns were different for rural and urban areas. In the rural areas, the larger welfare losses accrued to relatively well-off households (e.g. large farmer and non-farm), whereas the reverse happened in urban areas, with the poorer households suffering more. Poverty also deteriorated in both urban and rural areas. A fall in export of ready-made garments also showed a deterioration of welfare and poverty status for all 7 representative households, as reduced exports lead to a reduction in GDP and a loss in households' income. An increase in remittances raised welfare for all household groups. In contrast, the poverty profile deteriorated for rural household groups though it improved for urban household groups.

Annabi *et al.,* (2005) examined the impacts of the Doha agreement and domestic trade reform policies on welfare and poverty in Bangladesh. However, unlike previous poverty studies, the authors developed a sequential dynamic CGE model. It was used for long run analyses. Following a non-parametric representative approach, poverty estimation was conducted using 2000 Bangladesh Household Expenditure Survey data. The model was numerically calibrated to the 2000 SAM of Bangladesh with 15 production sectors, 4 factors of production and 9 representative household groups. A set of simulations was undertaken, including Doha agreements on agricultural trade, free world trade, domestic trade liberalisation, a combination of free world trade and domestic liberalisation, and increases in remittances. Simulation results showed that the Doha agreement had negative implications for overall poverty and welfare for households. Similar results were found for free world trade, but with greater magnitudes. Domestic trade liberalisation also caused welfare losses and increased poverty in the short run, but welfare increased and poverty fell in the long run as capital adjusted through new investments.

Khondker *et al.,* (2006) used a computable general equilibrium model, based on a social accounting matrix, to investigate welfare and poverty impacts of trade liberalisation in Bangladesh. Calibrated to the 1995-96 SAM for Bangladesh, their model included 6 types of labour, 7 representative households and 26 production sectors. Three types of simulations were examined, viz: 1) full tariffs elimination with an accompanying 55 per cent increase in existing production taxes to compensate government revenue loss; 2) full tariff removal with an increase in the income tax rates of households; and 3) changes in tariffs in such a way that bear a resemblance to actual tariff reforms undertaken in the economy. Poverty estimates were found using a parametric representative household approach that followed the approach of Decaluwe *et al.*, (1999). The results from simulation 1 showed that welfare losses are larger for rural households compared to urban households. In the second simulation, the patterns of welfare changes were found to be progressive for rural household groups when government revenue was maintained by increasing income taxes. The rural poverty situation improved under simulations 2 & 3 whereas in the case of simulation 1 it declined. In contrast, in urban areas all poverty indices deteriorated under the first and the third simulation, whereas under the second simulation, these improved.

Hoque (2006) developed a large scale static computable general equilibrium model for Bangladesh, BAORANI, following ORANI, a multi sectoral computable general equilibrium model for the Australian economy (Dixon, *et al.,* 1997). However, following Horridge *et al.,* (1995), Hoque's model includes multiple households with a detailed income mapping between agents and institutions. Based on the 2000 Input-Output table and SAM for Bangladesh, his Johansen-type model included 86 industries, 94 commodities, 9 representative households and 8 types of labour. Counterfactual simulation experiments were carried out first for a removal of tariffs; and secondly, an improvement in investor confidence.

The first case was expressed with three alternate scenarios of tariff cuts: 1) without maintaining government budget neutrality and with real national savings; 2) an across-the-board adjustment in tax rates with real national savings; and 3) an across-the-board adjustment in tax rates and considering real national savings exogenous. Simulation results were presented in terms of changes in macroeconomic indicators, sectoral outputs, employment, and real consumption of households.

There are few CGE models constructed for Bangladesh that analyse issues other than trade, taxation and agricultural policies. For example, Fontana *et al.,* (2001) developed a CGE model to analyse the impact of different external shocks and policy changes on the rice and wheat sector in Bangladesh. Their model was calibrated to a 1993-94 SAM for Bangladesh with 10 agricultural activities, 32 non-agricultural activities, 8 labour groups and 9 household groups. Simulations were carried out for the impact of 1) a decline in rice production due to floods; and 2) a cut in food aid (wheat).

Arndt *et al.,* (2002) constructed a CGE model with special treatment of the rice and wheat sectors to analyse the effects of a change in rice productivity, change in world rice price and a ready-made garment export shock. The model was based on IFPRI's standard CGE model (Lofgren, Harris, and Robinson, 2001) with 52 production sectors, 21 factors of production, 16 labour categories, 12 household types, and the model was calibrated to the 1999-2000 SAM for Bangladesh.

4.4.2 Justification of the Present Study

From the review of Bangladesh CGE models in the previous section, it is evident that there are some welfare analyses of trade policy reforms with limited distributional aspects (e.g. Hossain (1989); Chowdhury (1990); Ahammad (1995); Arndt *et al.,* (2002); and Hoque (2006)). Some of these studies included only one representative household group, which is not sufficient to reveal the income distribution or welfare effects conclusively. Even though some studies have used more representative household groups in the model, they provide only a partial picture, as no information about poverty was provided. Only the studies of Mujeri and Khondker (2002), Khondker and Raihan (2004), Annabi *et al.*, (2005), and Khondker *et al.,* (2006) examined trade reform results in terms of poverty and welfare. However, in these studies no income inequality measurements have been calculated.

These studies, excluding the study of Annabi *et al.*, (2005), display similarities in many respects. The studies of Mujeri and Khondker (2002), Khondker and Raihan (2004), and Khondker *et al.,* (2006) all used a comparative static CGE model to assess the impacts of different policy reforms. Their models used a similar nested production structure where at the top level, real value added and intermediate inputs are combined by a Constant Elasticity Substitution (CES) production. These studies also used similar expressions for their structure of demand, private consumption demand, and applied the same assumptions for market behaviour. Further, these studies involved similar macroeconomic closures. In addition, all of the studies were calibrated to the same data base (1995-96 Bangladesh SAM), where there are 26 production sectors (7 agricultural, 12 industries and 7 service), 7 factors of production and 7 disaggregated household groups. Similarities arose in model specification, data base and closures except that the simulation design however produced differentiated results, in terms of poverty and inequality. The study of Annabi *et al.*, (2005) deviates from these by using a sequential dynamic CGE model, calibrated to the most recent SAM 2000 for Bangladesh. Because of the dynamic nature of the model, it does take into account accumulation effects and thus permits for a long run analysis. The 2000 SAM is more detailed in terms of household classification (9 household groups) but it is more aggregated in terms of production sectors (15 production sectors) and factors of production (4 factors of production) compared to the 1995-96 SAM for Bangladesh.

Furthermore, all of the previous studies have been implemented by different software/ programming, GAMS (USA-Canada style single country CGE model). Usually, this type of model is calibrated to SAM, whereas GEMPACK (Australia-style single country CGE model) uses an input-output table in calibrating. According to Butt and Bandara (2008), the Australian ORANI tradition CGE model is capable of identifying the winners and losers clearly as a result of any policy shocks because its data base is more detailed and disaggregated than the US tradition of CGE model.

Hoque (2006) developed a comparative-static ORANI-type model for Bangladesh, BAORANI, which was solved using GEMPACK. Incorporation of multiple households and a complete income mapping between agents and institutions made it an appropriate model for poverty and income distribution analysis. Further, Hoque's study was more detailed in the production side and labour category compared to studies of Mujeri and Khondker (2002), Khondker and Raihan (2004) and Khondker *et al.,* (2006) as it has 86 industries and 8 labour types. Most importantly, Hoque (2006) used a more recent input-output table and SAM for Bangladesh. However, the main limitations of his study are that it does not contain poverty and income inequality analysis, and shows only the short run implications of trade liberalisation.

Moreover, none of the studies stated above performed sensitivity analysis which is crucial for this type of modelling, as modellers often use elasticity parameters from the available literature, or use a good guess. In addition, very few studies are concerned with the revenue effects which are of the utmost importance in a country like Bangladesh where trade reforms put downward pressure on the already low tax/GDP ratio.

After reviewing the above mentioned models related to poverty and income inequality, it appears there is scope for advancing and extending the models for Bangladesh to capture poverty and inequality effects more clearly. It is worthwhile to undertake detailed industry and household classification by using most recent SAM and household survey data, to better capture the consequences of tariff reform policies changes and the compensatory fiscal policies on poverty and inequality. The following chapter will discuss the theoretical foundations of our CGE model as used to model income distribution and poverty aspects with underlying assumptions.

4.5 Conclusions

This chapter has provided a theoretical overview of the links between trade policy, income distribution and poverty. It also reviewed the applications of CGE models in addressing issues related to trade policies, WTO agreements and external shocks and their impact on welfare, poverty and income distribution situations in developing countries. Particular attention has been given to the various CGE models developed for the Bangladesh economy.

For modelling trade policy, poverty and income distribution in a CGE model, there is a variety of methodologies available, starting with the representative household approach to household micro-simulation approach. The trend suggests that integration of detailed household survey information with general equilibrium models has become an increasingly common feature of the literature. This study will use the non-parametric traditional representative household approach following Decaluwe *et al.*, (1999) where a static CGE model is linked with the distribution function estimated directly from the household survey data. The micro-simulation approach, which provides much more accurate results in terms of poverty and inequality by taking into account individual heterogeneities, is yet to be used in a country like Bangladesh. This method needs econometric estimation of household behavioural equations, using data collected at the household level. With these limitations in mind, in the present study, we have used the representative household approach with actual intra-group income distributions. The following chapter will discuss the theoretical foundations of our CGE model used to model income distribution and poverty aspects of Bangladesh.

Chapter 5

The Bangladesh Model: The Theoretical Structure of the CGE Model for the Bangladesh Economy

5.1 Introduction

In this chapter a static, multi-factor, multi-household and multi-sectoral computable general equilibrium model, hereafter the Bangladesh model, is developed to assess the economic impacts of tariff liberalisation scenarios in Bangladesh. The model follows Horridge *et al.*, (1995)'s IDC-GEM, a SAM based computable general equilibrium model of the South African economy. IDC-GEM is patterned from ORANI-F (Horridge *et al.*, 1993), which closely follows ORANI, a multisectoral computable general equilibrium model of the Australian economy (Dixon *et al.*, 1997) that uses the Johansen approach of linearising to find the general solution for equilibrium prices and quantities (Johansen, 1960). In the Johansen approach, the model is first approximated by a series of linear equations relating percentage changes in the model variables[55]. Like many other CGE models, IDC-GEM uses microeconomic theory to specify the behaviour of producers, consumers, and investors. It is assumed that producers minimise their costs or maximise their profits whereas consumers maximise their utility. The demand and supply equations for private sector agents are derived from the optimisation problems. Thus, similar to the ORANI-G (Horridge, 2000, 2001a, 2001b, 2004, 2006; Horridge, Parmenter, and Pearson, 1998) model, the theoretical structure of the IDC-GEM model consists of the following equations: 1) producer's demand for intermediate and primary factor inputs; 2) producer's supplies of commodities; 3) households and other final demands for commodities; 4) zero-pure profit condition; 5) market clearing condition for primary factors and commodities; and 6) the relationship of basic values to purchasers price and production costs.

In addition to this static core, another distinctive feature of the IDC-GEM model is that it can capture the distributionary impacts of government policies. The model has a social accounting matrix (SAM) extension which provides a suitable quantitative framework by which the value

[55] Vincent (1985) and Coxhead (1989) for examples of Johansen style method.

added originating in the production process flows down to various factors of production as returns, that in turn flow to various household groups and other institutions as income flows. In addition, in this model, household's disposable income is linked to expenditure directly through the consumption function. Thus, the model can estimate the income distribution and welfare impacts. However, the model cannot predict the poverty impact directly as it does not contain any equation relating to a poverty line. Therefore, one development in the Bangladesh model is to endogenise the poverty lines following Decaluwe *et al.*, (1999) to capture the effects of trade reform policy on absolute poverty in Bangladesh. Further, important developments especially with respect to household income groups, the labour market and industry structure are included to accommodate the Bangladesh situation. For example, the labour sector is disaggregated by gender and skill groups and the household sector is disaggregated by location into urban and rural categories.

The main objective of this chapter is to present the theoretical structure of the Bangladesh model, although this model closely follows ORANI, which has been documented in detail- see, for example, Dixon *et al.*, (1977; 1997). Hence the derivation of the model equations does not need to be repeated here. Instead, this study uses the template of ORANI-G (Horridge, Parmenter, and Pearson (1998), Horridge (2001b), Horridge (2003), Horridge (2004) and Horridge (2006)), which was made available by the Centre of Policy Studies, Monash University, to explain the theory of the model in TABLO code which resembles the algebra[56]. Furthermore, since the Bangladesh model contains multiple households instead of a single household, this study follows the multiple household version of ORANI-G (Horridge, 2004). In TABLO, the equations of the model are defined in percentage change form, which implements the model in GEMPACK[57]. In this chapter, in presenting the model theory, the equations for various problems are formulated in the levels of the variables, whereas the solution of the problems are linear in percentage change form and are presented by a series of

[56] TABLO is the name of the GEMPACK program which processes the file (containing equations of algebra-like syntax) and converts the information on it to a form suitable for running simulations on the model (Harrison and Pearson, 1996).
[57] GEMPACK is a suite of general purpose economic modelling software for calculating solutions of economic models, especially general and partial equilibrium models. It has been developed by the Centre of Policy Studies, Monash University.

TABLO excerpts[58]. The percentage change in a variable and its levels value are distinguished by using lower-case script for percentage change and upper-case script for levels[59].

Before explaining the equations of the Bangladesh model, it is important to introduce the main sets, variables, coefficients and parameters of the model with their notations. This is done in the next section. The remainder of the chapter is organised as follows. Section 5.3 presents the structure of the core CGE model[60]. Section 5.4 discusses income distribution and section 5.5 presents poverty aspects of the model. Standard closures of the model are discussed in section 5.6. Section 5.7 discusses the approach in solving the model, while section 5.8 presents some concluding remarks.

5.2 Sets, Variables and Coefficients of the Model

In TABLO, set names appear in upper-case letters and each set is expressed by one index. As an example, the set 'COM' contains all the commodities in the model with the index 'c'. Another example is 'SRC' expressed by index 's' with two (dom, imp) elements. There are some sets that are subsets of other sets. For example, 'MAR', which is a set of margin-type commodities (e.g. transport and trade commodities), is basically a subset of 'COM' as each element of set MAR is also an element of set COM. Table 5.1 presents the main sets used in the Bangladesh model. There are 86 industries and 94 commodities in the model which are indexed with 'c' and 'i' under the set names 'COM' and 'IND'. This classification ensures multiproduction in the model. A list of the commoditiy and industry classifications is provided in Appendix Table C 6.1. Labour is disaggregated into gender and skill-based occupational categories described by the set 'OCC' which are: 1) Male low-skilled (Mallowskill); 2) Male high-skilled (Malhighskill); 3) Female low-skilled (Femlowskill); and 4) Female high-skilled (Femhighskill). There are 6 margin commodities: 1) wholesale trade; 2) retail trade; 3) air transport; 4) water transport; 5) land transport; and 6) rail transport. They are the commodities required to facilitate the flows of other commodities from producers and importers to users (Horridge *et al.*, 1993). Household groups are disaggregated into 9

[58] The complete description of the theoretical specification of the model around the TABLO frame is available at http://www.monash.edu.au/policy/oranig.htm.

[59] The percentage change in variable X can be defined as $x = 100(\Delta X/X)$. In deriving the percentage-change equations from the non-linear equations, there are three rules (Peter *et al.*, 1996) which are described below:

the product rule, $X = \beta YZ \rightarrow x = y + z$, where β is a constant,

the power rule, $X = \beta Y^{\alpha} \rightarrow x = \alpha y$, where α and β are constants, and

the sum rule, $X = Y + Z \rightarrow Xx = Yy + Zz$.

[60] This section draws mainly on Horridge (2006) and Dixon *et al.*, (1997).

categories based on the Bangladesh Social Accounting Matrix 2000: 1) Rural landless households (LandlessHH); 2) Rural marginal farmer households (MargfarmHH); 3) Rural small farmer households (SmallfarmHH); 4) Rural large farmer households (LargefarmHH); 5) Rural non-agricultural households (NonagriculHH); 6) Urban illiterate households (IlliterateHH); 7) Urban low-educated households (LoweduHH); 8) Urban medium-educated households (MediumeduHH); and 9) Urban high-educated households (HigheduHH)[61].

Table 5.1: Main sets of the Bangladesh model

Index	Set name	Description	Typical size
c	COM	Commodities	94
i	IND	Industries	86
s	SRC	Domestic and imported sources	2
m	MAR	Margin commodities	6
o	OCC	Occupations	4
h	HOUS	Household groups	9

In general, in a TABLO input file variables are measured in percentage changes and they appear as lower-case letter[62]. Conventionally, names of variables consist of a letter or letters indicating the type of variable and a main user number. Here are the examples of letters indicating the type of variables,

a	technical change
del	ordinary (rather than percentage change)
f	shift variable
p	price, local currency
p_f	price, foreign currency
x	input quantity
t	tax

The main user numbers (each of the digits 0 to 6 indicates users) are,

1	firms, current production
2	firms, capital creation
3	households

[61] Details of the classification of the household groups are provided in Chapter 6.
[62] For some variables such as changes in inventories, the ratio of nominal balance of trade and nominal GDP where ordinary changes are preferred, their values are reported as the changes in the level values.

4	foreign exports
5	government
6	inventories
0	all users

As an example, x1(c, s, i) implies the percentage changes in the direct demands by producers for source-specific intermediate inputs. Some variables are associated with an underscore character indicating that these variables are an average over the sets of the original variables. As an example, $p1lab\_io$ represents average nominal wage over IND and OCC.

Appendix Table B 5.1 reports the list of variables contained in the Bangladesh model. In contrast, coefficients are the constants in the linear approximation of the equations. They appear in upper-case characters in the model. They are either directly supplied from the database or computed from the database using a formula statement. Appendix Table B 5.2 presents the list of coefficients and parameters for the Bangladesh model.

Further, in the model, three or more letters form a descriptor for the variables. As an example, descriptor 'bas' stands for basic - not including margins or taxes, 'cap' 'imp', 'lab', 'lnd', 'lux', 'mar', 'oct', 'prim', 'pur' and 'sub' imply capital, imports (duty paid), labour, land, linear expenditure system (supernumerary part), margins, other costs tickets, all primary factors (land, labour or capital), at purchasers' prices and linear expenditure system (subsistence part).

5.3 Structure of the Core Model

5.3.1 Structure of production

The Bangladesh model assumes that each industry can produce several commodities by using domestic and imported intermediate commodities, labour of several types, land, capital and other costs[63]. This multi-product, multi-input specification follows a series of separability assumptions of typical computable general equilibrium (CGE) models. With the separable production function, the decision as to what combination of products to produce is not dependent on the decision of input use. Similarly, product prices have no effect on input

[63] Other cost refers to production taxes, cost of holding liquidity and other miscellaneous production costs which appear in the production process.

combinations except through their effect on the level of activity in the industry (Oktaviani, 2000). As an example of input-output separability, following Horridge *et al.*, (1993), the following generalised production function for some industry

$$F \text{ (inputs, outputs)} = 0 \tag{1}$$

can be written as

$$G \text{ (inputs)} = X1TOT = H \text{ (outputs)} \tag{2}$$

where, X1TOT is an index of industry activity level. The structure of this production function for the Bangladesh model is illustrated by the nesting structure as shown in Figure 5.1. In the top level of the diagram, the separable function of output is derived from a constant elasticity of transformation aggregation function, while in the bottom part, the input separable function is hierarchically nested in a sequence of nests. It is assumed that product markets and factor markets are competitive so that producers are price takers both in input and output markets. Given constant returns to scale in production, producers are assumed to make optimal input demand decisions by using a cost minimisation decision rule.

At the top level of the nests for the input function, commodity composites made up of intermediate inputs, a primary factor composite and other cost are combined using a Leontief production function. Thus, there is no substitution between intermediate inputs or between intermediates and primary factors and other costs in producing unit of industry activity. As a result, these input categories - the commodity composites, primary factor composites and other costs are demanded in direct proportion to the industry activity level. At the second level, the aggregated intermediate input is calculated to obtain the composite intermediate input quantities according to a constant elasticity of substitution (CES) behavioural function. Such aggregation is in turn based on the assumption of imperfect substitutability between imported and domestic commodities (Armington, 1969; Armington, 1970). The primary factor composite is also a CES aggregation of land, capital and composite labour. In addition, the labour composite is a CES aggregation of skilled and unskilled male and female labour.

The following sub-sections will provide a brief explanation for each block of equations in the model along with their TABLO excerpts. We begin with the intermediate input branch.

5.3.1.1 Intermediate input demand equations

As stated in section 5.3.1, each industry chooses the cost minimising combination of imported and domestic intermediate inputs of goods subject to the CES production function. The CES specification implies that inputs of the same commodity type are not perfect substitutes for one another (Peter *et al.*, 1996). Here is a very simple example of deriving the percentage change equations of the CES production nest[64].

Suppose, to determine the composition of intermediate inputs, the costs $\sum_i PiXi$ are minimised subject to the following CES production function:

$$Z = \left(\sum \delta_i X_i^{-\rho} \right)^{-1/\rho} \tag{3}$$

where Z is output, the X_i's are inputs and δ_i, ρ are positive parameters. Now to optimise the above problem, the first order conditions are

$$P_k = \lambda \partial Z / \partial X_k = \lambda \delta_k \, X_k^{-(1+\rho)} \left(\sum \delta_i X_i^{-\rho} \right)^{-(1+\rho)/\rho} \tag{4}$$

Thus, $$P_k / P_i = \delta_k / \delta_i \left(X_i / X_k \right)^{1+\rho} \tag{5}$$

or, $$X_i^{-\rho} = \left(\delta_i P_k / \delta_k P_i \right)^{-\rho/(\rho+1)} X_k^{-\rho} \tag{6}$$

Substituting the value of X_i into the production function and solving for the following input demand functions:

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[64] This derivation is adapted from Horridge (2006). For more details derivation and linearising the resulting level equations refer to Dixon, et al. (1997, pp. 68-90), Dixon *et al.*, (1992, pp. 88-96,124-126), and Dixon, Bowles, and Kendrick (1980).

$$X_k = Z\left(\sum_i \delta_i \left[\frac{\delta_k P_i}{\delta_i P_k} \right]^{\rho/\rho+1}\right)^{\frac{1}{\rho}} \tag{7}$$

or, $$X_k = Z\delta_k^{1/(\rho+1)} \left[\frac{P_k}{P_{ave}} \right]^{-1/(\rho+1)} \tag{8}$$

where, $$P_{ave} = \left(\sum_i \delta_i^{1/(\rho+1)} P_i^{\rho/\rho+1} \right)^{(\rho+1)/\rho} \tag{9}$$

The percentage form of equation (8) is as follows:

$$x_k = z - \sigma(p_k - p_{ave}) \tag{10}$$

where, $$P_{ave} = \sum_i S_i P_i \tag{11}$$

and $\sigma = 1/\rho + 1$ indicates the elasticity of substitution between imported and domestic goods as inputs into the production of the industry.

$S_i = \delta_i^{1/(\rho+1)} P_i^{\rho/\rho+1} \Big/ \sum_k \delta_k^{1/(\rho+1)} P_k^{\rho/(\rho+1)}$, which denotes the weighted average of all intermediate input prices. (12)

and the lower case letters such as x's, p's and z's represent the percentage changes in the variables of the corresponding upper case variables. Multiplying both sides of equation (8) by P_k we obtain,

$$S_k = P_k X \Big/ \sum_i P_i X_i \tag{13}$$

where S_k is the cost shares for an intermediate input in the total cost of inputs in an industry.

Equation (10) shows the simple general percentage-change input demand function of a CES nest[65]. Now by allowing the technological change in production process and using proper notations for the users and sources in the general input demand functions, the import/domestic composition of intermediate input demand is shown in the following TABLO excerpt no. 1.

Excerpt 1 of TABLO input file

Industries choices between domestic and imported goods

```
(Parameter)(all,c,COM)SIGMA1(c)  # Armington Elasticities: Intermediate #;
Equation E_x1 # source specific commodity demand #
(all,c,COM)(all,s,SRC)(all,i,IND)x1(c,s,i)-a1(c,s,i)=x1_s(c,i)-
SIGMA1(c)*[p1(c,s,i)+a1(c,s,i)-p1_s(c,i)];                                  (14)
Equation E_p1_s # Effective price of commodity composite #
(all,c,COM)(all,i,IND)p1_s(c,i)=
                 sum{s,SRC,S1(c,s,i)*[p1(c,s,i)+a1(c,s,i)]};               (15)
```

Equation (14) shows that the demand for intermediate input, c, from source, s (s = 1 refers to domestic output, whereas s = 2 denotes imports), by industry, i, for current production, x1 (c, s, i) is proportional to demand for the composite, x1_s (c, i), the relative prices of commodities from different sources (effective price from sources relative to the effective cost of the import/domestic composite), and the elasticity of substitution, SIGMA1. If there is no technical change (i.e. a_i's are zero), and no change in the relative prices from alternative sources, then a proportionate change in x1_s (c, i) leads to the same proportionate change in x1 (c, s, i)[66]. This reflects the constant returns to scale assumption in production. However, changes in relative prices of domestic and imported goods initiate a substitution in favour of the cheaper source, the magnitude of which depends on the value of the substitution parameter, SIGMA1 (c).

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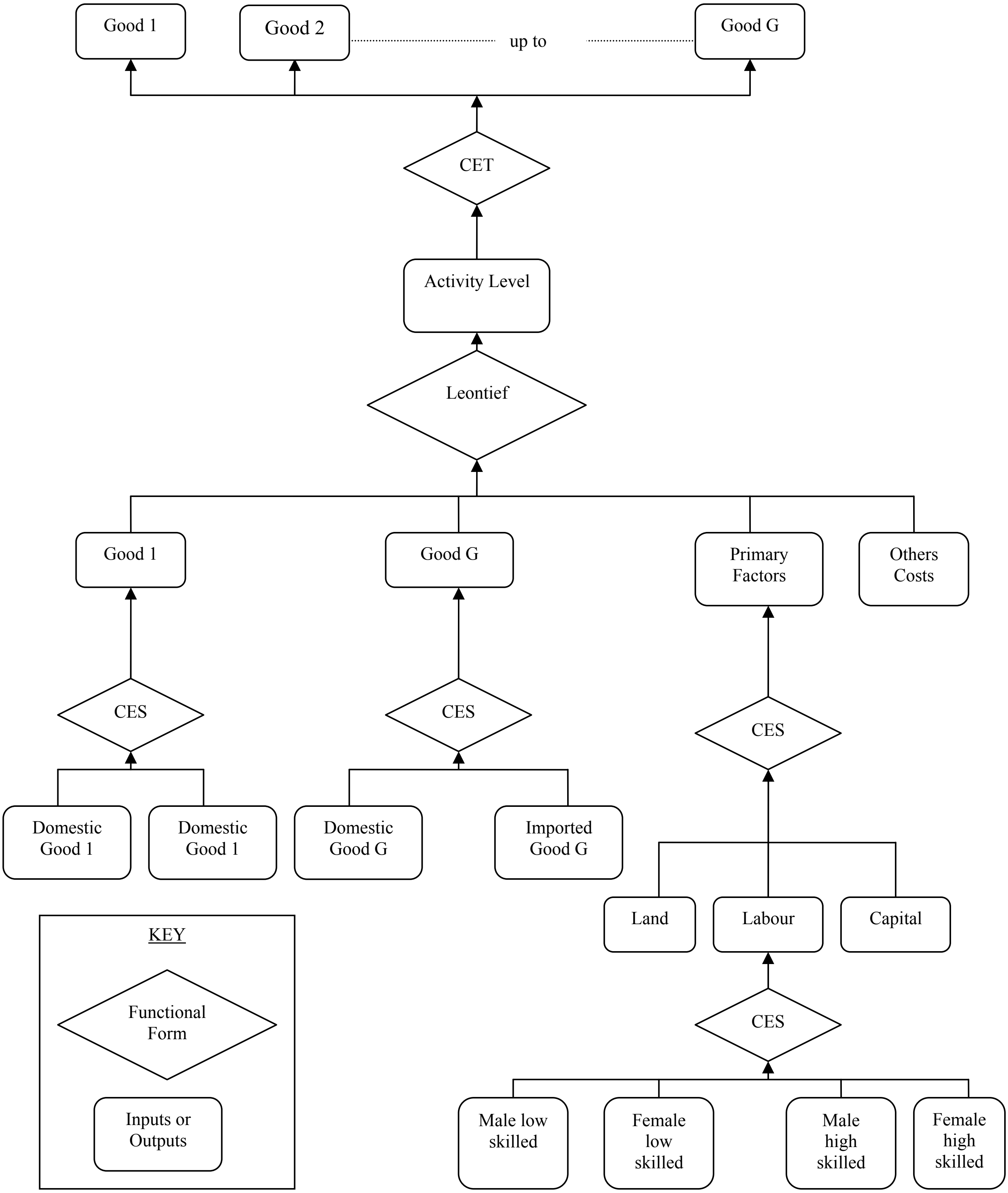
[65] A similar procedure is used for the derivation of labour inputs and primary factor inputs.

[66] For discussion with technical change, refer to Dixon *et al.*, (1997, p. 82).

Figure 5.1: **Structure of production**



5.3.1.2 Demand for primary factors

In Figure 5.1, at the lowest level nest in the primary-factor branch of the production tree, producers choose a combination of four occupation-specific labour inputs to minimise total labour costs. These labour categories are male low-skilled, male high-skilled, female low-skilled and female high-skilled category. The Bangladesh model assumes that producers chose a CES combination to minimise the costs. For each industry *i*, the optimisation problem can be written as follows:

Choose inputs of occupation-specific labour,

$$X1LAB(i,o)$$

to minimise total labour cost,

$$\sum_{o}^{4} P1LAB(i,o) * X1LAB(i,o) \tag{16}$$

subject to,

$$X1LAB\_O(I) = CES\{X1LAB(i,o)\} \tag{17}$$

where $P1LAB(i,o)$ is the price paid by industry for each occupation-specific labour type and $X1LAB\_O(I)$ denotes an effective labour input demanded by industry *i*. Following the derivation of intermediate input demand in section 5.3.1.1, the demand for labour by occupation can be stated in levels as:

$$X1LAB(i,o) = X1LAB\_O(I) * \left(\frac{P1LAB(i,o)}{P1LAB\_O(i)} \right)^{SIGMA1LAB} \tag{18}$$

where $SIGMA1LAB$ is the parameter for the substitution of various skilled and unskilled labourers and $P1LAB\_O(i)$ is the price to each industry of labour composite. The solution to this problem in percentage change form is shown in the following TABLO excerpt no. 2.

Excerpt 2 of TABLO input file

Occupational composition of labour demand

```
Coefficient
(parameter)(all,i,IND)SIGMA1LAB(i)# CES Substitution between skill type  #;
(all,i,IND) V1LAB_O(i) # Total labour bill in industry i #;
Read SIGMA1LAB from file BASEDATA header "SLAB";
Equation
E_x1lab # Demand for labour by industry and skill group #
(all,i,IND)(all,o,OCC)x1lab(i,o)=x1lab_o(i)-SIGMA1LAB(i)*[p1lab(i,o)-   p1lab_o(i)];
                                                                              (19)
E_p1lab_o # Price to each industry of labour composite #
(all,i,IND)[TINY+V1LAB_O(i)]*p1lab_o(i)=sum{o,OCC,V1LAB(i,o)*p1lab(i,o)};  (20)
E_employ(all,i,IND)ID01[V1LAB_O(i)]*employ(i)=
                      sum{o,OCC,V1LAB(i,o)*x1lab(i,o)};                    (21)
E_employ_i  V1LAB_IO*employ_i=sum{i,IND,V1LAB_O(i)*employ(i)};             (22)
```

Equation (20) shows that the occupation specific demand for labour is proportional to the demand for the effective composite labour demand and the relative prices of occupational specific labour and an elasticity of substitution, SIGMA1LAB(i). The interpretation of (19) is similar to that of (14). If there is no change in the relative prices of the different types of labour, then the occupational composition of industry $i's$ labour force remains the same. However, with a given level of demand for effective labour, if the wage rate of the labour type o increases relative to a weighted average of the wage rates of all different types of labour, then there will be a substitution of other types of labour for that specific type of labour. This responsiveness of occupational employment in turn depends on the magnitude of $SIGMA1LAB$, the CES substitution between skill types.

At the next level of the of the primary factor branch of the production nest in Figure 5.1, we determine the composition of demand for primary factors. In the Bangladesh model, the primary factors are land, capital and labour. Their derivation follows the same constant elasticity of substitution (CES) pattern as the previous nests. For a given primary input requirement, firms have to form a primary factor composite such that the total primary costs are minimised. Here, it is important to note that whereas in previous sections we have excluded the technology variables to simplify, in this section we introduce factor-saving technical changes. In this case, total primary costs are minimised subject to the following production function:

$$X1PRIM(i) = CES\left[\frac{X1LAB\_O(i)}{A1LAB\_O(i)}, \frac{X1CAP(i)}{A1CAP(i)}, \frac{X1LND(i)}{A1LAND(i)}\right] \tag{23}$$

where $X1PRIM(i)$ denotes the industry's overall demand for primary factors and variables $A1LAB\_O(i)$, $A1CAP(i)$ and $A1LND(i)$ denote factor specific technical change variables. The resulting demand equations can be expressed in level form as:

$$\frac{X1LAB\_O(i)}{A1LAB\_O(i)} = X1PRIM(i) * \left(A1LAB\_O(i) * \frac{P1LAB\_O(i)}{P1PRIM(i)}\right)^{SIGMA1PRIM(i)} \tag{24}$$

$$\frac{X1LND(i)}{A1LND(i)} = X1PRIM(i) * \left(A1LND(i) * \frac{P1LND(i)}{P1PRIM(i)}\right)^{SIGMA1PRIM(i)} \tag{25}$$

$$\frac{X1CAP(i)}{A1CAP(i)} = X1PRIM(i) * \left(A1CAP(i) * \frac{P1CAP(i)}{P1PRIM(i)}\right)^{SIGMAPRIM(i)} \tag{26}$$

The following TABLO excerpt 3 shows the equivalent percentage-change demand equations for primary factors. For a given level of technology, the demand function for each factor is proportional to overall factor demand, $x1prim(i)$ and a relative price term (the unit cost of the factor relative to the overall effective cost of primary factor inputs). Changes in the price of a primary factor relative to the average factor price change the demand for that factor. Producers substitute relatively cheaper factors. For example, if the price of labour composite, $p1lab\_o(i)$, increases relative to the effective price of the primary factor composite, $p1prim(i)$, with a given level of primary factor requirement, $x1prim(i)$, the industry will reduce its demand for labour and substitute other factors such as land and capital. The strength of this substitution effect depends on the value of the parameter, $SIGMA1PRIM(i)$, the CES for primary factors. Equation (30) shows that the percentage change in the price of an effective unit of composite primary factor is equal to the weighted average of the percentage changes in the costs of the three groups of primary factors. All the demand equations contain technical change variables which affect quantity demanded and price variables related to primary factors. These technical change variables are usually set exogenously at zero.

Excerpt 3 of TABLO input file

Primary factor proportions

```
Coefficient(all,i,IND)SIGMA1PRIM(i)# CES Substitution, primary factors #;
Read SIGMA1PRIM from file BASEDATA header "P028";
Equation
E_x1lab_o # Industry demands for effective labour #
(all,i,IND)x1lab_o(i)-a1lab_o(i)=x1prim(i)-SIGMA1PRIM(i)*[p1lab_o(i)+a1lab_o(i)-
p1prim(i)];                                                                  (27)
E_p1cap # Industry demands for capital #
(all,i,IND)x1cap(i)-a1cap(i)=x1prim(i)-SIGMA1PRIM(i)*[p1cap(i)+a1cap(i)-p1prim(i)];
                                                                             (28)
E_p1lnd # Industry demands for land #
(all,i,IND)x1lnd(i)-a1lnd(i)=x1prim(i)-SIGMA1PRIM(i)*[p1lnd(i)+a1lnd(i)-p1prim(i)];
                                                                             (29)
E_p1prim # Effective price term for factor demand equations #
(all,i,IND)V1PRIM(i)*p1prim(i)=V1LAB_O(i)*[p1lab_o(i)+a1lab_o(i)]+
V1CAP(i)*[p1cap(i)+a1cap(i)]+V1LND(i)*[p1lnd(i)+a1lnd(i)];                   (30)
```

5.3.1.3 Demands for primary factors and commodity composites

At the top-most input demand nest of Figure 5.1 commodity composites, the primary-factor composites and ‘other costs’ are combined using a Leontief production function to determine the activity level for the industries. This type of production function is similar to a CES production function with the elasticity of substitution set equal to zero. The production function is given by:

$$X1TOT(i)=\frac{1}{A1TOT(i)}xMIN\left[All,c,COM:\frac{X1\_S(c,i)}{A1\_S(c,i)},\frac{X1PRIM(i)}{A1PRIM(i)},\frac{X1OCT(i)}{A1OCT(i)}\right] \qquad (31)$$

where $X1TOT(i)$ is the activity level or value-added, $A1TOT(i)$ is the Hicks-neutral technological change term[67], $A1PRIM(i)$ is the all input augmenting technological change and $A1OCT(i)$ is the technological change associated with other cost tickets.

Because of the Leontief specification of the production function, the demand equations for composite primary factors, for intermediate inputs and for other cost tickets are directly proportional to the level of the activity in the industry. These are indicated by equations

[67] Hicks-neutral technological change refers to a situation where technological change raises the output by a factor of proportionality that is independent of the composition of inputs employed in production (Helpman, 2004, pp. 19-20).

E_x1_s, E_x1prim and E_x1oct in the TABLO excerpt no. 4. Equations (32), (33) and (34) show that with technology parameters set exogenously, the effective demand for each of these categories of inputs depends only upon each industry's activity level rather than relative prices of these inputs.

Excerpt 4 of TABLO input file

Top nest of industry input demands

```
Equation E_x1_s # Demands for composite commodities #
(all,c,COM)(all,i,IND)x1_s(c,i)-[a1_s(c,i)+a1tot(i)]=x1tot(i);          (32)
Equation E_x1prim # Demands for primary factor composites #
(all,i,IND)x1prim(i)-[a1prim(i)+a1tot(i)]=x1tot(i);                      (33)
Equation E_x1oct # Demands for other costs tickets #
(all,i,IND)x1oct(i)-[a1oct(i)+a1tot(i)]= x1tot(i);                       (34)
```

5.3.1.4 Output decisions: From industry output to commodity outputs

The top level of Figure 5.1 explains the relationship between activity level and outputs of an industry. Following ORANI-G, the Bangladesh model allows some industries to produce a mixture of all the commodities[68]. It is assumed that for a given level of activity and commodity prices, industries will choose their output mix to maximise their revenue. The commodity output combination is formed based on a CET (constant elasticity of transformation) functional form[69]. Thus, the revenue from the output is maximised by the following production function:

$$X1TOT(i) = CET[ALL, c, COM : Q1(c,i)] \tag{35}$$

where $Q1(c,i)$ denotes output by commodity and industry and CET is the functional form of a constant elasticity of transformation production possibility frontier[70]. The percentage change form of commodity supply equation which is shown by equation (36) in excerpt 5 of the TABLO input file shows that each industry's supplies of composite commodities depends

[68] IDC-GEM model assumes a single product in the production system.

[69] Powell and Gruen (1967) and Powell and Gruen (1968) were the first to introduce CET function into CGE modeling.

[70] The CET form is identical to the CES form except for the restriction on ρ. With CES, ρ is greater than or equal to -1, whereas, with CET, ρ is less than or equal to -1. In case of CES, the curves are concave from above, in contrast, in the CET case, the curves are concave from below (Dixon *et al.*, 1992).

upon the industry's overall activity level and the relative prices of the various composite commodities it produces. An increase in a commodity price, relative to the average price of all commodities produced induces a transformation in favour of that commodity. Transformation into that commodity is governed by SIGMA1OUT, the CET transformation elasticities between different commodities. Equation (37) shows that the percentage change in composite commodity prices is a revenue-share weighted average of the percentage change in individual commodity prices.

Excerpt 5 of TABLO input file

Output mix of commodities

```
Equation E_q1 # Supplies of commodities by industries #
(all,c,COM)(all,i,IND)q1(c,i)=x1tot(i)+SIGMA1OUT(i)*[p0com(c)-p1tot(i)];        (36)
E_x1tot # Average price received by industries #
(all,i,IND)p1tot(i)=sum{c,COM,[MAKE(c,i)/MAKE_C(i)]*pq1(c,i)};                 (37)
```

5.3.1.5 Input demands for the creation of fixed capital

In the Bangladesh model it is assumed that producers of fixed capital goods combine inputs to form units of fixed capital and in so doing they minimise their cost subject to technologies. The nesting structure for the production of new units of fixed capital is given in Figure 5.2, where it is shown that the production function for capital goods is a multi-stage production procedure with Leontief technology for combining composite intermediate goods at the top level and the CES technology for combining imported and domestically produced goods at the bottom level. It is also assumed that capital creation requires no primary factor inputs (for example, land, labour, capital and other cost tickets) and these goods are created efficiently and competitively. Thus, the model's investment demand equations are derived from the following two-part investor's cost minimising problem. In Figure 5.2, at the bottom level of the nest, the total cost of the domestic-foreign import composite, $X2\_S(c,i)$ is minimised subject to the CES production function:

$$X2\_S(c,i) = CES\left[ALL, s, SRC : \frac{X2(c,s,i)}{A2(c,s,i)}\right] \tag{38}$$

where $A2(c,s,i)$ denotes the basic technical change parameters for investment.

The resulting demand equation in percentage form is presented in TABLO excerpt no. 6 by equation no. (40), which shows that the demand for source-specific inputs, $x2(c,s,i)$, is a function of total fixed capital units produced, Armington substitution in investment, SIGMA2 (c), and the relative prices of goods from different sources. In the absence of technical change, an increase in the domestic price of a commodity, $p2(c,s,i)$ compared to the weighted average price of imports and domestic commodities, $p2\_s(c,i)$, will decrease the demand for that domestic commodity and increase the demand for the imported commodity. This substitution is governed by SIGMA2 (c), the Armington substitution elasticities for investment. Equation (41) describes the percentage change in the effective price of the commodity composite as the average cost of producing a unit of fixed capital from two sources. At the top level of Figure 5.2, the total cost of effective units of produced inputs is minimised according to a Leontief production function:

$$X2TOT(i) = \frac{1}{A2TOT(i)} MIN\left[ALL, c, COM : \frac{X2\_S(c,i)}{A2\_S(c,i)} \right] \tag{39}$$

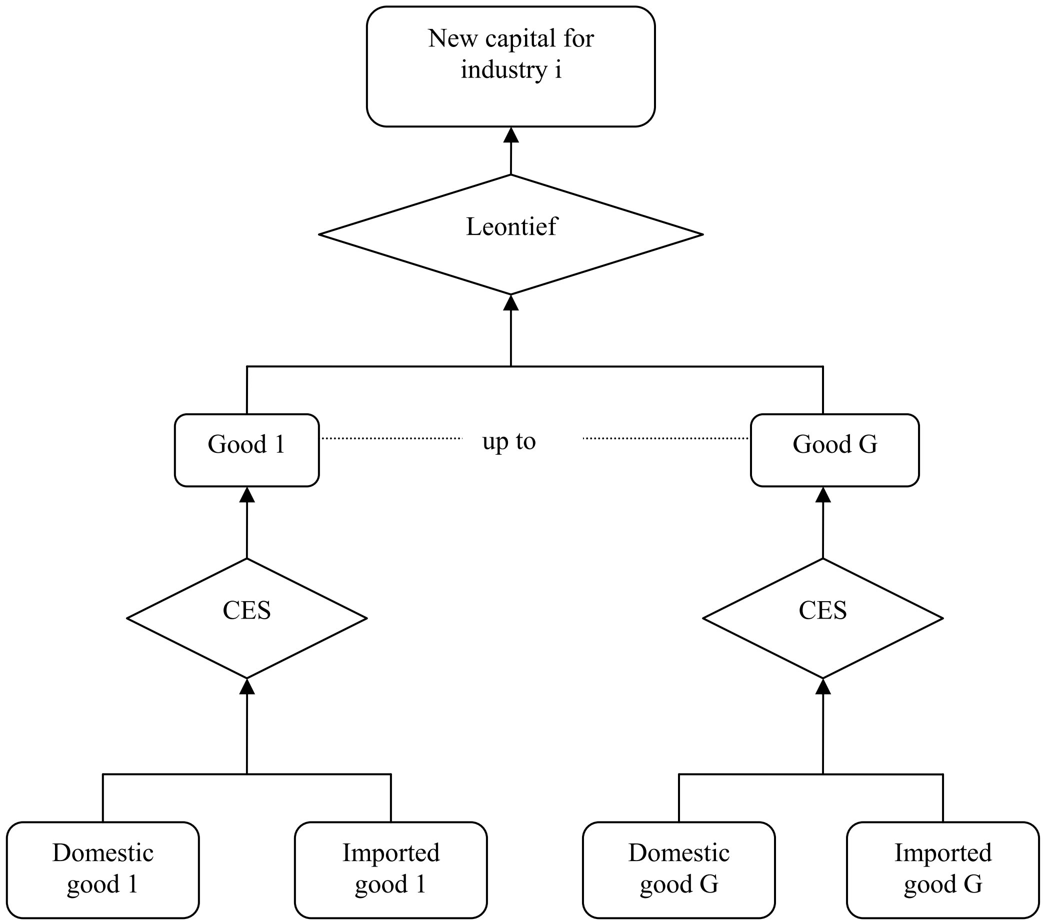
Here, $X2TOT(i)$, the total amount of investment in each industry is assumed exogenous for the above cost minimising problem. The resulting percentage-change demand equation (42) shows that the effective unit of goods i, $x2\_s(i)$ is directly proportional to the number of units of fixed capital produced, irrespective of relative input price change.

Excerpt 6 of TABLO input file

Investment demands

```
Coefficient
(parameter)(all,c,COM)SIGMA2(c)# Armington elasticities: Investment#
Read SIGMA2 from file BASEDATA header "2ARM";
Equation
E_x2 # Source specific commodity demands #
(all,c,COM)(all,s,SRC)(all,i,IND)
x2(c,s,i)-a2(c,s,i)-x2_s(c,i)=-SIGMA2(c)*[p2(c,s,i)+a2(c,s,i)-p2_s(c,i)]; (40)
E_p2_s # Effective prices of domestic composite #(all,c,COM)(all,i,IND)
p2_s(c,i) = sum{s,SRC, S2(c,s,i)*[p2(c,s,i)+a2(c,s,i)]};                  (41)
E_x2_s(all,c,COM)(all,i,IND)x2_s(c,i)-[a2_s(c,i)+a2tot(i)]=x2tot(i);      (42)
```

Figure 5.2: Structure of investment demand



5.3.1.6 Investment allocation

The technology for creating fixed capital is described in section 5.3.1.5. This section discusses how the investment level is determined for each industry. In the Bangladesh model, following ORANI and ORANI-G, rate of return theory is used to explain the allocation of investment among industries. In other words, newly created units of capital distributed between industries on the basis of relative rates of return. In allocating investment across industries, Dixon *et al.*, (1997, pp. 118-122) outlined a number of steps[71].

[71] For a detailed discussion refer to Dixon *et al.*, (1997).

It is assumed that the rate of return on fixed capital in industry j is given by

$$R_j(0) = \frac{P^{(1)}{}_{(n+1,2)j}}{\Pi_j} - d_j \tag{43}$$

where d_j is the rate of depreciation, $P^{(1)}{}_{(n+1,2)j}$ is the rental value of a unit of capital in industry j, and Π_j is the cost of unit of capital in industry j.

It is also assumed that investors expect that industry j's rate of return schedule in period 1 time will have the following form:

$$R_j(1) = R_j(0)\left(\frac{K_j(1)}{K_j(0)}\right)^{-\beta_j} \tag{44}$$

where β_j is a positive parameter, $K_j(0)$ is the current level of the capital stock in industry j and $K_j(1)$ is the level of capital stock at the end of period 1.

It is further assumed that total private investment expenditure is allocated across industries in such a way so as to equate the expected rates of return. This means that there exists some rate of return Ω such that

$$\left(\frac{K_j(1)}{K_j(0)}\right)^{-\beta_j} R_j(0) = \Omega \qquad j \in J \tag{45}$$

Also, the only variables which determine the capital stock at the end of period 1 are the current capital stock, its rate of depreciation, and the current level of investment, as shown by equation (46).

$$K_j(1) = K_j(0)(1 - d_j) + Y_j \tag{46}$$

Equations (43)-(46) can be represented in percentage form as follows:

$$r_j(0) = Q_j\left(p^{(1)}{}_{(n+1,2)j} - \pi_j\right) \tag{47}$$

where Q_j is the ratio of gross to net rate of return.

$$\beta_j\left(k_j(1)-k_j(0)\right)+r_j(0)=w \tag{48}$$

$$k_j(1)=k_j(0)(1-G_j)+y_jG \tag{49}$$

where G_j is the ratio of gross investment to future capital stock in industry j.

On the basis of the above investment theory, investment follows one of the three rules for each industry:

Firstly: in the short run, investment is positively related to the profit rate. In excerpt 7 of the TABLO input file, equation (50) and (51) define the percentage change in the gross growth rate of capital and the gross rate of return on capital in industry i respectively. Equation (52) relates the gross growth rate to the net rate of return (relative to the economy-wide rate, *invslack*[72]*)* for selected industries. This equation implies that industries for which gross rates of return are higher, attract more investment. The variable finv1 (i) allows for exogenous shifts in each industry i.

Secondly: for exogenous investment industries, investment follows national investment, x2tot_i. These are the industries for which the previous investment theory is inappropriate[73]. Equation (53) states that with finv2 (i) exogenous, investment depends on aggregate investment in the economy.

Thirdly: it is assumed that in the long run, the aggregate capital stock adjusts to match with the previously determined economy-wide rate of return, and the allocation of capital across industries or the industry demand for investment goods is determined by fixed investment/capital ratios. This rule is shown by equation (54). For an industry with fixed finv3 (i), it fixes the gross capital growth rate.

[72] This equation comes from substituting equations (47) and (49) in equation (48). The value 0.33 corresponds to the sensitivity of capital growth to rates of return, G_j and 2.0 corresponds to the rates of gross to net rate of return, Q_j. These values are from Dixon *et al.*, (1997) and are typical values of these ratios.

[73] They are industries where investment is determined by government policy and not driven by current profits (e.g. education, and public health).

Following ORANI-G, in this model the demand for inventories is set to be fixed.

Excerpt 7 of TABLO input file

```
Equation
E_ggro(all,i,IND)ggro(i)=x2tot(i)-x1cap(i);                                    (50)
E_gret(all,i,IND)gret(i)=p1cap(i)-p2tot(i);                                    (51)
E_finv1 # DPSV investment rule #
(all,i,IND)ggro(i)=finv1(i)+0.33*[2.0*gret(i)-invslack];                       (52)
E_finv2 # Alternative rule for exogenous investment industries #;
(all,i,IND)x2tot(i)=x2tot_i+finv2(i);                                          (53)
E_finv3# Alternative long run investment rule #;
(all,i,IND)ggro(i)=finv3(i)+invslack;                                          (54)
```

5.3.1.7 Household demands

Since the effects of trade liberalisation on income distribution and poverty are the main concerns of this study, the household sector has been disaggregating in the Bangladesh model into nine representative household groups on the basis of the rural/urban differences, education levels of heads of households, and households' ownership of land. Households' demands are explained by a utility maximisation model following the neoclassical theory which assumes that consumers purchase commodities to maximise utility subject to an aggregate expenditure constraint.

Figure 5.3 depicts the structure of household consumer demand. It has nearly the same nesting structure as investment demand. The only difference is that in the household demand nest, commodity composites are aggregated by a Klein-Rubin (Stone-Geary) utility function[74]. The Klein-Rubin utility function in turn leads to the linear expenditure system (LES). Following the Keynesian consumption function, it is assumed that for each representative household group, total consumption expenditures are determined by disposable income.

In Figure 5.3, at the bottom level of the nest, the representative household in each group, h, chooses combinations of domestic and imported commodities to minimise cost subject to a CES utility function. Using a similar derivation to the demand equation for intermediate inputs in section 5.3.1.1, households demand functions for commodity composites in

[74] The Klein-Rubin Stone-Geary utility function is often referred to as the Stone-Geary utility function in recognition of the contribution of Stone (1954) and Geary (1949-50) on this utility function.

percentage change form are given by the equations (55) and (56) in the TABLO excerpt no. 8. Equation (55) shows that in the absence of changes in taste, the demand for household commodities from a specific source, $x3(c,s,h)$ depends on the household demand for commodity composite, $x3\_s(c,h)$, relative prices of household commodities from different sources and the Armington substitution elasticity for households, SIGMA3(c). Changes in relative commodity prices will affect the household demand for commodities from different sources the way they affect demands for intermediate and investment requirements.

Excerpt 8 of TABLO input file

Import/domestic composition of household demands

```
Coefficient
(parameter) (all,c,COM)SIGMA3(c) # Armington Elsaticities: Households #;
 Read SIGMA3 from file BASEDATA header "3ARM";
Equation  E_x3 # Sourse-specific commodity demands #
(all,c,COM)(all,s,SRC)(all,h,HOUS)
x3(c,s,h)-a3(c,s)=x3_s(c,h)-SIGMA3(c)*[p3(c,s,h)+a3(c,s)-p3_s(c,h)];          (55)
E_p3_s # Effective price of commodity composite # (all,c,COM)(all,h,HOUS) p3_s(c,h)
=sum{s,SRC, S3(c,s,h)*[p3(c,s,h)+a3(c,s)]};                                    (56)
```

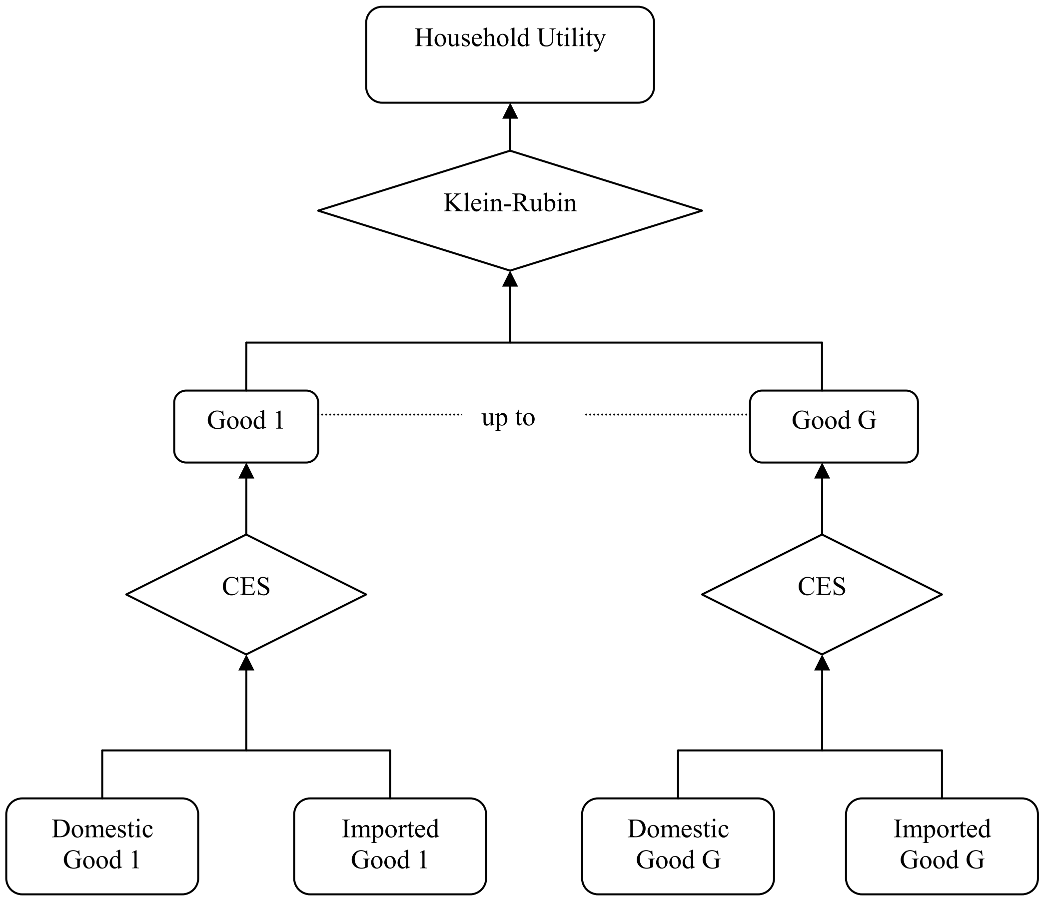
At the top level of the household demand nest, households allocate expenditure between composite commodities according to a Klein-Rubin utility function. The demand equations derived from this utility function consist of the subsistence demand for the good, and the supernumerary expenditure. The expenditure equation obtained from this demand function is a linear function of income and prices (Chung, 1994). Per capita utility at the household level is given by:

$$UTILITY_h = \frac{1}{Q_h}\prod_c \left(X3\_S(c,h) - X3SUB(c,h)\right)^{S3LUX(c,h)}, h = 1,2,....9 \qquad (57)$$

where $X3SUB(c,h)$ and $S3LUX(c,h)$ are behavioral coefficients, Q_h is the number of households of that specific group and $\sum_c S3LUX(c,h) = 1$. $X3SUB(c,h)$ denotes the subsistence level of consumption and $S3LUX(c,h)$ is the proportion of the supernumerary income spent on good c or the marginal budget share of total spending on luxuries. A representative consumer for a specific household group chooses the commodity composite, $X3\_S(c,h)/Q_h$, to maximise the equation (57) subject to the budget constraint :

$$\sum_c \frac{X3\_S(c,h)}{Q_h} * P3\_S(c,h) = \frac{V3TOTh(h)}{Q_h} \tag{58}$$

Figure 5.3: Structure of consumer demand



where $V3TOTh(h)$ is the total purchases by a representative household of a given group.

The demand equations that arise from this utility function are[75]:

$$X3\_S(c,h) = X3SUB(c,h) + S3LUX(c,h) * \frac{V3LUX\_C(h)}{P3\_S(c,h)} \tag{59}$$

[75] Derivation of the demand equations is provided in Appendix B 5.3.

where

$$V3LUX\_C(h) = V3TOTh(h) - \sum X3SUB(c,h) * P3\_S(c,h) \tag{60}$$

$V3LUX\_C(h)$ represents the supernumerary expenditure, or the amount of total income of the representative consumer of a particular household group that is left over when all of the subsistence requirements have been fulfilled. Equation (60) has the property that expenditure on each good is a linear function of prices $P3\_S(c,h)$ and expenditure $V3TOTh(h)$. Thus, in level form the equations can be written as:

$$X3\_S(c,h) = X3SUB(c,h) + X3LUX(c,h) \tag{61}$$

$$X3LUX(c,h) * P3\_S(c,h) = S3LUX(c,h) * V3LUX\_C(h) \tag{62}$$

$$X3SUB(c,h) = Q_h * A3SUB(c,h) \tag{63}$$

The percentage changes of these equations are shown in the TABLO excerpt no. 9. Equation (64) shows that the percentage change in subsistence demand for a composite commodity by all households in group h, is a function of the percentage change in the number of households and the percentage change in the average household subsistence demand. The percentage change in representative household luxury demand for a commodity composite, shown by equation (65), is a function of the percentage change in nominal luxury household expenditure and the relative price of the commodity composite. Equation (66) shows the percentage change in the total household demand equation for composite goods, which is the sum of the percentage changes in subsistence consumption and luxury consumption for goods with their respective shares in total expenditure on commodity, c. Equation (67) is the percentage change form of the utility function (57). The equations described here determine the composition of household demands but not total consumption. Total household consumption is determined by total household disposable income which is described in sub-section 5.4.2.

Excerpt 9 of TABLO input file

Household demands for composite commodities

```
Equation
E_x3sub # Subsistence demand for composite commodities #
(all,c,COM)(all,h,HOUS)x3sub(c,h)=qh(h)+a3sub(c,h);                    (64)
E_x3lux # Luxury demand for composite commodities #
(all,c,COM)(all,h,HOUS)x3lux(c,h)+p3_s(c,h)=w3luxh(h)+a3lux(c,h)        (65)
E_x3_s # Total household demand for composite commodities #
(all,c,COM)(all,h,HOUS)
x3_s(c,h)=B3LUX(c,h)*x3lux(c,h)+[1-B3LUX(c,h)]*x3sub(c,h);              (66)
E_utilityh # Change in utility disregarding taste change terms #
(all,h,HOUS)utilityh(h)+qh(h)=sum{c,COM,S3LUX(c,h)*x3lux(c,h)};        (67)
```

5.3.1.8 Foreign export demands

Following ORANI-G and ORANI-F, export commodities are divided into two groups: *traditional* export commodities, mainly agricultural and manufacturing products which comprise the greater volume of exports; and *non-traditional* exports, mainly service commodities and other commodities[76]. For most commodities in the traditional exports list, exports constitute a large share of total output, whereas for *non-traditional* commodities, shares are small. Demand for a *traditional* export commodity is modelled as a downward sloping foreign export demand function given by:

$$X4(c) = F4Q(c)\left[\frac{P4(c)}{PHI * F4P(c)}\right]^{EXP\_ELAST(c)} \qquad (68)$$

where $X4(c)$ is the export volumes of commodity c, $EXP\_ELAST(c)$ is the constant own price elasticity of foreign export demand, which is negative. PHI is the exchange rate which converts Bangladesh *taka* to foreign currency units, and the shift variables, $F4Q(c)$ and $F4P(c)$ allow for horizontal (quantity) and vertical (price) shifts in the export demand curve. Equation (68) states that traditional exports are a negative function of their foreign currency

[76] In this model the traditional export commodities are Jute and jute products, tea, shrimps, leather products, ready-made garments, knitting, toiletries manufactures, fertilizer, insecticides and miscellaneous industrial products.

prices[77]. The percentage-change form of this equation is provided in the TABLO excerpt no.10 by equation E_x4A.

In case of *non-traditional* export commodities, the above mentioned demand rule seems inappropriate as historically, these commodities comprise only small shares in total output. Typically, export volumes do not necessarily depend on their respective prices in this category. Following ORANI-G, the commodity composition of aggregate *non-traditional* exports is exogenised by treating *non-traditional* exports as a Leontief aggregate (equation E_X4B in excerpt 10). For these types of commodities, exports are assumed to be directly proportional to aggregate *non-traditional* commodities. The demand for the aggregate *non-traditional* exports is assumed to be inversely related to the average price of non-traditional export commodities by a constant-elasticity demand curve (equation 72).

Excerpt 10 of TABLO input file

Export demands

```
Set
TRADEXP # Traditional Export commodities #
NTRADEXP # Non-Traditional export commodities # = COM-TRADEXP;
Equation E_x4A # Individual export demand functions #
(all,c,TRADEXP)x4(c)-f4q(c)=-ABS[EXP_ELAST(c)]*[p4(c)-phi-f4p(c)];        (69)
E_X4B # Collective export demand functions #
(all,c,NTRADEXP)x4(c)- f4q(c) = x4_ntrad;                                  (70)
E_p4_ntrad # Average price of collective exports #
[TINY+V4NTRADEXP]*p4_ntrad = sum{c,NTRADEXP, V4PUR(c)*p4(c)};              (71)
E_x4_ntrad # Demand for collective export aggregate #
X4_ntrad-f4q_ntrad=-ABS [EXP_ELAST_NT]*[p4_ntrad-phi-f4p_ntrad];           (72)
```

5.3.1.9 Government consumption demands

In modelling government demands for both domestic and imported goods, ORANI does not provide any theoretical explanation. Following ORANI-G, the percentage change equations of government demands are provided in the TABLO excerpt 11. In equation (73), the shift variables $f5$ and $f5tot$ represent respectively the source-specific commodity shift term and the overall shift term for government demand. Now, with both these shift variables constant, the level and composition of government demand is also determined exogenously.

[77] Export prices here are considered as f.o.b prices in foreign currency.

Alternatively, it is possible to treat the government demand endogenously. In this case it is assumed that government expenditure changes in direct proportion to real aggregate household consumption. This can be achieved by treating the shift variable $f5tot2$ (which denotes the ratio of overall shift term of government demand to real aggregate household expenditure) as exogenous and $f5tot$ as endogenous in equation (74). In our model, both alternatives of treating government demand are specified by short run and long run closure respectively[78].

Excerpt 11 of TABLO input file

Government demands

```
Equation E_x5 # Government demands #
(all,c,COM)(all,s,SRC) x5(c,s) = f5(c,s) + f5tot;                    (73)
E_f5tot # Overall Government demands shift #
f5tot= sum {h, HOUS,S3_H(h)*x3toth(h)} + f5tot2;                     (74)
```

5.3.1.10 Trade and transport margins

Trade and margin commodities are treated as goods and services that are used to facilitate trade, e.g. the use of transport, storage and wholesale and retail services transfer to commodities from producers to users. In the Bangladesh model, there are 6 margin commodities: wholesale trade, retail trade, air transport, land transport, rail transport and water transport. In addition to direct consumption (as for example, households' use of transport), these commodities are used to help move products to direct demanders such as producers, investors, households, governments and foreigners. In both IDC-GEM and ORANI-G, the demands for these commodities are modeled as proportional to the commodity flows with which the margins are associated.

[78] Detailed government revenue and expenditure elements included in this model are provided in section 5.4.

Excerpt 12 of TABLO input file

Margin demands

```
Equation
E_x1mar   # Margins to producers #   (all,c,COM)(all,s,SRC)(all,i,IND)(all,m,MAR)
x1mar(c,s,i,m)=x1(c,s,i)+a1mar(c,s,i,m);                                    (75)
E_x2mar # Margins to investment #
(all,c,COM)(all,s,SRC)(all,i,IND)(all,m,MAR)
x2mar(c,s,i,m)=x2(c,s,i)+a2mar(c,s,i,m);                                    (76)
E_x3mar # Margins to households #
(all,c,COM)(all,s,SRC)(all,h,HOUS)(all,m,MAR)
x3mar(c,s,h,m)=x3(c,s,h)+a3mar(c,s,m);                                      (77)
E_x4mar # margins to exports #
(all,c,COM)(all,m,MAR)x4mar(c,m)=x4(c)+a4mar(c,m);                          (78)
E_x5mar # Margins to government #
(all,c,COM)(all,s,SRC)(all,m,MAR)x5mar(c,s,m)=x5(c,s)+a5mar(c,s,m);        (79)
```

5.3.1.11 Zero pure profit and the price system

There are several price sets of commodity prices in the Bangladesh model, for example, basic values, purchasers' prices, *f.o.b* foreign currency export prices, *c.i.f* foreign currency import prices and prices of capital units. Basic values are the prices received by producers. They consist of the cost of raw materials and the cost of the factors of production. Sales taxes and margin costs are not included. For importers, basic prices are *c.i.f* import prices paid by importers plus import duties and tariffs. However, they do not include sales taxes and margin costs needed to deliver the products from ports to domestic users. In contrast, purchasers' prices of commodities consist of the basic prices of the goods plus the indirect taxes and the cost of margin commodities. There are two initial assumptions behind this price system. The first is the zero pure profit condition that is perfect competition exists in all markets. This implies that revenue per unit of output in each industry equals cost per unit of output, a condition that also holds for the distribution of commodities (importing, exporting, transporting etc.). The second condition is that basic prices are uniform across users and producing industries in the case of domestic goods and importers, in the case of imported goods.

Keeping these assumptions in mind, the basic value of the output of industry j is equal to the total payments of industry j for its inputs which is as follows:

$$\sum_{i=1}^{g} P_{(i1)}^{(0)} X_{(i1)j}^{(0)} = \sum_{i=1}^{g}\sum_{s=1}^{2} P_{(is)j}^{(1)} X_{(is)j}^{(1)} + \sum_{m=1}^{4} P_{(L,m)j}^{(1)} X_{(L,m)j}^{(1)} + P_{(K)j}^{(1)} X_{(K)j}^{(1)} + P_{(N)j}^{(1)} X_{(N)j}^{(1)} + P_{(oct)j}^{(1)} X_{(oct)j}^{(1)} \quad (80)$$

where $P_{(i1)}^{(0)}$ is the basic price of output of industry j and $X_{(i1)}^{(0)}$ is the production of good $(i1)$ by industry j. $P_{(is)j}^{(1)}$ is the payment for domestic or imported intermediate inputs i from source s which is used in industry j and $X_{(is)j}^{(1)}$ denotes intermediate inputs, domestic and imported used in the output of industry j. $P_{(L,m)j}^{(1)}$, $P_{(K)j}^{(1)}$, $P_{(N)j}^{(1)}$, $P_{(oct)}^{(1)}$ denote respectively the price to industry j of a unit of labour of skill m, rental cost of capital, the price of land to industry j of units of capital and land and the price of other cost tickets in industry j. The percentage-change form of the above zero-profit condition is given by[79]

$$\sum_{i=1}^{g} p_{(i1)}^{(0)} H_{(i1)}^{(0)} = \sum_{i=1}^{g}\sum_{s=1}^{2} p_{(is)j}^{(1)} H_{(is)j}^{(1)} + \sum p_{(L,m)j}^{(1)} H_{(L,m)j}^{(1)} + p_{(K)j}^{(1)} H_{(K)j}^{(1)} + p_{(N)j}^{(1)} H_{(N)j}^{(1)} + p_{(oct)j}^{(1)} H_{(oct)j}^{(1)} \quad (81)$$

where $H_{(i1)j}^{(0)}$ is the revenue share of industry j accounted for by its sales of commodity ($(i1)$. $H_{(is)j}^{(1)}$, $H_{(L,m)j}^{(1)}$, $H_{(K)j}^{(1)}$, $H_{(N)j}^{(1)}$ and $H_{(oct)j}^{(1)}$ are the shares of industry j's costs accounted for by intermediate inputs (is), by inputs of labour of skill m, by inputs of capital, land and other costs respectively. Equation (81) implies that the revenue–share weighted sum of percentage changes in the basic value of output is equal to the sum of the percentage changes in the industry's input prices weighted by cost-shares.

Similarly, the zero-profit condition for the creation of fixed capital states that the value of new capital equals its cost of production, which is given as:

$$\Pi_j Y_j = \sum\sum P_{(is)j}^{(2)} X_{(is)j}^{(2)} \quad (82)$$

[79] For a detailed derivation and fuller description refer to Dixon *et al.*, (1997, pp. 108-117).

where Π_j is the price of a unit of fixed capital and Y_j is the quantity of fixed capital created in industry j. $P_{(is)j}^{(2)}$ and $X_{(is)j}^{(2)}$ are the price and quantity of good i used as intermediate inputs from all sources in the creation of capital. In percentage-change form,

$$\pi_j = \sum_{i=1}^{g} \sum_{s=1}^{2} p_{(is)j}^{(2)} H_{(is)j}^{(2)} \qquad i = 1, 2, 3, \ldots, g \qquad (83)$$

where $H_{(is)j}^{(2)}$ is the share of good i from source s in the costs of creation of one unit of capital for industry j.

For imports, the zero pure profit condition equates the basic price of imported goods with the product of the foreign price of the import, the exchange rate, and the power of the tariff[80]:

$$P_{(i2)}^{(0)} = P_{(i2)}^{(m)} \phi T_{(i2,0)} \qquad i = 1, 2, 3, \ldots\ldots, g \qquad (84)$$

where $P_{(i2)}^{(m)}$ is the foreign currency *c.i.f* price of imported units of goods i , ϕ is the exchange rate and $T_{(i2,0)}$ is the power of tariff .

Similarly, for exports, zero pure profit ensures that the foreign currency *f.o.b* price, converted to local currency is equal to the basic price of goods, the taxes and margin costs associated with delivering goods to the foreigners from a Bangladesh port. The relation is given by:

$$P_{(i1)}^{(e)} \phi = P_{(i1)}^{(0)} T_{(i1,4)} \sum_{r=1}^{6} A_{(r1)}^{(i1)(4)} P_{(r1)}^{(0)} \qquad (85)$$

where $P_{(i1)}^{(e)}$ is the foreign currency *f.o.b* price, $P_{(i1)}^{(0)}$ is the basic price of good i , $A_{(r1)}^{(i1)4}$ is the quantity of domestically produced good[81] which is required as margin per unit of export of good and $P_{(r1)}^{(0)}$ is the price of margins.

[80] Power of the tariff is defined as one plus the ad valorem rate of tariff on imports of goods. Sales taxes are treated as ad valorem tax on basic values; however, in percentage-change form, they are treated as power of taxes.
[81] In the Bangladesh model there are six margin commodities.

The above price equations depict zero pure profit in production, capital creation, importing and exporting. In the model there are some other types of price equations which show a zero pure profit condition in the distribution of commodities. These are imposed in the model by equating changes in the prices paid by domestic users for all goods with the commodities' changes in basic values plus commodity taxes and the costs of margins. In the TABLO excerpt 13 these conditions are shown by equations E_p1, E_p2, E_p3, E_P4 and E_p5[82]. These are also called purchasers' price equations.

Excerpt 13 of TABLO input file

Purchasers' prices

```
Equation E_p1 # Purchasers prices - producers #
(all,c,COM)(all,s,SRC)(all,i,IND)
[V1PUR(c,s,i)+TINY]*p1(c,s,i)=[V1BAS(c,s,i)+V1TAX(c,s,i)]*[p0(c,s)+t1(c,s,i)]
   + sum{m,MAR, V1MAR(c,s,i,m)*[p0dom(m)+a1mar(c,s,i,m)]};                 (86)

Equation E_p2 # Purchasers prices - capital creators # (all,c,COM)(all,s,SRC)
(all,i,IND)[V2PUR(c,s,i)+TINY]*p2(c,s,i)=[V2BAS(c,s,i)+V2TAX(c,s,i)]*[p0(c,s)+t2(c,
s,i)]+sum{m,MAR,V2MAR(c,s,i,m)*[p0dom(m)+a2mar(c,s,i,m)]};                 (87)

Equation E_p3 # Purchasers prices - households # (all,c,COM)(all,s,SRC)
(all,h,HOUS)[V3PUR(c,s,h)+TINY]*p3(c,s,h)=[V3BASHOU(c,s,h)+V3TAXHOU(c,s,h)]*[p0(c,s
)+t3(c,s)]+ sum{m,MAR, V3MARHOU(c,s,h,m)*[p0dom(m)+a3mar(c,s,m)]};         (88)


Equation E_p4 # Zero pure profits in exporting #
(all,c,COM)[V4PUR(c)+TINY]*p4(c)=[V4BAS(c)+V4TAX(c)]*[pe(c)+t4(c)]
    + sum{m,MAR, V4MAR(c,m)*[p0dom(m)+a4mar(c,m)]};                         (89)

Equation E_p5 # Zero pure profits in distribution to government # (all,c,COM)
(all,s,SRC)[V5PUR(c,s)+TINY]*p5(c,s)=[V5BAS(c,s)+V5TAX(c,s)]*[p0(c,s)+t5(c,s)]+
sum{m,MAR,V5MAR(c,s,m)*[p0dom(m)+a5mar(c,s,m)]};                               (90)
```

5.3.1.12 Market-clearing equations for commodities

This condition ensures that demand equals supply both for domestically produced commodities and imported commodities. This condition also holds for primary factors of

---

[82] In each equation, the coefficient TINY (a very small number) is added in the left-hand side to avoid the problem of zero-divide or singularity.

production. As we know, total demand for commodities consists of: 1) demand for intermediate inputs into current production; 2) demand for inputs for fixed capital creation; 3) demand for consumption goods; 4) demand for exports; 5) government demand for goods; 6) demand for margin commodities for the delivery of commodities to current production, capital creation, households, government; and 7) demand for margin commodities for the delivery of exports from producers to domestic ports.

Similarly, demands for imported commodities are also broken down into intermediate input demand, capital creation demand, households' demand and government demand[83]. For a locally–consumed domestic commodity, the market clearing equation is given by equation (91), which shows that the percentage change in the aggregate supply of a locally consumed domestic commodity, $x0dom(c)$ is equal to the sum of ordinary changes of levels of all the non-export demands for the commodity[84]. Similarly, equation E_x0imp (92) computes the percentage changes in the aggregate usage of an imported commodity including the demand for all local users, which is in turn equal to the total supply of the imported good.

Excerpt 14 of TABLO input file

```
Set LOCUSER # Non-export users #
(Interm, Invest, HouseH, GovGE, Stocks, Margins);
Equation E_p0A # Supply = Demand for domestic commodities #(all,c,COM)
0.01*[TINY+DOMSALES(c)]*x0dom(c)=sum{u,LOCUSER,delSale(c,"dom",u)};        (91)
Variable x0imp(c) # Total supplies of imported goods#
Equation E_x0imp # Import volumes # (all,c,COM)
0.01*[TINY+V0IMP(c)]*x0imp(c) =sum {u,LOCUSER,delSale(c,"imp",u)};         (92)
E_x1lab_i # Demand equals supply for labour of each skill #
(all,o,OCC)V1LAB_I(o)*x1lab_i(o)=sum{i,IND,V1LAB(i,o)*x1lab(i,o)};         (93)
E_p1lab # Flexible setting of money wages #
(all,i,IND)(all,o,OCC)p1lab(i,o)=sum{h,HOUS,S3_H(h)*p3toth(h)}+f1lab_io+
             f1lab_o(i)+f1lab_i(o)+f1lab(i,o);                             (94)
```

The market clearing equation for primary factors is also derived in the model, so that the demand for each factor of production is equal to supply. The market clearing equation for labour is given by equation (93) in excerpt 14, which shows the percentage change in the aggregate demand for occupation-specific labour. However, following ORANI, ORANI-G does not contain any theory of labour supply but modellers have the option of setting

[83] No imported goods are exported.
[84] In equation (91), delSale shows the ordinary changes in quantity.

aggregate employment as exogenous, with market clearing real wages determined endogenously or setting the real wage rate exogenously while determining aggregate employment endogenously.

In the standard ORANI-G model, in the short run, all the wage shift variables are considered exogenous. As a result all money wages are indexed to the consumer price index (CPI). It is shown in equation (94) that with all $f1lab$ variables exogenous, nominal wages, $p1lab(i,o)$ are proportional to the consumer price index, $p3tot$. It is also assumed that labour is mobile between industries and the supply of each skill type is elastic. In contrast, in a typical long run closure, the supply of labour is set exogenously, while endogenising the overall wage shifter, $f1lab\_io$ or the real wage rate. However, other wage shifters included in equation (94) are held constant, reflecting the fixed wage relativities.

5.3.1.13 GDP from the income and expenditure sides

In this model, GDP is calculated by both income and expenditure approaches. On the income side, GDP is made up of the nominal aggregation of all factor payments, the value of other costs and all payments for indirect taxes. In level form, this relation can be written as:

$$\text{V0GDPINC} = \text{V1PRIM\_I} + \text{V0TAX\_CSI} \qquad (95)$$

where the coefficient V0GDPINC denotes nominal GDP from the income side, V1PRIM_I describes total primary factor payments inclusive of depreciation in the case of capital and V0TAX_CSI denotes total indirect tax revenue. In equation (95), V1PRIM_I can be written as the sum of total payments to labour, land and capital as follows:

$$\text{V1PRIM\_I} = \text{V1LAB\_IO} + \text{V1CAP\_I} + \text{V1LND\_I} \qquad (96)$$

Aggregate revenue from all indirect taxes, V0TAX_CSI, is made up of total intermediate tax revenue (V1TAX_CSI), total investment tax revenue (V2TAX_CSI), total households' tax revenue (V3TAX_CS), total export tax revenue (V4TAX_CS), total government tax revenue (V5TAX_CS), total tariff revenue (V0TAR_C), and total other cost ticket payments (V1OCT_I). The linearised form of the formula in equation (95) is given in the excerpt 15 by equation (99).

On the other hand, GDP from the expenditure side consists of total household consumption (V3TOT_H), total fiscal investment (V2TOT_I), total government consumption expenditure (V5TOT), total investment in inventories (V6TOT), total export earnings (V4TOT) and the negative value of imports at CIF price. In level form, this relation is given by the following equation:

V0GDPEXP=V3TOT_H + V2TOT_I + V5TOT + V6TOT + V4TOT –V0CIF_C (97)

Equation E_w0gdpexp is the change form of this formula. It divides the nominal percentage change of GDP into price (p0gdpexp) and quantity (x0gdpexp) components. Following ORANI-G and IDC-GEM, for each expenditure component of GDP we define a quantity index and a price index. Equation E_p0gdpexp describes the GDP price index from the expenditure side as a weighted average of final-demand of local prices, less the average change in the border price of imports. Using E_p0gdpexp as the GDP price deflator, the change in real GDP is calculated by equation E_x0gdpexp.

It is an accounting identity that in both level and percentage changes forms, GDP from income side and expenditure sides must be equal:

V0GDPEXP = V0GDPINC and w0gdpexp = w0gdpinc (98)

Excerpt 15 of TABLO input file

```
Variable
w0gdpinc # Nominal GDP from income side #;
x0gdpexp # Real GDP from expenditure side #
p0gdpexp # GDP price index, expenditure side #
w0gdpexp # Nominal GDP from expenditure side #;
Equation
E_w0gdpinc V0GDPINC*w0gdpinc = V1PRIM_I*w1prim_i + 100*delV0tax_csi;      (99)
E_x0gdpexpx0gdpexp=[1/V0GDPEXP]*[V3TOT_H*x3tot_h+V2TOT_I*x2tot_i+V5TOT*x5tot
          +V6TOT*x6tot+V4TOT*x4tot-V0CIF_C*x0cif_c];                     (100)
E_p0gdpexp p0gdpexp=[1/V0GDPEXP]*[V3TOT_H*sum{h,HOUS,S3_H(h)*p3toth(h)}
+ V2TOT_I*p2tot_i+V5TOT*p5tot+V6TOT*p6tot+V4TOT*p4tot
-V0CIF_C*p0cif_c];                                                       (101)
E_w0gdpexp w0gdpexp = x0gdpexp + p0gdpexp                                (102)
```

5.3.1.14 Trade balance and other aggregates

The balance of trade (B) describes the difference between the foreign currency values of imports (M) and exports (E), which is written as:

$$B = E - M \qquad (103)$$

Since zero is a feasible base-period value for balance of trade[85], thus, in the model, the balance of trade is calculated as an ordinary change ($delB$) and to avoid choosing units, this has been expressed as a fraction of GDP i.e. $delB$ = Nominal balance of trade/ {nominal GDP} (104)

The terms of trade, P0TOFT, are given by the ratio of the export price index (local currency) to the import price index (local currency). The real exchange rate, P0REALDEV, is the ratio of the domestic price level to the foreign price level. Excerpt 16 contains the change in balance of trade and measures of percentage changes in the terms of trade ($p0toft$) and the real exchange rate, i.e. real devaluation ($p0realdev$). In excerpt 16, equations (108) to (111) relate to various aggregates of primary factors across all industries. They are the percentage changes in aggregate employment weighted by the wage bill, $employ\_i$, percentage changes in the aggregate capital stock weighted by rental values of capital, $x1cap\_i$, percentage change in the aggregate land stock weighted by land rent, $x1\ln d\_i$, and the average real wage.

Excerpt 16 of TABLO input file

Trade balance index and primary factor aggregates

```
Equation
E_delB100*V0GDPEXP*delB =V4TOT*w4tot-V0CIF_C*w0cif_c-[V4TOT-V0CIF_C]*w0gdpexp;
                                                                          (105)
E_p0toft p0toft = p4tot-p0cif_c                                           (106)
E_p0realdev p0realdev = p0cif_c-p0gdpexp                                  (107)
E_employ_i V1LAB_IO*employ_i = sum{i,IND,V1LAB_O(i)*employ(i)};           (108)

E_x1cap_i V1CAP_I*x1cap_i = sum{i,IND,V1CAP(i)*x1cap(i)}                  (109)
E_x1lnd_i ID01[V1LND_I]*x1lnd_i = sum{i,IND, V1LND(i)*x1lnd(i)};          (110)
E_realwage realwage = p1lab_io -sum {h,HOUS,S3_H(h)* p3toth(h)};          (111)
```

[85] In that case, the percentage change in B might become undefined.

5.4 Income Distribution, Saving and Consumption

This section discusses the distributional aspects of the model. It describes the methods used to model the incomes, expenditures and saving patterns of various agents included in the core CGE model in section 5.3. In so doing, this section closely follows IDC-GEM, a SAM based CGE model for the South African economy developed by Horridge, et al. (1995). As discussed previously, there are four categories of income recipients or institutions in the model viz. firms, household groups, government and the rest of the world, and they receive income from various sources. The primary income distribution originates in the value added of the production process and the endowment of factors of production. In addition to factor income, institutions also receive transfers, for example, transfer payments between households, government, firms and the rest of the world. Institutions dispose of income in some or all of the following ways: consumption, tax payments, saving and other transfer payments.

A simplified representation of the Bangladesh model SAM database is provided in Chapter 6, which captures the mapping of the income payments to factors of production and the subsequent disposal of income by different institutions. The following sub-sections discuss the generation of income of the institutions along with its disposal. AS with the core CGE model equations, inclusion of distributional aspects involves defining a set of variables, coefficients and some behavioral equations in several TABLO excerpts[86].

5.4.1 Gross Operating Surplus

It is assumed that total gross operating surplus (GOS) is derived from aggregate payments to capital (V1CAP_I), aggregate payments to land (V1LND_I), aggregate payments to other cost tickets (V1OCT_I), interest on public debt (WGOVGOS) paid by government[87] and gross operating surplus from the rest of the world (WROWGOS). Thus, in level form the equation is written as:

$$VGOS = V1CAP\_I + V1LND\_I + V1OCT\_I + VROWGOS + VGOVGOS \qquad (112)$$

[86] For a fuller description of all the equations refer to http://www.monash.edu.au/policy/oranig.htm

[87] In this model we follow the interest on public debt as a transfer payment not to households but the gross operating surplus of the enterprise sector.

The corresponding percentage change form is given by equation (115) in the TABLO excerpt 17. In equation (115), all terms (variables) on the right-hand side are determined from our core CGE model in section 5.3 except for the variables, $wrowgos$ (Gross operating surplus from the rest of the world) and $wgovgos$ (interest on public debt). Following IDC-GEM, in the Bangladesh model these variables are set to move proportionally with the nominal GDP. These equations are shown by the following equations (113) and (114) respectively.

E_wgovgos # interest on public debt # wgovgos = w0gdpexp, (113)

E_wrowgos # GOS from rest of the world # wrowgos = w0gdpexp (114)

where $w0gdp\exp$ denotes nominal GDP from the expenditure side.

In apportioning the disposal of total GOS, the first step is to determine total post-tax gross operating surplus (VGOS_POSTTAX) by subtracting corporation tax (VGOSTAX) from total gross operating surplus (VGOS). This relation is given by equation (116) in excerpt no.17. In equation (116), the right-hand side variable, $wgostax$, is corporation tax which is determined by equation (117) in the same TABLO excerpt. In equation (117), the right hand side variable, $fgostax$ represents the percentage rate of corporation tax.

The post-tax gross operating surplus (VGOS_POSTTAX) is then distributed to different institutions such as household groups, government and the rest of the world. It is assumed that distribution to these institutions is proportionate to post-tax gross operating surplus. Thus, household groups receive gross operating surplus, $wgoshous(h)$, which moves in proportion to post-tax gross operating surplus, $wgos\_posttax$. Similarly, government receipts from gross operating surplus, $wgosgov$ are set to move proportionally with post-tax gross operating surplus income. Further, post-tax GOS accruing to the rest of the world, $wgosrow$ also moves proportionally with $wgos\_posttax$. See equations (120), (118) and (119) respectively. Subtracting the transfer payments to households and government that have been paid and the income tax paid by GOS to government, we obtain the gross retained earnings, $wgossave$, which is given by equation (121) in TABLO excerpt 17.

Excerpt 17 of TABLO input file

Work out total GOS income and disposal

```
Coefficient VGOS # Total GOS #;
Equation E_wgos # GOS from income side #
VGOS*wgos=V1CAP_I*w1cap_i+V1LND_I*w1lnd_i+V1OCT_I*w1oct_i+VROWGOS*wrowgos
+VGOVGOS*wgovgos;                                                              (115)
Coefficient VGOS_POSTTAX # VGOS less VGOSTAX #
Equation E_wgos_posttax # VGOS less VGOSTAX #
VGOS_POSTTAX*wgos_posttax = VGOS*wgos - VGOSTAX*wgostax;                      (116)
Equation E_wgostax # Corporation tax #
wgostax=fgostax+wgos;                                                          (117)
Equation E_wgosgov # GOS to government #
wgosgov=wgos_posttax;                                                          (118)
Equation  E_wgosrow # GOS to ROW #
wgosrow=wgos_posttax;                                                          (119)
Equation E_wgoshou # GOS to households #
(All,h,HOUS) wgoshou(h) = wgos_posttax;                                        (120)
Equation E_wgossav # Find VGOSSAVE as residual #
VGOSSAV*wgossav=VGOS*wgos-Sum(h,HOUS,VGOSHOU(h)*wgoshou(h))-VGOSGOV*wgosgov-
VGOSTAX*wgostax-VGOSROW*wgosrow;                                               (121)
```

5.4.2 Households

In this model it is assumed that the main sources of household income are from labour (V1LABINC_O)[88] and capital (VGOSHOU). The coefficient V1LABINC_O, which denotes total wage income of households, is derived by summing all labour income from occupations, V1LABINC (o, h). In Bangladesh, where there is a high prevalence of unincorporated business enterprises, most of the operating surplus is accruing to household capital income from unincorporated businesses. Besides factor income, households also receive income from government in the form of transfer payments (VGOVHOU), transfers from the rest of the world (VROWHOU) and transfers from other households (VHOUHOU). Thus, the total pre-tax household income for each household group can be defined in level form as:

VHOUSINC (h) = VGOSHOU (h) + V1LABINC_O (h) + VHOUSHOU (h) + VGOSHOU (h) + VROWHOU (h) (122)

[88] In Chapter 6, in the Bangladesh model SAM, incomes from different labour categories are distributed across 9 household groups according to an allocation matrix.

The percentage-change form of this equation is provided in the TABLO excerpt 18 by equation (129), which shows that the percentage change in a household group's pre-tax income (per household) is a weighted average of the percentage change in the transfers from GOS, government, the rest of the world and other households plus the percentage change in the group's total labour income. Further, in equation (129), the right-hand variable $wlabinc\_o(h)$, which denotes the percentage change in the total labour income of the household group, is assumed to be a function of the population (household type), $qh(h)$, total wage payments by all industries (classified by occupation), $w1lab\_i(o)$, and total employment rate, $labslack(o)$ which is shown by equation (130). These variables in turn are determined by the following equations:

E_w1lab_i # all-industry labour bills #

(All,o,OCC)(TINY+V1LAB_I(o)*w1lab_i(o)=Sum(i,IND,V1LAB(i,o)

*{p1lab(i,o)+x1lab(i,o)} (123)

where $p1lab(i,o)$ denotes wages by industry and occupation and $x1lab(i,o)$ represents employment by industry and occupation. Both of these variables are determined in our core CGE model in section 5.3.

E_labslack # employment rate # (All, o ,OCC) (TINY_V1LAB_I(o))*w1lab_i(o)= Sum{h,HOUS, V1LABINC(o,h)*w1labinc(o,h)} (124)

E_qh # rule of population growth # (All, h, HOUS) qh (h) = q_h (125)

which shows that the percentage change in the number of households in each household group is a function of percentage change in the total number of households.

The transfer from GOS $wgoshou(h)$ is already determined in the TABLO excerpt 17 by equation (120). The rest of the world's transfers to the household groups, $wrowhou(h)$, and government transfers to households, $wgovhou(h)$ are set to move proportionally with nominal GDP, $w0gdp\exp$. These are written as follows:

E_wgovhou # government transfers to households' #

(All, h, HOUS) wgovhou (h) = w0gdpexp (126)

E_wrowhous # Rest of the world transfers to households'#

(All, h, HOUS) wrowhou (h) = w0gdpexp (127)

In the model, inter-household transfers have been set to move proportionally with post-tax household income which is:

E_whoushous # inter-household transfers # (All, hto, HOUS) (All, hfrom, HOUS) whouhou (hto, hfrom) = wdispinc (hfrom) (128)

where $wdispinc(hfrom)$ denotes the percentage change in the household's disposable income.

Excerpt 18 of TABLO input file

Total households pre-tax income

```
Coefficient (All,h,HOUS) VHOUSINC(h) # pre-tax h'hold income #;
Variable (All,h,HOUS) whousinc(h) # pre-tax h'hold income #;
Equation E_whousinc # Pre-tax household income #
(All,h,HOUS)VHOUSINC(h)*whousinc(h)=VGOSHOU(h)*wgoshou(h)+V1LABINC_O(h)*w1labinc_o(
h)+Sum(hfrom,HOUS,VHOUHOU(h,hfrom)*whouhou(h,hfrom))+VGOVHOU(h)*wgovhou(h)+
VROWHOU(h)*wrowhou(h);                                                      (129)
Equation E_w1labinc # Labour income to households'#
(All,o,OCC)(All,h,HOUS)w1labinc(o,h)=qh(h)+w1lab_i(o)+labslack(o);          (130)
```

Households pay taxes and other transfers to government. After subtracting income tax and transfers from households' total income, we get disposable income as follows:

VDISPINC (h) = VHOUINC (h)-VHOUGOV (h) (131)

The corresponding percentage change equation is given in the TABLO excerpt 19 by equation (133) where variable $whouinc(h)$, which denotes pre-tax household income, is already determined by equation (129). The other right-hand side variable $whougov(h)$, households' payment of income taxes and transfers to government is given as follows:

E_whougov # households to government: income taxes and transfers #

whougov (h) = whousinc (h) + f_inctaxrate (h) + f_inctaxrate_h (132)

where $f\_inctaxrate(h)$ denotes income tax shifter by income and $f\_inctaxrate\_h$ is the overall tax shifters. Normally $f\_inctaxrate\_h$ is considered as exogenous and $whou\sin c(h)$ is determined previously from the model, so, equation (120) determines $whougov(h)$.

Households' outlays consist of: 1) total consumption by households ($w3toth(h)$); 2) inter-household transfers ($whouhou(hto,h)$); 3) households' transfers to government ($whougov(h)$); and 4) households' transfers to rest of the world ($whourow(h)$). After subtracting these outlays from households' disposable income, we obtain households' saving, $whousav(h)$ as a residual. See equation (134) in excerpt 19. In equation (134), the right-hand side variable, $w3toth(h)$ or nominal total household consumption can be linked with households' disposable income by the equation (135), where the variable, $f3toth(h)$ denotes the shift term for consumption by household and $f3toth\_h$ denotes the overall shift term for consumption. The other right-hand side variables of equation (135) are already determined except $whourow(h)$, household transfers to rest of the world. This variable is set to move proportionally with the post-tax household income, $wdispinc(h)$.

Excerpt 19 of TABLO input file

Apportion household expenditure

```
Equation E_wdispinc # Post-tax household income #
(All,h,HOUS)VDISPINC(h)*wdispinc(h)=VHOUSINC(h)*whousinc(h)-
VHOUGOV(h)*whougov(h);                                                    (133)
Equation E_whousav # household saving #
(All,h,HOUS)VHOUSAV(h)*whousav(h)=VHOUSINC(h)*whousinc(h)-V3TOTh(h)*w3toth(h)
-Sum(hto,HOUS,VHOUHOU(hto,h)*whouhou(hto,h))-VHOUGOV(h)*whougov(h)-
VHOUROW(h)*whourow(h);                                                    (134)
Equation E_f3tot # Consumption function #
```

```
(All,h,HOUS)w3toth(h)=f3tot(h)+f3tot_h+wdispinc(h);                    (135)
```

5.4.3 Government

Government receives income from total indirect tax revenues on goods and services (sales taxes on producers, investors, households, exports and government, import duties and other cost ticket payments), direct taxes (income taxes from households and corporate taxes from firms), transfers from gross operating surplus and transfers from the rest of the world. In level form, the income equation can be written as:

VINGOV = V0TAX_CSI + VGOSGOV + VGOSTAX + Σ VHOUGOV (h) + VROWGOV (136)

where VINGOV = Government income and V0TAX_CSI = Total indirect tax revenue.

The corresponding linear form equation is provided by equation (139) in the TABLO excerpt 20. In equation (139), apart from $wrowgov$, (transfers from the rest of the world), all other right–hand side variables are already determined in our model. For example, variable $w0tax\_csi$, which denotes aggregate revenue from all indirect taxes, is determined in our core CGE model by the following equation:

V0TAX_CSI = V1TAX_CSI + V2TAX_CSI + V3TAX_CSH + V4TAX_C + V5TAX_CS + V0TAR_C + V1OCT_I (137)

In the model, transfers from the rest of the world, $wrowgov$, are set to move in proportion to nominal GDP from expenditure side, $w0gdp\exp$, i.e.:

wrowgov = w0gdpexp (138)

Following IDC-GEM, government total expenditures (VGOVEXP) are divided into: 1) government current expenditure; and 2) government capital expenditure. Government current expenditures consist of aggregate nominal value of government consumption demands for goods and services (V5TOT), interest on public debt (VGOVGOS), government transfers to the rest of the world (VGOVROW) and government transfers to households (VGOVHOU). In percentage-change form, the equation for current government expenditure is given in excerpt 20 by equation (140). It shows that the percentage change in government current expenditure is a weighted average of the percentage changes in the various types of government outlays.

Excerpt 20 of TABLO input file

Fill in government income and expenditures

```
Equation E_wincgov # Government income #
VINCGOV*wincgov=V0TAX_CSI*w0tax_csi+VGOSGOV*wgosgov+VGOSTAX*wgostax+Sum(h,HOUS,
VHOUGOV(h)*whougov(h))+VROWGOV*wrowgov;                                   (139)
Equation E_wgovcur # Current government expenditure #
VGOVCUR*wgovcur=V5TOT*w5tot+VGOVGOS*wgovgos+VGOVROW*wgovrow+Sum(h,HOUS,
VGOVHOU(h)*wgovhou(h));                                                   (140)
Equation    E_wgovcap#    Investment     government     expenditure#VGOVCAP*wgovcap=
Sum(i,IND,GOVSHRINV(i)*V2TOT(i)*{s2gov(i)+p2tot(i)+x2tot(i)});            (141)
Equation E_wgovsav # Government saving (Income-Expenditure) #
    VGOVSAV*wgovsav=VINCGOV*wincgov-VGOVEXP*wgovexp;                      (142)
Equation E_realgovsav # Real government (Income-expenditure) #
realgovsav=wgovsav-p0gdpexp;                                              (143)
```

In equation (141), the variables $wgovgos$ and $wgovhou(h)$ are determined previously by the equations (113) and (126) respectively. The variable $wgovrow$, government transfers to the rest of the world, is assumed to move proportionally with nominal GDP from expenditure side. The other right-hand side variable $w5tot$, aggregate nominal value of government demands, is determined in the core CGE model by summing the purchasers' value of government purchases of domestically produced and imported goods and services.

Government capital expenditure is undertaken by public sector corporations. In this model, government investment expenditure, VGOCAP, is obtained by multiplying total capital created for industry i, V2TOT (i), with GOVSHRINV (i), the government share of investment by industry i which is written as:

$$\text{VGOCAP} = \sum_i GOVSHRINV(i) * V2TOT(i) \tag{144}$$

The percentage change form of this equation is given in the TABLO excerpt 20 by equation (141), which states that the percentage change in government investment expenditure is a function of the percentage change in the government share of investment by industry i, $s2gov(i)$, the cost of unit of capital, $p2tot(i)$, and investment by using industry, $x2tot(i)$. The model assumes the government share of investment by industry, $s2gov(i)$, is exogenous.

Government saving, $wgovsav$, is calculated as the difference between government income, $wincgov$, and government current expenditure, $wgov\exp$, which is given as:

VGOVSAV = VINCGOV-VGOVEXP (145)

In percentage change form, the relationship is given in excerpt 20 by equation (142). By deflating the percentage change in nominal government saving, $wgovsav$, by the percentage change in the GDP price deflator, $p0gdp\exp$, we obtain real government saving which is shown in the TABLO excerpt 20 by equation (143).

5.4.4 Rest of the World

In the IDC-GEM model, it is assumed that the rest of the world derives income (VINCROW) from households' transfers (VHOUROW (h)), government transfers (VGOVROW), gross operating surplus transfers (VGOSROW), total local currency import costs (V0CIF_C) and wages paid to the rest of the world (VLABROW_O)[89]. In level form:

VINCROW = ΣVHOUROW (h) + VGOVROW + V0CIF_C + VGOSROW + VLABROW_O (146)

The percentage change form of the equation is given in the TABLO excerpt 21 by equation (147). In equation (147), the right-hand side variables $whourow(h)$, $wgovrow$, $wgosrow$ are determined in sections 5.4.2, 5.4.3 and 5.4.1 respectively. In the model, it is assumed that the wages paid to rest of the world, $wlabrow\_o$, is proportional to total labour bill, $w1lab\_i(o)$. The coefficient, V0CIF_C, total local currency import costs, is obtained by taking the difference between the total basic value of imports (including tariffs) and total tariff revenue.

[89] Due to unavailability of data, and following Hoque (2006), it is assumed that in the Bangladesh model, Bangladesh households, government and gross operating surplus transfers to the rest of the world are zero.

The rest of the world's expenditure (VROWEXP) is obtained by summing total export earnings (V4TOT), the transfers to government (VROWGOV), (as an example, foreign aid), gross operating surplus (VROWGOS), (as an example, dividends and interest from abroad) and total households (VROWHOU) (as an example, remittances from abroad). The percentage change form of this relation is given in the excerpt 21 by equation (148) where the variables, $wrowgov$, $wrowgos$ and $wrowhou(h)$ are already determined in the previous sections 5.4.3, 5.4.1 and 5.4.2 by equations (138), (114) and (127) respectively. The coefficient V4TOT which represents total export earnings is determined in the core CGE model by summing purchasers' values of export commodities, V4PUR (c). The rest of the world's saving (VROWSAV) is the difference between the ROW's income (VINCROW) and expenditure (VROWEXP) which can be written as:

VROWSAV = VINCROW- VROWEXP. The percentage change form is given by equation (149).

Excerpt 21 of TABLO input file

Find Rest of the world income and expenditure

```
Equation E_wincrow # Total ROW income #
VINCROW*wincrow=Sum(h,HOU,VHOUROW(h)*whourow(h))+VGOVROW*wgovrow+
V0CIF_C*w0cif_c+VGOSROW*wgosrow+VLABROW_O*wlabrow_o;                (147)
Equation E_wrowexp # Total ROW expenditure #
VROWEXP*wrowexp=V4TOT*w4tot+VROWGOV*wrowgov+VROWGOS*wrowgos
           +Sum(h,HOUS,VROWHOU(h)*wrowhou(h));                      (148)
Equation E_wrowsav # ROW (Income-Expenditure) #
      VROWSAV*wrowsav=VINCROW*wincrow-VROWEXP*wrowexp;              (149)
```

5.5 Endogenising Poverty Lines

The main focus of our study is the poverty and inequality impacts of trade shocks. Therefore, along with income and expenditure patterns, the poverty line needs to be incorporated with the core CGE model. Our model follows the approach of Decaluwe *et al.*, (1999) and Decaluwe, Savard, and Thorbecke (2006) in endogenising a poverty line within a CGE model. The monetary poverty line is derived from a basket of goods that reflects basic needs:

$$\text{Monetary poverty line} = \sum W_{com}^{p} P_{qcom} \qquad (150)$$

where $\sum W^{p}_{com}$ represents basic-need quantities of commodities and P_{qcom} denotes their respective prices.

Commodity prices are endogenously determined within the model, and so the nominal value of this basket, i.e. the poverty line is also determined within the model. As prices rise or fall after shocks, the monetary poverty line also rises or falls. However, the Bangladesh model adopts a slightly different approach to Decaluwe *et al.*, (1999). Instead of endogenising the monetary poverty line, following Naranpanawa (2005), the model endogenises changes of the monetary poverty line. A price index has been defined in the model that reflects changes of prices of commodities that are basic needs. For the base period (2000), the poverty lines for rural and urban areas are those estimated by the Bangladesh Bureau of Statistics. The new poverty lines are then estimated by adjusting the base period poverty lines by the percentage changes in prices generated by the model. Excerpt 22 shows the relevant sets, variables, coefficient and equations for poverty lines[90] for both rural and urban areas. Equation E_pliner shows percentage changes in poverty lines for rural household groups while equation E_pline_phr shows the percentage change in the aggregate poverty line for all rural groups. Equation (153) and (154) show corresponding changes in poverty lines for urban areas.

Excerpt 22 of TABLO input file

Incorporation of poverty lines

```
Set
PRCOM # commodities used in computing rural poverty line # (wheat, potatoCulti,
VegCulti,FruitCulti,Milkfat,poultrymeat,Fish,Riceflorbran,EdiNoedoil,SugGuMolass,Te
aproduct,Millcloth,Medicines,Electwater);!prc!
PRHG # Household groups used in computing poverty line #
(LandlessHH,MargfarmHH,smallfarmHH,largefarmHH,NonagriculHH,smallfarmHH,largefarmHH
,NonagriculHH);!prh!
Subset PRHG is subset of HOUS
Subset PRCOM is subset of COM
Variable
(all,prh,PRHG)pliner(prh) # Poverty line for rural #
Equation E_pliner # Poverty line for rural #
(all,prh,PRHG)V3TOTh(prh)*pliner(prh)=sum{prc,PRCOM,sum{s,SRC,V3PUR(prc,s,prh)
 *p3(prc,s,prh)}};                                                        (151)
Coefficient
V3TOT_phr;
Formula
```

[90] This part of the TABLO code closely follows Naranpanawa (2005).

```
V3TOT_phr=sum{prh,PRHG,V3TOTh(prh)};
Variable
pline_phr;
Equation
E_pline_phr # Aggregate poverty line #
V3TOT_phr*pline_phr=sum{prh,PRHG,V3TOTh(prh)*pliner(prh)};                    (152)
Set
PUCOM#(Commodities    used    in    computing    urban    poverty    line)#(wheat,
potatoCulti,VegCulti,FruitCulti,Milkfat,poultrymeat,Fish,Riceflorbran,EdiNoedoil,Su
gGuMolass,Teaproduct,Millcloth,Medicines,Electwater);!puc!
PUHG # Household groups used in computing poverty line) #
(IlliterateHH,LoweduHH,MediumeduHH);!puh!
Subset PUHG is subset of HOUS
Subset PUCOM is subset of COM
Variable
(all,puh,PUHG)plineu(puh) # Poverty line for urban #
Equation
E_plineu(all,puh,PUHG)V3TOTh(puh)*plineu(puh)=sum{puc,PUCOM,sum{s,SRC,V3PUR(puc,s,p
uh)*p3(puc,s,puh)}};                                                           (153)
Coefficient
V3TOT_phu;
Formula
V3TOT_phu=sum{puh,PUHG,V3TOTh(puh)};
Variable
pline_phu;
Equation
E_pline_phu # Aggregate poverty line #
V3TOT_phu*pline_phu=sum{puh,PUHG,V3TOTh(puh)*plineu(puh)};                    (154)
```

5.6 Closing and Checking the Model

The Bangladesh model described above has more variables than equations. Thus to close the model, we need to choose which variables are to be endogenous and which exogenous[91]. In particular, a solution of the model requires that the number of endogenous variables equals the number of equations. There is no specific rule to make a sensible closure, as it depends on the nature or availability of data, objectives of research and on the circumstances of the application. Following Horridge (2001a) and Horridge (2006), we present in Table 5.2 a common specification for a standard closure of the Bangladesh model. In making the closure, we identify the variables as endogenous that are explained by equations in the TABLO input file. Variables not explained by any equation are considered exogenous variables. In Table

[91] In GEMPACK, a choice of which variables are to be exogenous is called a closure (Horridge, 2006).

5.2, the first column shows the dimension, while the second column gives the variable count in the entire model. The third column indicates the number of equations that seems to explain those variables[92]. In our model, we have 117 scalar variables but only 100 equations to explain these variables. Thus, as shown in the fourth column, we have 17 variables that have no matching equations. Termed as exogenous variables, these are itemised in the fifth column.

Having undertaken this procedure for each of the dimensions presented in the model, we determine the probable standard closure for the model. For a ORANI-G type model, the following variables are often chosen to be exogenous (Horridge, 2006): technical change variables mostly beginning with '*a*', shift variables beginning with '*f*', industry capital stock: *x1cap*, land endowment: *x1lnd*, foreign prices: *pf0cif*, inventory to sales ratio: *fx6*, and the exchange rate: *phi,* which act as a *numeraire*[93]. Although column 5 defines a valid closure for the Bangladesh model, consideration of our research objectives, suggests a slightly different closure, with some variables being swapped between the endogenous and exogenous lists[94].

[92] In the TABLO input file, most equations are named after variables which make it easy to select exogenous variables.

[93] Like other CGE models, price variables in ORANI-G appear as price ratios. Thus, to determine the overall price level/absolute price level, there must be at least one exogenous variable measured in local currency units which is termed the numeraire. Taylor and Black *(*1974*)* used the money wage rate as a numeraire in their model.

[94] A detailed description of model closures for the Bangladesh model is provided in Chapter 7.

Table 5.2: Tally of variables and equations of the Bangladesh model (Standard closure)

Dimension	Variable count	Equation count	Exogenous var. count	Unexplained variables
Scalar	117	100	17	Capslack, f1lab_io, f1tax_csi, f2tax_csi, f3tax_cs, f3tot_h, f4p_ntrad, f4q_ntrad, f4tax_ntrad, f4tax_trad, f5tax_cs, f5tot2, fgostax, f_inctaxrate_h, invslack, phi, q_h
IND	39	25	14	a1cap, a1lab_o, a1lnd, a1oct, a1prim, a1tot, a2tot, delPTXRATE, f1lab_o, f1oct, s2gov, x1cap, x1lnd, x2tot
COM	18	13	5	f0tax_s, f4p, f4q, pf0cif, t0imp
OCC	5	4	1	f1lab_i
HOUS	17	15	2	f_inctaxrate, w3luxh
COM*IND	8	6	2	a1_s, a2_s
COM*SRC	11	8	3	a3, f5, fx6
COM*HOUS	7	6	1	a3_s
COM*MAR	2	1	1	a4mar
IND*OCC	3	2	1	f1lab
COM*SRC*IND	10	8	2	a1 a2
COM*SRC*MAR	3	1	2	a3mar, a5mar
COM*SRC*IND*MAR	4	2	2	a1mar, a2mar
EXPMAC	1	1	0	
CONTFAC	1	1	0	
CONTINC	1	1	0	
PRHG	1	1	0	
PUHG	1	1	0	
COM*FANCAT	1	1	0	
COM*DESTPLUS	1	1	0	
OCC*HOUS	1	1	0	
HOUS*HOUS	1	1	0	
COM*SRC*DEST	1	1	0	
COM*SRC*HOUS	3	3	0	
COM*SRC*HOUS*MAR	1	1	0	
Total	258	205	53	

It is a usual practice to perform a number of tests to check for any computational errors in the model results. In ORANI-G, these tests are: 1) the price homogeneity test; and 2) the real homogeneity test. The price homogeneity test ensures that there is no money illusion in the model, i.e. a uniform increases in all prices will keep quantity variables unchanged. To implement this test, all exogenous variables are set equal to zero except for the variable, *phi,* the exchange rate[95]. That is satisfied if, with money wages fully indexed, a 1 per cent increase in the exchange rate produces an exactly 1 per cent increase in all domestic prices and nominal flows, with all real endogenous variables unchanged. In contrast, the real homogeneity test ensures constant returns to scale in the production functions in the model. The test is satisfied if, keeping all nominal exogenous variables constant, a uniform increase in all real exogenous variables leads to the same proportionate change in all real endogenous variables, leaving relative prices constant.

Along with these homogeneity tests, modellers sometimes use another test to check that a change in GDP on the income side is the same as one in the expenditure side. Any error in an equation or an unbalanced data set can violate this identity. We perform all the above tests for the Bangladesh model, and it passes all tests.

5.7 Solution Approaches and Using GEMPACK to Solve the Bangladesh Model

Johansen (1960) first developed the solution strategy for economy-wide general equilibrium models. The Johansen approach takes the logarithmic derivates of a nonlinear general equilibrium specification and then derives a linear approximation of the non linear model that can be solved by matrix inversion (Wobst, 2001). Another approach was developed by (Scarf, 1967, 1973). It involves a fixed-point algorithm capable of solving a nonlinear CGE equation system without linear approximation. Scarf (1967)'s solution algorithm[96] works directly with excess demand equations, which is consistent with Arrow-Debreu general equilibrium theory. In the 1970s, two other approaches were developed to solve non linear general equilibrium models. One is based on a tatonnement process where prices in each sector are adjusted to that sector's excess demand. The other method used the matrix of the first partial derivatives of excess demand functions. Dervis *et al.*, (1982) termed this approach "Jacobian algorithms", as their performance is sensitive to the determinant of the matrix of numerical derivatives, the Jacobian.

The ORANI model uses a Johansen-style solution that relies on a matrix inversion and a matrix multiplication (Dixon *et al.*, 1997, p. 199). In the Johansen method, all of the non-linear equations of a model are approximated by a set of simultaneous equations that are

---

[95] The consumer price index (p3tot) also can be used as the numeraire.
[96] See Mitra-Kahn (2008) for details of Scarf's algorithm method.

linear in percentage changes in the variables. This approach has the flexibility of facilitating changes in the structure of the model and in selection of exogenous variables. However, one shortcoming of this method is that it creates linearisation errors, especially for changes in the exogenous variables. To eliminate these linearisation errors, Dixon *et al.*, (1997) developed Euler's method which is in fact an extension to the Johansen method, as in this method multi-step solutions are obtained by solving the equations several times. The following subsections describe the Johansen solution method and the extended Johansen method.

5.7.1 Johansen Solution[97]

Suppose a class of general equilibrium models in which an equilibrium is a vector, V of length n satisfying the following system of equations:

$$F(V) = 0 \tag{1}$$

where F is a vector of m differentiable functions. It is assumed that the number of variables n is greater than the number of equations m. Thus, $n - m$ variables must be set exogenous to close the model and to solve for the remaining m, the endogenous variables. Johansen's linearised approach assumes that there is an initial solution to the system i.e. $F(V^0) = 0$[98]. By assuming V_1 is a vector of m endogenous variable, and V_2 is a vector of n - m exogenous variables, equation (1) can be written as:

$$F(V_1^0 V_2^0) = 0 \tag{2}$$

By taking the total differential of equation (2),

$$F_{v1}(V_1^0, V_2^0)dV_1 + F_{v2}(V_1^0, V_2^0)dV_2 = 0 \tag{3}$$

[97] For detailed discussion of the Johansen approach, see Dixon *et al.*, (1992, pp. 73-81).
[98] Usually, the initial solution (initial values of prices and quantities, tariffs etc.) is taken from input-output data.

where F_{v1} and F_{v2} are the matrices of partial derivatives of F with respect to V_1 and V_2 evaluated at (V_1^0, V_2^0). By considering dV_1 and dV_2 as small percentage change and terming them as v_1 and v_2 we obtain the following linearised system of equation[99]

$$F_{v1}\left(V_1^0, V_2^0\right)v_1 + F_{v2}\left(V_1^0, V_2^0\right)v_2 = 0 \tag{4}$$

By using the standard technique of linear algebra, we obtain the solution of vector v_1 as

$$v_1 = -F_{v1}\left(V_1^0, V_2^0\right)^{-1} F_{v2}\left(V_1^0, V_2^0\right)v2 \tag{5}$$

This is known as the Johansen solution of the simulation. However, since the levels equations of this model are usually nonlinear, the Johansen approach provides only an approximation of the corresponding solution of the levels equations of the model (Harrison and Pearson, 1996). According to Dixon *et al.*, (1997, p. 199), such approximation errors can be eliminated by using a multi-step Johansen solution technique or the Euler approach.

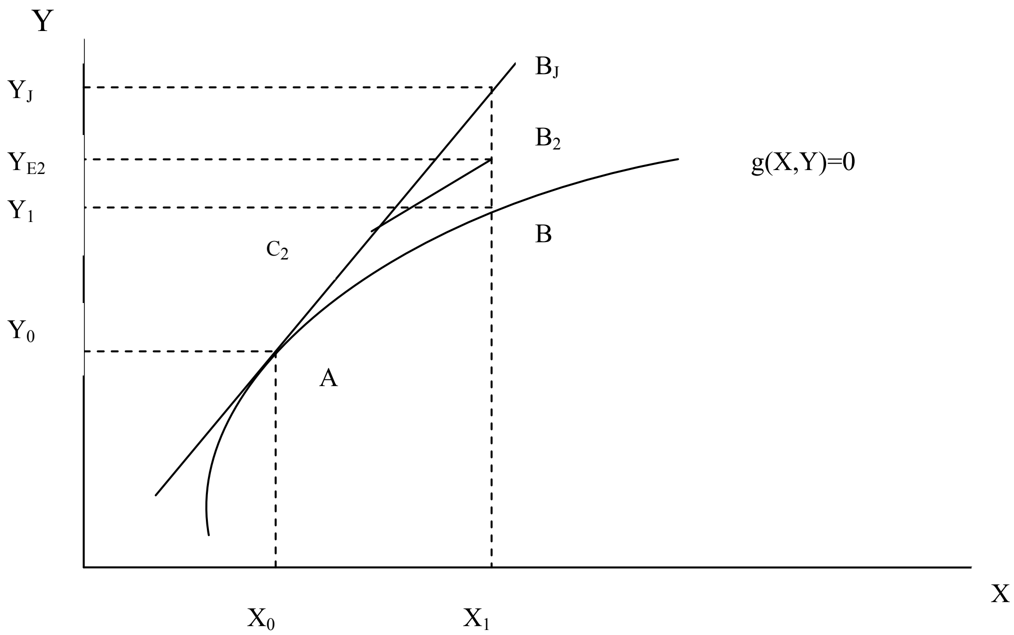
5.7.2 Euler's Approach

Euler's approach involves breaking each of the shocks up into several steps. At each step, the linearised equations are solved for each small shock. After each step, the data, cost and sales shares and elasticities are recalculated to take into account the changes from the earlier shock. Increasing accuracy of solution depends on an increasing number of steps in a multi-step solution.

Figure 5.4 illustrates the technique where the initial values of exogenous variable X and endogenous variable Y are X_0 and Y_0 at the point A. Now suppose X is shocked from value of X_0 to value X_1. The ideal solution will follow the curve g (X, Y) =0. In a Johansen method (i.e. one step Euler solution) we follow the straight line, which is a tangent to the curve at point A and get a solution at Y_J. In fact, at each step, the direction to move is the tangent to the curve at the appropriate point. As an example, in a two step Euler solution, we follow a path of two straight line segments and approach at point C_2 and finally reach point B_2, to obtain a solution at Y_{E2}.

[99] As $v_1 = 100 * dV_1 / V_1$ and $v_2 = 100 * dV_2 / V_2$.

Figure 5.4: Multi-step solution using Euler's method



Source: Harrison and Pearson (1996)

For a four step Euler solution, there will be a path of four line segments. In a similar way, as the number of steps approach infinity, the width of the line segments tends to zero and the results will approach the exact solution. To obtain an accurate solution, GEMPACK software provides the following solution methods: Johansen, Euler, Gragg[100] or the mid point method with various steps. As an example, the modeller can choose Euler's and Gragg's method with 4-steps, 8-steps, 16-steps or 32-steps to improve the solution.

5.7.3 Computing Solutions for the Bangladesh Model Using GEMPACK

This study uses GEMPACK (General Equilibrium Model Package) (Harrison and Pearson, 1996) WinGEM[101] version of 9.0 to solve the model developed in the previous sections. Starting from an algebraic representation of the equations of the model, GEMPACK provides software for calculating the solutions of the model[102]. In implementing the model by GEMPACK, the first task is to specify the model's equations using the TABLO language contained in the TABLO input file, MODEL.TAB (Figure 5.5). Since the Bangladesh model

[100] In breaking the shocks into N parts, Euler's method does N separate calculations, while Gragg's method does N+1. In this respect, Gragg's method is more accurate than Euler's method in calculating the direction in which to move at each step (Harrison and Pearson, 1996).
[101] WinGEM is the Windows version of GEMPACK.
[102] Detailed discussion about GEMPACK development and use can be found in Pearson (1986), Codsi and Pearson (1988).

is a large model containing 86 industries, 94 commodities, 9 households, 4 labour groups and 6 margin commodities, an efficient solution requires the size of the model to be reduced through condensation. Condensation reduces the size of the system of equations by substitution and elimination of variables (Harrison and Pearson, 1996)[103]. In Figure 5.5, the MODEL.STI file contains information about the variables for substitution and elimination.

Next, in running the model by the TABLO-generated program method[104], the GEMPACK program TABLO is used to convert the algebraic expression of the equations into a FORTRAN program specific to the model by using TAB and STI files. MODEL.FOR (Figure 5.5) contains the model-specific code needed for a solution program. TABLO also produces two auxiliary files, MODEL.AXS and MODEL.AXT containing lists of variable names and the same sort of data. The FORTRAN program is then compiled and linked to a library of GEMPACK subroutines to produce an executable program MODEL.EXE, which then is used to solve the model.

In the next step, MODEL.EXE computes simulation results (Figure 5.6) in conjunction with two auxiliary files, MODEL.AXS, MODEL.AXT, a data file containing input-output data and behavioural parameters and a command file, MODEL.CMF. In the CMF file there is specification of the exogenous variables, the names of input-output files, detailed solution procedures and the shocks to some exogenous variables[105]. Using these inputs, MODEL.EXE computes a solution file (SL4) where the effects on endogenous variables are shown in the forms of percentage changes from the initial solution. It is expressed in binary format which is viewed by Windows program ViewSOL. Figure 5.6 provides a diagrammatic representation of how the GEMPACK program computes simulation results.

[103] More details about model condensation can be found in Dixon *et al.*, (1997, pp. 207-210).
[104] The TABLO-generated program can result in much quicker simulations for large models whereas the GEMPACK program GEMSIM is appropriate for small size models.
[105] The shocks are numerical values specifying how much the exogenous variables will change.

Figure 5.5: From TAB to EXE file

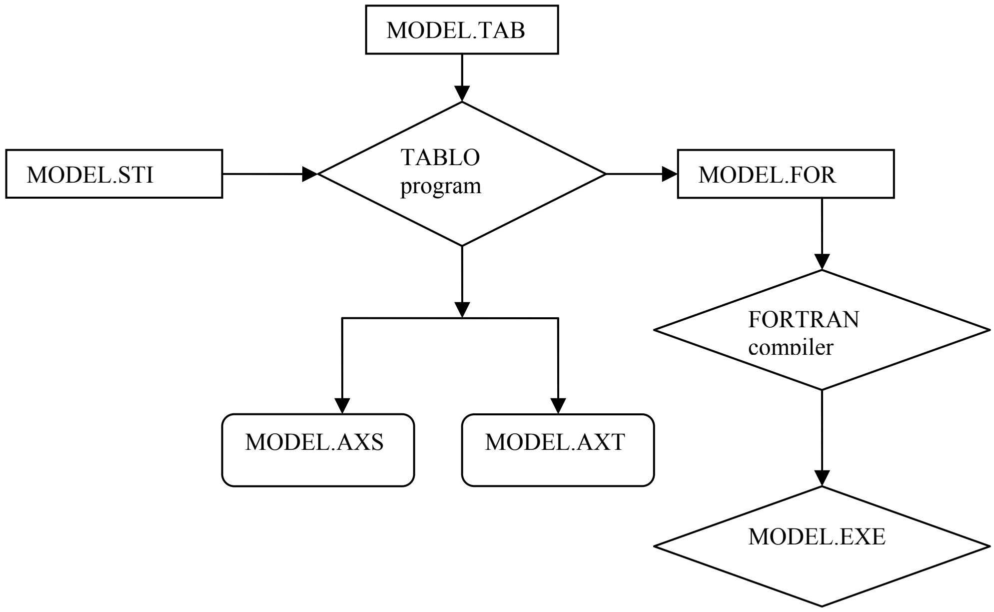
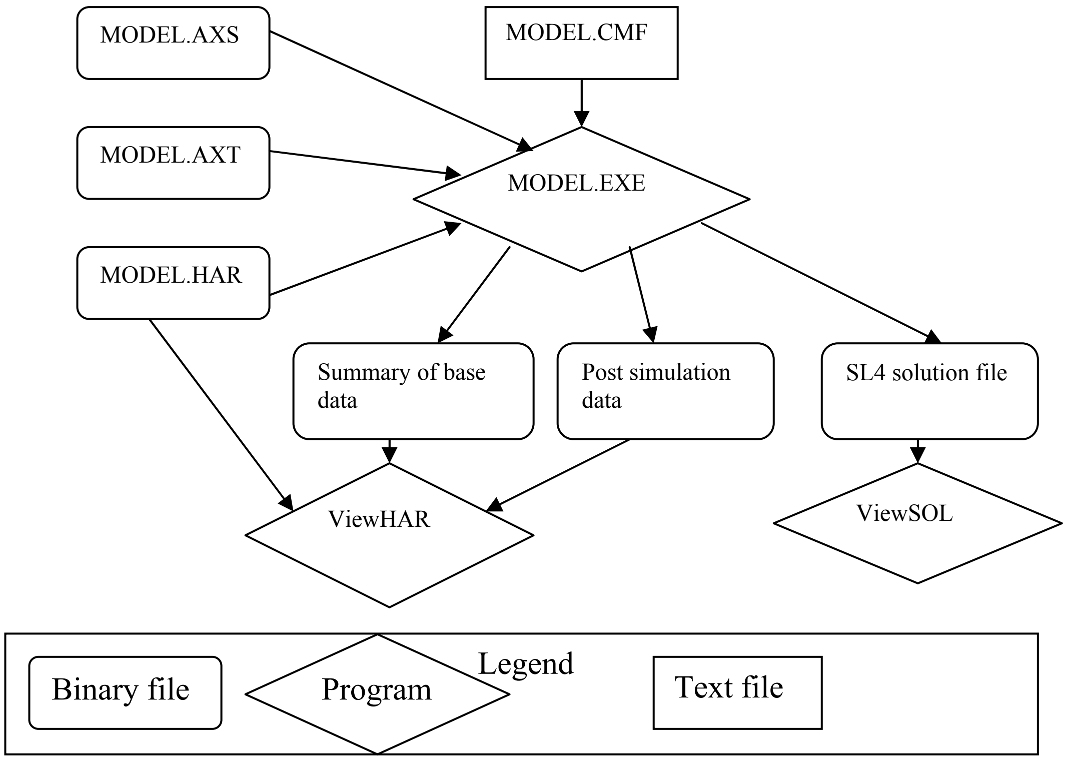


Figure 5.6: From EXE file to model solution



Source: Horridge (2006)

5.8 Conclusions

This chapter has introduced the main features of the theoretical specification of the Bangladesh model developed in this study around the TABLO input file. The core CGE section describes the basic structure of any typical CGE model, including production and value added generation, determination of commodity and factor prices, zero-pure profit conditions, market-clearing conditions and various aggregates such as aggregate employment and the balance of trade. The Core CGE section is followed by the income and expenditure equations of various agents in the economy. The income equations describe the distribution of factor income to institutions and the expenditure equations represent the budget constraints. This chapter also discusses the standard closures, the solution algorithms and the model solution procedures using GEMPACK. The next chapter will discuss the data requirements of the model and the procedures of data base construction needed to implement the model.

Chapter 6

The Database

6.1 Introduction

The main objective of this study is to analyse the effects of trade policies on income distribution and poverty in the Bangladesh economy. In addition, this study tries to gain insight into how a reduction in tariffs affects various macro economic indicators, industries output and employment and households' welfare level. To achieve these objectives, a comparative-static applied general equilibrium model has been designed which is drawn from the earlier work of Johansen (1960). Models of this type are linear in percentage changes of variables. To compute the general equilibrium rates of changes in the endogenous variables, requires data on various costs and revenue shares, sales shares of different production activities; and the product expenditure shares of the different agents in the economy. These are the model coefficients. In this chapter, the data requirements of the model and the procedures for base data construction are discussed. The database for the Bangladesh model consists of two main parts:

a) input-output database to compute base year sales, revenue, cost shares and the various elasticity parameters; and,

b) a SAM (social accounting matrix) centered around an Input-Output table to implement the income distribution part of the model.

Section 6.2 describes the basic input-output data required for the Bangladesh model whereas section 6.3 gives a brief description of the sources of the base period data used in the Bangladesh model. Section 6.4 explains the compilation of the Bangladesh model input-output database. Procedures for assembling elasticity estimates are discussed in section 6.5. Section 6.6 describes the compilation of income distribution data which allows the basic input-output database to be expanded to include the mapping of the factor income distribution from the structure of production, which in turn is distributed to various household groups.

Section 6.8 discusses the household income distribution pattern. Section 6.9 provides some concluding remarks.

6.2 Basic Data Requirements for the Model

6.2.1 The Bangladesh Model Input-Output Database

Figure 6.1 is a schematic representation of the model's input output database[106]. The figure divides the structure of the Bangladesh input-output database into three parts: an absorption matrix, a production matrix and a trade tax matrix. The column headings in the absorption matrix identify six types of demanders in the economy:

1) domestic producers divided into I industries;

2) investors divided into I industries;

3) households divided into H household groups;

4) an aggregate foreign purchaser of exports;

5) government demands; and

6) changes in inventories.

The rows show the sources of purchases made by the agents of each column. As an example, the first row in the absorption matrix, sub matrices (V1BAS, V2BAS,…, V6BAS) shows flows in a specific year of commodities to the demanders. Each of these sub matrices has CxS rows, which implies that each of the commodity types (c) identified in the model can be obtained (s) locally or imported from overseas. In this model, C is 94 and S is 2. Both domestic and imported commodities are absorbed as inputs to current production, as fixed capital formation, as consumption by households and government, are exported, or are added to or subtracted from inventories.

[106] This figure has been adopted from Horridge (2006). It resembles the original ORANI specification and is designed as an introduction to the ORANI methodology.

Figure 6.1: The Bangladesh model input-output database

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Households	Export	Government	Stocks
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →
Basic Flows domestic	↑ CxS ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	↑ CxSxM ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	
Taxes	↑ CxS ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	
Labour	↑ O ↓	V1LAB					
Capital	↑ 1 ↓	V1CAP					
Land	↑ 1 ↓	V1LND					
Other Costs	↑ 1 ↓	V1OCT					
Production Taxes	↑ 1 ↓	V1PTX					

C = Number of Commodities

I = Number of Industries

S = 2: Domestic, Imported

O = Number of Occupation Types

M = Number of Commodities used as Margins

H = Number of Household Types

Note: Export column is for domestic goods only

	Make Matrix	Total
Size	← I →	
↑ C ↓	MAKE	
Total		

	Import Duty
Size	← 1 →
↑ C ↓	V0TAR

However, only domestically produced goods appear in the export column. All the direct flows are valued at basic prices.[107]

The second row (V1MAR,…, V5MAR) shows the flows of domestically produced commodities used as margins to facilitate the flows of commodities in the matrices V1BAS, V2BAS,……,V6BAS. ORANI-G assumes that all margin flows are domestically produced. In this model, the commodities used as margins are wholesale trade, retail trade, air transport, water transport, land transport and railway transport. Each of the margin matrices corresponds to CxSxM rows which imply the flows of domestically produced commodities used as margins (M) to facilitate the flows of C commodities from S sources. Here it is also assumed that all the margin flows are valued at basic prices. Since inventories (column 6) comprises mainly of unsold products, it is assumed that they do not bear margins (Tran, 2007).

The tax matrices in the third row (V1TAX, V2TAX,…, V5TAX) show the taxes on commodities as consumed by producers, investors, households, the government and the export sectors. Like margins, here it is also assumed that there are no sales taxes on inventories.

Since current production needs primary factors (such as land, labour and capital) in addition to intermediate inputs, this model uses three types of primary factors: agricultural land, fixed capital and labour (which is divided into 4 occupational skill types[108]). The rows of V1LAB, V1CAP, V1LND show the primary factors usage for each industry in the first column of the absorption matrix. In particular, matrix V1LAB represents the wages according to different occupational categories; V1CAP shows the rental value of each industry's fixed capital; and V1LND shows the rental value of agricultural land used by each industry. As well as purchasing factor inputs, industries have to pay production taxes and other costs tickets (represented in the absorption matrix as V1PTX and V1OCT). Production taxes include output taxes or subsidies that are not user-specific. The other cost category includes various miscellaneous taxes on firms such as municipal taxes, charges and the costs of holding inventories (Horridge, 2006).

[107] 'The basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output, minus any tax payable, and plus any subsidy receivable on that unit. It excludes any transport charges invoiced separately by the producers' (United Nations, 1999).

[108] Occupational types will be discussed later in this chapter.

The final two matrices are the MAKE (joint production) matrix and the import duty matrix. The joint production matrix (MAKE) shows the value of output of each commodity by each industry.

In this model there are 86 industries and 94 commodities[109]. In principle, each industry can produce any of the commodity types. However, this model does not meet the one-to-one correspondence between commodities and industries. As a result, the joint production matrix is not diagonal. The import duty matrix contains the import duty paid on each commodity imported by each industry. ORANI-G assumes that tariff rates on imports vary by commodity but not by user.

Now by summing up all the matrices in the producers' column in the absorption matrix we obtain the base-period value of output for industries (j) in basic prices. This can also be obtained by adding the value of commodities produced by the industries or by adding the columns of the joint product matrix. In the same way, by adding the usage of commodities (i), i.e. the sum across the ith rows of V1BAS, V2BAS,…., V6BAS (direct use) and the margin matrices V1MAR, V2MAR, ….,V5MAR we can get the value of commodities produced by industries, which will also be equal to the rows of joint productions matrix. This corresponds to two basic condition of database balancing, vis-à-vis:

1) The value of output by each industry must equal the total of production costs, i.e. the column sums of the MAKE matrix must equal the sum of the first producer's column of Figure 6.1.

2) The output of domestically produced commodities must equal the total of the demands for them, i.e. the row sums of the MAKE matrix must equal the row sums of the BAS and MAR rows of Figure 6.1. This corresponds to the model's commodity market clearing condition.

[109] Industry and commodity classification of I-O table 2000 for Bangladesh has been provided in Appendix Table C 6.1

6.2.2 Parameters and Elasticities

In addition to input-output data, the following elasticities and other parameters are required to implement the model outlined in Chapter Five:

1) The Armington[110] elasticities between domestic and imported use of commodities for intermediate inputs (SIGMA1);

2) The Armington elasticities between the domestic and imported use of commodities for investment (SIGMA2);

3) The Armington elasticities between the domestic and imported use of commodities by households (SIGMA3);

4) Elasticities of substitution between primary factors (SIGMA1PRIM);

5) Elasticities of substitution between different skilled types of labour (SIGMA1LAB);

6) Export demand elasticities (EXP_ELAST; EXP_ELAST_NT);

7) The household expenditure elasticities for each product in the economy (EPS); and,

8) The Frisch parameters[111] (FRISCH).

[110] The concept of Armington elasticity commonly used in CGE analysis originated from the idea of Armington (1969) who first emphasised the differentiation of products with respect to their origin and the imperfect substitution in demand between imports and domestic supply.

[111] The Frisch parameter shows the elasticity of the marginal utility of the total expenditure with respect to total expenditure.

6.3 Data Sources

6.3.1 The Input-Output Table for Bangladesh for the Year 2000

The Input-Output (I-O) Table 2000 for Bangladesh[112] provides the main source for the Bangladesh model absorption matrix. An input-output table is a means of presenting a detailed analysis of the process of production and the use of goods and services. In national income accounting, there are two kinds of input-output tables:

1) Supply and Use tables; and

2) Symmetric input-output tables.

The Symmetric input-output tables are often termed as 'Leontief-type' input-output tables, whereas the Supply and Use tables are often called rectangular input-output tables.

In constructing an I-O framework for 2000, Bangladesh followed the System of National Accounts (SNA, 1993) recommendations. In line with SNA (1993), non-symmetric Supply and Use tables were constructed where production activities were distinguished from commodities. In the 1993 Bangladesh I-O table[113] there were 79 activities and there was one-to-one correspondence between activities and commodities, but, in the 2000 I-O table new activities and commodities were added, resulting in the number of commodities (94) exceeding the number of activities (86)[114]. For example, Information Technology and E-Communication (ITC), which was included in the 1993 I-O table's communication sector, was separated into an additional activity in the I-O table 2000. Similarly, trading activities were divided into 'Retail trade' and 'Wholesale trade', and the 'Transport sector' was divided into air, water, land and rail.

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[112] I-O Table 2000 was prepared by the General Economic Division, and the Sustainable Human Development Unit, Planning Commission, Bangladesh.

[113] The Input-Output table for the Bangladesh economy 1993-94 was prepared by The General Economic Division, Planning Commission, Government of the People's Republic of Bangladesh and the Bangladesh Institute of Development Studies (BIDS).

[114] In the I-O table 2000, one industry supplies more than one commodity and a commodity is supplied by more than one industry. For example, the Livestock and rearing industry produces 5 commodities (such as meat, milk and fat, animal draft, manure, hides and skin), the poultry industry produces 2 commodities (such as meat and poultry eggs). Similarly, the commodity 'waste' is produced by 12 industries as by product. Despite the presence of these by-products the supply matrix appears almost a diagonal matrix, meaning most of the industries supply one commodity, where the shares of by-products of those industries are almost negligible (GOB, 2003b).

The schematic representation of the Supply and Use tables of the I-O table 2000 for Bangladesh is provided in Tables 6.1 and 6.2 respectively. The Supply table contains a matrix of domestic production broken down by 94 commodities and 86 industries and a vector of imported goods and services (Table 6.1). Total supply was first valued at producers' prices[115] and then it was transferred into purchasers' prices by adding a vector of trade and transport margins. This has been done to match the figure of total supply with that of total demand in the Use table (Table 6.2).

Table 6.1: Domestic Supply table at purchasers' prices

	Industries 1,2,………,86	Imports	Total supply at producers' values	Trade and transport margins	Total supply at purchasers' values
Products 1 2 3 . . . 94	Domestic supply matrix product by industry (producers' value)				
	Total industry output (producers' values)				

The Use Table (Table 6.2) in purchasers' prices contains a matrix of intermediate consumption of domestic and imported goods and services by 94 commodities and 86 industries. There are columns containing final consumption of households, government final consumption expenditure, gross fixed capital formation, changes in stocks and exports of goods and services. The value added block includes the following rows (according to industry breakdown): compensation of employees, gross operating surplus (including gross mixed incomes) and indirect taxes. Taxes on imports and taxes on domestic products by 94 commodities are shown in Table 6.3 and 6.4 respectively. Table 6.3 shows taxes on imports including custom duty, VAT, supplementary duty, advance income tax, license fee, development surcharge, fine and penalty whereas taxes on domestic products include excise

[115] Producers' prices are equal to basic prices plus indirect taxes and subsidies on domestic products and import duties and taxes on imports whereas purchasers' prices are equal to producers' prices plus trade and transport margins.

tax, VAT in product stage, VAT in trade item, VAT in service, supplementary duty on manufacturing and supplementary duty on service (Table 6.4).

Table 6.2: Use Table at purchasers' prices

	Industries 1,2…86	Public consumption	Private consumption	Export goods	Export service	Capital formation	Stock change	Total uses at purchasers price
Products 1 . . . 94	Intermediate part of Use table; products by industry/ imported 94x86							
Input use								
Value added components by industry								
Gross output								

Table 6.3: Import duties by commodity

Com	Import value	Custom duty	VAT	Supp. duty	Advanced income tax	Licence fee	Dev. sur-charge	Fine	Penalty	Total import duty
1 2 3 . . . 94										
Total										

Table 6.4: Domestic taxes by commodity

Commodity	Excise tax	VAT (products)	VAT (trade)	VAT (service)	Supp.duty (manufac. stage)	Supp.duty (service)	Total domestic tax

6.3.2 Social Accounting Matrix (SAM)

The Sustainable Human Development Unit (SHDU) and the General Economic Division (GED) of the Planning Commission of Bangladesh also publish a Social Accounting Matrix (SAM) for Bangladesh at five yearly intervals. The latest SAM for Bangladesh is available for 2000. The main sources of information for the SAM are: a) the I-0 table 2000 for Bangladesh prepared by the Planning Commission, Government of Bangladesh; b) Labour Force Survey 2000 by Bangladesh Bureau of Statistics; c) Household Expenditure Survey 2000 by Bangladesh Bureau of Statistics; and d) National Income Estimates by Bangladesh Bureau of Statistics.

The SAM is a single entry accounting system whereby each macroeconomic account is represented by a column for outgoings and a row for incomings (Round, 1981). Unlike the Input-Output table, which only shows the inter-industry linkages through flows of intermediate inputs, in a SAM the input-output accounts are extended to capture income and expenditure flows between institutions; namely, household, government, and the rest of the world (Reinert & Ronald-Holst, 1997). The Bangladesh SAM for 2000 classifies the economic transactions of the economy in terms of the following accounts:

1) Production activity[116] accounts for 45 sectors;

2) 6 factors of production with 4 different types of labour, one land and one capital;

3) Current account transaction among households, government, corporations, and the rest of the world; and,

4) One consolidated capital account which captures the flows of investment and savings by institution and sectors.

By allowing for regional differences (i.e. urban and rural), the educational level of the household head and the ownership of agricultural capital by the household, households have been divided into 9 groups. There are five groups in rural areas and four groups in urban

[116] In the Bangladesh SAM 2000, no distinction is made between production activity and commodity.

areas. Rural households are classified according to occupation and ownership of agricultural capital as follows:

1) landless households (no cultivable land);

2) marginal farmer households (up to 0.49 acre of land);

3) small farmer households (0.5 to 2.49 acres of land);

4) large farmer households (2.50 acres of land and above); and

5) non-agricultural households.

Urban households are classified according to the education level of the household head as follows:

1) illiterate (no education);

2) low-educated household (class I to class IX);

3) medium-educated household (class X to class XII); and

4) high-educated household (graduate and above).

The 2000 SAM also classifies the labour force according to the gender and skill level of the workers as follows:

1) male low-skilled;

2) male high-skilled;

3) female low-skilled; and,

4) female high-skilled.

6.3.3 GTAP Database for Bangladesh

The Global Trade Analysis Project (GTAP) provides a global database. It includes detailed bilateral trade, transport and protection data and the individual country input-output databases which account for inter-sectoral linkages within regional groups of countries. The current release of data is the seventh (GTAP7) version since 1993. GTAP also includes behavioural parameters such as elasticities of substitution between domestic product and imports, factor substitution elasticities, and consumer demand elasticities. In the absence of useful estimates of household expenditure elasticities for various goods in Bangladesh, this study uses estimates of the expenditure elasticities in the GTAP 6.0 database for Bangladesh (Dimaranan, 2001). However, because of differences in commodity classification between the GTAP database and the Bangladesh I-O table, a mapping is required between the sectors. In the GTAP 6.0 database there are 57 commodities and 87 regions, but in estimating consumer demand elasticities, commodities were aggregated to 10 commodities. Accordingly, a mapping was performed between the 94 commodities of the I-O table 2000 for Bangladesh and the aggregated 10 commodities of GTAP 6.0.

6.3.4 Household Income and Expenditure Survey 2000 for Bangladesh

To identify the poverty impacts, the aggregate results from the model were linked to data from the Household Income and Expenditure Survey 2000 conducted by the Bangladesh Bureau of Statistics. The survey included 7440 households comprising 5040 rural households and 2400 urban households.

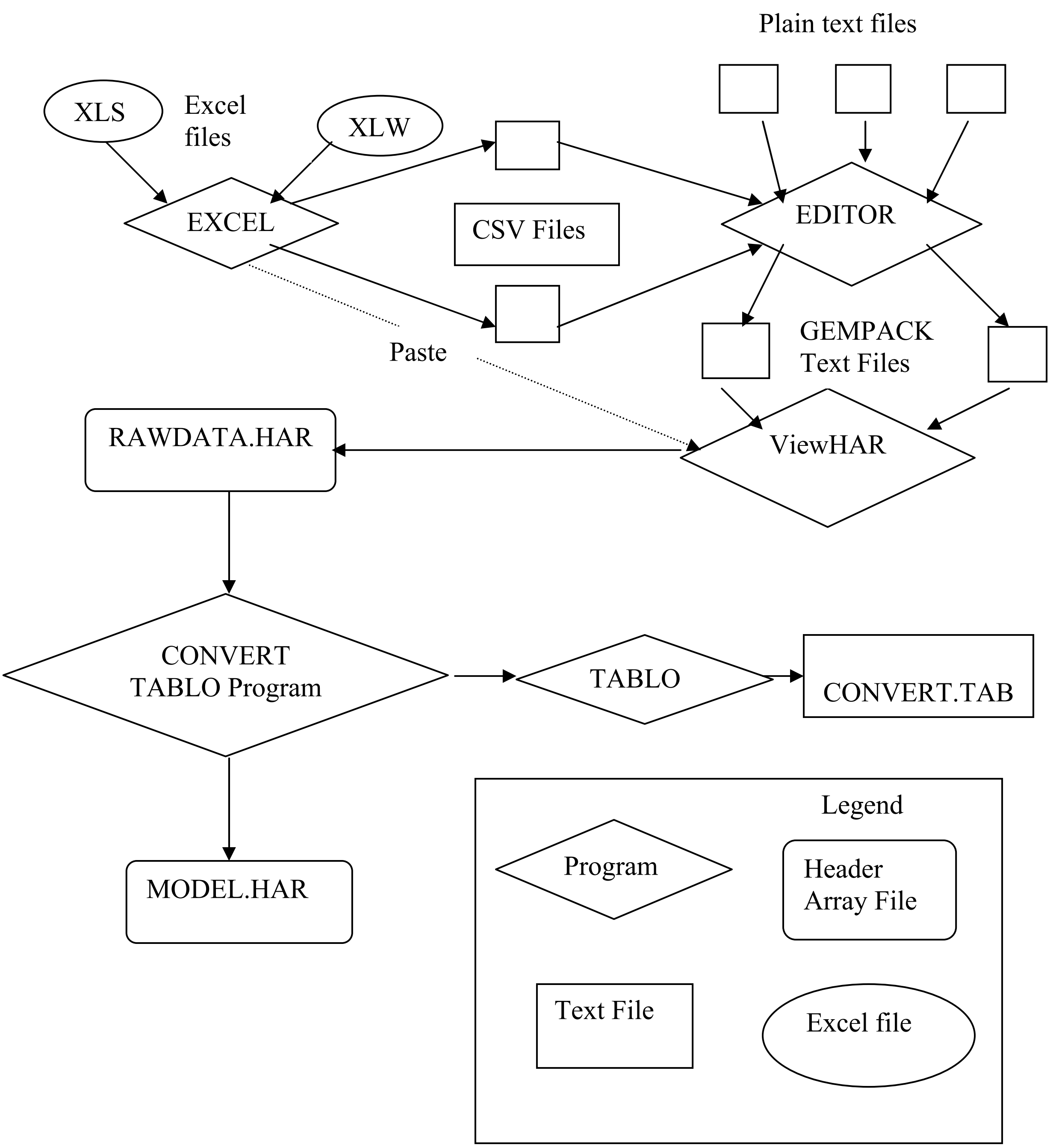
6.4 Steps in the Compilation of Input-Output Database

The general procedure for transforming the original data into model data is presented in Figure 6.2. Usually, the raw data are supplied in Excel (XLS) format or in plain text (TXT) format, as shown at the top of the figure. There are various ways to convert this raw data from TXT or XLS into the binary Header Array (HAR) file. One method is to move data from the XLS sheet to CSV[117] files. Then by using a text editor (which adds a few lines of descriptive data to the CSV files) to the original text files, GEMPACK text files are made. However, these text data files are especially suitable for a small model whereas for large or complex models, Header Array (HAR) files are more convenient. GEMPACK text files can be converted into HAR files, either by using ViewHAR or MODHAR.[118] The next step is to create TABLO files which perform all the numerical operations needed to turn original data into forms which can be used in the model (Figure 6.2). However, the tab files contain no variables or equations. They consist mainly of read statements, formulae, which manipulate the data, and written statements which output the manipulated numbers into the desired format (J. Harrison & Horridge, 2006).

[117] CSV stands for comma-separated values.

[118] These are various utility GEMPACK programs. They are used to process various GEMPACK files which are binary files and thus cannot be read or modified in a text editor.

Figure 6.2: Overview of data preparation steps



Source: Harrison and Horridge (2006)

The present study followed the procedures described below to convert the I-O table and SAM into the format required by the Figure 6.1.

6.4.1 Conversion of HAR Format

First, the original spreadsheet format of data was converted into binary Header Array (HAR) files, called RAWDATA.HAR using the ViewHAR program which is provided in Table 6.5. Then for each database creation, a separate TABLO input file has been written which converts the RAWDATA.HAR into final MODEL.HAR similar to the ORANI-G data input format (Table 6.6).

6.4.2 Creating Value-added Matrices

The present model distinguishes six types of factors of production: male low-skilled, male high-skilled, female low-skilled, female high-skilled, capital and land. To allocate the factor payments from the I-O table was not a straightforward process. The I-O table 2000 for Bangladesh has one row for "compensation of employees (COE)", one row for "mixed income and operating surplus" and one row for indirect taxes. Since ORANI-G requires a separate category of returns to land, labour and capital, we first split the mixed income and operating surplus into payments to land and capital.

Table 6.5: Contents of the RAWDATA.HAR

Header	Size	Coefficient	Long name
MAKE	COM94*IND86	MAKEPD	MAKE matrix at producers' prices
USEP	COM94*USERS	USEPUR	Usage of commodities at purchasers' prices
INTD	COM94*IND86	INTDOM	Intermediate use of domestic products
INTM	COM94*IND86	INTIMP	Intermediate use of imported products
CTAX	COM94*CTAX SET	CTAX	Commodity taxes by commodity and types of tax
FDD	COM94*FDEST	FDD	Final demand
VA	IND86*VASET	VA	Value added by industry and by VA component
VDUT	COM94*MTAX SET	VDUT	Taxes on imports by commodity and types of tax

Source: The Bangladesh model database

Table 6.6: Contents of the ORANI-G data files

Header	Size	Coefficient	Long name
1BAS	COM*SRC*IND	V1BAS	Intermediate Basic
1MAR	COM*SRC*IND*MAR	V1MAR	Intermediate Margins
1TAX	COM*SRC*IND	V1TAX	Intermediate Tax
1CAP	IND	V1CAP	Capital
1LAB	IND	V1LAB	Labour
1LND	IND	V1LND	Land
1OCT	IND	V1OCT	Other Costs
2BAS	COM*SRC*IND	V2BAS	Investment Basic
2MAR	COM*SRC*IND*MAR	V2MAR	Investment Margins
2TAX	COM*SRC*IND	V2TAX	Investment Tax
3BAS	COM*SRC	V3BAS	Households Basic
3MAR	COM*SRC*MAR	V3MAR	Households margins
3TAX	COM*SRC	V3TAX	Households Tax
4BAS	COM	V4BAS	Exports Basic
4MAR	COM*MAR	V4MAR	Exports Margins
4TAX	V4TAX	V4TAX	Exports Tax
5BAS	COM*SRC	V5BAS	Government Basic
5MAR	COM*SRC*MAR	V5MAR	Government Margins
5TAX	COM*SRC	V5TAX	Government Tax
6BAS	COM*SRC	V6BAS	Stocks
MAKE	COM*IND	MAKE	Multiproduct Matrix
OTAR	COM	VOTAR	Tariff Revenue
1ARM	COM	SIGMA1	Intermediate Armington
2ARM	COM	SIGMA2	Investment Armington
3ARM	COM	SIGMA3	Households Armington
EXNT	1	EXP_ELAST_NT	Non-Traditional Export Elasticity
P018	COM	EXP_ELAST	Traditional Export Elasticity
P021	1	FRISCH	Frisch Parameter
P028	IND	SIGMA1PRIM	Primary Factor Sigma
SCET	IND	SIGMA1OUT	Output Sigma
SLAB	IND	SIGMA1LAB	Labour Sigma
XPEL	COM	EPS	Expenditure Elasticities

Source: Horridge (2006)

According to the principles of United Nations System of National Accounts (United Nations, 1999), mixed income is income of unincorporated enterprises owned by members of households either individually or in partnership with others, in which the owners or members of their households may work without receiving a wage or salary. In dividing the vector of mixed income and operating surplus into payments to land and capital, following S. Hoque (2006)[119], we assume that for land-using industries, land comprises 23 per cent of total payments to mixed income and operating surplus. However, for non-extractive industries these figures were assumed to be zero. Thus we get returns to land, V1LND (i). From the remainder of mixed income and operating surplus, a fraction was allocated to labour. Following S. Hoque (2006), the ratios for land-using industries and non-land using industries were fixed at 0.35 and 0.08 respectively. By combining these shares with the compensation of employees (COE) vector in the I-O table we obtain returns to labour, V1LAB (i). After these adjustments, what remains in mixed income and operating surplus is attributed to returns to capital, V1CAP (i). Thus this stage gives us the values for the coefficients V1CAP (i), V1LND (i), and V1LAB (i). Because of lack of data, we assume that there is no other cost ticket, OCT (i) in the base year.

Disaggregation of Labour

The I-O table 2000 for Bangladesh has only one row for compensation of employees with no separate data for different skill levels. However, the Bangladesh model requires information on the labour expenditure by each industry on each type of labour; namely male low-skilled, male high-skilled, female low-skilled and female high-skilled. Therefore, labour cost has been divided into different skill groups based on the information in SAM 2000. Since the sectoral classification in I-O 2000 is different from SAM 2000, in order to combine the data from the SAM, a mapping between the I-O table and SAM sectors was needed. This is provided in Appendix Table C 6.2. Applying the mapping between the 45-sector SAM and the 94-sector I-O table for 2000, we first obtained the occupational composition of labour from the SAM 2000. This was then used to allocate the total labour bill into four different categories of labour in each industry.

[119] I am indebted to Dr. Serajul Hoque, as this chapter of my thesis mostly follows his procedure in making the database.

6.4.3 Conversion from Producers' Prices to Basic Prices and Separating out Margins

As stated before, the I-O table 2000 for Bangladesh contains a Use table valued at purchasers' prices, USEPUR (c, u), and a Supply matrix valued at producers' prices, MAKEPD (c, i). However, to implement the model, I-O data matrices need to be valued at basic prices. The supply matrix, MAKEPD (c, i), was converted to basic prices by deducting commodity taxes from it in the following manner. First, industry shares in commodity output, MAKESHR (c, i), were estimated using MAKEPD (c, i). Second, based on industry shares in commodity output, a tax matrix, MAKETAX (c, i) was formed by distributing total tax on domestic commodities, DTAX (c) to industries. Total tax on commodities, DTAX (c) was formed by adding over an index t running over the set CTAX of the domestic tax matrix, CTAX (c, t). Then, the supply matrix at producers' prices, MAKEPD (c, i) was converted to a supply matrix at basic prices, MAKEBASE (c, i) by subtracting MAKETAX (c, i) from MAKEPD (c, i). Production tax, PTX (i), was calculated by summing MAKETAX (c, i) over commodity and by subtracting from indirect taxes on industry, VA (i, "IndTax").

The model also required separate margin matrices (V1MAR, V2MAR,…, V5MAR) for each commodity. These values were also necessary to convert the Use table at purchaser prices, USEPUR (c, u) to basic prices, USEBAS (c, u). We have total supply of margin commodities, MAR_USM (c), from the Supply table and the value of direct usage of margin commodities, DIRSALE (m), from the Use table. Adding MAKEPD (m, i) over i and subtracting the vector DIRSALE (m) from the resulting vector, we obtained MARSALE (m) which represents the sales of margin commodities for margin purposes. Next, we needed to allocate that amount to each margin commodity. We assumed that each commodity uses the same proportion of margin commodities.

In the next step, to allocate margins to different users or to create the margin matrix, MARGIN_S (c, u, m), a vector of weight, MARFAC (u, m), reflecting the intensity of margin usage by users was made based on S. Hoque (2006)'s assumption. By using USEPUR (c, u), MARGIN_S (c, u, m) and MARFAC (u, m), we produced the margin matrix, MARGIN_S (c, u, m), on composite commodities. Finally, by summing MARGIN_S (c, u, m) over m and by deducting the resulting margin matrix from the USE matrix at purchasers' prices, we obtained USE matrix at producers' prices, USEPD_S (c, u).

6.4.4 Splitting the USEPD Matrix by Sources

All matrices created up to this point include flows for the composite (imported + domestic) commodities. However, the model requires that the domestic and import commodity flow matrices should be separated. A separate matrix of competing imports by commodity and by user would achieve this, but unfortunately the I-O table 2000 for Bangladesh provides only the matrix of imported intermediate inputs, INTIMP (c, i), and a vector of total imports IMP (c). We obtained the values of imports for final demand, FDMPUR_F (c), by subtracting the values for intermediate inputs from the total imports in the Supply table. However, this procedure revealed some unusual import flows in the original data. We used the import share, MSHR (c) for those unusual allocations. The value of imports for final demand was then allocated to final users using the import weight assumed in S. Hoque (2006). Thus we obtained the USE matrix at producers' prices from an imported source, USEPD_0 (c, "imp", u). By subtracting the matrix, USEPD_0 (c, "imp",u), from USEPD_0 (c, u), the USE matrix of composite commodities at purchasers' prices, we produced USEPD_0 (c,"dom",u) which represents the USE matrix at producers' prices from domestic sources. Thus we obtained the USE matrix by commodity, sources and user, USEPD_0 (c, s, u).

6.4.5 Pro-rate Indirect Tax across Users and Subtract from USE Matrix

As a first step for allocating taxes, matrix USEPD_0 (c, s, u), which was created in section 6.4.4, was used to estimate non-stock users' shares in the total use of commodity USHR (c, s, u). These users' shares were used to allocate taxes on domestic and imported commodities to users. As stated previously, I-O table 2000 has an import duty table and domestic tax table containing a disaggregation of taxes on imports and domestic products. Combining all non-tariff taxes on imports by commodity we got MTAX (c). Then multiplying this vector with USHR (c, "imp",u) we obtained TAX (c,"imp",u) while multiplying USHR (c,"dom",u) with DTAX (c) provided us with TAX (c,"dom",u). Thus, we obtained a TAX matrix for all users, TAX (c, s, u). We subtracted the TAX matrix from the USEPD_0 (c, s, u) matrix obtained in section 6.4.4 to produce the USE matrix at basic prices, USEBAS (c, s, u).

6.4.6 Estimation of Shares of Investment According to Capital Rentals

The I-O table 2000 for Bangladesh provides capital formation data by a one-column vector, which represents the inputs of each commodity which go into fixed capital formation by all industries. However, to implement the model, a commodity by industry investment matrix was required. To distribute gross fixed capital formation to industries, we needed to know a capital stock matrix of the value of inputs of each commodity in the capital stock of each industry. However, in the absence of readily available published data on investment with respect to different industries in Bangladesh, following Oktaviani (2000), an alternative method has been adopted where it is assumed that the share of investment of each industry follows the share of return to capital earned by each industry.

INVSHR (i) = V1CAP (i)/V1CAP_i

where

INVSHR (i) = Investment share in each industry;

V1CAP (i) = value of capital returns in each industry and

V1CAP_i = Total value of capital returns.

This investment share matrix was used later in splitting the basic flows, USEBAS (c, s, i). The same investment shares were used to split the margin and tax matrices to V2MAR (c, s, i) and V2TAX (c, s, i).

6.4.7 Creating ORANI-G Basic Flows

The use matrix at basic prices, USEBAS (c, s, u), derived in section 6.4.5 served as the basis for the various basic flows matrices V1BAS to V6BAS (row 1 in Figure 6.1) for various users. Investment share matrix, INVSHR (i) derived in section 6.4.6 was used to estimate an investment basic flows matrix V2BAS (c, s, i). Further, the TAX matrix TAX(c, s, u) created in section 6.4.5 was used to create coefficients for the taxes on basic flows V1TAX, V2TAX,….,V5TAX (row 3 in Figure 6.1). Investment tax matrix, V2TAX, was formed by using the INVSHR matrix. Note that in section 6.4.3 the margin matrix on composite commodity to users, MARGIN_S (c, u, m) was created. By using the source splitting share, USEBAS(c,s,u)/[sum{s,SRC,USEBAS(c,s,u),}], a matrix of margins, MARGIN (c, s, u, m) was produced at this stage which was again used later to create the coefficients for the margin flows (row 2 in Figure 6.1) V1MAR, V2MAR,…,V5MAR.

6.4.8 Disaggregation of the Household Sector

To see the impact of tariff reductions on income distribution and poverty, disaggregation of the household sector was essential. Accordingly, households were disaggregated using the household data recorded in the SAM 2000 for Bangladesh. Thus the model contains 9 major household groups - five rural and four urban. Accordingly, we required households' expenditure matrices for domestic and imported goods (V3BASHOUS), their associated margin matrices (V3MARHOUS) and tax matrices (V3TAXHOUS) to compute various expenditure shares for the model. However, the I-O table 2000 for Bangladesh assumes only one aggregate consumer. By applying the mapping between the I-O table and the SAM 2000 for Bangladesh (Appendix Table C 6.2), the total household expenditures reported in the I-O table were disaggregated to 9 household groups. The commodity expenditure shares of various household groups were calculated from SAM which was then used to split the aggregate consumption expenditure vector into 9 household groups.

6.4.9 Ensuring that Data Written to File Add Up, and Further Adjustments

As stated in section 6.2.1, the initial database should be balanced. The model solution must start from a database which is consistent in levels, for all equations (Horridge, 2006). The conditions to be satisfied are:

- The MAKE matrix's row sums must equal the row sums of the BAS and MAR rows of Figure 6.1. That is, the output of domestically produced commodities must equal the total of the demands for them;

- The MAKE matrix's column sum must equal the sum of the producers' column of Figure 6.1. That is, the value of output by each industry must equal the total of production costs; and,

- The average value of the household expenditure elasticities, EPS, should be one.

To check the initial conditions for this model database, two coefficients were used. These were:

DIFFIND (i) = COSTS (i) – MAKE_C (i)

DIFFCOM (c) = SALES (c) – MAKE_I (c)

In principle, their values should be close to zero to ensure balance in the initial database. However, at the first stage, some industry costs did not correspond to the MAKE column sums and many commodities sales did not correspond to the MAKE row sum. To secure the balance in the database, we adjusted the data by adjusting capital rentals and stocks. That is, the differences between industry costs and industry sales have been adjusted with V1CAP and STOCKS. This seems plausible as these items were used as balancing items in the Input-output table compilation. According to United Nations (1999), gross operating surplus (V1CAP) is by definition calculated as residual. It is the difference between industry output and the sum of intermediate input, compensation of employees and net taxes on products and production. Changes in stocks of goods are also treated as residual balance between total GDP obtained from the supply side and the sum of private consumption, private investment, government consumption and net exports (Saleh & Mangiri, 2000).

6.5 Elasticities and other Parameters

The elasticity parameters included in the model have been listed in section 6.2.2. Ideally these elasticities should be estimated econometrically using cross-sectional and time series data. However, due to constraints with respect to time and data, for this study elasticity values were borrowed from other studies of Bangladesh and other countries with similar characteristics. In some cases, personal judgment or "guesstimates" have been used.

6.5.1 The Elasticity of Substitution between Domestic and Imported Commodities

The elasticity of substitution between home and foreign produced goods is a common feature of international trade. Its intensity is captured by the Armington elasticity, named after Armington (1969). The higher the value of this parameter, the closer the degree of substitution between domestic and imported commodities. On the other hand, a lower value of this parameter implies weaker substitutability between the two sources. In the case of the Bangladesh economy, estimates of the elasticity of substitution between domestic and imported goods are lacking. In the absence of these elasticity values, Salma (1992), Ahammad (1995), Noman (2002) and S. Hoque (2006) borrowed these parameter values from Chowdhury (1990). In these studies a value of 1.8 was used for primary, semi-processed and light manufacturing commodities on the assumption that these commodities have relatively high substitution possibilities in the domestic market. Substitutability between domestic and imported sources in the case of capital goods and heavy manufacturing items was assumed to be 1.2, which is relatively low. The main characteristic of this group is that the domestic production of this category is not a close substitute for imports. These assumptions are considered plausible, and are used in this study. For other commodities, the study has used the value reported in previous studies by adjusting the characteristics of various commodities. The elasticity of substitution for various commodities is reported in Appendix Table C 6.3. Because of unavailability of data, and following ORANI (Dixon, et al., 1997) this study also assumes that the elasticity of substitution between domestic and imported goods is the same for all users, i.e. intermediate users, investors, and households. In model notation, SIGMA (1) = SIGMA (2) = SIGMA (3).

6.5.2 Elasticity of Substitution between Primary Factors in Each Industry

The elasticity of substitution between primary factors determines the responsiveness of the input supply in each sector because of the change in the relative returns. For Bangladesh, there are a number of estimates of these elasticities, though none is recent. For Bangladesh, Rahman (1973), Demery & Jahangir (1975), Rushdi (1982) and Bairam (1991) estimated factor substitutability between capital and labour though they used different methodological frameworks. Rahman (1973) used a constant elasticity of substitution (CES) production function, but did not take into account adjustment costs and time lags in his time series estimation. Taking these into account, Demery & Jahangir (1975) estimated the elasticity of substitution in Bangladesh by sector using pooled cross-sectional and time series data for the period 1962-63 to 1965-66. Their results were an improvement on Rahman's (1973) despite being based on underlying assumptions that may not have been entirely appropriate for a developing country like Bangladesh. Rushdi (1982) used a translog cost function to estimate factor substitutability between capital, labour and materials in the manufacturing industries of Bangladesh from data for the period 1969-70 to 1978-79. Bairam (1991) used a variable elasticity of substitution (VES) production function to estimate the elasticity of substitution between labour and capital, using cross-sectional data for forty-seven sectors of the Bangladesh economy in 1977-78. Nevertheless, Salma (1992) and Ahammad (1995) did not use any of these estimates as they were based on old data and various functional forms. Instead, Salma (1992) and Ahammad (1995) assumed a value of 1.00 for all the sectors. The present study has used a default value of 0.5 as the elasticity of substitution between primary factors for all industries following Wittwer (1999), and ORANI (Dixon *et al*., 1997). Caddy (1976) obtained this value after time series studies of capital-labour substitution on Australian manufacturing industries.

6.5.3 Substitution Elasticities between Different Occupational Types of Labour

In this model, labour has been classified into four occupational categories based on skill level and by gender. In the absence of estimates of the elasticities between occupational categories, following Wittwer (1999) and Horridge *et al.*, (1995), a value of 0.5 has been set as the substitution elasticity of different occupational groups in Bangladesh. By considering the structural and institutional factors in the labour market, this lower value of elasticity of substitution between labour seems plausible.

6.5.4 Export Demand Elasticities

For Bangladesh, estimates of individual export demand elasticities are rare and dated. In this study, approximation of a small country assumption has been used. The small country assumption states that Bangladesh's export commodities have insignificant shares in world market. Hence, Bangladesh's export commodities do not substantially influence world prices and the export demand elasticities are expected to be high. Therefore, following ORANI (Dixon *et al.*, 1997), Ahammad (1995), Hoque (2006), Bandara (1989) and Naranpanawa (2005), a value of -20 has been assumed for the traditional export goods and services except for raw jute and jute goods. It was decided to set the value of -1.00 for raw jute and -7.00 for jute textiles following Salma (1992), Ahammad (1995) and Hoque (2006). These values seem reasonable by considering the importance of Bangladeshi raw jute and jute products in the world market. In fact, Bangladesh was the biggest producer and exporter of jute goods in the global market until the mid 1970s. Because of the increased use of synthetics, the demand for jute in the international market went down in the 1970s, but its demand has resurfaced again because of its environmentally friendly nature. Over the last six years, the export of raw jute and jute products has increased by 120 per cent and 40 per cent respectively from Bangladesh (World Bank, 2007b). Bangladesh still meets 50-60 per cent of the world demand for jute goods and 90 per cent of raw jute (Rahman, 2007). For non-traditional exports, an elasticity value of -20 has been assigned in this model.

6.5.5 Household Expenditure Elasticities and Marginal Budget Shares

To implement the commodity demand equations for each of the 9 households, we require estimates of the marginal budget shares for every product that households consume in the Bangladesh economy. The estimation of the marginal budget shares in turn requires data on household expenditure elasticities for Bangladesh. There are several studies on complete demand system estimation for Bangladeshi households including Mahmud (1979), Pitt (1983), Chowdhury (1982), Kennes (1984), and Golleti (1993). Mahmud (1979) used pooled cross-sectional data from the *Quarterly Survey of Current Economic Conditions* for the years 1964, 1965, 1967 and 1969. Pitt (1983) estimated demand equations for 9 commodities using cross-sectional data from the 1973-74 Household Expenditure Survey of Bangladesh. Chowdhury (1982) first estimated expenditure elasticities for 25 commodities employing a simple log-linear functional form. Then, using these expenditure elasticities, he estimated own and cross price elasticities for commodities by applying the Frisch method (Frisch, 1959). Kennes (1984) also estimated elasticities by using the linear expenditure system (LES) and the Almost Ideal Demand System (AIDS) for nine commodities. Golleti (1993) used Tobins Probit or Tobit to estimate the food demand system. Thus, the literature on the Bangladesh expenditure elasticities provides estimates for the 1990s, whereas this study requires base data for 2000. Because of the absence of recent estimates of expenditure elasticities, we have used values from the GTAP 6.0 data base (Dimaranan, 2001). However, since the commodity classification in the GTAP database for Bangladesh differs from that in this study, we needed to match the commodities in this study with the GTAP database on Bangladesh.

In addition, the elasticity values were scaled so that their share-weighted sum is equal to one, i.e.

$$\sum EPS_c.Si^3 = 1 \text{ (Engel aggregation property of demand system)}$$

where *Si* is the average budget share of commodity *C* in total household consumption expenditure and EPS is the expenditure elasticity.

By definition, the expenditure elasticity of a good *C* is,

$$EPS_c = S3LUX_c / S3_{c\_s}$$

where S3LUXc is the marginal budget share; and S3c_*s* is the average budget share for good *C*.

For this study, average budget shares were collected from the input-output table. With known expenditure elasticities and average budget shares, the marginal budget shares for commodities were calculated as $S3LUX_c = EPS_c * S3_{c\_s}$. The expenditure elasticities for this study are provided in Appendix Table C 6.4.

6.5.6 Frisch Parameter

We needed the Frisch parameter to calculate the supernumerary expenditure (defined as the excess of total expenditure over subsistence expenditure) for each good. The Frisch parameter is the negative of the ratio between total final household expenditure and household supernumerary expenditure. According to Engel's law, the proportion of income spent on foods falls as income increases. Similarly, we can expect that as income increases, the proportion of income spent on other substantial items will fall. That is, the supernumerary proportion of household consumption should rise as income rises (Tran, 2007). Thus we assume that the Frisch parameter for low income groups will be higher than that for the higher income groups.

Bandara (1989) used the Frisch parameter values of -6.43, -5.45 and -4.57 for the estate, remaining rural and urban sectors respectively in his Sri Lankan model. Wittwer (1999) in his WAYANG model used the value of -4.00 for the rural landless group which was reduced gradually for other rural groups such as small cultivator, medium cultivator and large cultivator. For the urban groups 1, 2 and 3 in his study, the values were -3.50, -2.75 and -2.00 respectively.

For Bangladesh, Arndt, *et al.*, (2002) used the values of -1.6 for the urban non-poor households and -4.0 for all other households. For this study, a Frisch value of -4.0 was used for rural landless households and -1.5 for urban high-educated households. Values of -3.5, -2.75, -2.50, -2.00 and -3.50 were used for rural marginal farmers, small farmers, large farmers, and non-agricultural households, and urban illiterate households respectively while for urban low-educated and medium-educated households, values were fixed at -2.75 and -2.00 respectively.

6.6 Data Compilation for Income Distribution Analysis

The data described in previous sections provide the base data to implement the basic ORANI-G model. However, as our model follows IDC-GEM, a South African Model prepared by J.M. Horridge, et al. (1995), we also needed data on the generation of income flow from different activities to factors of production, the mapping of this factor income to households, and the spending of income by households on commodities. The circular flow captures the generation of income by activities in producing commodities, the mapping of these income payments to factors of production, the distribution of factor and non-factor income to households and the subsequent spending of income by households on commodities (Round, 2003). These linkages between factorial and household distribution of incomes in turn constitute the SAM, which is usually considered as an extension of the input-output table that provides information on the distribution of income and expenditure of the institutional sectors.

Table 6.7 presents a simplified representation of the Bangladesh model SAM database for the year 2000. It provides a comprehensive picture of the economy. Basically, it is an extension of the I-O database with complete income mapping. In addition to information on production structure, it includes information on distribution of income and accounts of the institutions. It is worth noting that the values of some cells in the SAM have already been determined by the main ORANI-G model which has been compiled in base data construction sections. The income mapping feature is completed by introducing income mapping variables following IDC-GEM (Horridge *et al.*, 1995)[120].

According to standard accounting principles, in a SAM, income in one account is balanced by disposal of incomes in another account. Thus in a SAM, for every row there is a

[120] Income mapping equations have been discussed in Chapter 5.

corresponding column. In Table 6.7, for each agent, the sum along the row represents their total income, while the column total represents expenditure. The difference between the two indicates the saving for each agent. It is a mathematical necessity that the sum over all sectors' net lending/borrowing, i.e. saving minus investment should be zero. In other words, total saving across institutions would be sufficient to cover total investment expenditure in the economy. The following discussion is concerned with the procedures for compilation of data for the SAM database.

6.6.1 Production Activities

The second row of Table 6.7 shows the allocation of domestically produced commodities to various destinations, i.e. it shows the amount of output of each industry sold domestically as intermediate inputs (V1BAS), for private consumption by households (V3BAS), for public or government consumption (V5BAS), as capital inputs (V2BAS), as exports (V4BAS) and as net additions to inventories (V6BAS). For this model, these figures along with their margins have been calculated in sections 6.4.7 and 6.4.8. On the other hand, the corresponding column (1st column) shows producers' payments for produced commodities and other production costs, e.g. wages. These values also have been processed in basic data base sections.

6.6.2 Gross Operating Surplus

Gross operating surplus (third row) from the income side, originates from total capital payments (V1CAP_I), total land payments (V1LND_I), total other costs ticket payments (V1OCT_I), interest on public debt (WGOVGOS) paid by government and gross operating surplus from the rest of the world (WROWGOS).[121] From the base data construction in section 6.4, we obtained the values for V1CAP_I, V1LAND_I and V1OCT_I which produce the total value of GOS. On the other hand, the 2nd column shows expenditures of GOS which takes the form of flow to households (VGOSHOU), corporate taxes to government (VGOSGOV), and transfer payments to the rest of the world (VGOSROW).

6.6.3 Labour Income

The fourth row (Table 6.7) shows the labour income which is created by compensation for the use of various types of labour by the industries. The corresponding column shows how this

[121] Following Hoque (2006), it is assumed that in Bangladesh during 2000, the value of WGOVGOS and WROWGOS were zero.

labour income is distributed among households. Because of the presence of unincorporated business in Bangladesh, a significant part of mixed income is included into labour income. The procedure to separate mixed income and operating surplus has been discussed in section 6.4.2. The total returns to labour were then distributed to various household groups by following the factor's shares in SAM 2000. Using the mapping between the I-O table and SAM, we splitted the total labour income among four labour categories. At first, we calculated households' share in factor payment in SAM, which was later used to split total labour income to various household groups.

Table 6.7: A simplified representation of the Bangladesh model SAM database (million taka)

		Expenditures									
		1.Firms	2.Gross operating surplus	3.Wages	4.Households	5.Government current expenditure	6.Government Investment	7.Private Investment	8.Stocks	9.Rest of the World	10.Total
Receipts	1.Domestic goods	Intermediate inputs 1972185.63	0	0	Final private consumption 1695949.63	Final govt. consumption 105677.02	Final govt. investment 90371.49	Private investment expenditure 390874.50	Inventories 28510.42	Exports 236403.25	4462951.00
	2.Gross operating surplus	1247584.75	0	0	0	0	0	0	0	0	1247584.75
	3.Wages	Labour income 998613.938	0	0	0	0	0	0	0	0	998613.94
	4.Households	0	Factor income 1131034.88	Wages 998613.94	Transfers 56341.70	Govt. transfers 11871.10	0	0	0	Foreign transfers 9825.10	2207686.75
	5.Government	Taxes on intermediate, import duties 59866.17	Corporation tax 2739.00	0	Income tax 59460.04	0	2561.11	11077.32	5934.55	582.397	142220.58
	6.ImportsCIF	Imports (intermediate) 184700.50	0	0	Household imports 88824.15	Govt.imports 2708.98	Govt. imports 9761.35	Import (investment) 42219.75	101378.75	0	429593.47
	7.Column Total	4462951.00	1133773.875	998614.00	1900575.50	120257.09	102693.95	444171.56	78802.88	246810.73	9488651.00
	8. Income Total	44462951.00	1247584.75	998613.94	2207686.750	142220.58	0	0	0	429593.469	9488650.00
	9. Saving	0	113810.875	-0.063	307111.25	-80730.47	0	-522974.44	0	182782.734	-0.109
	10.Total	13388853.00	3628943.5	2995842.00	6315949.00	302004.28	205387.90	365368.68	157605.75	1105997.62	28465952.00

6.6.4 Households

Household receipts are presented in the fifth row of the SAM, which includes income from gross operating surplus, labour income, transfers from the government and transfers from the rest of the world. In this model all wage income (V1LAB) has been allocated to households as remuneration for their supply of labour. Returns to land were also allocated to households based on SAM's factor share on the assumption that agricultural households own land. After deducting the rental shares and self employed labour share from the mixed income operating surplus in the I-O table 2000 for Bangladesh, the residual is returns to capital, which was decomposed into returns to unincorporated capital and corporate capital. It is assumed that households receive the bulk of unincorporated capital incomes. As stated earlier, in Bangladesh, most capital income accruing to private individuals derives from informal enterprises. For example, all returns to capital in the agriculture, forestry, construction, trade and transport sectors are assigned to unincorporated capital as most such enterprises are typically small. Similarly, the housing sector, which consists of urban and rural house building, is dominated by individuals and small farms, as is the other services sector which includes the professional services of doctors, lawyers, accountants and consultants (Khondker, 1999). The operating surpluses of these sectors are also accruing to unincorporated capital. The operating surplus originating from the manufacturing sectors consists of returns to unincorporated, government and corporate capitals as industries are owned by individuals, government and private or corporate firms (Khondker, 1999).

Because of the high prevalence of mixed income, 90 per cent of the residual operating surplus has been attributed to unincorporated capital income, and the same ratio is used by the 1993-94 SAM for Bangladesh. Besides labour income, rental income and capital income, households also receive transfers from other households, the government and the rest of the world. The income data from other sources have been taken from the SAM 2000 for Bangladesh.

6.6.5 Government Income

The sixth row (Table 6.7) shows government's income originating from indirect taxes from production activities (V0TAX_CSI), income taxes from households (VHOUGOV), and corporation taxes from enterprises (VGOSGOV). Total indirect tax revenue (V0TAX_CSI) includes taxes on intermediate goods (V1TAX_CSI), investment (V2TAX_CSI), consumption (V3TAX_CSI), exports (V4Tax_CS), stocks and import tariffs (V0TAR_C). Total indirect tax revenue collected on both domestically produced and imported commodities has been calculated in the base data construction section, whereas income taxes from households and corporation taxes from enterprises have been taken from SAM 2000 Bangladesh. Total corporation tax collection in 2000 was taka 2,739 million levied on profits of the corporation establishment.

6.6.6 Rest of the World Sector

The rest of the world account generates income through payments on imported goods and services (V0CIF_C) and transfer payments from households, government and enterprises. In the absence of data, this survey follows Hoque (2006), in assuming that transfer payments from government (GOVROW), households (HOUROW), and enterprises (GOSROW) are zero. Total payments for imported goods and services (V0CIF_C) includes cost insurance freight total cost by firms, Impcif ("Firms"), households, Impcif ("Households"), Impcif ("Government"), Impcif ("Private investment") and Impcif ("stocks"). These values have already been determined in the base data construction section.

SAM Data Base Balance

By summing the receipts along the rows of Table 6.7 for each agent, we obtain income totals for all agents which are shown in the ninth row in the table. Similarly, the corresponding columns show total expenditure for each agent (shown by the eighth row). A balanced database ensures equality of totals by rows to corresponding column totals. The difference between income total and expenditure total provides a saving for each agent (shown by tenth row). In this survey, a balance check (VSAMCHECK) ensures that the sum of all savings is equal to total investment expenditure in the economy.

6.7 Households' Income Distribution

Since the main objective of this study is to analyse the effects of trade policies on income distribution, the sources of income of the various household groups are of particular interest. The following section describes the sources of income of the various households groups in more detail. Table 6.8 presents the factorial sources of income for the various categories of households. There are four basic forms of income; namely labour income, income from unincorporated capital, land income and income from various transfers.

Table 6.8: Factorial income composition (%)

Households	Labour	Capital	Land	Intra-house transfers	Govt. transfers	ROW transfers	Total
a) Rural							
Landless HH	93.19	0	0	5.84	0.41	0.57	100
Marginal farmer HH	56.83	33.18	0.71	8.35	0.35	0.58	100
Small farmer HH	52.17	36.19	6.13	4.66	0.11	0.73	100
Large farmer HH	16.52	59.71	22.89	0.53	0.02	0.32	100
Non-agricultural HH	56.21	38.02	1.74	3.01	0.39	0.62	100
b) Urban							
Illiterate HH	60.63	37.33	0	1.60	0.05	0.39	100
Low-educated HH	41.19	53.03	2.28	2.81	0.25	0.43	100
Medium-educated HH	23.93	72.32	2.57	0.34	0.68	0.16	100
High-educated HH	15.39	75.13	4.99	1.07	3.21	0.20	100

Source: Bangladesh model database

Transfers consists of household transfers (for example, urban households sending money to their rural parents, rural parents sending money to their urban children for education), government transfers (such as pensions, government old age allowances for the elderly poor, allowances for widowed and distressed women, subsidised education and health services) and Rest of the World transfers (remittances from Bangladeshi workers working abroad). Table 6.8 shows that both in rural and urban areas, factors of production provide the largest source of income. Labour provides a major part of factor income for all household categories in rural areas, except large farmer households. For example, as much as 93.19 per cent of the income of the households with no cultivable land holdings comes from labour and the remainder from various transfers[122]. Marginal farmer households receive 56.83 per cent from labour and 33.18 per cent from capital (Table 6.8).

The household group with land holdings of 0.5 to 2.49 acres of land (small farmers) receives 52.17 per cent of its income from labour, and 36.19 per cent from land. The receipt of income from labour for these three rural households groups is derived mainly from unskilled labour income (Table 6.9). Here it is worthwhile to note that in Bangladesh, most of the landless and marginal landholders are poor and they mainly work as agricultural wage labourers. Over the last few years, the rapid expansion of non-farm activities has absorbed more labour and hence wage rates are higher in these activities (ADB, 2003). Large farmers have land and capital as their main sources of income. Non-agricultural households also receive higher percentages of labour income and capital income. As stated in Chapter 2, the main source of growth in Bangladesh has shifted from the farm to the non-farm sector. Rural non-farm activities include activities outside agriculture such as include livestock, fisheries, self-employed subsistence-oriented cottage industries, wage employment in rural business enterprises, transport operation, shop keepers, and petty trading.

In urban areas, with the exception of the illiterate, household groups receive more of their income from capital than from labour. Lower educated households receive 53.03 per cent of income from capital and 41.19 per cent from labour income, with only 2.28 per cent coming from land. Medium and high educated households receive 72.32 per cent and 75.13 per cent of income from capital and 23.93 per cent and 15.39 per cent from labour respectively, with labour income coming mostly from skilled labour income (Table 6.9). These differences in factorial income shares are important in investigating the impact of trade liberalisation on income distribution.

Table 6.9 shows household labour income composition by occupation for each household group. It is seen that the unskilled labour is the main source of labour income for landless farmers, marginal farmers, small farmers and non-agricultural households in the rural areas and illiterate and low-educated household groups in urban areas. On the other hand, skilled labour constitutes a main source of labour income for the medium-educated and high-educated groups in urban areas.

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[122] Households' definitions have been provided earlier.

Table 6.9: Labour income composition by occupation (%)

Households	Male low-skilled	Male high-skilled	Female low-skilled	Female high-skilled
a) Rural				
Landless HH	84.94	2.96	12.02	0.07
Marginal farmer HH	86.11	6.44	7.20	0.24
Small farmer HH	67.21	27.91	3.86	1.01
Large farmer HH	34.92	56.49	2.16	6.43
Non-agricultural HH	58.36	32.07	7.94	1.62
b) Urban				
Illiterate HH	79.91	2.05	17.91	0.12
Low-educated HH	76.85	12.35	9.30	1.48
Medium-educated HH	1.58	89.84	2.86	5.71
High-educated HH	0.29	95.87	1.29	2.54

Source: The Bangladesh model database

Another striking fact is that female labour contribution to the market is very low, especially in the high skilled category. It is highest for the rural large farmer household group, where it still comprises only about 6 per cent of total labour income. According to the World Bank (2002b), in Bangladesh approximately 80 per cent of the population lives in rural areas where farming, livestock and fisheries are the primary occupations for 53 per cent of working men and 77 per cent of working women. In rural areas women are mostly involved in the post harvest work and keeping livestock, poultry and small gardens. In contrast, women in cities are mostly found in domestic and traditional jobs, although from the 1980s manufacturing and services, especially ready-made garment manufacturing, have emerged as important sectors for working women. The ready-made garment sector went from 2 per cent of female employment in 1981-82 to 30 per cent in 1997-98 (Garrett and Chowdhury, 2004). Most of the female workers in the garment industry are illiterate and have migrated from rural areas.

Table 6.10 shows how unevenly income is distributed among households. For example, urban high educated households receive 7.37 per cent of total income but constitute only 1.39 per cent of the total population in the 2000 Household Survey of Bangladesh, while landless and marginal farmer households together receive only 9.11 per cent of total income despite comprising 22.44 per cent of the total population. Households without land represent about 16 per cent of all households, but receive only about 6 per cent of all income. Marginal farmer groups form about 7 per cent of households but receive only 3 per cent of income. Large farmers account for about 5 per cent of households and receive about 7 per cent of total income.

Table 6.10: Households' income distribution

Households	Percentage of total population	Income distribution (%)
a) Rural		
Landless HH	15.62	5.69
Marginal farmer HH	6.82	3.42
Small farmer HH	13.02	8.85
Large farmer HH	5.15	6.93
Non-agricultural HH	27.07	25.89
b) Urban		
Illiterate HH	13.06	11.29
Low-educated HH	10.48	13.81
Medium-educated HH	7.25	16.75
High-educated HH	1.39	7.37
Total	100	100

Source: Bangladesh Household Income & Expenditure Survey 2000 and the Bangladesh model data base.

Rural households are on the whole worse off than urban households. Rural households, despite comprising about 68 per cent of total population, receive only 50.78 per cent of total income, whereas urban households receive 49.22 per cent of total income even though their share in total population is only 32.18 per cent. It is also worth noting that about 71 per cent of total government transfers go to the richest urban households, while only about 9 per cent of government transfers go to poor rural household groups (Table 6.10).

6.8 Conclusions

This chapter has dealt with the compilation of the data required for the Bangladesh model described in Chapter 5. As already stated before, the main objective of this study is to trace the distributional impacts of trade policy issues on various household groups. For this reason, we required two types of data, the I-O data with related elasticity estimates and the data arranged in the social accounting matrix (SAM) framework. Hence, the database construction has been divided into two parts. The first part describes the process used to compile the core database required for the ORANI-G type model from the I-O table along with elasticity estimates. It includes explanation of the detailed methods of constructing separate matrices for basic, margins and tax flows for both domestic and imported commodities to domestic and overseas users and a matrix of factors of production. In the second part of the data construction procedure, the ORANI-G input-output database has been expanded by the mapping of the factor income distribution from the structure of production to various households groups. To emphasise the income distribution aspect, the factor account was disaggregated in terms of different occupational categories and the household account was disaggregated in terms of different household income groups. Then the income generated from various sources was allocated to relevant households. Similarly, income and expenditure for each non-household sector (firms, government and ROW) have been calculated.

Chapter 7

Application of the Bangladesh Model: The Macroeconomic and Household Level Effects of Across the Board Tariff Reduction

7.1 Introduction

As stated before, Bangladesh, as a member of the World Trade Organisation (WTO), is committed to opening up its markets. Accordingly, Bangladesh undertook several trade liberalisation programs and related economic reforms during the 1980s and 1990s. As well as unilateral trade liberalisation, Bangladesh continues to explore many possible regional, multilateral and bilateral trade arrangements to improve external competitiveness. In each successive development and poverty reduction strategy, trade policy remains as a major component. These policy measures have had and will have important effects on various macroeconomic variables and also on the structure of the economy. In the literature there is a growing body of research dealing with the impacts of trade liberalisation on the Bangladesh economy, but very few of them are concerned with the long run implications as well as the revenue effects.

Thus the main objective of this chapter is to report and analyse some of the results of the trade policy simulations undertaken in this thesis for both the short run and long run. It deals with the impacts on macroeconomic variables, sectoral level variables and household level variables. The poverty and income inequality impacts, which are the main objective of this thesis, will be discussed in the next chapter. The chapter is organised as follows. Section 7.2 discusses the simulation design. Section 7.3 describes the model closure. The method of interpretation of the comparative-static results is provided in section 7.4. Section 7.5 discusses the model results, which include the results of the policy simulations on various important macroeconomic variables, sectoral variables and household level variables. Section 7.6 presents a sensitivity analysis of the model results with respect to various elasticity values. Section 7.7 provides concluding comments.

7.2 Simulation Design

Bangladesh is progressively implementing tariff reform policies. Tariff structures are being simplified and tariff rates have been reduced. These reforms put downward pressure on the tax/GDP ratio[123] because in Bangladesh, revenue collected from import duties comprises a substantial part of total tax revenue[124]. Hence a complete removal of tariffs might seriously affect major macro variables unless the government initiates fiscal reform. By reducing tax revenue the elimination of tariffs would affect government current expenditure, investment expenditure and various transfers negatively, which in turn would affect various household groups differently. To overcome this problem, the present study includes a simulation where the revenue shortfall caused by tariff liberalisation has been offset by a compensatory consumption tax. The specific simulations are as follows.

Simulation 1: In this simulation existing tariffs in all sectors have been eliminated completely without any compensatory taxes.

Simulation 2: Existing tariffs have been eliminated completely. However, to compensate for the government budget loss, a uniform consumption tax (2.70 per cent), endogenously determined, has been imposed so that the government's pre simulation budgetary position is retained.

7.3 Model Closure

The list of possible exogenous variables or the standard closures has been discussed in Chapter 5 which outlined a number of alternative economic environments both for the short run and the long run. In fact, the choice of closure depends upon two considerations: First, the closure is associated with the simulation timescale, which would be needed for the economy to adjust to a new equilibrium. It may be short term tenure or long term. The differences between short run and long run are reflected in the assumptions underlying the factor markets. For example, in a short run simulation, capital is normally held fixed between sectors. In contrast, capital is assumed to be mobile across industries in the long run. Cooper, McLaren *et al,.* (1985), in their econometric experiment found evidence that short run equilibrium is

[123] In 2000-05, the tax revenue and GDP ratio was 8.22 per cent (GOB, 2006).
[124] In Bangladesh, custom tax revenue covers about 50 per cent of total indirect tax revenue and about 25 per cent of total tax revenue (GOB, 2006).

established in about 2 years, whereas long run equilibrium takes 10 to 20 years, which is long enough to ensure that changes in sectoral capital stocks eliminate differences in sectoral rates of return on capital. Second, the choice of closure is affected by the needs of a particular simulation (Horridge, 2006). For example, if the modeller wants to find out the aggregate welfare impacts of a trade shock, then real aggregate consumption expenditure should be listed in the endogenous variable category.

In this study the model is used for both the short run and long run simulations. Even though standard closure provides a perfectly valid exogenous set for the model, following the ORANI-G type models, we adopted slightly different closures for our short run and long run simulations. The set of assumptions underlying the short run and long run simulations is depicted by Figures 7.1 and 7.2 respectively.

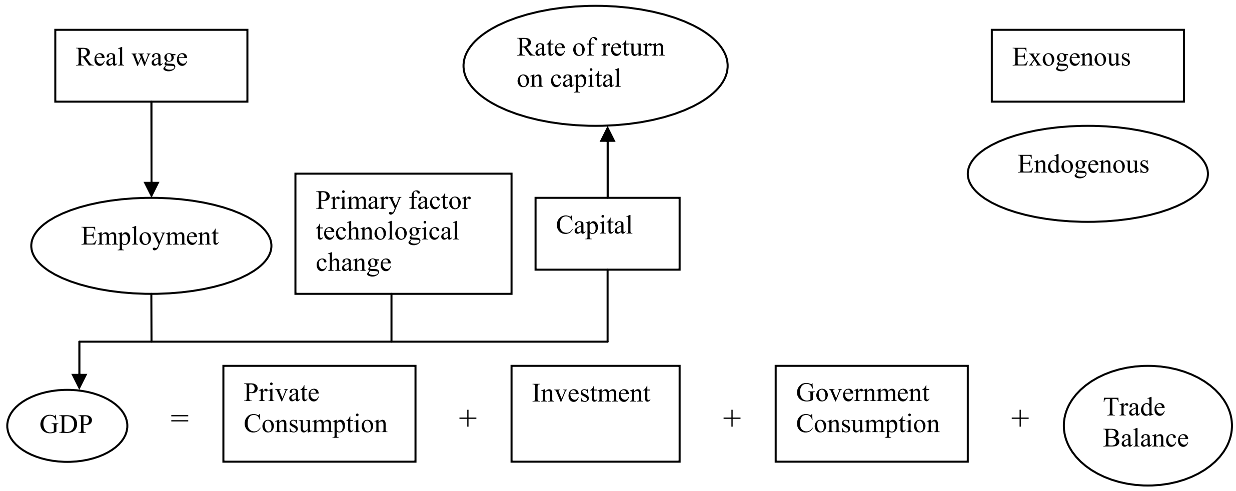
7.3.1 Short Run Closure

In Figure 7.1, the exogenous variables are presented in rectangles whereas the endogenous variables are presented in ovals. The arrow signs indicate a plausible direction of causation between variables. In the figure, the upper side reflects the supply side, whereas the lower part depicts the demand side. In the short run, on the supply side of the macro economy, we have exogenised the capital stock (*x1cap*), the real wage (*realwage*) and technology. Thus, with capital stock fixed, the only way to change the output level in each industry is to change the labour inputs. However, it is assumed that the rate of return in each industry adjusts to reflect any changes in the output level. Thus, with a given investment budget, changes are allowed in the allocation of the investment budget among investing industries in response to changes in relative rates of return (Dixon, *et al.*, 1997). In the labour market, it is assumed that there is a perfectly elastic supply of labour at a fixed real wage rate. Thus the volume of employment will adjust according to the change in labour demand. With the total stock of labour fixed, workers are freely mobile between sectors in the economy. This situation is common in the existing labour market in Bangladesh (high level of unemployment). Further, in conducting the simulations, the money wage rate is indexed to the consumer price index (CPI) and this has been implemented by setting all of the wage shift variables (*f1lab*) as exogenous. Now with real wages given, the model determines the aggregate employment level; and with a fixed capital stock and technology, it therefore also determines real output from the supply side.

On the demand side, the major expenditure aggregates such as real household consumption (*x3toth*), aggregate real fixed investment (*x2tot_i*), aggregate real government expenditure (*x5tot*) and the change in aggregate real inventories are held fixed. This assumption is imposed in the model by putting these variables in the exogenous list which is implemented by swapping *x2tot_i* with *invslack* and *x3toth* with *w3luxh* in the standard closure discussed in Chapter 5. Then, to make real government current spending exogenous and to disconnect government from household consumption, we swapped *x5tot* with *f5tot2* (the ratio between the overall shift term for government demand and real household consumption) in the standard closure. The rationale for making real aggregate absorption exogenous lies in the fact that tariffs are primarily expenditure switching instruments and tariff policy is simply designed to affect industrial structure, occupational employment and the balance of trade rather than the level of aggregate demand (Dixon *et al.*, 1997). Now, with domestic aggregate real absorption fixed and real GDP determined from the supply side, the balance of trade as a fraction of GDP (*delB*) is specified as an endogenous swing that satisfies the GNP identity. Thus, if any shock results in a GDP increase or decrease compared to domestic aggregate real absorption, the balance of trade variable will move accordingly towards a surplus or deficit.

Along with these, all technical change variables have been considered as exogenous. In other words, technical change is assumed to be a long term phenomenon. Further, all tax rate variables, shift variables, foreign prices of imports, number of households, land endowment, real demands for inventories, are considered as exogenous in the short run. The nominal exchange rate is fixed and serves as a numeraire in this model which implies that changes in the domestic price level are evaluated relative to world prices.

Figure 7.1: The schematic representation of short run closure



7.3.2 Long Run Closure

As opposed to the short run, in the long run it is assumed that capital stocks are free to adjust in such a way that fixed rates of returns (*gret*) are maintained. An open capital market is implicitly assumed, since there is no link between capital formation and domestic savings (Horridge, 2006). According to Dixon *et al.*, (1997) a tariff reform might be expected to affect rates of return in the short run, but in the long run adjustments in the level of foreign investment will force domestic rates of return into line with foreign rates of return through changes in national capital formation. As a result, the national investment level also changes as each industry's capital formation is related to its investment.

In the labour market it is assumed that aggregate employment (*employ_i*) is fixed while the average real wage is determined endogenously[125]. To implement this, the overall wage shifter (*f1lab_io*) has been swapped with *employ_i* variable while other wage shift variables (*f1lab*) remain exogenous. This also reflects the assumption of fixed wage relativities which also implies that firms do not substitute between labour of different types; however, labour is freely mobile between sectors in the economy in response to changes in labour demand.

On the demand side, it is assumed that real private consumption, real government consumption and real investment are determined endogenously. It is also assumed that nominal household consumption follows post-tax household income, and real government

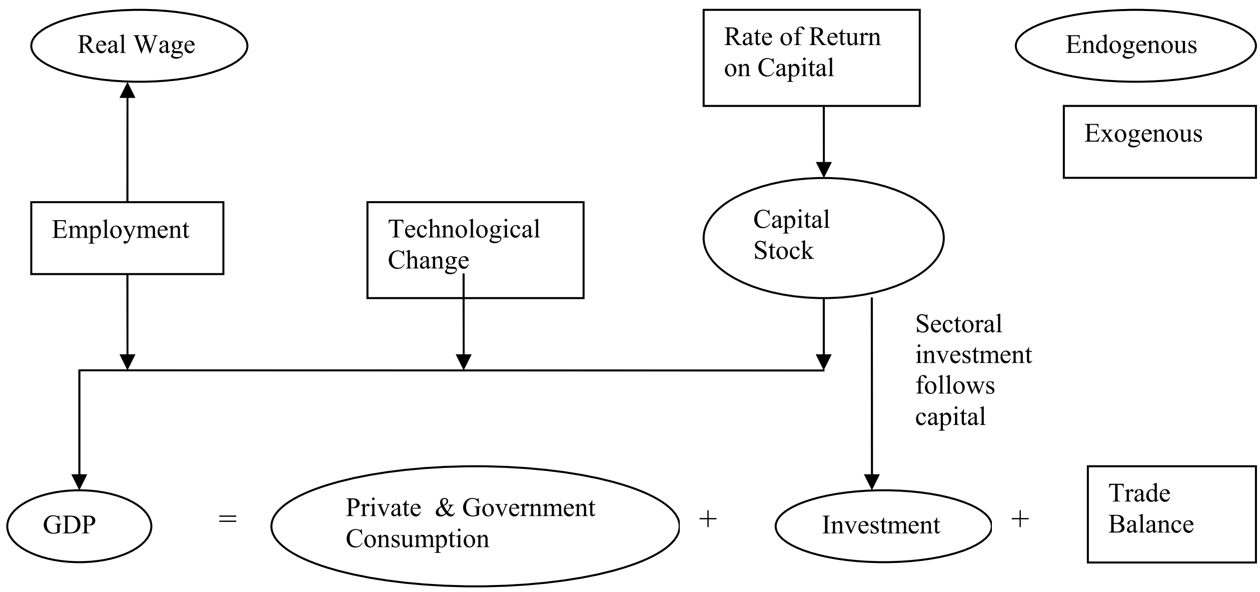
[125] The assumption is that in the long run, the employment level is determined by population growth, labour force participation rates and the natural rate of unemployment.

consumption follows real private consumption. To implement these assumptions, *f5tot2* has been swapped with *x5tot,* aggregate real government expenditure as an exogenous variable. With aggregate real absorption endogenous in the demand side, the balance of trade as a fraction of GDP (*delB*) has been considered as constant. The idea here is that, in the long run, the rest of the world might be unwilling to fund an increased trade deficit (Horridge, 2006).

As with the short run simulation, production technology, land, foreign prices of imports and the number of households are treated as exogenous in the long run. The numeraire is the exchange rate.

Both in the short run and long run, for our second simulation, we offset the loss in government revenue by imposing a uniform consumption tax, which will be determined endogenously. For this purpose, we swapped a tax variable, *f3tax_csi* (percentage changes in the powers of all taxes on household consumption) with *delV0tax_csi* (change in aggregate revenue from all indirect taxes) in the assignment of exogenous and endogenous variables. This gives the changes in taxes that leave total tax revenue constant.

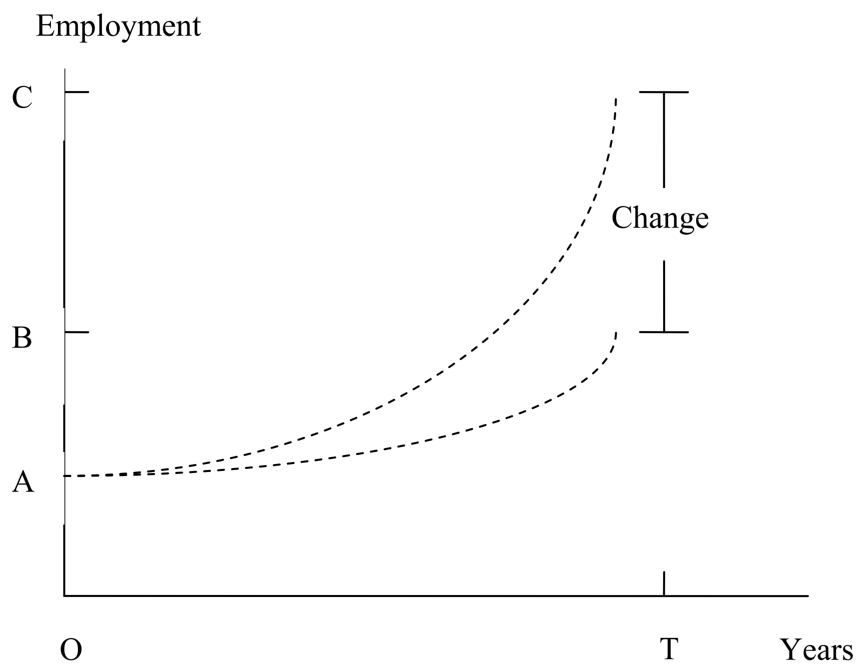
Figure 7.2: The schematic representation of the long run closure



7.4 A Comparative–static Interpretation of Model Results

The Bangladesh model, which follows ORANI-G and IDC-GEM, is a model for comparative-static analysis. The model variables and equations which were discussed in Chapter 5 refer implicitly to the economy at a future point of time, ensuring that all the necessary adjustments initiated by the change have to occur and a new equilibrium has to be reached. Figure 7.3 illustrates the interpretation of comparative-static analysis where the value of some arbitrary endogenous variables - for example, employment has been plotted against time. Suppose the research question is to see the effect of a certain policy change, say, a tariff change on employment. In the figure, 'A' is the current state of employment (base period). Suppose that in the base period, a sustained exogenous shock has been applied, a 100 per cent fall in tariffs. Because of this shock, with all other things remaining the same, 'C' is the level of employment that will be attained in 'T' years. In the absence of the shock, employment would grow to 'B' with all other things equal. Thus, the model evaluates the percentage change in employment, 100(C-B)/B. However, in this type of comparative-static simulation, the model does not take into account the time path of employment moving from one point to another.

Figure 7.3: Comparative-static interpretations of results



Source: Horridge (2006)

7.5 Simulation Results

In this chapter, the Bangladesh model which has been built in Chapter 5 is applied to analyse the impact of a uniform 100 per cent across the board tariff cut in Bangladesh. For this purpose, all exogenous variables were set equal to zero except changes in the power of tariffs (*t0imp*), which were set in such a way that the percentage change decrease in tariff rates for each good is 100 per cent. Results of the simulations under short run and long run closures are presented in terms of macro economic effects, sectoral effects, factor market effects and household-level effects which are described in the following sub-sections. In each sub-section, the results for simulation 2 have also been discussed.

7.5.1 Macroeconomic Impacts

7.5.1.1 Simulation 1: Projected effects of a 100 per cent tariff cut in all sectors

In general, the immediate effect of the tariff cut is to make imports cheaper relative to domestically produced import competing goods. Consequently, there is an increase in imports, reduction in government tariff revenue, and a reduction in output and employment in the previously protected import-competing sectors. At the same time, the tariff reduction also lowers the domestic costs of production by lowering the domestic prices of imported inputs to production. As a result, the country experiences an improvement in the competitiveness of the export sector. A tariff cut also causes depreciation in the real exchange rate via an upward pressure on the demand for imports and hence for foreign exchange. Depreciation makes tradable goods more expensive in the internal market and encourages resources to transfer to tradable goods production. This helps prevent deterioration of the current balance of trade[126]. Therefore, the ultimate effect of tariff liberalisation depends on various factors such as initial tariff rates, the state of domestic currency (whether it is depreciated or overvalued), the share of imported and exported commodities in foreign trade, and the foreign elasticities of the demand and supply for the commodities.

Table 7.1 presents the projections of the effects of the tariff cut in Bangladesh on a number of key macro variables such as aggregate employment, real GDP, real wages, consumer price index, aggregate imports and exports, trade balance as a fraction of GDP ($delB$) and

[126] It is worth mentioning that a tariff cut effect on the exchange rate may be indeterminate if there is a significant price reduction also. A fall in the price level of the country undertaking the reform relative to its trading partners could lead to an appreciation of the reforming country's real exchange rate.

aggregate consumption. All the variables have been presented as percentage changes except for the variable *delB*, which is reported as an ordinary change. Table 7.1 contains five columns. For simulation 1, the short run projection of across the board tariff reduction appears in column two, whereas the adjacent column (column 3) shows the long run effects. Similarly, for simulation 2, column 4 shows the short run impacts where there is a compensatory consumption tax, and column 5 depicts the compensatory long run impacts.

Table 7.1 shows, in the short run, aggregate employment has increased by 1.47 per cent and the real GDP by 0.70 per cent. Industry results show that increased employment in the most expanding export-oriented sectors has outweighed the decrease of employment in the import competing industries. The reason for the increased rate of employment compared to real GDP lies in our assumption about fixed industry usage of capital and land. With capital and land fixed in the short run, an increased use of labour causes the marginal productivity of labour to decline with increasing employment. This implies that to achieve a certain percentage of output increase, industry must increase labour inputs by more than that percentage. A consistency check, which shows that with capital and land fixed in the short run, the change in GDP can be described by the changes in the aggregate employment only, can be used to confirm the relationship. The percentage change in GDP can be defined as the weighted average of percentage changes of primary factor as follows:

$$x0gdpexp = S_{lab}.employ\_i + [S_{cap}.x1cap\_i + S_{lnd}.xlnd\_i] \qquad (1)$$

where *x0gdpexp* is the percentage change in real GDP; *employ_i*, *x1cap_i* and *x1lnd_i* are percentage changes in economy wide use of labour, capital and land and S_{lab}, S_{cap} and S_{lnd} are the shares of each factor in GDP at factor cost. In the short run simulation it is assumed that

$$x1cap\_i = xlnd\_i = 0 \qquad (2)$$

The value of S_{lab} in our database is about 0.42 so that equation (1) and (2) suggest a value of real GDP of about 0.617, given the value of aggregate employment (1.47) in Table 7.1. Our model result for real GDP in the short run under simulation 1 is 0.70. Therefore, the change in real GDP was not fully explained by changes in labour. Simulation results show an additional factor is at work which is indirect tax (0.081). This is responsible for the approximate change (0.617+0.081) = 0.698 which is similar to our model simulation result of real GDP of 0.70.

Now with real GDP determined from the supply side and domestic absorption (aggregate real consumption, aggregate real investment and aggregate government spending) fixed, the trade balance will move towards surplus/ deficit, depending upon the increase/decrease in real GDP relative to domestic absorption. Table 7.1 shows, in the short run, the balance of trade as a proportion of GDP has improved marginally (0.004). The projected increase in the import volume index of 1.53 has been more than offset by the net effect of a 9.72 per cent increase in the export volume index, and a 0.57 per cent fall in the export price index, thus resulting in a movement towards surplus in the balance of trade.

Table 7.1: Projected effects of a 100 per cent tariff cut in all sectors: Selected macro variables (percentage changes)

	Simulation 1		Simulation 2	
Macro Variables	**Short run**	**Long run**	**Short run**	**Long run**
Real GDP (Expenditure side)	0.70	0.82	-0.04	0.69
Aggregate Employment	1.47	0	-0.27	0
Aggregate real household consumption	0	0.57	0	-0.31
Aggregate real investment	0	1.12	0	4.35
Real Government consumption	0	0.57	0	-0.31
Consumer price index	-3.61	-1.25	0.27	0.89
Export volume index	9.72	6.35	2.82	5.07
Import volume index (CIF weights)	1.53	2.97	1.74	3.06
Poverty line (Rural areas)	-2.03	-0.55	0.26	0.56
Poverty line (Urban areas)	-1.69	-0.46	0.22	0.47
Terms of trade	-0.57	-0.30	-0.16	-0.24
Average real wage	0	3.24	0	0.74
Export price index	-0.57	-0.30	-0.16	-0.24
Real GDP at factor cost	0.65	0.72	-0.12	0.59
GDP price index (Expenditure side)	-4.03	-1.53	-0.39	0.28
Ordinary change to nominal trade balance GDP ratio (*delB*)	0.004	0	-0.001	0
Real depreciation	4.20	1.55	0.39	-0.28

This result can be confirmed with the following consistency check.

In percentage change form we may write:

$$gdp = S_A.a + S_E.e + S_M.m \qquad (3)$$

where *gdp* is the percentage change in gross domestic product; *a* is the percentage change in real domestic absorption; *e* is the percentage change in aggregate exports, *m* is the percentage change in aggregate imports and S_A, S_E and S_M are the shares of domestic absorption, exports and imports in the GDP. The values of S_E and S_M in our database are 0.10 and 0.18 respectively. By considering $a = 0$ (by assumption) and using the values for $e = 9.72$ and $m = 1.53$ from Table 7.1, equation (3) gives

$$gdp = (9.72*0.10)-(1.53*0.183)$$

$$= 0.692$$

which is very close to our model simulation result of 0.70 in the short run under simulation 1 (Table 7.1).

This movement of the trade balance is the result of an improvement in international competitiveness, i.e. a reduction in domestic costs relative to foreign prices. Tariff cuts reduce the domestic prices of imported manufactured goods that are used as inputs, as well as the prices of imported consumer goods. They also bring down the prices of the domestic counterparts of these goods, which brings down the consumer price index (CPI). Also because of our model's assumption of a fixed real wage rate, this reduction in the consumer price index leads to a corresponding decrease in nominal wages (-3.61). Since the foreign prices of export goods are not affected directly[127], this decrease in nominal wages leads to a reduction in real wages from the viewpoint of an exporter. Thus, tariff reform helps to induce lower domestic prices and to increase output and employment in exporting sectors. Table 7.1 shows export volume increasing by 9.72 per cent in the short run as Bangladesh expands production of commodities in which there is a comparative advantage. The sectors experiencing the largest export expansion are shrimp products, leather products, ready-made garments,

[127] Export selling prices are determined on world market and independent of domestic development (Dixon *et al.*, 1997).

knitting, and toiletries manufacturing, followed by miscellaneous industries and jute and jute products.

On the other hand, in the short run, a drop in domestic import prices (7.34 per cent) causes import volumes to increase by 1.53 per cent. To obtain the foreign currency to purchase these additional products, exports must increase more than proportionately (by 9.38 per cent). With a downward sloping export demand schedule, this growth in export volumes results in lower export prices (-0.57) leading to an equivalent deterioration in terms of trade (-0.57) (Table 7.1). Trade liberalisation also generates substantial real exchange rate depreciation. In the short run, with fixed world prices of imports (small country assumption), the decrease in domestic prices results in a real exchange rate depreciation of 4.20 per cent (Table 7.1). This depreciation again provides a general measure of the improvement in international competitiveness.

In the long run, in simulation 1, most macroeconomic variables change in the same direction as in the short run but by different magnitudes. For example, the percentage change in GDP in the long run is 0.821, which is higher than the short run figure of 0.70 per cent. The difference between the short run and long run results again reflects differences in the assumed closure. In long run closure, we treat the level of employment, rates of return on capital and the technical change variables as exogenous. On the supply side, with the above variables exogenous, the variation in real GDP comes mainly from increased capital inputs. As in the short run case, we can present the back-of-the-envelope calculations in the percentage change in GDP. Using equation (1) with respect to long run closure, we assume

employ_i = x1lnd_i = 0 (4)

The value of S_{cap} in our database is about 0.49 so that equations (1) and (4) suggest a value for GDP of about 0.686 (given the value of capital, *x1cap_i* (1.40)), which falls short of the simulation result of 0.82 (Table 7.1). Hence, the change in GDP is not fully explained by changes in capital. An additional factor which is at work is growth in indirect taxes (0.132), which need to be added to 0.686 to explain the full increase in GDP of 0.82.

In the long run, on the demand side, we assumed the trade balance to be exogenous, so that real aggregate absorption is determined endogenously. Now, with the fixed trade balance, the increased GDP from the supply side is matched by increased real absorption. The simulation results shows that in the long run, complete tariff removal has led to an increase in real aggregate private investment by 1.12 per cent and of aggregate capital stock by 1.40 per cent. In fact, capital has moved to those industries which are capital intensive and have a higher rate of return. Table 7.1 also shows in the long run, under simulation 1, real aggregate consumption has increased by 0.57 per cent, which can be viewed as one indicator of the welfare impact of tariff liberalisation. By assumption, government consumption demand also increased by 0.57 per cent. To prove that the model calculated the simulation results correctly, we performed a consistency check by employing the national income identity. Recalling equation (3)

$gdp = S_A.a + S_E.e + S_M.m$

where

$$S_A.a = S_c.c + S_i.i + S_g.g \quad (5)$$

In equation (5), c, i and g denote the aggregate real private consumption, aggregate real private investment and aggregate real government consumption; S_c, S_i, and S_g are the shares of real aggregate private consumption, real aggregate investment expenditure and real government consumption in GDP respectively. In our model database, the highest share is for real aggregate consumption (0.77 percent) followed by the share of investment (0.23 per cent). The share of imports (0.18 per cent) is higher than that of exports (0.10 per cent) while the share of government expenditure is only 0.05 per cent. Substituting these values along with model simulation results into equation (3) we compute the real GDP as follows:

$$gdp = 0.77*0.57 + 0.23*1.12 + 0.05*0.57 + 0.10*6.35 - 0.18*2.97$$

$$= 0.84$$

which is very close to our model simulation result (Table 7.1).

Imports also show faster growth (2.97 per cent) in the long run. This probably reflects increased consumption and investment, which showed no growth in the short run. Table 7.1 shows exports have also increased (6.35 per cent), and by more than imports, as the trade balance is assumed to be zero in the long run. However, the export growth rate in the long run is less than that in the short run (9.72 per cent). These differences can be explained in terms of differences in the model closure. In the short run, with fixed domestic absorption, any increase in real GDP is reflected entirely on the expenditure side by a change in the balance of trade (X-M). In contrast, in the long run with the fixed balance of trade assumption, expansion of the GDP is matched by the increase in domestic absorption.

In the long run also we observe the real exchange rate depreciates by 1.55 per cent which is less than in the short run; and export prices decrease by 0.30 per cent, which results in an equivalent deterioration of terms of trade of 0.30 per cent which is also less than the short run deterioration. Table 7.1 also shows that in the long run, tariff liberalisation induces an increase in real wages by 3.24 per cent which reflects the increased derived demand for labour stemming from the expansion of labour-intensive manufacturing industries[128]. Another striking feature is that both in the short run and in the long run, falls in the commodity prices of the basic need consumption bundles result in a decline in poverty lines (rural and urban) (Table 7.1). The rates of decline are higher for rural areas than for urban areas. These changes in poverty lines will be considered further in a later chapter (Chapter 8) to calculate the poverty incidences.

7.5.1.2 Simulation 2: Projected effects of a 100 per cent tariff cut in all sectors with a uniform consumption tax (2.70 per cent)

The short run and long run macroeconomic results of simulation 2 where a consumption tax is imposed to compensate for the revenue loss from an across the board tariff reduction are presented in columns 4 and 5 of Table 7.1. It is clear from the table that the macroeconomic impacts are less pronounced in this simulation than in the previous one. Table 7.1 shows that the imposition of the general consumption tax reduces real GDP (-0.04) and aggregate employment (-0.27) in the short run. The general consumption tax, which is levied on a broad range of goods and services, raises the consumer price index by the amount of the tax. However, the producer price index (price received by the producers) remains the same. Because nominal wages move with consumer prices (model assumption), there is a rise in real wages from the viewpoint of employers. As a result, aggregate employment decreases, which leads to decreased output for the economy as well as for the industries concerned.

[128] Simulation results for various labour types have been discussed in section 7.5.3.

A consistency check confirms that in the short run, with capital and land fixed, the decrease in real GDP originates from the percentage change in aggregate employment. By using the equation (1) and (2) from section 7.5.1.1 and the labour share of 0.42 from our database, we obtain a decrease in real GDP of about 0.113 per cent, given the fall of aggregate employment (-0.27) in Table 7.1. As before, by adding the change in indirect tax of 0.077 from the short run model simulation, we obtain an approximate change of (-0.113+0.077) = -0.036, which is approximately the same as our model simulation result.

With fixed real domestic absorption, the decreased real GDP from the supply side has to be matched by a decrease in the balance of trade. Table 7.1 shows that the balance of trade as a proportion of GDP has decreased slightly (-0.001). Using the values from Table 7.1 for e = 2.82 and m = 1.74 equation (3) also gives us

gdp = (0.10*2.82)-(0.183*1.74)

= -0.036

where $a = 0$, $S_E = 0.10$ and $S_M = 0.183$.

The reason for the deterioration in the trade balance is that the country's international competitiveness has decreased relative to simulation 1, because of the compensatory consumption tax. Increased costs of production reduce the volume of exports and increase the volume of imports compared to simulation 1. Moreover, the increased consumer price index (0.27 per cent) promotes an increase in the exchange of goods and services with the rest of the world, which leads to an increase in the import volume index of 1.74 per cent which is larger than the figure in simulation 1 (Table 7.1). However, the real exchange rate still depreciates marginally (0.394 per cent), and the terms of trade also fall marginally (-0.16 per cent).

In contrast to the short run, the long run simulation shows that real GDP increases by 0.69 per cent (Table 7.1). The increase in real GDP mainly results from growth in the capital stock and improved factor allocation efficiency. Not only are capital goods cheaper, but free capital mobility ensures that capital moves to the sectors where it is most productive. Because of the assumed closure, the aggregate employment and capital rate of return are unchanged, so the real GDP varies only with the total capital stock. In our simulation, the aggregate capital stock increased by 1.142 per cent. By using equations (1) and (4) from section 7.5.1.1 and the share for capital, S_{cap}= 0.49 from our database, our consistency check gives:

gdp = 0.49*1.142

= 0.559.

By adding the value of change in indirect tax (0.126), our calculated value of real GDP then becomes about 0.685, which is effectively the same as the simulated value of 0.686.

This increase in GDP from the supply side might be expected to increase real aggregate consumption. However, the imposition of the compensatory consumption tax directly increases consumer prices and reduces the purchasing power of disposable income and hence consumption. In simulation 2 in the long run, the fall in aggregate consumption is 0.310 per cent which can also be viewed as an aggregate welfare loss.

By assumption, since real government expenditure follows private expenditure, real government expenditure also falls by 0.310. Over the same period there is a 1.142 per cent growth in aggregate capital stock due to the fall in the aggregate rental price of capital (-0.62 per cent). Trade liberalisation reduces the domestic prices of imported capital goods which in turn reduces the overall costs of constructing capital (Adams, Horridge, Parmenter, & Zhang, 2000). Since aggregate investment follows the aggregate capital stock, aggregate real investment expenditure increases by 4.34 per cent (Table 7.1).

The expansion in the export volume index causes the export price index to decrease by 0.242 per cent and as a result the terms of trade also decrease by 0.242 per cent (Table 7.1).

Finally, as with simulation 1, tariff reductions with a compensatory consumption tax have changed the monetary poverty lines. However in this case they have risen, not fallen. Imposition of a uniform consumption tax increases consumer good prices and since consumers have no incentive to substitute between commodities, the result is an increase in monetary poverty lines both in the short run and the long run (Table 7.1).

7.5.2 Sectoral Effects

7.5.2.1 Simulation 1: Projected effects of a 100 per cent tariff cut in all sectors

As stated earlier, a reduction in tariff rates makes imports cheaper which leads to an increased inflow of imports. Lower import prices reduce the demand for domestic goods relative to imports. As a result, the output of import competing sectors falls. The extent of the fall depends on the import-elasticity of substitution, the import intensity of the sectors and the base line tariff. Appendix Table D 7.1 presents the pre-liberalisation situation in Bangladesh in 2000 as an aid to explaining the simulated industry results presented in Table 7.2. In Appendix Table D 7.1, the second column shows the share of imports in the local market sales. The base period values of the nominal tariff rates obtained from the I-O table 2000 for Bangladesh are shown in the third column, and the fourth column shows the share of output which is exported. For each commodity, import share is the ratio of the total imports of that commodity to the total value of domestic production and imports. Similarly, export share is calculated by the ratio of total exports of that commodity to total domestic output. Depending on export share and import penetration, in column five we classify the industries as import-competing (IC), export industries (E), export-related industries (ER) and non-traded goods[129]. Import competing (IC) industries are those which sell in markets where the level of import penetration is higher. For export industries (E), exports constitute a large part of total output and the level of export of these goods is endogenously determined in the model. Export-related (ER) industries do not export directly, but sell a large part of output to export industries. The remaining industries are termed non-traded (NT) industries.

According to Appendix Table D 7.1, in Bangladesh in 2000, export dependency was high for the ready-made garments industry (RMG) and knitting industry, with more than 75 per cent of their products sold abroad. In addition, the jute and jute products industries sold almost 20 per cent and 56 per cent respectively of their outputs in the international market. The tea cultivation, shrimp, leather products, fertiliser and insecticide industries were also important export industries. On the other hand, the machinery and cement industries were clearly import-competing industries, facing import shares of about 71 per cent and 67 per cent respectively. Glass products, chemical products, miscellaneous industries, chemical industries

[129] As discussed in Chapter 6, the negligible shares of by-products in total output of various industries in I-O table 2000 are ignored. It is assumed that most of these industries supply one commodity.

and petroleum products were also prominent import-competing industries. Baling and cloth mill industries are considered export-related industries, as they sell a major part of their output to export oriented industries such as jute fabrication and the ready-made garments (RMG) industry

Ready-made garments, knitting and petroleum products have both high export and import shares, reflecting the fact that a large percentage of production of these industries represents the processing and assembling of products from abroad. Output of the non-traded industries is sold mainly to final demand. The sectoral tariff rates suggest that Bangladesh provides high protection for manufacturing and some final consumption goods industries. In some sectors such as ready-made garments and knitting the tariff rate is very small, less than 10 per cent, implying that tariff exemptions are applied to their imports of intermediate inputs and processed goods.

Industry results for simulation 1 are shown in column 3 to 6 of Table 7.2. They are interpreted in the light of the macroeconomic results. Our macroeconomic results show that in the short run tariff liberalisation induces a move towards trade surplus. Referring back to the assumptions used in the closure, in the short run the major components of real absorption (real aggregate household consumption, real government expenditure and real aggregate investment) are fixed, so the main contributing element is the increase in exports. Thus we expect that trade liberalisation induces export-oriented industries to expand both in terms of output and employment. In simulation 1, in the short run the expanding industries are jute cultivation, tea cultivation, and shrimp farming in the agricultural sector. In the manufacturing sector ready-made garments, knitting, baling, jute fabrication, toiletries manufacturing, cloth milling and leather industries are the largest winners. Amongst these, baling and cloth milling are export related industries. The baling industry supplies the majority of its output to the jute fabrication industry whereas the ready-made garments industry uses 75 per cent of cloth milling products. Thus, expanding the jute fabrication industry and ready-made garments industry has initiated the corresponding expansion of these two ER industries.

A decomposition (Fan decomposition)[130] of the output results presented in Table 7.2 shows that the changes in the total output can be divided into:

(1) local market effects - overall increase in local demand for the corresponding commodity whether it is produced locally or imported;

(2) domestic share effect - replacement of imports by domestic goods; and

(3) export effect - the contribution of growth in exports to the change in the output.

These three contributions to changes in output are reported for simulation 1 in Appendix Table D 7.2 for both the short run and long run. Fan decomposition reveals that for most of the expanding manufacturing and agricultural industries, it is the increase in exports which leads to this expansion. For example, for the ready-made garments industry in the short run, its output increases by 4.85 per cent (Table 7.2). This is mainly the result of an increase in exports of ready-made garment products by 6.47 per cent (simulation output). Since exports account for about 75 per cent of the total sales of this industry, the contribution of the increased export to the change in the total output is 4.85 per cent (6.47*0.75). In this case, the local demand effect and import competition contributes a negative but negligible effect to its output change effects (Appendix Table D 7.2). Likewise in the knitting industry, its output increases by 5.41 per cent (Table 7.2).

With an export share of 0.75 per cent and the increase in exports of 7.31 per cent, the contribution of the export expansion is 5.48 per cent (0.75*7.31). The same is true for jute cultivation, tea cultivation, shrimp farming, leather products, toiletries manufacturing and miscellaneous industries. These industries were efficient before the tariff cut and trade liberalisation has initiated productive resources to move from inefficient import substituting and non-exportable industries to these exportable sectors.

[130] Fan decomposition was named after Fan Ming-Tai, of the Academy of Social Sciences, Beijing, who defined the relative magnitude of three possible contributions to output change.

Table 7.2: Projected effects of a 100 per cent tariff cut: output and employment by industry (percentage changes)

		Simulation 1				Simulation 2			
		Short run		Long run		Short run		Long run	
Industry	Trade cate-Gory	Output	Employment	Output	Employment	Output	Employment	Output	Employment
Paddy	NT	-0.057	-0.096	0.117	-0.38	-0.382	-0.642	-0.41	-0.825
Wheat	IC	-0.225	-0.375	0.213	-0.262	-0.87	-1.443	-0.81	-1.272
Othergrain	NT	-0.201	-0.445	0.365	-0.293	-0.473	-1.044	-0.815	-1.485
JuteCultiv	E	2.278	3.397	-0.261	-0.683	0.097	0.143	-0.675	-1.023
SugcaneCulti	NT	-0.856	-1.836	-1.02	-1.931	-1.262	-2.695	-1.698	-2.523
PotatoCulti	NT	-0.033	-0.08	0.138	-0.624	-0.135	-0.326	-0.218	-0.815
VegCulti	IC	0.333	0.746	-0.92	-1.837	-0.665	-1.47	-1.149	-1.89
PulseCulti	NT	-0.051	-0.121	0.177	-0.572	-0.201	-0.482	0.117	-0.404
OilseedCulti	IC	-0.512	-0.934	-1.969	-2.859	-1.135	-2.06	-2.209	-2.962
FruitCulti	IC	-1.28	-3.786	-1.799	-3.184	-1.531	-4.505	-2.219	-3.427
CottonCulti	IC	0.694	1.955	0.503	-0.258	-0.423	-1.167	-0.06	-0.687
TobaccoCulti	IC	-0.245	-0.494	-0.575	-1.342	-0.979	-1.965	-1.495	-2.225
TeaCulti	E	2.161	4.671	0.48	-0.122	0.252	0.534	-0.069	-0.564
SpiceCulti	IC	-2.301	-5.104	-3.541	-4.99	-2.829	-6.235	-4.008	-5.325
OthcropCulti	NT	0.031	0.07	-0.201	-0.995	-0.484	-1.1	-0.211	-0.778
LivstockRear	NT	0.054	0.125	0.588	-0.05	-0.264	-0.609	1.673	1.505
PoultryRear	IC	-0.187	-0.447	0.313	-0.404	-0.41	-0.975	-0.702	-1.398
ShrimFarming	NT	2.683	6.111	2.113	1.819	0.679	1.508	1.421	1.208
Fishing	NT	-0.211	-0.557	0.458	-0.287	-0.29	-0.765	-0.447	-1.144
Forestry	NT	-0.088	-0.26	0.703	-0.038	-0.261	-0.766	2.269	2.227
RiceMilling	NT	-0.057	-0.274	0.041	-1.232	-0.315	-1.494	-0.554	-1.431
GrainMilling	NT	-0.286	-1.466	0.291	-1.01	-0.361	-1.844	-0.42	-1.317
FishProcess	E	0.565	3.261	0.172	-1.151	-0.374	-2.065	-0.928	-1.836
OilIndustry	NT	-0.499	-2.319	-2.65	-3.884	-1.024	-4.674	-3.248	-4.099
SweetenerInd	NT	-0.841	-1.003	-0.996	-1.255	-1.22	-1.454	-1.606	-1.784
TeaProduct	NT	-0.612	-1.017	-0.145	-0.788	-0.612	-1.017	-0.77	-1.213
SaltRefining	IC	-0.011	-0.017	0.513	-0.006	-0.422	-0.621	0.182	-0.177
FoodProcess	IC	-1.051	-2.233	-1.432	-2.28	-1.461	-3.09	-2.087	-2.67
TannFinish	IC	1.516	4.959	1.265	0.153	0.294	0.935	1.648	0.873
LeatherInd	IC	1.739	5.242	1.501	0.43	0.34	0.997	1.963	1.216
Baling	ER	7.198	21.699	-0.595	-1.591	1.091	2.95	-0.942	-1.63
JuteFabricat	IC	4.927	5.62	-0.515	-0.703	0.743	0.843	-0.721	-0.851
YarnIndustry	IC	0.982	1.385	0.821	0.354	-0.961	-1.344	-0.188	-0.509
ClothMill	ER	2.727	5.348	3.074	2.284	0.422	0.809	1.874	1.333
HandloomClot	E	-0.375	-0.497	0.253	-0.141	-0.372	-0.493	-0.646	-0.918
DyeingBlech	NT	-0.222	-0.36	0.294	-0.325	-0.404	-0.655	-0.784	-1.209
RMG	E	4.853	8.128	5.37	4.72	0.924	1.509	3.453	3.01
Knitting	IC	5.41	9.093	8.809	8.137	1.52	2.492	7.532	7.072
ToiletrieMfg	IC	2.448	5.828	10.56	9.555	0.855	1.993	8.612	7.926
CigarettInd	NT	0.108	0.807	0.691	-0.709	0.177	1.333	-0.03	-0.994
BidiIndustry	NT	0.01	0.035	0.458	-0.689	0.042	0.147	-0.117	-0.908
SawPlane	E	0.075	0.18	0.266	-0.669	-0.324	-0.769	-0.326	-0.97
Furniturind	E	0.456	1.093	0.56	-0.378	-0.255	-0.606	-0.188	-0.834
PaperInd	E	-0.64	-2.206	-2.46	-3.579	-1.39	-4.702	-3.242	-4.012
PrintPub	NT	0.432	0.699	-0.17	-0.781	-0.611	-0.983	-0.517	-0.939
PharmaMfg	NT	0.315	0.728	0.512	-0.402	-0.195	-0.447	0.206	-0.426

FertiliseInd	NT	0.649	2.852	3.469	2.193	-0.006	-0.024	0.934	0.07
BasiChemical	NT	0.356	0.776	-0.884	-1.742	-0.752	-1.616	-1.163	-1.757
PetroleumRef	IC	-2.805	-12.506	-7.013	-8.205	-3.823	-16.451	-7.511	-8.334
EarthwareInd	NT	0.05	0.223	-0.775	-2.014	-0.78	-3.404	-1.67	-2.522
ChemicalInd	IC	-0.366	-1.164	-0.279	-1.381	-0.448	-1.423	-0.214	-0.979
GlassInd	IC	-1.996	-3.888	-4.202	-4.966	-3.088	-5.952	-4.282	-4.811
ClayInd	IC	0.116	0.269	0.994	0.07	-0.002	-0.004	3.642	2.984
CementMfg	IC	-2.198	-6.282	-4.938	-5.953	-2.816	-7.955	-3.399	-4.115
BasicMetaMfg	IC	-0.363	-0.723	-0.526	-1.326	-0.993	-1.968	0.529	-0.032
MetalMfg	IC	-0.635	-1.285	-0.59	-1.403	-1.041	-2.096	-0.872	-1.434
MachineEquip	IC	-0.729	-1.083	-3.497	-4.007	-2.828	-4.158	-2.994	-3.35
TranspoEquip	NT	-0.205	-0.792	-0.936	-2.117	-0.931	-3.522	-0.425	-1.249
MiscellaInd	IC	1.554	4.145	5.049	4.01	0.109	0.283	2.269	1.567
Urbanbuild	IC	0.183	0.51	1.152	0.112	0.084	0.234	4.009	3.267
RuralBuild	IC	0.06	0.198	1.068	-0.062	-0.028	-0.092	4.046	3.239
PPlantBuild	IC	-0.011	-0.052	1.155	-0.124	0.003	0.015	4.398	3.482
RuRoadBuild	IC	-0.015	-0.044	1.124	0.059	-0.014	-0.04	4.369	3.607
PoRoadBuild	IC	0.406	0.692	1.114	0.446	0.094	0.16	3.599	3.123
CaDyothBuild	NT	-0.013	-0.022	1.115	0.416	-0.001	-0.001	4.348	3.847
ElectWatGene	NT	0.292	1.294	0.764	-0.486	-0.158	-0.689	-0.218	-1.077
GasExtDist	NT	-0.145	-0.503	0.405	-0.745	-0.45	-1.551	-1.045	-1.831
MinQuarring	NT	-0.164	-0.376	-0.048	-0.817	-0.531	-1.215	0.254	-0.218
WholeTrade	NT	0.622	1.433	1.024	0.111	0.051	0.117	0.607	-0.024
RetailTrade	NT	0.534	1.235	1.01	0.094	0.048	0.111	0.553	-0.08
AirTransport	NT	1.435	2.231	1.104	0.533	0.291	0.45	0.691	0.296
WatTransport	NT	2.981	11.627	1.274	0.099	0.747	2.739	0.916	0.103
LanTransport	NT	0.579	1.789	1.073	-0.019	0.055	0.167	0.524	-0.23
RaiTransport	NT	0.629	0.765	1.016	0.729	0.051	0.062	0.571	0.373
OthTransport	NT	1.905	3.717	0.707	-0.067	0.056	0.108	0.165	-0.369
HousingServ	NT	0.027	0.341	0.505	-0.981	-0.123	-1.519	-0.455	-1.476
HealthServ	NT	0.116	0.244	0.551	-0.295	-0.237	-0.497	0.913	0.324
EducatServ	NT	-0.013	-0.015	0.196	-0.062	-0.403	-0.48	-0.795	-0.972
PubAdDefence	E	5.325	6.605	1.221	0.922	1.456	1.79	0.779	0.573
BanInsRestat	NT	0.713	1.128	0.569	-0.021	-0.156	-0.245	0.305	-0.103
ProfesioServ	NT	0.893	2.359	0.667	-0.329	-0.097	-0.253	0.465	-0.225
HotelRest	NT	0.258	0.493	0.479	-0.288	-0.227	-0.433	-0.587	-1.114
Entertainmen	NT	0.057	0.109	0.238	-0.527	-0.421	-0.8	-0.877	-1.402
Communicatio	NT	1.866	3.655	0.506	-0.269	-0.032	-0.062	-0.456	-0.989
OthServices	NT	0.201	0.243	0.096	-0.184	-0.512	-0.619	-0.521	-0.714
InfotechEcom	E	1.427	2.783	0.551	-0.225	-0.044	-0.085	-0.004	-0.539

A decomposition analysis of output price (*p1tot*) with AnalyseGE[131] (Horridge and Harrison, 2004) shows that the decrease in the prices of material inputs (*p1*) and the reduction in labour costs (*p1lab*) have contributed to this significant expansion of the above mentioned export-oriented industries. Besides these, some export-oriented and import-competing oriented industries have gained the benefits of cheaper inputs. For example, cheaper fish imports

[131] AnalyseGE is a software tool of GEMPACK that provides modeller with "point and click" access to the model equations, the data and the simulation results. By quickly moving between these information sources, the modeller can explain the main mechanism of simulation results.

which have expanded the fish processing industry which uses 89 per cent of imported fish. Similarly, increased imports of sugar, gur, and molasses have benefited the food processing industry which uses about 47 per cent of this imported product in its production. Other industries, especially service industries such as urban and rural building, land transport and other transport which use intensively imported petroleum products, glass products, cement and transport equipments, enjoy a substantial reduction in their input costs, leading to a reduction in their output costs.

On the other hand, increased import competition as a result of tariff elimination has led to reduced output of some import-competing (IC) industries. In the short run, the maximum decline in production are in fruit cultivation (-1.28 per cent), spice cultivation (-2.30 per cent), food processing (-1.05 per cent), the glass industry (-1.20 per cent), petroleum refinery industry (-2.81 per cent) and cement manufacturing industry (-2.20 per cent).

These are the industries which were protected by high tariff rates on competing imports (Appendix Table D 7.1) and they sell mainly to final consumption. Decomposing the change in total imports by commodity and by usage (Appendix Table D 7.3) shows that households account for most of the changes in imports that compete with local output. For example, for fruit cultivation commodities, about 91 per cent of the increase in imports was absorbed by household consumption whereas for spice cultivation, the sweetener industry, food processing industry, petroleum refinery industry and glass product industry these figures were 83.54 per cent, 98.15 per cent, 91.44 per cent, 60.26 per cent and 99.35 per cent respectively (Appendix Table D 7.3). Fan decomposition (Appendix Table D 7.2) also reveals that in the short run, for the majority of the above mentioned industries, a substitution from domestic goods to cheaper import goods has led to contraction in their outputs. For example, the petroleum products industry which experienced the largest decline in output (-2.81 per cent), has an import intensity of 0.61 per cent and comparatively high tariff rates (24.40 per cent) (Appendix Table D 7.1). The reason for this decline can be clarified as follows.

In Bangladesh, consumption of petroleum products depends heavily on imports and most of the imported products are consumed by the transport sector, industry sector, agricultural sector and household sector. Bangladesh also imports crude petroleum to manufacture different kinds of petroleum products used in various industries. Now with tariff reduction, import expansion to substitute cheaper imports of petroleum products for a high cost domestic alternatives is the main reason for the decline of this sector's output. Fan decomposition table (Appendix Table D 7.2) also shows that the increase in local demand (1.17 per cent) and marginal increase in export (0.41 per cent) are far outweighed by increased import penetration (-4.39 per cent) for the petroleum product industry. The same is true for the spice industry, where output decreases by 2.30 per cent (Table 7.2). Our input-output database shows that this industry sells about 70 per cent of its total output to the household sector. With tariff elimination, households' substitution for a cheaper imported variety has led to its decreased production. Decomposition of total imports among various users (Appendix Table D 7.3) also shows that about 83 per cent of the increase in total imports of spice has been directed to the household sector. For other industries, such as wheat, other grains, sugar cane cultivation, oilseed cultivation, oil industry, tea products, handloom cloth and dyeing bleach, shrinking local market effects have contributed to marginal declines in output (Table 7.2).

Another most striking feature is that along with the expansion of export-oriented and export-related industries, trade liberalisation also brings an increase in output in service sectors. Service sectors, especially air transport, water transport, other transport, retail and wholesale trade, public administration and defense and communication sectors, experience positive growth because they are interlinked with the trade sectors. Trade liberalisation does not affect them directly as initially they were unprotected. However, tariff elimination, which results in decreased domestic prices and increased local demand for other products, also leads to increased activities in these sectors. The service sector, public administration and defense have experienced the highest growth in output (5.33 per cent) and employment (6.61 per cent) (Table 7.2) in the short run. A sales decomposition analysis shows that for these sectors, although household demand contributes negatively, it's overall output change is dominated by a large increase in export demand, e.g. UN peace keeping service from Bangladesh. For education services for which the household sector is a main customer, its output changed mainly because of a fall in household demand.

In the long run as in the short run, the impact of tariff removal on imports is felt most strongly in those import-competing industries with a positive level of protection. Imports rise most for fruit cultivation, spice cultivation, tea products, fish and seafood followed by sugar, gur, and molasses, china pottery, processed food, milk fat and leather products. These are the commodities that experienced higher import growth in the short run. However, the degree of expansion is larger in the long run. Because of cheaper imports, output declines mostly in the petroleum refinery industry (-7.01 per cent), cement manufacturing (-4.94 per cent), glass industry (-4.20 per cent), machinery equipment (-3.50 per cent) and spice cultivation (-3.54 per cent) (Table 7.2). Accordingly, employment also decreases for these industries. As in the short run, Fan decomposition reveals that for most of these industries, a substitution from domestic to cheaper imported products has initiated the decrease in their output (Appendix Table D 7.2). A decomposition analysis by AnalyseGE (Horridge & Harrison, 2004) also shows that households account for most of the changes in the imports of the above mentioned commodities.

In contrast, the most rapidly expanding industries in the long run are ready-made garments (5.37 per cent), knitting (8.81 per cent), toiletries manufacturing (10.56 per cent), miscellaneous industry (5.04 per cent), fertiliser and insecticide industry (3.47 per cent) and the cloth milling industry (3.07 per cent). These industries also experienced expansion in the short run, but long run output and employment growth are more pronounced (Table 7.2). Capital mobility has made output growth more pronounced in the long run. Referring back to the method of closure in the long run, with aggregate employment fixed (even though labour is mobile between sectors), any increase in real GDP must come from an increase in capital usage and improved factor allocation. According to our macro simulation results, in the long run tariff reduction increases real wages (3.24 per cent) and decreases the cost of using capital (-1.30 per cent). The reduced capital costs induce industries to increase their capital to labour (K/L) ratios. With aggregate employment fixed in the long run, this increase in K/L ratios implies increased investment which contributes to increases in output. Export-oriented industries such as ready-made garments, knitting, the toiletries manufacturing industry, shrimp farming and miscellaneous industries have mostly reaped the benefit of lower capital costs in the long run.

Nevertheless, tariff liberalisation has also helped expand the industries which sell mainly to the household sector and investors because with the trade balance as a percentage of GDP (*delB*) fixed, real aggregate absorption increases. In the long run, increases in output in paddy, wheat, other grains, potato cultivation, tea cultivation, poultry rearing, fishing, the cigarette industry, bidi industry, handloom cloth industry, processed food, housing service, hotel and restaurant and entertainment can all be regarded as primarily the result of increased real aggregate consumption. The sales structure database (Appendix Table D 7.4) shows that for these industries, the household sector occupies a major part of their sales. Similarly, increases in output in urban building, rural building, power plant building, rural road building, port-road-railway building, and canal dyke and other building can all be attributed primarily to increases in real aggregate investment.

Another striking feature in the long run is that, as opposed to the short run, the jute fabrication and baling industries have contracted (Table 7.2). Among the agricultural products it is the contraction of the jute industry which has led to the contraction of these industries. According to our input-output database, the jute fabrication industry uses about 86 per cent of its input from jute products whereas the baling industry uses about 82 per cent of jute fabrication. The fall in jute production is explained by its increased average input cost. A decomposition analysis by AnalyseGE (Horridge and Harrison, 2004) reveals that in the long run increased labour cost, have contributed to the increased input price of this sector; in addition this sector did not reap any lower import benefit because of tariff liberalisation. Thus output fell for this sector. The decreased output of this sector also contributed to the decrease in volume of exports in the long run (6.35 per cent) compared to short run (9.72 per cent).

In the long run results, as in the short run, many service sectors have experienced output gains. Table 7.2 shows that all service sectors have shown positive growth in the long run. The service industries mainly linked with the expanding agricultural and manufacturing industries seem especially to have grown. For example, wholesale trade, retail trade, various transport, storage, bank and insurance, communication and information technology sectors have shown significant growth (Table 7.2). The reason is that the expanding agricultural and manufacturing industries have direct backward linkages for these service sectors where their outputs are used as inputs.

7.5.2.2 Simulation 2: Projected effects of a 100 per cent tariff cut in all sectors with a uniform consumption tax (2.70 per cent)

The sectoral results of a 2.70 per cent consumption tax along with complete tariff removal are presented in columns 7 to 10 of Table 7.2. Because of tariff liberalisation, domestic import prices generally decline. However, because of the general consumption tax levied on a broad range of goods and services, the decline in prices is less than before. In fact, the consumption tax increases the consumer price index (CPI), which in turn increases nominal wages (model assumption). Since the general consumption tax does not change relative commodity prices, for consumers there is no incentive to substitute goods. Thus, output contracts in most sectors, especially the labour intensive sectors, related with household consumption and local consumption. In the short run the most affected industries are the petroleum refining industry (-3.83 per cent), the glass industry (-3.09 per cent), machinery and equipment (-2.83 per cent) and spice cultivation (-2.83 per cent) (Table 7.2). For these industries, the decreases in output are larger than in simulation 1. A Fan decomposition analysis (Appendix Table D 7.5) by AnalyseGE reveals that for most of the commodities, decreased local demand and substitution of imported commodities has led to decreases in output. In addition, short run falls in output in vegetable cultivation, other crop cultivation, housing service, hotel and restaurant, entertainment and communication services can be regarded as the direct effect of the consumption tax (Table 7.2).

In our analysis of the macro economy we noticed a small move towards a trade deficit (Table 7.1). With real aggregate absorption fixed in the short run, the decrease in real GDP has been matched by decreased export volumes and increased import volumes. The main reason for the decrease in export volumes is the increase in domestic costs relative to foreign prices. Increases in production costs because of a uniform consumption tax have led to a loss of international competitiveness, which harms those industries that sell a large part of their output to foreigners. It also harms import-competing industries, which are already adversely affected by tariff cuts. Thus, it appears that a policy of eliminating tariffs accompanied by a compensatory consumption tax results in a comparatively poor performance of the export sector of the economy. The export-oriented agricultural and manufacturing industries experience lower production increases than under tariff reform only without a compensatory consumption tax. For example, under a uniform consumption tax, the ready-made garments, knitting, toiletries manufacturing, jute and jute products, and shrimp farming industries had output growth rates of only 0.92 per cent, 1.52 per cent, 0.86 per cent, 0.10 per cent, 0.74 per cent and 0.68 per cent respectively. These are substantially lower than the corresponding short-run figures under simulation 1 (Table 7.2). The main reason is that for these commodities, their f.o.b export prices fell less than in the case of simulation 1 because of the basic price of domestically produced commodities fell less or increased slightly in some cases, owing to increased production costs. A decomposition analysis by AnalyseGE reveals that increases in nominal wages exerted upward pressure on the basic prices of these export commodities.

Along with the contraction of many manufacturing and agricultural sectors, growth in the service sectors was also hampered. The output growth rates for the wholesale trade, retail trade, air transport, water transport, land transport, bank and insurance and communication sectors are 0.05 per cent, 0.05 per cent, 0.29 per cent, 0.75 per cent, 0.06 per cent, -0.16 per cent and -0.03 per cent respectively (Table 7.2). This is a result of the deficient domestic final demand and reduced input demand from the trade related sectors.

In the long run, tariff liberalisation with a compensatory consumption tax produces similar effects but with some exceptions. In the long run with fixed aggregate employment, the increase in real GDP is attributable, apart from changes in resource allocation, to faster growth in the fixed capital stock. Accordingly we expect faster expansion in output in the investment related sectors. Take, for example, urban building (4 per cent), rural building (4.05 per cent), power plant building (4.40 per cent), rural road building (4.37 per cent), port-road-building (3.60 per cent) and canal dyke and other buildings (4.35 per cent) which all show impressive expansion compared to the short run. However, as with the short run, there are falls in output for labour-intensive consumption goods sold mainly to households, as the consumption tax reduces disposable income. Examples are found in vegetable cultivation, oilseed cultivation, fruit cultivation, spice cultivation, the oil industry, sweetener industry, food processing industry, paper industry, glass industry and gas extraction and distribution industry. For vegetable cultivation, fruit cultivation, spice cultivation, the fish industry, food processing industry, sweetener industry, glass industry and cigarette industry, households constitute about 88 per cent, 99 per cent, 70 per cent, 90 per cent, 75 per cent, 89 per cent 80 per cent and 89 per cent respectively of total sales (I-O table database).

However, compared with the short run, tariff elimination with a compensatory consumption tax has helped export industries. In this case, inter-industry mobility in capital and labour has offset the impacts of increased production costs. By allocating capital and labour to the more efficient sectors, trade liberalisation enhances output growth. The next section will discuss the simulation results for factor price changes and the associated employment effects by occupation.

7.5.3 Effects on Factor Price Changes and Employment by Occupation

Simulation 1 shows that in both the short run and long run there is a re-allocation of resources towards exportable sectors from non-exportable sectors and from the import competing sectors. In the short run, this re-allocation has caused all factors of production to suffer a decline in their nominal remuneration. The main reason is the contraction of major domestic sectors and falls in product prices. In the case of land, contraction in agricultural outputs such as paddy, wheat, sugar cultivation, fruit cultivation, spice cultivation, fishing and forestry reduce the demand for land, whereas expanding output in other agricultural industries such as jute cultivation, cotton cultivation, tea cultivation, and shrimp farming has increased demand for land and the return of it. In the short run, the net effect is a decreased demand for land, resulting in a decline in the land factor return (-3.53 per cent) (Table 7.3). However, after deflating with the GDP deflator, the real return to land enjoys a small increase of 0.49 per cent.

A similar effect occurs with the return to capital. Since capital has been considered as fixed in the short run, the real return of this factor varies with the output of the related industry. Referring back to our sectoral results, in the short run output has increased for the manufacturing and service sectors. Even though capital intensities are low in agricultural production activities, they are relatively high in manufacturing and some service sectors such as rural building, electricity and water generation, wholesale trade and retail trade, housing services and professional services. With increasing demand in expanding sectors the return on capital increases, while in declining sectors such as in food processing, petroleum refinery, the cement manufacturing industry and in mining and quarrying, capital returns decline. In aggregate, the real return to capital increases by 2.87 per cent.

Table 7.3 shows that under simulation 1 in the short run, nominal wages fall by 3.61 per cent. This reflects the closure assumption that the nominal wage rate is fully indexed to the CPI. In our first simulation, in the short run, tariff removal leads to a fall of the CPI by 3.61 per cent; as a result, the nominal wage rate declines by this amount.

Table 7.3: Percentage changes in nominal factor prices

	Simulation 1			Simulation 2	
ORANI-G code	**Short run**	**Long run**	**Variable**	**Short run**	**Long run**
P1lab_i	-3.61	1.96	Price of labour	0.27	1.63
P1cap_i	-1.24	-1.30	Rental price of capital	-0.77	-0.62
P1lnd_i	-3.53	0.99	Rental price of land	-1.43	0.67

Under simulation 1, in the long run nominal returns to labour and land increase, but the return to capital declines. The reasons again lie in the closure rule. In the long run, aggregate employment is fixed but labour is allowed to move between sectors, while capital is also mobile whereas its rate of return is fixed. Recalling our long run sectoral results, the removal of tariffs results in expanded production in exportable sectors such as ready-made garments, knitting, toiletries, cloth mills, miscellaneous industries and, most importantly, in many non-tradable service sectors, which are relatively labour intensive. Thus the increased demand for labour triggers an increase in money wages (Table 7.3). With the increase in labour costs, producers will try to substitute alternative factors, which results in a decrease in employment. With the decrease in labour employment, the capital to labour ratio (K/L) increases, which in turn decreases the marginal productivity of capital, and as a result, capital rewards will also decline. Table 7.3 shows, in the long run, nominal capital rewards have declined by 1.30 per cent.

Increased output of some agricultural sectors such as paddy, wheat, other grains, cotton cultivation, tea cultivation, livestock rearing, shrimp farming, and forestry tends in the long run to boost returns to land, but decreased production of some other agricultural products such as sugarcane cultivation, oilseed cultivation, fruit cultivation, and spice cultivation places downward pressure on these returns. On balance, the upward pressure outweighs the downward pressure so that the nominal return on land increases by 0.99 per cent.

In the full tariff elimination scenario with a replacement consumption tax, nominal factor returns fall in the short run for all factors except labour (Table 7.3). The fall in domestic output prices as a result of the removal of import tariffs causes this effect. Note that these falls in nominal factor remuneration are less than those in the simulation 1 short run case. This is because increased consumer prices have partially offset the output price effect. The slight increase in the nominal factor returns from labour (0.27 per cent) can be traced to the closure rule. In the short run, nominal labour returns are fully indexed with the consumer price index. Thus, the introduction of the consumption tax raises consumer prices, which ultimately increases money wages.

The long run changes in nominal factor returns under simulation 2 are similar in direction to the long run results of simulation 1, though the magnitudes are less. Recalling our macroeconomic results, with a fixed balance of trade/GDP ratio, and with reduced aggregate real household consumption and government expenditure, the increase in real GDP is confined/confirmed on the expenditure side to the increase in aggregate real investment. Increased output in capital goods producing sectors (for example, urban building, rural building, power plant building, rural road building, canal dyke and other building, port-road-building and the forestry industry) is a reflection of the increase in investment. This increase adds to the capital stock, so that with aggregate employment unchanged, the marginal productivity of capital decreases, which in turn reduces its return (-0.62 per cent).

Table 7.4 depicts the employment results among occupational categories. These projections reveal that in the short run under simulation 1, the female low-skilled category gains most, followed by the male high-skilled category. The reason is the high concentration of low-skilled female workers in the expanding ready-made garments industry. Our model database for Wage Bill Matrix V1LAB (Appendix Table D 7.6) shows that workers in this labour category constitute about 63 per cent of the labour force in the expanding ready-made garments industry and knitting industry. As a result, low-skilled female workers experience the highest rate of employment growth in the short run. In contrast, low-skilled male workers are highly concentrated (about 87 per cent) in the contracting paddy sector where employment falls in the short run. However, this decrease in male employment is offset by increased employment in expanding service sectors such as urban building, rural building, wholesale trade, retail trade, land transport and other transport, so that total low-skilled male employment increases by 1.18 per cent.

Table 7.4: Employment by occupation (percentage changes)

	Simulation 1		Simulation 2	
Occupational groups	**Short run**	**Long run**	**Short run**	**Long run**
Male low-skilled	1.18	-0.15	-0.05	1.58
Male high-skilled	1.81	0.02	-0.09	1.54
Female low-skilled	2.53	0.99	0.66	2.30
Female high-skilled	1.09	0.14	-0.31	1.32

In the long run also under simulation 1, the low-skilled female category benefits most whereas the benefit to high-skilled males is negligible. The worst case is for low-skilled males whose employment decreases by 0.15 per cent. Our simulation results show that in the long run, total employment in the industries where this labour category is highly involved has seriously contracted, with cheaper capital being substituted for labour (Table 7.2). As a result, the male low-skilled labour category as a whole experiences a contraction in employment.

In simulation 2 where the revenue effect of tariff reduction is compensated by a consumption tax, the female low-skilled category again experiences the highest rate of increase in employment in both the short and long runs.

The next sub-section discusses how the changes in factor prices affect household income.

7.5.4 Effects on Households' Income

Variation in factor remuneration affects the income of household groups according to their sources of income. Household income changes for various scenarios are summarised in Table 7.5. It shows that in the short run under simulation 1, nominal income falls for all household groups. The most substantial decline is experienced by the rural landless household group, whose nominal income falls by 2.26 per cent, whereas for marginal farmers, small farmers and non-agricultural labour, these values are -1.94 per cent, -1.85 per cent, and -1.84 per cent respectively. Large farmer households experience the smallest decrease in their nominal income (-1.51 per cent). Urban household groups also experience a decline in their nominal income. As with the rural groups, richer households in urban areas - such as medium-educated and high-educated households - experience a smaller percentage decline than other urban groups (Table 7.5). For each household category, real income has been calculated by deflating the changes in each household's nominal income with the corresponding consumer price index. Our simulation results show even though the rural and urban household groups suffer from the decrease in nominal income, however, they can mitigate their income loss with the benefit from price decrease.

In contrast to the short run, the percentage changes in income (both in nominal and real terms) in the long run under simulation 1 are positive for all household groups, both in rural and urban areas. Moreover, the types of households that are relatively unfavourably affected by the tariff removal in the short run are relatively favourably affected in the long run. For example, the rural landless household group, which was identified as the maximum income loser in the short run simulation, experiences the highest income increase in the long run. Agrawal (1989) found the same sort of results for her tariff reform experiment on the distribution of income for 40 types of Australian household groups. In our case, the difference in closure assumptions between the two simulations is responsible for the different distributional results. In the long run, it is assumed that the real wages are endogenously determined, whereas aggregate employment is held fixed i.e. the economy is in full employment, and labour is mobile among industries. As a result, real wages increase in the long run, whereas in the short run the gains from the removal of tariffs are absorbed by the increase in employment.

The distributional results can also be analysed in terms of changes in the sources of income changes for household groups. Referring back to Table 6.9 in Chapter 6, which provides the factorial income composition for each household group, it is observed that in rural areas landless households and marginal farmer households receive income mainly from wages, with wages accounting for about 99 per cent and 70 per cent of total factor income respectively. On the other hand in urban areas, capital income accounts for the major part of the factor income of urban medium-educated and high-educated households (59 per cent and 62 per cent respectively). Thus, a fall in wage income can be expected to affect the rural poor more than the urban household group, while a decline in capital income is likely to hurt the urban rich groups more than the rural poor.

Our simulation results show that in the short run, rural households have a more substantial loss of nominal income than their urban counterparts. The main reason is the contraction of output mostly in the agricultural sectors such as paddy, wheat, sugarcane cultivation, spice cultivation and the tea product industry, upon which a large number of rural poor depend for their livelihoods (Appendix Table D 7.6). Another reason for the comparatively marked decline in the income of rural landless and marginal farmer households is the reduction in transfer income from government, due to the decline in the government revenue collection from tariffs. In contrast, large farmer households in the rural areas and households headed by medium-educated and high-educated in urban areas appeared to suffer less in terms of nominal income because of their reliance on income for capital and high-skilled labour (Table 6.8 and 6.9 of Chapter 6). Expansion of the manufacturing and service sectors in the short run increases the gross operating surplus which forms a significant income source for these groups (Table 6.8).

In the long run however, all types of households experience an increase in their nominal disposable income and nominal income gains are greater for rural poor groups and urban illiterate household groups (Table 7.5). Increased returns to labour and decreased returns to capital in the long run have led to these results.

As stated in an earlier section, the positive output effects in manufacturing industries and service sectors are more pronounced in the long run than the short run because of their increased employment of both capital and labour. Expanded output in most manufacturing and service sectors such as livestock rearing, fishing, leather industry, yarn industry, cloth mill, miscellaneous industry, urban building, rural building, wholesale trade, land transport and other transport has favoured rural poor and urban illiterate groups in the long run as they form the main labour component of these industries.

By contrast, a comparatively larger increase in income in urban illiterate household group can be explained by the increased employment of male and female low-skilled labour in the expanding ready-made garments and knitting industries. As our database shows, these two categories account for a major part of low-skilled employment in illiterate households. Urban medium-educated and high-educated household groups, who are relatively well-endowed with capital along with male high-skilled labour, experience positive income gains despite reduced capital returns. The expansion of the health service, public administration and defense, bank and insurance and professional service industries, all of which are male skill-intensive is the main source of these gains (Appendix Table D 7.6).

Table 7.5: Changes in nominal and real income of households (percentage changes)

Household groups	Simulation 1				Simulation 2			
	Short run		Long run		Short run		Long run	
	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
Rural								
Landless HH	-2.26	1.35	1.84	3.05	-0.09	-0.38	1.61	0.73
Marginal farmer HH	-1.94	1.65	1.14	2.33	-0.38	-0.69	1.16	0.72
Small farmer HH	-1.85	1.74	1.05	2.24	-0.40	-0.71	1.09	1.0
Large farmer HH	-1.51	2.05	0.43	1.61	-0.68	-1.02	0.69	-0.23
Non-agricultural HH	-1.84	1.78	1.13	2.40	-0.36	-0.64	1.34	0.26
Urban								
Illiterate	-1.89	1.74	1.24	2.51	-0.35	-0.59	1.22	0.42
Low-educated HH	-1.75	1.87	0.85	2.13	-0.50	-0.74	0.97	0.07
Medium-educated HH	-1.52	2.08	0.55	1.85	-0.60	-0.83	0.76	-0.16
High-educated HH	-1.53	2.11	0.39	1.71	-0.66	-0.87	0.69	-0.24

In simulation 2, where a compensatory consumption tax has been introduced to make the government budget balance, all household groups experience smaller short-run proportionate reductions in income than they experience in simulation 1. In addition, rankings change. For example, whereas in simulation 1 the rural landless group suffers the biggest percentage loss, in simulation 2, this group loses the least. The main reason is the heavy dependency of this group on their labour, the price of which shows a small positive change in this simulation. In addition, higher transfer payments to poor household groups from the government could also contribute positively, as government revenue is less constrained in this simulation. Real income changes are also negative for all household groups because of increased consumer price indices.

In the long run under simulation 2, the changes in income for household groups' results are broadly similar to simulation 1 results except for rural large farmer and urban medium-educated and high-educated household groups where there income reduced slightly while considered in real term. These results will be helpful in calculating changes in poverty indices in the next chapter.

7.5.5 Households' Consumption Effects

The simulation 1 results show that tariff elimination induces decline in the aggregate consumption price index, down by 3.61 per cent in the short run and by 1.25 per cent in the long run. However, across households, the variation in the drop in consumer prices is not uniform. In the short run, under simulation 1, the biggest falls are for urban high- educated households (-3.64 per cent) and illiterate households (-3.63 per cent) followed by rural non-agricultural households (-3.62 per cent), landless households (-3.61 per cent) and marginal farmer households (-3.59 per cent). The same pattern occurs in the long run. By contrast, in simulation 2, where there was a uniform consumption tax, in both the short run and long run the aggregate consumption price index increased as expected. Decomposing the results by household type, in the short run the highest increases are for the rural large farmer household group (0.34 per cent) followed by the rural small farmer household group. In the long run the rural large farmer household group also experiences the highest increase in CPI in rural areas, whereas in urban areas the high-educated household group experiences the highest increase (0.93 per cent).

Table 7.6 shows the long run changes in consumption by household. On average, in the long run under simulation 1, nominal consumption declines for all household groups. The rural landless household group is the most affected group. However, when the results are expressed in real terms, they changes significantly. The relatively larger reduction in consumer prices offsets the overall decline in nominal consumption. In the long run, real consumption increases for all household groups. This implies that tariff reduction has a welfare-enhancing impact on households.

However, the gains in real consumption tend to be proportionately larger for urban household groups (Table 7.6). Rural landless households achieve the least. Simulation results show that in both the short run and long run, tariff liberalisation brings the largest price falls in edible and non edible oil, milk fat, pulp paper board, petroleum products, china pottery, glass products, fabricated metal products, land transport, railway transport, housing service, hotels and and restaurants and entertainment. Consumption shares for different commodities by household groups (Appendix Table D 7.7) confirm that most of these products contribute more to the expenditure baskets of urban households than of rural households. As a result, the real effect is greater on urban groups than on rural groups.

There are significant differences in the consumption results when a compensatory consumption tax is imposed along with tariff liberalisation (Table 7.6). In contrast to simulation 1, households' nominal consumption increases whereas real consumption decreases. The main reason is that the increased consumer price indices are large enough to offset the increases in nominal consumption. As stated previously, a compensatory consumption tax directly increases consumer prices, thereby reducing the purchasing power of nominal disposable income and hence real consumption. Thus, tariff reductions with a compensatory consumption tax are welfare reducing.

Table 7.6: Households' consumption effects in the long run (percentage changes)

	Nominal consumption		**Real consumption**	
Household groups	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**
Rural				
Landless HH	-0.88	0.69	0.34	-0.19
Marginal farmer HH	-0.82	0.68	0.38	-0.22
Small farmer HH	-0.72	0.62	0.48	-0.29
Large farmer HH	-0.67	0.60	0.52	-0.32
Non-agricultural HH	-0.56	0.50	0.69	-0.37
Urban				
Illiterate	-0.87	0.67	0.41	-0.21
Low-educated HH	-0.76	0.62	0.52	-0.27
Medium-educated HH	-0.58	0.54	0.73	-0.38
High-educated HH	-0.34	0.41	1.00	-0.51

7.6 Sensitivity Analysis

As stated in Chapter 6, the lack of econometric estimates of the elasticity values required for calibrating the model led to elasticity values being based on estimates from similar studies conducted for Bangladesh or elsewhere. This section seeks to assess how sensitive our simulation results described above are to some of these elasticity values by comparing the results with those obtained using different elasticity values. The analysis is confined to the Armington elasticities between imported goods and domestic goods and the substitution elasticities between primary factor parameters. These elasticities were changed by +50 per cent and -50 per cent from the base elasticities.

7.6.1 Sensitivity of the Armington Elasticity

The short run results of the sensitivity analysis in Table 7.7 indicate that the magnitude of the Armington elasticities has a minor influence on the outcomes of the tariff liberalisation shocks. Under simulation 1, 50 per cent higher elasticities of substitution between domestic and foreign products lead to slightly higher growth in real GDP, aggregate employment, the import volume index and the export volume index. The percentage declines in the consumer price index, real exchange rate and the terms of trade, are also slightly higher. However, the trade balance/ GDP ratio is unaffected. In the case of the rural and urban poverty lines, higher substitution elasticities bring slightly larger reductions in their values. In contrast, lower Armington elasticity values, which imply less scope for substitution between domestic and imported commodities, have the opposite effects, except on the balance of trade/GDP which remains unaffected.

In the case of simulation 2, increasing the values of the Armington elasticities by 50 per cent, leads in the short run to slightly smaller falls in real GDP, aggregate employment, and slightly larger increases in exports and imports. As expected, when the elasticity values are reduced by 50 per cent, the opposite effects are observed. Balance of trade figures remain, however, completely insensitive to the changes of elasticity values.

Table 7.7: Effects of tariff liberalisation for different values of Armington elasticities in the short run (percentage changes)

	Base case		50 % increase		50 % decrease	
Index	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**
Real GDP	0.70	-0.04	0.73	-0.006	0.67	-0.08
Aggregate employment	1.47	-0.27	1.51	-0.24	1.42	-0.32
Consumer price index	-3.61	0.27	-3.81	-0.04	-3.32	0.69
Import volume index	1.60	1.81	1.89	2.22	1.22	1.27
Export volume index	9.72	2.83	10.51	3.87	8.70	1.46
Balance of trade/GDP	0.004	-0.001	0.004	-0.001	0.004	-0.001
Terms of trade	-0.57	-0.16	-0.61	-0.22	-0.51	-0.08
Real devaluation	4.20	0.39	4.41	0.71	3.89	-0.03
Rural poverty line	-2.03	0.26	-2.16	0.07	-1.87	0.51
Urban poverty line	-1.69	0.22	-1.82	0.06	-1.58	0.43

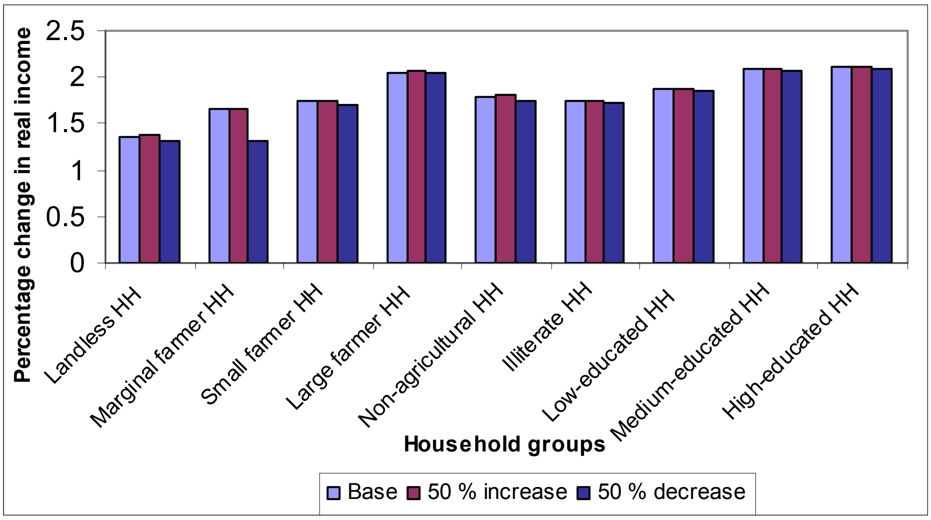
Table 7.8: Effects of tariff liberalisation for different values of Armington elasticities in the long run (percentage changes)

	Base case		50 % increase		50 % decrease	
Index	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**
Real GDP	0.82	0.69	0.82	0.69	0.82	0.68
Average real wage	3.24	0.74	3.26	0.77	3.23	0.70
Consumer price index	-1.25	0.89	-1.36	0.76	-1.12	1.04
Import volume index	3.04	3.14	3.91	4.01	2.15	2.24
Export volume index	6.35	5.07	8.10	6.84	4.53	3.23
Real aggregate consumption	0.57	-0.31	0.62	-0.26	0.52	-0.37
Real aggregate investment	1.12	4.34	1.39	4.09	1.39	4.61
Terms of trade	-0.30	-0.24	-0.21	-0.33	-0.21	-0.15
Real devaluation	1.55	-0.28	1.41	-0.13	1.41	-0.43
Rural poverty line	-0.55	0.56	-0.61	0.48	-0.48	0.64
Urban poverty line	-0.47	0.47	-0.52	0.41	-0.41	0.54

In the long run, in both simulations 1 and 2, changes of the Armington elasticities do not affect the growth of real GDP (as in the short run) and have relatively small effects on the simulated changes in other macroeconomic variables (Table 7.8).

Figures 7.4 and 7.5 show the short run and the long run real income effects of different Armington elasticity values on the incomes of different household groups[132]. We would expect more positive income effects of tariff elimination in cases of higher elasticity values as trade liberalisation initiates a more efficient allocation of resources over sectors, which in turn leads to higher real incomes. As expected, in our case in the short run, complete tariff removal with high Armington elasticities has initiated more positive income effects for all household groups even though the magnitudes are too small to see in some cases (Figure 7.4). This negligible impact reflects the interaction of very marginal sectoral shifts and small variation in the marginal yield of endowments among sectors.

Figure 7.4: Short run effects of complete tariff reduction on real incomes of household groups under different sets of Armington elasticities (Simulation 1)

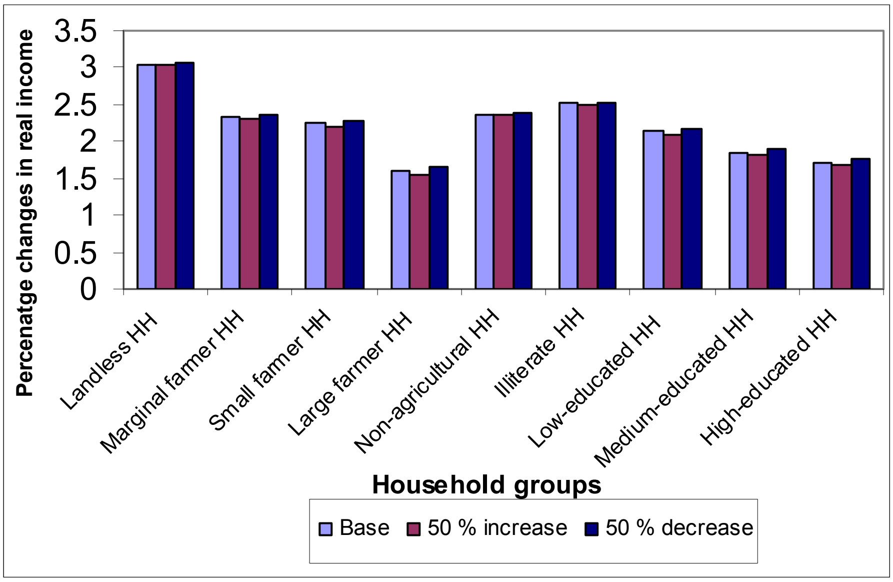


In the long run, if Armington elasticities are raised by 50 per cent from the base elasticities, the income effects are still positive, but less than the base results and vice versa for a 50 per cent reduction in elasticities (Figure 7.5)[133]. The general outcome of this sensitivity analysis is that the results are relatively insensitive to changes in Armington elasticities. For nearly all

[132] We have derived the real income for each household group, by deducting the value of the consumer price index from their respective nominal income.
[133] For simplicity, sensitivity analysis for income distribution for simulation 2 has been avoided.

macroeconomic indicators the qualitative effects of tariff shocks are invariant with respect to the size of elasticities. In addition, the effects on income are not substantially different.

Figure 7.5: Long run effects of complete tariff reduction on real incomes of household groups under different sets of Armington elasticities (Simulation 1)



7.6.2 Sensitivity of the Primary Factor Substitution Elasticity

The simulation results for complete tariff simulation, i.e. for simulation 1 under different values of primary factor substitution elasticities are reported in Tables 7.9 and 7.10 respectively. Under simulation 1, a 50 per cent increase in the elasticities of substitution between primary factors leads to slightly larger increases in real GDP and aggregate employment in the short run (Table 7.9). For imports, higher elasticity values have also led to only a moderate change. The most striking change is in the growth of total exports. Greater factor substitutability means that the labour intensive manufacturing industries such as the ready-made garments and knitting sectors experience greater production effects, which in turn increases exports. The improved export situation in turn improves the balance of trade situation slightly. In the case of the poverty lines, the increases in factor substitution elasticities result in marginally smaller declines.

Table 7. 9: Effects of tariff liberalisation for different values of primary factor elasticities in the short run (percentage changes)

	Base case		50 % increase		50 % decrease	
Index	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**
Real GDP	0.70	-0.04	0.97	-0.09	0.41	0.02
Aggregate employment	1.47	-0.27	2.09	-0.42	0.79	-0.13
Consumer price index	-3.61	0.27	-3.49	0.57	-3.92	-0.33
Import volume index	1.60	1.81	1.80	1.95	1.30	1.53
Export volume index	9.72	2.83	12.73	2.47	6.24	2.84
Balance of trade/GDP	0.004	-0.001	0.006	-0.001	0.000	-0.001
Terms of trade	-0.57	-0.16	-0.72	-0.14	-0.38	-0.17
Real devaluation	4.20	0.39	4.10	0.09	4.49	0.99
Rural poverty line	-2.03	0.26	-1.97	0.45	-2.23	-0.12
Urban poverty line	-1.69	0.22	-1.66	0.38	-1.88	-0.09

In contrast, a 50 per cent decrease in factor substitution elasticities leads to a smaller real GDP increase in the short run under simulation 1, as expected (Table 7.9). For other macroeconomic variables such as aggregate employment, the consumer price index, imports and exports, their sensitivity to decreased elasticity values is similar to the effects on real GDP, although for the poverty lines the changes are greater than in the base case.

For simulation 2, where complete tariff removal is accompanied by a compensatory consumption tax, raising factor substitution elasticities by 50 per cent from the base elasiticities produces greater negative impacts on real GDP and aggregate employment in the short run (Table 7.9). The result is also similar for export performance, where raising factor substitution leads to slightly reduced exports. Increased elasticity values result in a slightly larger increase in the consumer price index and poverty lines. Overall, for simulation 2, increased factor elasticities produced slightly different values in the short run, but for all indicators qualitative effects are invariant.

Table 7.10 shows that in the long run under simulation 1, the higher values of factor substitution elasticity lead to a slightly greater production effect than the base case. Easing factor substitutability leads to a smaller decrease in real wages. The effects on the export volume index and the import volume index are also minor, but there is a somewhat larger increase in real aggregate investment. The poverty lines experience insignificant decreases in their values. Directions of change are generally reversed when factor substitution elasticities are reduced. Qualitatively similar outcomes emerge under simulation 2.

Table 7.10: Effects of tariff liberalisation for different values of primary factor elasticities in the long run (percentage changes)

	Base case		50 % increase		50 % decrease	
Index	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**	**Simulation 1**	**Simulation 2**
Real GDP	0.82	0.69	1.10	0.89	0.49	0.44
Average real wage	3.24	0.74	3.10	0.66	3.48	0.85
Consumer price index	-1.25	0.89	-1.25	0.89	-1.27	0.87
Import volume index	3.04	3.14	3.30	3.33	2.72	2.89
Export volume index	6.35	5.07	6.58	5.25	6.06	4.84
Real aggregate consumption	0.57	-0.31	0.57	-0.31	0.58	-0.30
Real aggregate investment	1.12	4.34	2.42	5.30	-0.47	3.14
Terms of trade	-0.30	-0.24	-0.31	-0.25	-0.28	-0.23
Real devaluation	1.55	-0.28	1.51	-0.30	1.62	-0.24
Rural poverty line	-0.55	0.56	-0.56	0.55	-0.54	0.54
Urban poverty line	-0.47	0.47	-0.48	0.47	-0.46	0.45

With respect to the effects on real incomes of household groups, it is expected that the higher (lower) the elasticity of substitution between factors, the more likely it is that tariff reduction will increase (decrease) real income. As expected, both in the short run and long run household groups' real income increases more with higher levels of elasticity of substitution and less with lower levels of elasticity values, except for the marginal farmer household group in the short run and the landless household group in the long run[134]. A 50 per cent reduction in elasticities leads to marginal farmer group's real income increasing in both the short run and the long run by more than it does in the base case (Figures 7.6 & 7.7). Similarly, in the long run, a 50 per cent decrease in elasticities leads to the landless household group's real income increasing.

[134] As with the Armington elasticity of substitution case, in this case also sensitivity analysis for income distribution is not provided.

Figure 7.6: Short run effects of complete tariff reduction on real incomes of household groups for different values of primary factor elasticities (percentage changes) (Simulation 1)

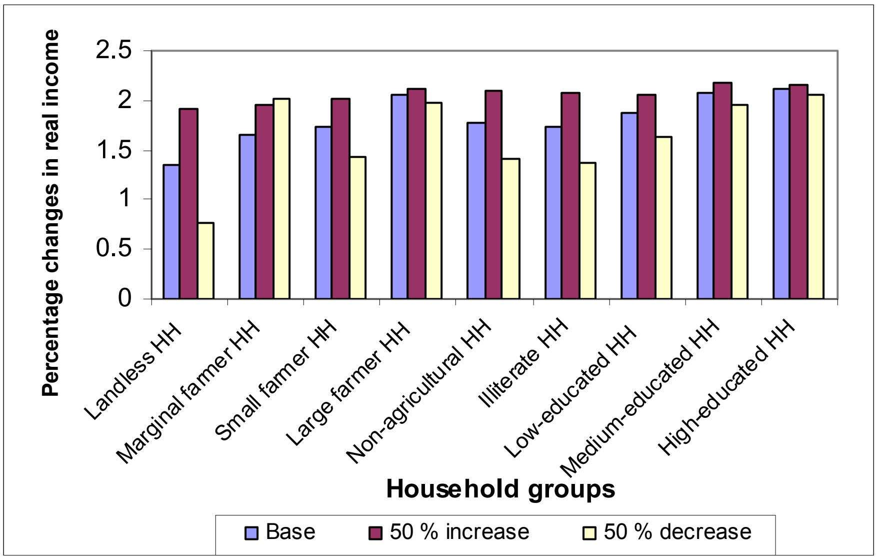
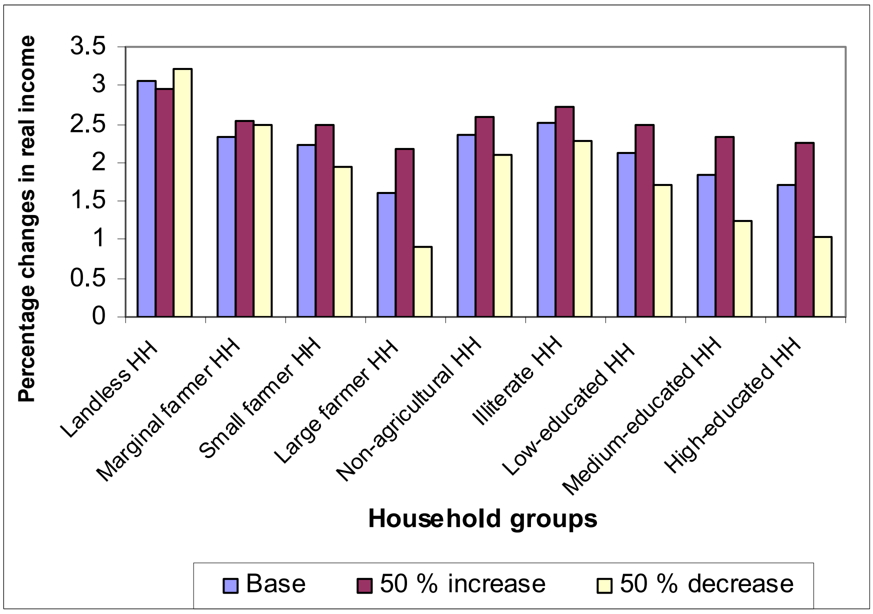


Figure 7.7: Long run effects of complete tariff reduction on real incomes of household groups for different values of primary factor elasticities (percentage changes) (Simulation 1)



In general, the sensitivity analysis suggests that the model results are slightly more sensitive to variations in factor substitution elasticities than to variations in Armington elasticities, both in the short run and the long run. However, for both sets of elasticities, the qualitative impacts of policy shocks on various macroeconomic indicators and household groups' real income are invariant to the size of the elasticity and the quantitative effects are also robust, as there are very small changes in the magnitudes of endogenous variables from the base cases.

7.7 Conclusions

The present chapter has examined the impact of trade liberalisation in Bangladesh on some broad macroeconomic variables, sectoral level variables and household level variables. The model was simulated first by reducing import tariffs on all imported goods and services without any revenue-compensatory changes in other taxes. The second simulation was conducted with the same tariff shock, but with a uniform 2.70 per cent compensatory consumption tax to keep total government revenue unaffected.

The results of the first simulation show that, both in the short run and long run, tariff reduction enhances increased real GDP, and total exports. It also increases aggregate employment in the short run. Trade liberalisation also ensures real depreciation which in turn improves the country's international competitiveness. The increase in aggregate consumption in the long run can be considered as the aggregate welfare improvement of the tariff reduction.

At the sectoral level, the sectors with initial higher tariff rates tend to suffer the biggest percentage falls in output and employment while the export-oriented labour-intensive manufacturing and agricultural sectors experience the biggest increases. In addition, expansion in the service sector occurs both in the short run and the long run. Among occupational categories, the female low-skilled category of labour experiences the highest increase both in the short run and the long run, which is largely a reflection of the growth of the export oriented ready-made garments and knitting industries.

In the second simulation, a tariff reduction with compensatory consumption tax induces negative growth in real GDP and aggregate employment in the short run. This happens because the revenue-neutral consumption tax leads to a decrease in demand. In the long run, however, free capital mobility helps increase real GDP. Further, the imposition of a consumption tax increases production costs, which in turn initiates a decrease in international competitiveness. As a result, exports increase less than in simulation 1, both in the short run and long run. Negative growth rate of aggregate real consumption in the long run suggests an aggregate welfare loss because of tariff shocks in the presence of compensatory tax.

Output declines in most industries (even in the long run when real GDP rises), with the greatest contraction in labour intensive sectors where the household sector is the main customer. In addition, the export-oriented manufacturing and agricultural industries experience lower production as the consumption tax constrains the fall in their f.o.b export prices.

With respect to household income changes, tariff liberalisation alone induces nominal factor income decreases for all groups in the short run. The rural landless group suffers the most substantial decline, whereas rural large farmers and the urban medium-educated group experience the smallest decline. In contrast, in the long run the percentage changes in nominal income are positive for all groups with the rural landless group gaining the biggest increase. The tariff reduction with a consumption tax reduces real consumption for all household groups in the long run, as increases in consumer prices more than offset the impacts of nominal income gains on real purchasing power.

Sensitivity analysis for key parameters suggests that the simulation results of tariff shocks, with or without accompanying consumption tax, are robust. The qualitative effects on various macroeconomic indicators and on real income are invariant under different elasticity values. In addition, the quantitative effects are relatively insensitive.

The following chapter considers the impact of trade liberalisation on income inequality and poverty situation.

Chapter 8

Poverty and Inequality Measurement

8.1 Introduction

The main objective of this chapter is to analyse the poverty and income distribution impacts of trade liberalisation in the Bangladesh economy. Trade liberalisation affects income distribution and the poverty scenario in a country by two main transmission channels. One is the income channel, where the resource allocation changes the factor intensities which in turn change factor prices. The other is through changes in relative product prices which are changed by import tariffs. These changes will lead some households to gain and some others to lose. As discussed in Chapter 4, in the CGE modelling context there are many approaches to calculating income distribution and poverty variations. Among them, the traditional and most frequently used method is the representative household (RH) approach where poverty analysis is performed with income variations in combination with an endogenous poverty line (Decaluwe *et al.*, 1999). In this approach, a specific distribution of income is specified within each category of representative household (RH) and the change in income of the RH in the CGE model is then used to estimate the change in the average income for each household group. However, the variance of the income distribution is assumed fixed or determined exogenously.

To model the income distribution of the groups of households and to apply poverty indicators, different functional forms have been used by different modellers. For example, Dervis *et al.* (1982) use the log-normal distribution for Korea; de Janvry, Sadoulet, and Fargeix (1991) use the Pareto distribution for Ecuador; Chia, Wahba and Whalley (1994) use a log-normal distribution for Ivory Coast; and Decaluwe *et al.*, (1999) use the beta distribution for the African archetype economy. This approach is called *parametric* modelling of income distribution, where it is assumed that the income distribution follows a functional form but with unknown parameters.

In our study, the measurement of poverty profiles follows the method adopted by Decaluwe *et al.*, (1999). However, unlike Decaluwe *et al.,* (1999), in this study poverty indices are calculated using a *non-parametric* approach. In particular, the Kernel density estimation method was used in specifying the probability density function (PDF).

This chapter has been organised as follows. It starts with a description of *non-parametric* methods of poverty estimation. Various Foster, Greer, and Thorbecke (1984) FGT indices of poverty are then discussed in section 8.2. This section also examines a range of other poverty indices that are used to check the robustness of the FGT results. Section 8.3 discusses the incorporation of the poverty analysis in CGE analysis. Section 8.4 discusses the base-case and post-shock poverty profiles. Section 8.5 describes a range of inequality measures, including their functional forms and parameters. An estimation of various inequality measures during the pre- and post- liberalisation periods is undertaken in section 8.6 and section 8.7 performs a sensitivity analysis. The chapter finishes with some concluding remarks in section 8.8.

8.2 The Non-parametric Approach of Income Distribution: Estimation with the Kernel Method

In estimating the distribution of income in the *parametric* approach, it is assumed that the income distribution follows a known particular functional form, but with unknown parameters (Duclos and Araar, 2006). In this case, modellers need to estimate the unknown parameters of that functional form. In contrast, in the *non-parametric* method one can estimate the distribution function directly from the given data without any prior assumption of particular form. Moreover, in this method, the modeller can determine whether the distribution is skewed or unimodal by simply looking at the graph of the estimated density function. This method is most easily understood by reviewing the density estimation procedure used in the histograms. In general, a histogram is a simple *non-parametric* estimation of a probability distribution, where one needs the width of the bins (equal sub-intervals where the whole data interval is divided) and the end points of the bins. Given a sample of data, the density of the data is a smoothed presentation of the histogram. There are many ways of converting histograms into density estimates. Among them the most widely used density estimate is the "Kernel estimate" where a histogram is transferred to a density function by smoothing over the boundaries using a Kernel weight function (Rosenblatt, 1956)[135]. Suppose x is a random

[135] For detailed discussion of the Kernel estimate refer to Deaton (1997), Duclos and Araar (2006) and Rosenblatt (1956).

variable with continuous probability density function $f(x)$. The Kernel estimation of the density $f(x)$ or the smoothed histogram can be defined as follows:

$$f(x) = \frac{1}{N}\sum_{i=1}^{N} \frac{1}{h}K\left(\frac{x - x_i}{h}\right)$$

where K is the Kernel function which is generally symmetric and unimodal, and h is the bandwidth or smoothing parameter (Boccanfuso *et al.*, 2002).

In the use of this estimator, each observation will provide a "bump" to the density estimation of $f(x)$ whose shape and width in turn depends upon the shape of K and the size of h respectively. By summing all the "bumps" the distribution of all data points is obtained. In implementing the Kernel estimator, the selection of Kernel and bandwidth is important as these two affect the structure of the distribution. For example, the smaller the value of the bandwidth, the less smooth will be the density estimates. In contrast, if the bandwidth is too large, the estimated density function will be too smooth. In selecting the Kernel, DAD software adopts the Gaussian Kernel type as it has nice continuity and differentiability properties[136].

8.3 Poverty Measures

In the literature, there are a large number of poverty measures. Among them the most widely used measure is the head count index (H) which is simply the proportion of the total population that falls below the poverty line. It is obtained by dividing the number of people (q) living below the poverty line (z) by the total population (n).

Formally,

$$H = \frac{q}{n}$$

[136] DAD or Distributional analysis software (Duclos, Araar, and Fortin, 2000) was developed specifically for poverty and inequality estimation. It is freely distributed and available at www.mimap.ecn.ulaval.ca.

Once the poverty line is known, this index is very simple to compute, but it has some drawbacks. First, the head count index does not reflect the intensity of poverty suffered by the poor (Chotikapanich, 1994, p. 197). It can not capture the extent of the income shortfall of the people who live below the poverty line: that is, whether someone is just below the line or far below the line. Second, the measure is also completely insensitive to the distribution of income among the poor. A pure transfer of income from the poorest poor to those who are comparatively better off will never increase poverty as measured by the head count index (Sen, 1976)[137].

The second most commonly used measure of poverty is the poverty gap index (PG). This index measures the extent to which individuals on average fall below the poverty line. Thus this index is used to indicate the level of hardship and the total income needed to take all the poor up to the poverty line. This index is commonly formulated as:

$$PG = \frac{1}{n}\sum_{i-1}^{q}\left[\frac{z - y_i}{z}\right]$$

where z is the poverty line, q is the number of poor people, n is the number of people in the population and y_i is the poorest income.

The above index is related to head count index (H) by the following form:

$$PG = I * .H$$

where I is the income gap ratio defined as:

$I = \frac{z - y_m}{z}$; y_m = mean income of the poor.

As an indicator of the potential for eliminating poverty by targeting transfers to the poor, this index is preferable to the head count index. However, like the head count index, this measure

[137] According to Sen (1976), the head count measure violates two axioms: 1) the monotonicity axiom, which states that given other things, a reduction in income of a person below the poverty line must increase the poverty measure; 2) the transfer axiom, which states that given other things, a pure transfer of income from a person below the poverty line to anyone who is richer must increase the poverty measure.

also violates the transfer axiom (Sen, 1976). Therefore, this index does not consider income inequality among the poor. In other words, this measure does not capture differences in the severity of poverty.

Sen (1981) proposed a measure which takes into account the severity of poverty[138], but according to Ravallion and Sen (1996), this measure does not satisfy the property of additive decomposability which requires that aggregate poverty be equal to the population-weighted sum of poverty levels in the various sub-groups of the society. All poverty measures proposed after Sen (1976) were inadequate in the sense that they were not decomposable. It was Foster, *et al.*, (1984) who first developed a poverty measure that: 1) is additively decomposable with population-share weights, 2) satisfies the basic properties proposed by Sen (1976); and 3) is justified by a relative deprivation concept of poverty (Foster *et al.*, 1984). Known as the FGT measure, it consists of a class of additively decomposable poverty measures simultaneously considering the percentage of the poor, the average income (consumption) and the distribution of the income (consumption). The mathematical expression is as:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^\alpha$$

where n is the number of people, q is the number of poor people, z is the poverty line, y_i is the income of ith poor individual and α is a parameter which acts as a measure of poverty aversion. The parameter α can take any positive value or zero. The higher the value, the more the relative importance accorded to individuals below the poverty line. When parameter α = 0, P_0 is simply the head count index. For α = 1, P_α becomes the income poverty gap where the relative importance of individuals below the poverty line is proportional to their income. When α = 2, P_α measures the severity of poverty, with a greater weight assigned to the households with income far below the poverty line.

In this study, to evaluate the impacts of trade policy simulations on the poverty profiles of various representative households, we have used the Foster-Greer-Thorbecke (FGT) class of poverty decomposition approach. However, to test the robustness of the FGT poverty indices, several other poverty indices were computed. They are as follows:

[138] Sen's (1976) poverty measure is defined later.

Watts Index:

Harold Watts first proposed the distribution sensitive poverty measure in 1968 (Zheng, 1993). It is defined as:

$$W = \frac{1}{N}\sum_{i=1}^{q}\left[\ln(z) - \ln(y_i)\right]$$

where N is the total population, z is the poverty line and y_i is the individual income.

This index satisfies all the axioms essential for any good measure of poverty.

Sen Index:

Sen (1976) proposed a poverty measure which was designed to overcome the limitations of the head count index and the poverty gap index by incorporating inequality amongst the poor. Sen's measure of poverty index is as follows (Deaton, 1997):

$$P_s = P_0\left[1 - (1 - \gamma_p)\frac{\mu_p}{z}\right]$$

where P_0 is the head count index, μ_p is the mean income of the poor, and γ_p is the Gini coefficient of inequality among the poor. If the inequality among the poor is zero, P_s reduces to the poverty gap measure P_1. In contrast, when all but one of the poor has nothing, $Ps = P_0$ and the measure becomes the head count ratio.

S-Gini Index:

Kakwani (1980) proposed a generalisation of Sen's poverty index, which is called the S-Gini poverty index. The failure of Sen's poverty measures to satisfy some transfer-sensitivity axioms prompted Kakwani (1980) to develop this measure. The generalised Gini poverty index is expressed as a composite function of the proportion of the population below the poverty line $(F(Z))$, and the normalised Gini welfare indices defined for the poor.

The S-Gini poverty index can be defined as (Barrett and Donald, 2009):

$$P(\partial, z) = F(z) - \frac{1}{z}\partial(\partial - 1)\int_0^1 (1-p)^{\partial-2} G(pF(z))dp$$

where $1 < \partial < \infty$, ∂ is the inequality aversion parameter which determines the social weight attached to different points in the distribution, z is the poverty line and $G(p) = \int_0^p Q(q)dq$ is the generalised Lorenz curve. For the value of ∂=2, the above poverty indices turn into the original poverty indices proposed by Sen (1976).

8.4 Incorporating Poverty Analysis into the CGE Model

In the representative household approach, the poverty incidence for each household group is calculated by linking the model output of the percentage change in average income of each household group and the poverty line with the household survey data. The initial income vector of a nationally representative household survey is first adjusted by the average income variation of the corresponding household category which is calculated from the main model. Following Decaluwe *et al.*, (1999), it is assumed that because of a policy change, intra-group distribution will not change; however it will shift proportionately due to changes in mean income. Since we are unaware of how the increase or decrease in income is distributed, in other words, whether the increase or decrease of the mean income originated from the poorest income group or the richest group, we randomly distribute the gain or losses to all the households within the group. As a result, the income of each household group within a group increases by the same percentage.

To compute FGT poverty indices, a basic needs poverty line is also required. According to Decaluwe *et al.*, (1999), the poverty line is determined endogenously within the CGE model by multiplying the quantities of commodities in a basic needs basket by their respective prices and aggregating across commodities. The monetary value of the poverty line is determined before and after the trade shock. By using the after-simulation income vector and changed poverty line, FGT poverty indices are calculated by using the software DAD in combination with Excel. In calculating poverty indices, it is necessary to first organise the data into an ASCII file containing information on sample weights, initial household income and after-simulation household income. This ASCII file is then imported using DAD's data import wizard.

In our case, as the income and percentage changes of the poverty line of all households groups are incorporated in the model presented in Chapter 5, the simulation results provide us with the percentage changes in post-tax income of all household groups and the percentage changes in the separate poverty lines for rural and urban areas. We multiplied the base year (2000) household per capita income vector obtained from the Bangladesh Household Income and Expenditure Survey 2000 by the percentage change in income of the households after the shock. For the base year, we used two separate poverty lines, one for rural and another for urban areas estimated by the Bangladesh Bureau of Statistics (BBS) for the year 2000. BBS estimated these poverty lines using the cost of basic needs method. This involved first estimating the cost of a fixed food bundle[139]. The bundle provides minimal nutritional requirements corresponding to 2,122 kilocalorie (kcal.) per day per person. The required minimum expenditure for food items is then estimated by multiplying the items by the reference year (2000) prices. An additional 40 per cent allowance is then made for income needed to satisfy non-food basic needs (Hossain, Naher, and Shahabuddin, 2005). Thus, the estimates of the poverty line for 2000 calculated by the BBS are US$146 (per person/per year) for rural areas and US$167 (per person/per year) for urban areas. Converted to domestic currency of the 2000 exchange rate of US$1= TK. 52.14, the monetary poverty line for rural areas is TK. 7612.73 whereas the urban figure is TK. 8707.71. These monetary poverty lines were adjusted by the percentage change value from the model to perform the post shock FGT calculations.

8.5 Estimation of Poverty Indices

8.5.1 Base Year Poverty Profiles

The base case scenario suggests to us that the incidence of poverty is higher in rural areas than in urban areas (Table 8.1). In rural areas, about 49 per cent of rural populations are poor, while for urban areas this figure is only 32.56 per cent. In terms of the poverty gap and severity of poverty indices, poverty incidence is also higher in rural areas than in urban areas.

[139] The bundle consists of eleven items such as rice, wheat, pulses, milk, oil, meat, fish, potato, other vegetable, sugar and fruits as recommended by Ravallion and Sen (1996).

If we decompose the results by household group, we find that in rural areas the landless household group has the highest proportion of the poor at 71.85 per cent, followed by the marginal farmer and small farmer household groups at 60.66 per cent and 45.46 per cent respectively. The same trend is observed for the poverty gap (P_1) and poverty severity (P_2) indices, with the landless household group having the highest poverty gap index (21.63 per cent) and poverty severity index (8.74 per cent) followed by the marginal farmer household group and the small farmer household group with the values of poverty gap (P_1) and poverty severity (P_2) of 15.96 per cent, 10.30 per cent and 5.70 per cent and 3.35 per cent respectively.

In urban areas, poverty incidence is mainly concentrated in the illiterate household group with 60.11 per cent of the poor, followed by the low-educated household group at 24.34 per cent. In terms of the poverty gap (P_1) and poverty severity (P_2), illiterate households also experience the highest incidence of poverty with the values at 17.44 per cent and 6.77 per cent respectively. For the low-educated household group, its values for the poverty gap (P_1) and poverty severity (P_2) indices of 5.32 per cent and 1.61 per cent also show the greater vulnerability of this group compared with other urban household groups.

Table 8.1: Base year estimates of FGT poverty indices in Bangladesh

	Poverty Index (in percentages)		
Household groups*	**Head count index(P_0)**	**Poverty gap(P_1)**	**Squared poverty gap(P_2)**
Rural (All)	49.20	13.09	4.73
Landless HH	71.85	21.63	8.45
Marginal farmer HH	60.66	15.96	5.70
Small farmer HH	45.46	10.30	3.35
Large farmer HH	20.40	4.36	1.24
Non-agricultural HH	43.45	11.42	4.10
Urban (All)	32.56	8.70	3.21
Illiterate HH	60.11	17.44	6.77
Low-educated HH	24.34	5.32	1.61
Medium-educated HH	5.77	0.97	0.32

*the high–educated household group has not been incorporated in this table as its per capita income is well above the poverty line.

Source: Simulation results of the Bangladesh model and Bangladesh Household Income & Expenditure Survey 2000.

The high incidence of income poverty among the rural landless, marginal farmer households and urban illiterate can be explained by the fact that these household groups receive income mainly from labour income and especially from unskilled labour income (Tables 6.8 and 6.9 of Chapter 6). The landless household group in rural areas depends heavily on selling labour in both agricultural and non-agricultural labour markets for their livelihoods. The seasonal nature of agricultural employment and limited opportunities for non-farm employment cause the great majority of the group to suffer from chronic or transitory food insecurity (Hossain *et al.*, 2005). In urban areas the illiterate household group is mainly involved in petty trade activities or service activities such as push-carts, rickshaw driving, and shoe cleaning. Most of this group are likely to migrate from rural areas where they were mostly landless or asset-less and could not earn a livelihood.

8.5.2 Post Simulation Poverty Profiles

We simulate two scenarios: 1) an elimination of import tariffs across the board; and 2) the elimination of import tariffs accompanied by the imposition of a uniform compensatory consumption tax of 2.70 per cent which is determined endogenously.

8.5.2.1 100 per cent tariff reduction on imports

Table 8.2 provides percentage changes in the average poverty line both for the rural and urban areas for simulations 1 and simulation 2 respectively. It shows that the poverty line declines both in the short run and long run for rural and urban groups in simulation 1, even though the magnitude of values decreased in the long run. This reflects the fact that a tariff cut makes the prices of the basic needs commodities cheaper. However, imposition of a consumption tax raises the prices paid by the consumers. As a result, the monetary poverty line increases in simulation 2. The estimated values of income and new prices generated in the simulations were used in the FGT Poverty indices to estimate the post simulation poverty profiles.

Table 8.2: Changes in poverty line (in percentages)

	Simulation 1		Simulation 2	
Household groups	**Short run**	**Long run**	**Short run**	**Long run**
Rural	-2.034	-0.545	0.257	0.556
Urban	-1.693	-0.458	0.218	0.471

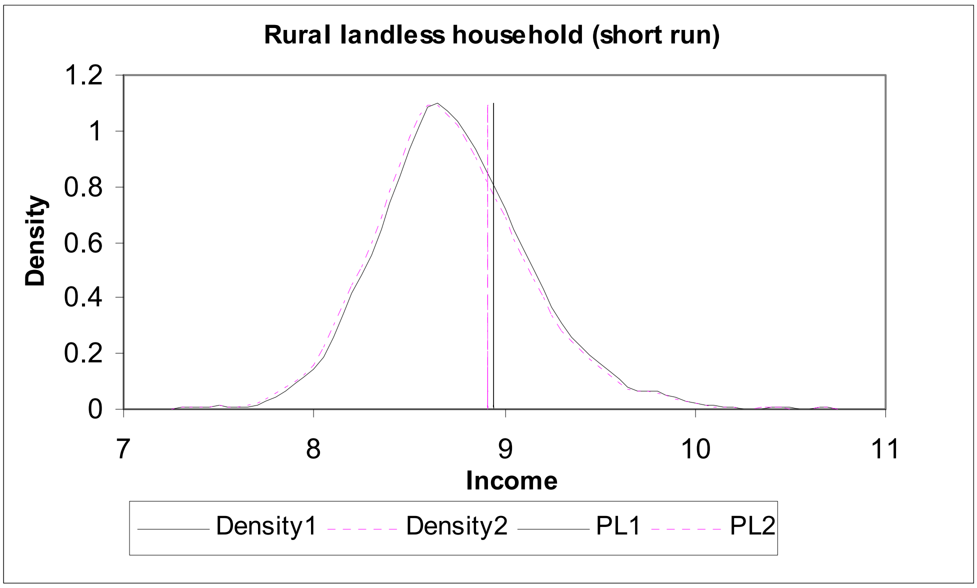
Source: Simulation results of the Bangladesh model

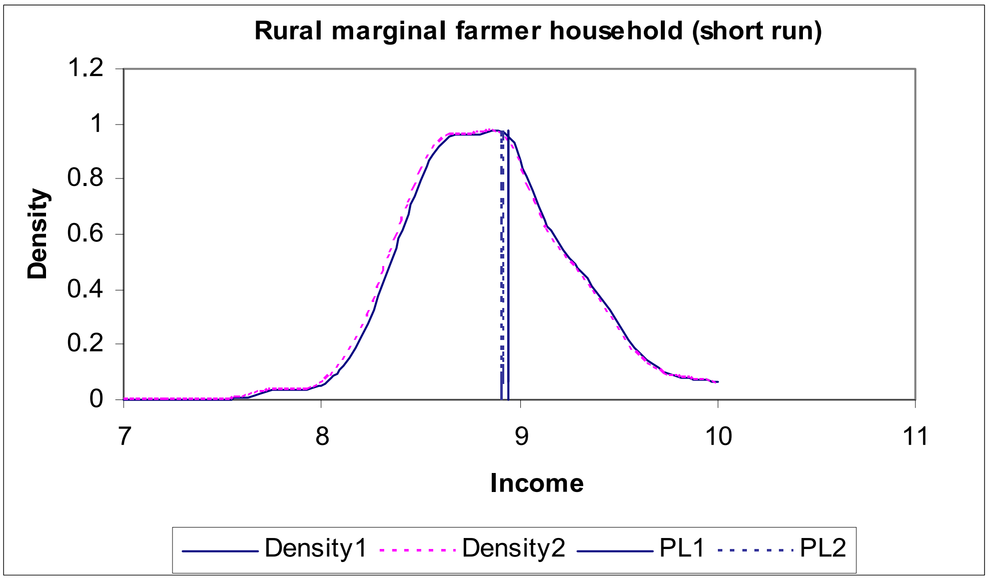
The income distributions and the money metric poverty lines for various categories of households for the base year and post simulation year are presented in Figures 8.1 to 8.4[140]. In DAD, at first after loading the base year income vector, we obtain a simulated income vector by the variation obtained in GEMPACK output. To plot the distribution, both income vectors are transformed into logarithmic form. In all the figures, the continuous lines show the base year density function and poverty line, whereas the dotted lines show the after shock density function[141] and poverty line. From Figure 8.1 it is evident that in the short run in the rural areas, the density functions for all the household groups shift to the left[142], demonstrating lower average incomes. This shift in the density functions increases the proportion of population below the pre-shock poverty line for each household group. However, because of the changes in the value of the rural poverty line by 2.03 per cent due to changes in the consumer prices, the poverty line also shifts to the left.

For some household groups such as the rural landless, urban illiterate and urban low-educated households, the change in the poverty line is smaller than the change in the average nominal income, which results in an increase of the poverty indices for these household groups. It is important to note that because the tariff shock percentage changes in income for various household groups and in poverty lines are small in magnitude, differences between base year income values and the after-simulation income values are often difficult to observe. Thus, it is preferable to examine the change in poverty indicators in numbers.

[140] For simplicity, graphical presentations for simulation 2 are not provided here as they are very similar to those in Figures 8.1 to 8.4.
[141] Density function for income shows the percentage of individuals with a given income.
[142] Since our simulated post shock values are comparatively smaller in magnitude, as a result, in most cases density functions overlap; so too for the poverty line.

Figure 8.1: Changes in absolute poverty within rural households (Short run)





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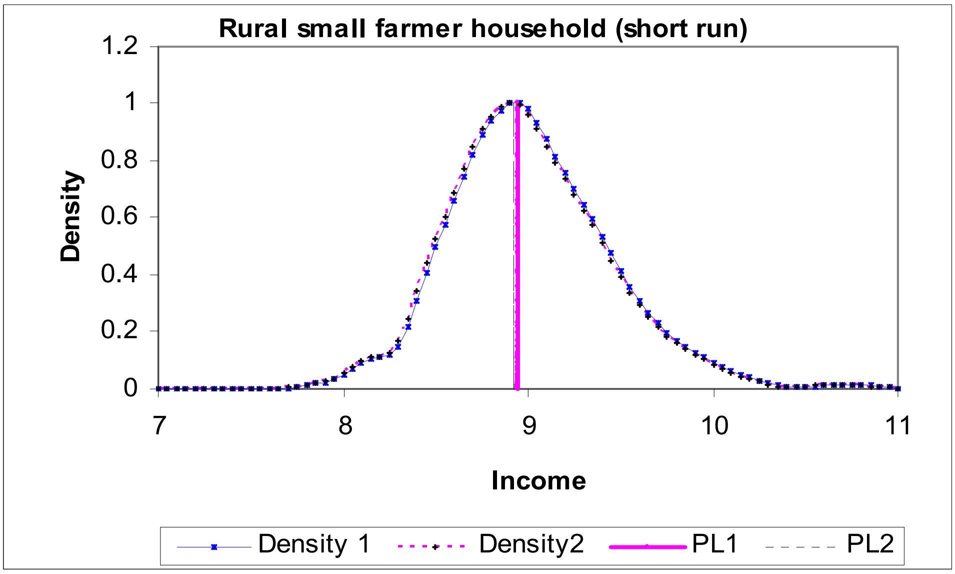

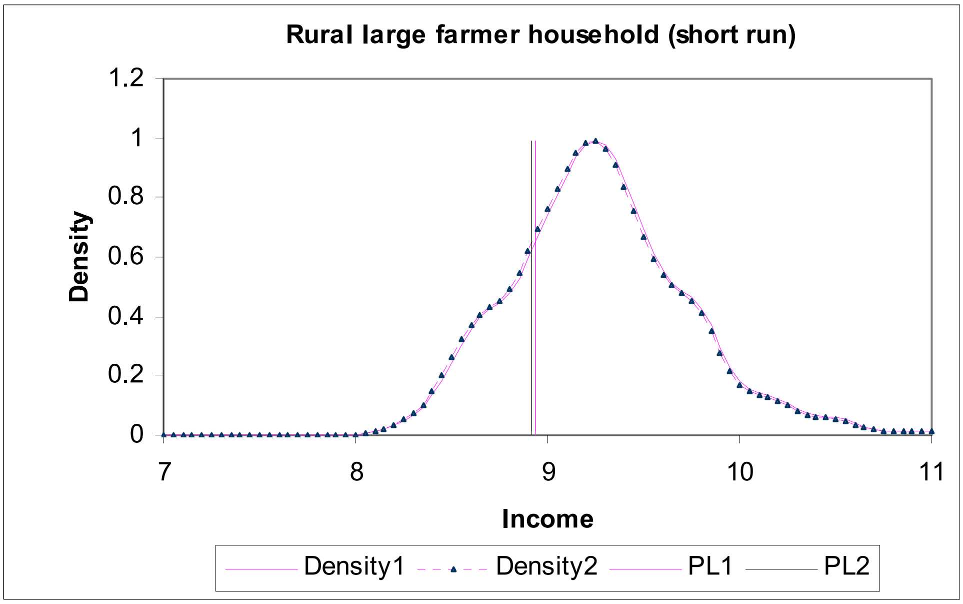

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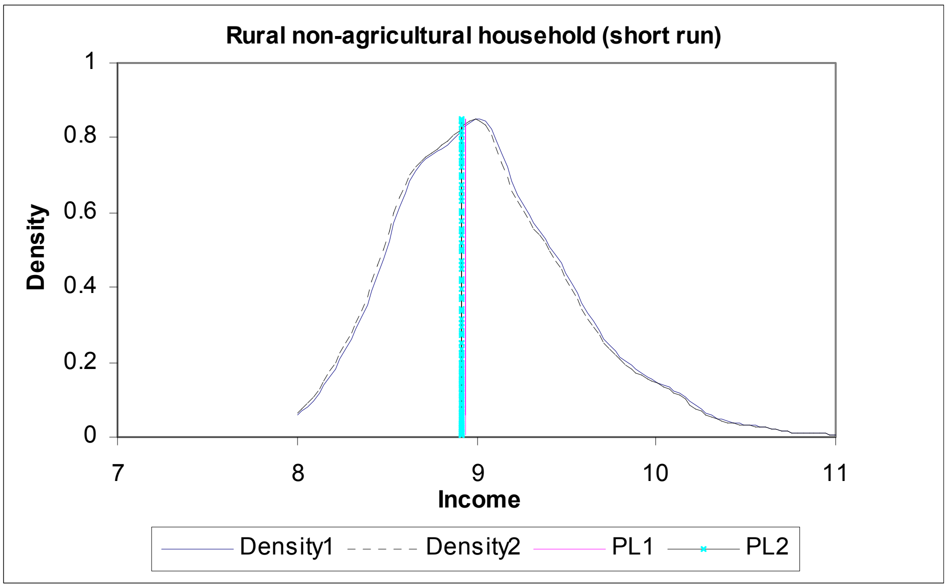
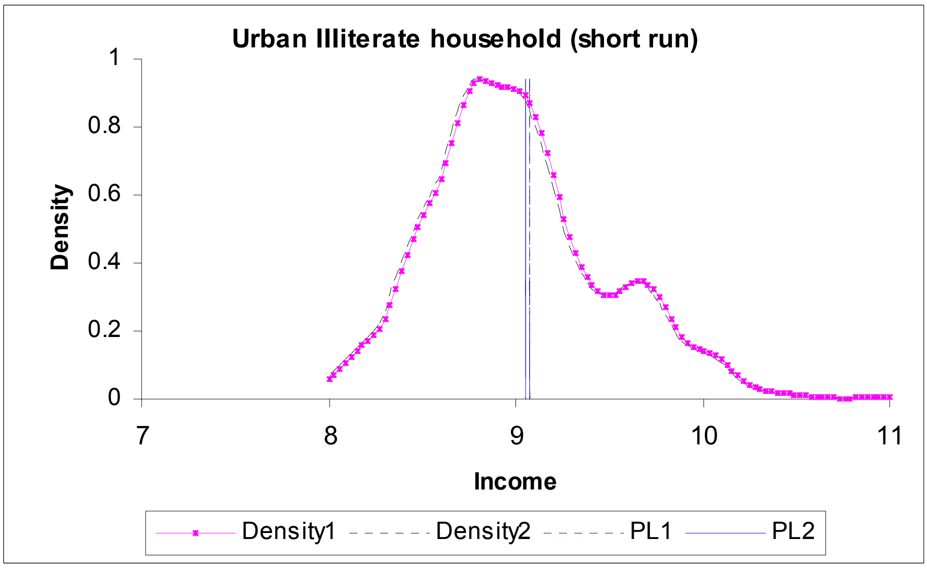


Figure 8.2: Changes in absolute poverty within urban households (Short run)



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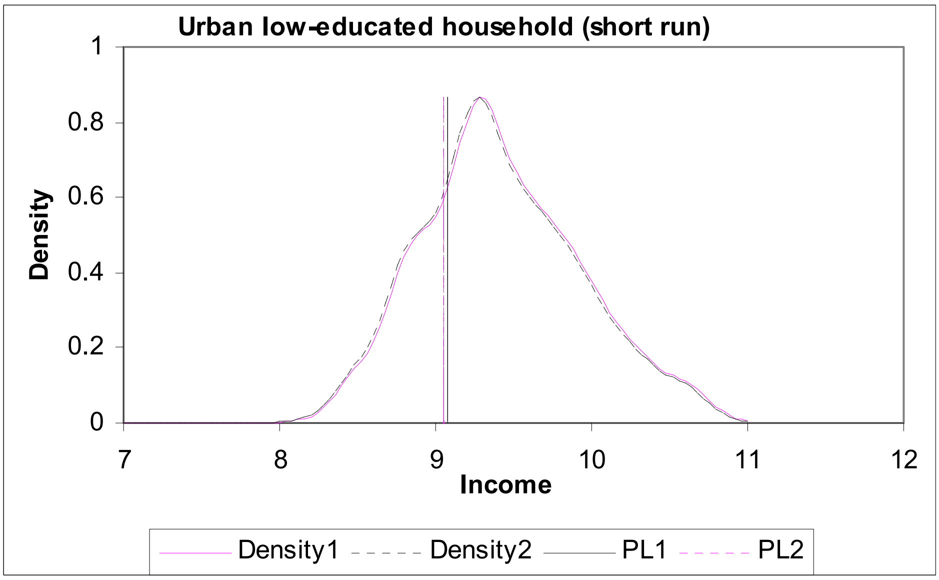


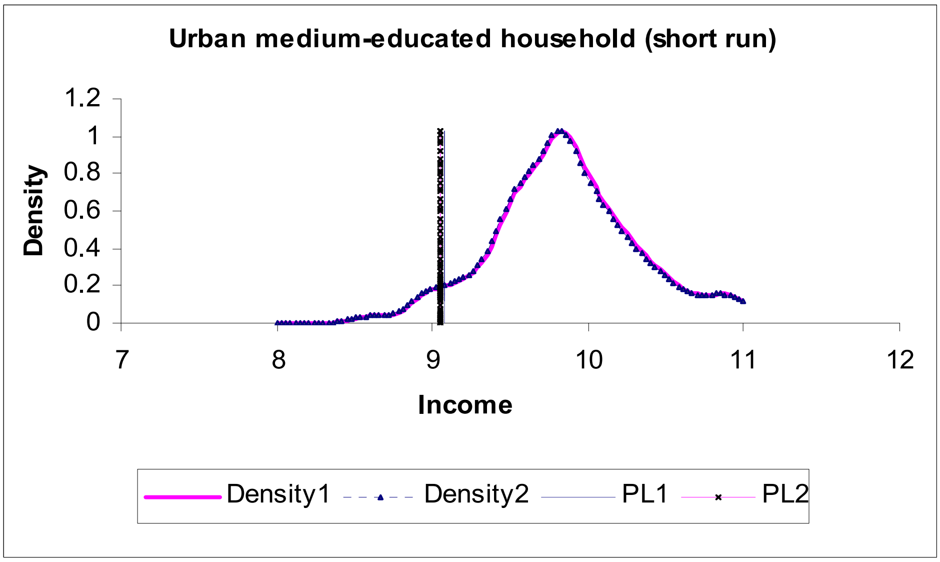
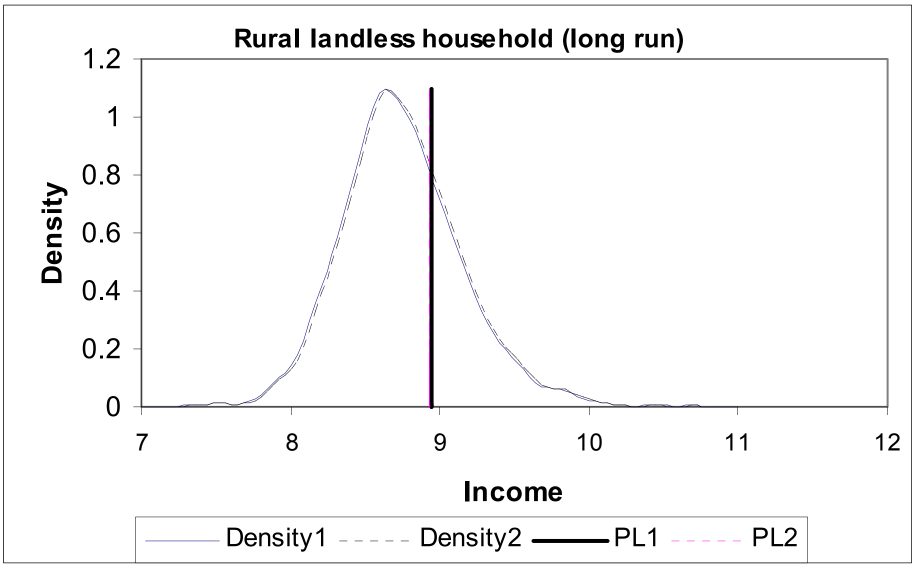
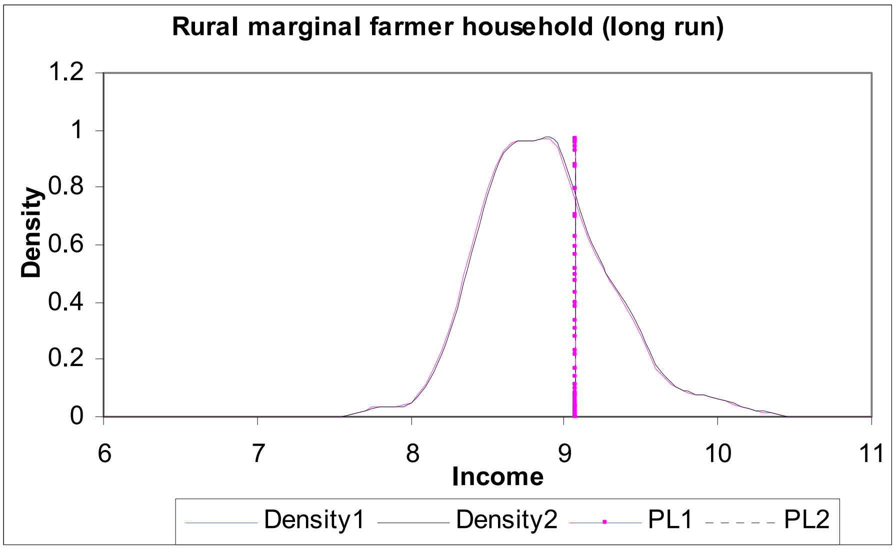
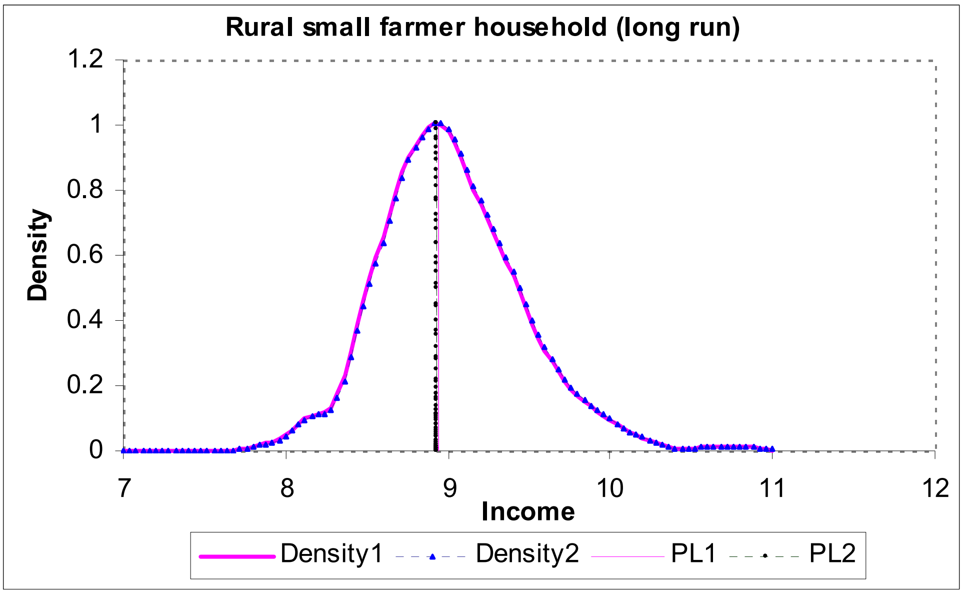


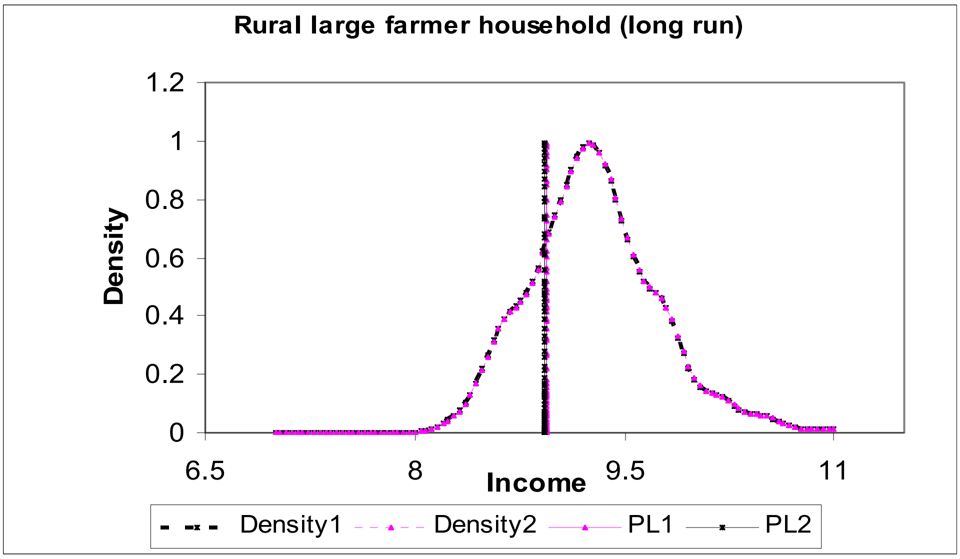
Figure 8.3: Changes in absolute poverty within rural households (Long run)





……….Figure 8.3 (continued)





……….Figure 8.3 (continued)

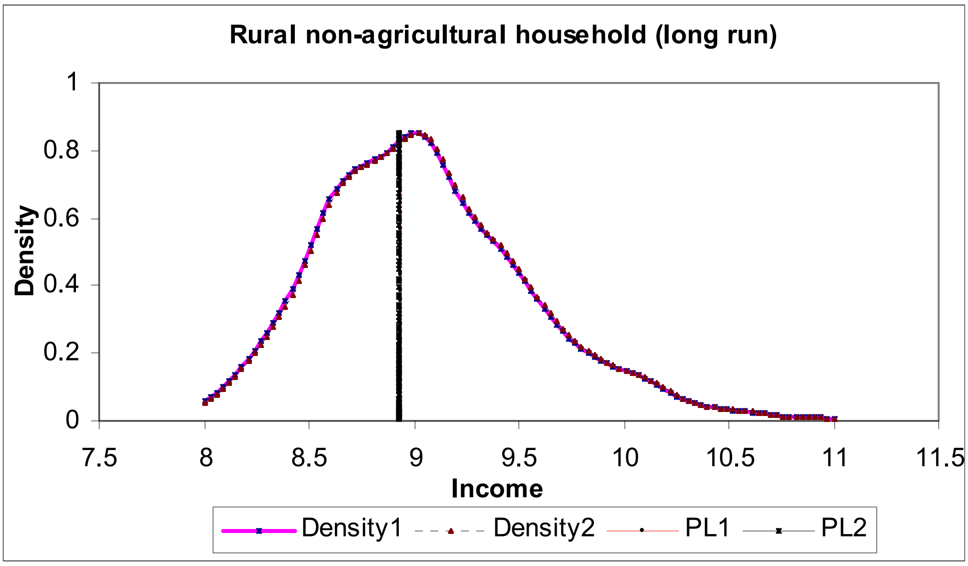
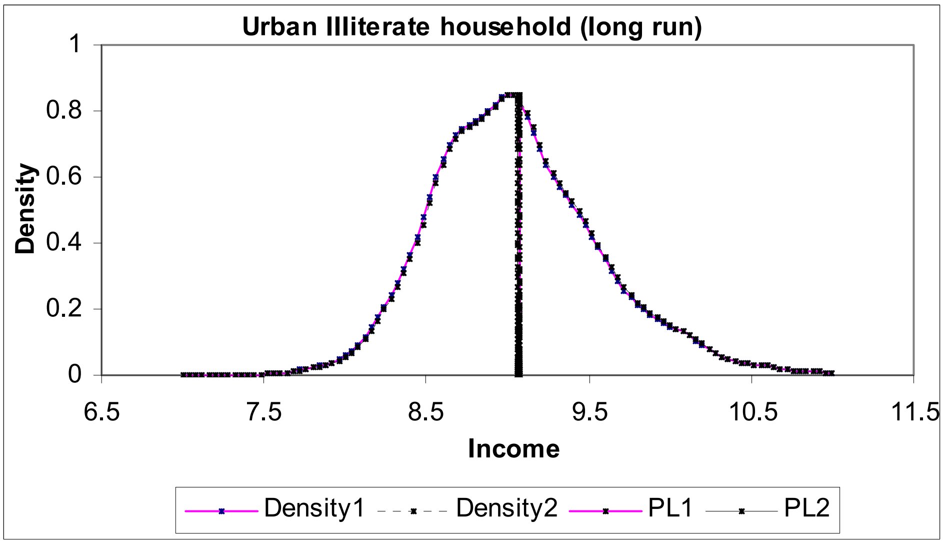


Figure 8.4: Changes in absolute poverty within urban households (Long run)



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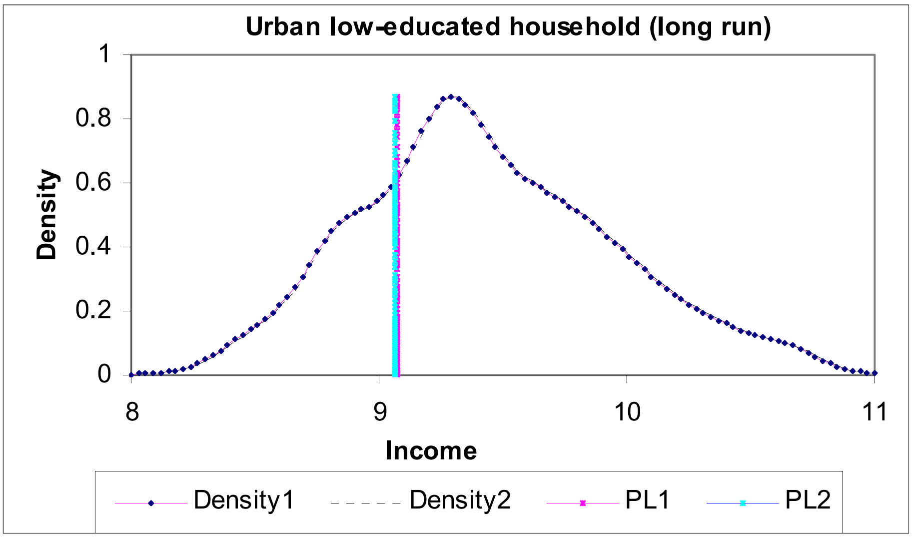

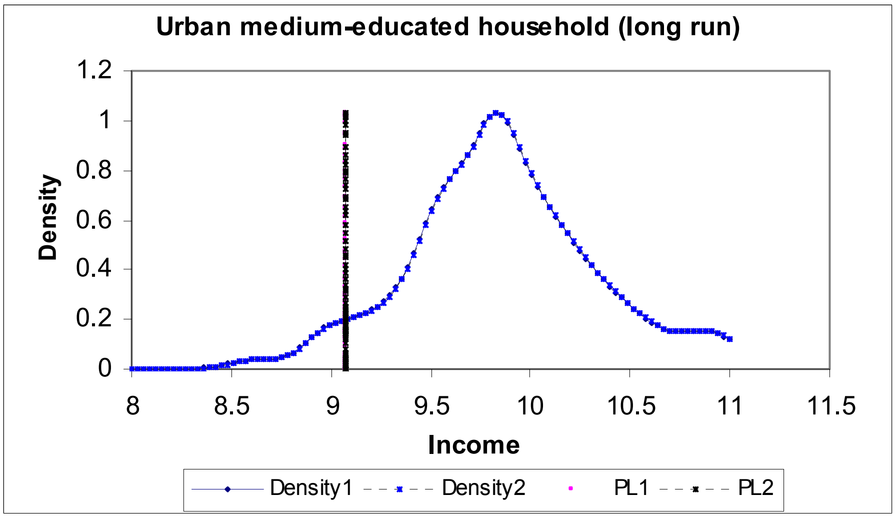

Tables 8.3 to 8.6 present the simulation results for the FGT poverty indices. The three types of FGT poverty estimates were estimated and compared with the base case. A negative change in poverty indices indicates reductions in poverty whereas positive changes indicate increases in poverty. Tables 8.3 and 8.4 show that in the short run the poverty consequences are mixed for rural and urban households. In the short run, under simulation 1, the three measures of poverty decrease marginally for the overall rural group whereas for the overall urban group the first measure (head count index) decreases. However, the poverty gap (P_1) and poverty severity (P_2) increase. The implication of this result is that in the short run in rural areas, trade liberalisation has a positive impact on poverty whereas in urban areas, trade liberalisation has helped some of the poor people (0.58 per cent) to go from poor to non-poor. However, the increased values of P_1 and P_2 by 0.38 per cent and 0.62 per cent respectively, reminding us of the deteriorating situation of households who remained poor. In other words, in urban areas, in the short run the poverty situation has intensified. This variation mainly comes from the differences in the changes in household income and consumer prices because of the tariff removal.

Table 8.3: FGT Poverty Indices (in percentages) for various policy experiments (Short run)

	Simulation 1			Simulation 2		
Household groups	**Head count ratio(P_0)**	**Poverty gap(P_1)**	**Squared poverty gap(P_2)**	**Head count ratio(P_0)**	**Poverty gap(P_1)**	**Squared poverty gap(P_2)**
Rural (All)	49.06	13.06	4.72	49.92	13.38	4.87
Landless HH	71.93	21.75	8.50	72.02	21.80	8.53
Marginal farmer HH	60.41	15.95	5.69	61.75	16.25	5.83
Small farmer HH	45.35	10.24	3.32	46.03	10.53	3.44
Large farmer HH	20.14	4.27	1.20	21.53	4.52	1.30
Non-agricultural HH	43.24	11.35	4.07	43.99	11.62	4.19
Urban (All)	32.37	8.73	3.23	33.08	8.85	3.28
Illiterate HH	60.19	17.53	6.81	61.15	17.69	6.89
Low-educated HH	24.34	5.33	1.62	24.69	5.46	1.67
Medium-educated HH	4.77	0.85	0.28	5.79	1.01	0.33

Source: Simulation results of the Bangladesh model and Bangladesh Household Income & Expenditure Survey 2000.

Table 8.4: Percentage changes of Poverty Indices from the base case scenario (Short run)

	Simulation 1			Simulation 2		
Household groups	**Head count ratio(P_0)**	**Poverty gap(P_1)**	**Squared poverty gap(P_2)**	**Head count ratio(P_0)**	**Poverty gap(P_1)**	**Squared poverty gap(P_2)**
Rural (All)	-0.28	-0.23	-0.21	1.46	2.22	2.96
Landless HH	0.11	0.55	0.59	0.24	0.79	1.19
Marginal farmer HH	-0.41	-0.06	-0.18	1.80	1.82	2.28
Small farmer HH	-0.24	-0.58	-0.90	1.25	2.23	2.76
Large farmer HH	-1.27	-2.06	-3.23	5.54	3.67	4.84
Non-agricultural HH	-0.48	-0.53	-0.73	1.28	1.75	2.20
Urban (All)	-0.58	0.34	0.62	1.60	1.72	2.18
Illiterate HH	0.13	0.52	0.59	1.71	1.43	1.77
Low-educated HH	0	0.19	0.62	1.44	2.63	3.73
Medium-educated HH	-17.33	-13.05	-12.22	0.35	3.77	2.33

Source: Author's own calculation from Table 8.1 and 8.3.

By contrast, the removal of import tariffs leads in the long run to reductions in all poverty indicators for the overall rural and urban groups (Tables 8.5 and 8.6). The head count index decreases by 3.00 per cent and 2.79 per cent among the overall rural and urban groups respectively, whereas the poverty gap and poverty severity indices decrease by 5.27 per cent and 6.34 per cent for rural households and 4.25 per cent and 5.30 per cent for urban households.

Decomposing the results among household types, poverty incidence varies greatly across rural and urban areas for different household groups. For example, in the short run in rural areas, landless households experience an increase in poverty incidence (Tables 8.3 and 8.4). The reason is that for this household group, as stated earlier, nominal post-tax income suffers a lot because of their declining factor income (Table 7.5 of Chapter 7). For this household group, trade liberalisation in the short run has not been offset by the fall in the monetary poverty line. Moreover, a reduction in government transfer payments as a result of government revenue loss induced by the tariff cuts also exacerbates the situation in the short run. For other rural household groups, all poverty indicators show a reduction in the short run. The large farmer household group experiences the largest decrease in poverty (Table 8.4). On the other hand, for urban groups, decomposition results show slightly increased poverty for the urban illiterate and low-educated household groups. All the poverty indicators reveal an impressive improvement for the urban medium-educated household group in the short run.

In the long run under simulation 1, decomposition of the results among household groups shows a reduction of all poverty indicators for all household groups (Table 8.6) both in rural and urban areas, suggesting that trade liberalisation policy has poverty reducing effects in the long run. In rural areas, the effect is greatest for the marginal farmer households in terms of the head count index, however, in terms of poverty gap (P_1) and poverty severity (P_2), the effects are higher for the landless household group. In urban areas, the effects are greatest for the medium-educated household group. These changes in poverty across different household groups can be traced to changes in factor prices, changes in the sources of household income and by changes in consumer prices. As discussed in Chapter 7, in the short run trade liberalisation encourages a reallocation of resources from heavily protected and inward oriented paddy and other food crop sectors to manufacturing and service sectors, which leads to a fall in the remuneration of labour and land relative to capital. Thus, in the short run, the effects on nominal income are biased against rural and urban poor households who largely depend on labour income. However, the significant drop in consumer prices offsets all of these negative effects except in the case of the rural landless, urban illiterate and urban low-educated households.

On the other hand, in the long run, tariff removal stimulates the export-oriented labour intensive manufacturing industries such as the ready-made garments and knitting industries. They attract labour from the low productive import-competing agricultural and manufacturing sectors, which serves to increase the nominal income of a substantial proportion of low-income households, especially the rural poor and the urban poor who are most dependent on labour income. In this case, the income effect dominates the price effect. Thus, poverty impacts depend on the model closure.

Table 8.5: FGT Poverty Indices (in percentages) for various policy experiments (Long run)

Household groups	Simulation 1			Simulation 2		
	Head count ratio(P_0)	Poverty gap(P_1)	Squared poverty gap(P_2)	Head count ratio(P_0)	Poverty gap(P_1)	Squared poverty gap(P_2)
Rural (All)	47.72	12.40	4.43	48.75	12.84	4.61
Landless HH	70.45	20.45	7.83	71.25	21.11	8.16
Marginal farmer HH	57.92	15.23	5.36	59.18	15.70	5.57
Small farmer HH	44.55	9.75	3.13	45.20	10.12	3.28
Large farmer HH	19.86	4.21	1.18	20.40	4.34	1.23
Non-agricultural HH	43.24	11.35	4.07	43.12	11.24	4.01
Urban (All)	31.65	8.33	3.04	31.99	8.54	3.14
Illiterate HH	58.78	16.73	6.42	59.25	17.13	6.61
Low-educated HH	23.81	5.07	1.52	24.29	5.23	1.58
Medium-educated HH	4.77	0.85	0.28	4.82	0.96	0.32

Source: Simulation results of the Bangladesh model and Bangladesh Household Income & Expenditure Survey 2000

Table 8.6: Percentage changes of Poverty Indices from the base case scenario (Long run)

Household groups	Simulation 1			Simulation 2		
	Head count ratio(P_0)	Poverty gap(P_1)	Squared poverty gap(P_2)	Head count ratio(P_0)	Poverty gap(P_1)	Squared poverty gap(P_2)
Rural (All)	-3.00	-5.27	-6.34	-0.91	-1.91	-2.54
Landless HH	-1.95	-5.46	-7.34	-0.84	-2.40	-3.32
Marginal farmer HH	-4.52	-4.57	-5.96	-2.44	-1.63	-2.28
Small farmer HH	-2.00	-5.34	-6.57	-0.57	-1.75	-2.09
Large farmer HH	-2.65	-3.44	-4.84	0	-0.46	-0.81
Non-agricultural HH	-0.48	-0.61	-0.73	-0.76	-1.58	-2.20
Urban (All)	-2.79	-4.25	-5.30	-1.75	-1.84	-2.21
Illiterate HH	-2.21	-4.07	-5.17	-1.45	-1.78	-2.36
Low-educated HH	-2.18	-4.70	-5.59	-0.21	-1.69	-1.86
Medium-educated HH	-17.33	-12.37	-12.5	-16.46	-1.23	0

Source: Author's own calculation from Table 8.1 and 8.5.

8.5.2.2 100 per cent tariff reduction on imports and consumption tax adjustment

Under simulation 2, where the effects of tariff removals on government revenue are offset by an increased consumption tax, the incidence of poverty increases for both rural and urban areas in the short run (Tables 8.3 and 8.4). In the case of rural areas, the poverty head count index (P_0) increases by 1.46 per cent suggesting that about 1.46 per cent of the population would fall into poverty as a result of the complete tariff removal with a compensatory adjustment in consumption tax. For urban areas, the figure is 1.60 per cent. The other two measures of poverty also suggest that in both rural and urban areas the poverty situation worsens (Table 8.4). The poverty gap (P_1) and poverty severity (P_2) indices increase by 2.22 per cent and 2.96 per cent respectively for rural areas and by 1.72 per cent and 2.18 per cent respectively for urban areas.

Decomposing poverty consequences among household groups, monetary poverty increases by all indicators for all rural and urban groups by more or less similar magnitude, except in the case of the large farmer household group in rural areas. The reason for the large increase in the head count index for the rural large farmer group (5.54 per cent) is that in the short run this group suffers because of its large share of land holdings, the returns to which decrease as a result of both the compensatory consumption tax and the tariff removal. These results indicate that in the short run, trade liberalisation with an accompanying consumption tax would worsen the poverty situation in Bangladesh.

In contrast, in the long run the situation seems to improve. Table 8.6 shows all FGT measures of poverty decrease both for rural and urban areas and for all household groups except for the large farmer group where the poverty head count index remains unchanged. In urban areas, the medium-educated household group experiences the greatest benefit in terms of poverty reduction, as measured by the head count index.

To analyse the changes in poverty incidence, we need to investigate the changes in the incomes of the representative household groups and the changes in commodity prices, as changes in poverty incidence are determined by changes in the monetary poverty line and changes in nominal income. As we stated before, imposing a consumption tax causes an extra distortion which affects household consumption levels and poverty as it affects consumption decisions. It raises the prices paid by the consumers, which in turn increases the value of the monetary poverty line. In our simulation in the short run, changes in the poverty lines for rural and urban areas are 0.26 per cent and 0.22 per cent whereas in the long run they are 0.56 per cent and 0.47 per cent respectively (Table 8.2). These changes in poverty lines in turn shift the post-shock poverty lines rightward. On the other hand, changes in the factor prices induce changes in household income. As stated in Chapter 7, with full tariff elimination and a replacement consumption tax means that in the short run all nominal factors return, except labour returns decline, with the greatest reduction in returns to land (Table 7.3) This result can be explained by the fall in domestic prices resulting from the removal of import tariffs. All households suffer from declining nominal income, but in smaller magnitudes than in simulation 1 (Table7.5). This decrease in nominal income and the increase in the poverty lines lead to the increased incidence of poverty in the short run in simulation 2 (Table 8.4). In contrast, in the long run, despite the increases in the poverty line, poverty incidence decrease for all household groups as increased income for all groups in the long run offsets the increase in the poverty line (Table 8.6).

Emini, Cockburn, and Decaluwe (2006) examined why poverty gets worse in Cameroon when a consumption tax is used to compensate for lost tariff revenue. The main reason is supplementary distortions created by uniform consumption tax which is regressive in its incidence.

In this study we use a range of other poverty measures such as Watt's index, the Sen index and the S-Gini index as a check on the robustness of the FGT poverty measures. The results of these indices under the base case scenario and the two different policy scenarios are presented in Tables 8.7 to Table 8.10. The results are consistent with those from the FGT indices, suggesting that the latter are robust in nature.

Table 8.7: Other poverty indices under different policy scenario (Short run)

	Sen Index (%)				Watts Index (%)				S-Gini Index (%)			
	Simulation 1		Simulation 2		Simulation 1		Simulation 2		Simulation 1		Simulation 2	
Households	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Landless HH	28.35	28.46	28.35	28.53	27.95	28.11	27.95	28.20	32.55	32.69	32.55	32.76
Marginal farmer HH	21.38	21.30	21.38	21.82	20.06	20.00	20.06	20.45	25.54	25.48	25.54	25.54
Small farmer HH	14.11	14.04	14.11	14.40	12.66	12.57	12.66	12.96	17.66	17.56	17.66	18.00
Large farmer HH	5.76	5.64	5.76	6.06	5.17	5.06	5.17	5.37	8.12	7.97	8.12	8.40
Non-agricultural HH	15.33	15.24	15.33	15.60	14.40	14.32	14.40	14.67	19.58	19.48	19.58	19.88
Illiterate HH	23.19	23.28	23.19	23.60	22.56	22.68	22.56	22.91	27.87	28.19	27.87	28.19
Low-educated HH	7.16	7.17	7.16	7.33	6.41	6.42	6.41	6.58	9.80	9.82	9.80	10.04
Medium-educated HH	1.37	1.28	1.37	1.41	1.24	1.23	1.24	1.28	1.92	1.90	1.92	1.99

Table 8.8: Percentage changes of other poverty indices from the base case scenario (Short run)

	Sen Index		Watts Index		S-Gini Index	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2	Simulation 1	Simulation 2
Households	% change	% change	% change	% change	% change	% change
Landless HH	0.57	0.63	0.39	0.89	0.43	0.65
Marginal farmer HH	-0.30	2.06	-0.37	1.94	-0.23	1.49
Small farmer HH	-0.71	2.06	-0.50	2.37	-0.57	1.93
Large farmer HH	-2.13	5.21	-2.08	3.87	-1.85	3.45
Non-agricultural HH	-0.56	1.76	-0.59	1.88	-0.51	1.53
Illiterate HH	0.53	1.77	0.39	1.55	1.15	1.15
Low-educated HH	0.16	2.37	0.14	2.65	0.20	2.45
Medium-educated HH	-0.81	2.92	-6.57	3.25	-1.04	3.65

Table 8.9: Other poverty indices under different policy scenario (Long run)

	Watts Index (%)				Sen Index (%)				S-Gini Index (%)			
	Simulation 1		Simulation 2		Simulation 1		Simulation 2		Simulation 1		Simulation 2	
Households	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Landless HH	27.95	26.27	27.95	27.20	28.35	27.03	28.35	27.77	32.55	31.14	32.55	31.93
Marginal farmer HH	20.06	19.06	20.06	19.70	21.38	20.25	21.38	20.89	25.54	24.56	25.54	25.19
Small farmer HH	12.66	11.94	12.66	12.42	14.11	13.49	14.11	13.91	17.66	16.82	17.66	17.38
Large farmer HH	5.17	4.97	5.17	5.14	5.76	5.54	5.76	5.74	8.12	7.85	8.12	8.08
Non-agricultural HH	14.40	13.40	14.40	14.16	15.33	14.64	15.33	15.11	19.58	18.78	19.58	19.30
Illiterate HH	22.56	21.56	22.56	22.12	23.19	22.32	23.19	22.75	27.87	26.93	27.87	27.46
Low-educated HH	6.41	6.09	6.41	6.29	7.16	6.86	7.16	7.06	9.80	9.37	9.80	9.64
Medium-educated HH	1.24	1.19	1.24	1.22	1.37	1.25	1.37	1.28	1.92	1.84	1.92	1.89

Table 8.10: Percentage changes of other poverty indices from the base case scenario (Long run)

	Watts Index		Sen Index		S-Gini Index	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2	Simulation 1	Simulation 2
Households	% change	% change	% change	% change	% change	% change
Landless HH	-6.01	-2.68	-4.66	-2.05	-4.33	-1.90
Marginal farmer HH	-4.98	-1.79	-5.29	-2.29	-3.84	-1.37
Small farmer HH	-5.68	-1.90	-4.39	-1.42	-4.76	-1.59
Large farmer HH	-3.87	-0.58	-3.82	-0.35	-3.33	-0.49
Non-agricultural HH	-6.94	-1.67	-4.50	-1.44	-4.09	-1.43
Illiterate HH	-4.43	-1.95	-3.75	-1.90	-3.37	-1.47
Low-educated HH	-4.99	-1.87	-4.19	-1.40	-4.39	-1.63
Medium-educated HH	-4.03	-1.61	-8.76	-6.57	-4.17	-1.56

8.6 Inequality Measures

This study uses the following measures of inequality to examine the underlying inequality situation in both the base period and post-shock simulation period.

Gini Index:

One of the most commonly used measures of inequality is the Gini coefficient. It is based on the Lorenz curve, a cumulative frequency curve which plots the cumulative percentages of total consumption against the cumulative percentage of households ranked from bottom to top. The Gini coefficient is calculated as the ratio of the area between the Lorenz curve and the 45^{o} line to the total area under the 45^{o} line. It can be expressed as (De Silva, 2008):

Gini index of inequality = $2\int_0^1 (p - L(p))dp$

where the implicit assumption is that the distance, $p - L(p)$, from the line of perfect equality in consumption is weighted equally across percentiles, p. A well-known single parameter generalisation of the Gini (S-Gini) is obtained by applying a percentile dependent weight to the distance $p - L(p)$, between the line of perfect equality (45^{o}) and the Lorenz curve. The single parameter Gini (S-Gini) index can be defined as follows:

$$I(\rho) = \int_0^1 (p - L(p))k(p;\ \rho)\,dp.$$

where $k(p;\rho) = \rho(\rho - 1)(1 - p)^{(\rho-2)}$

when ρ = 2, $I(2)$ become the standard Gini coefficient.

Atkinson Index:

The Atkinson inequality measure is based on an additive social welfare function. It introduces a parameter "epsilon" (ε) which measures the aversion to inequality, representing the strength of society's preference for equality. It ranges from 0 to ∞. The Atkinson index can be defined as[143]:

$$\text{Atkinson index} = 1 - \frac{1}{\bar{y}}\left(\frac{1}{N}\sum_{i-1}^{N} y_i^{1-\varepsilon}\right)^{1/1-\varepsilon} \qquad \text{, when } \varepsilon \neq 1$$

$$1 - \frac{1}{\bar{y}}\Pi_{i=1}^{N} y_i \qquad \text{, when } \varepsilon = 1$$

where y_i denotes the income of the *i-th* person, N is the population size, $\bar{y}$ is mean income. A zero value of ε implies that the society is indifferent towards distribution, in contrast the higher the value of ε the more society cares about the welfare of the lower income groups.

Entropy Index:

Another important inequality measure, the generalised entropy family, is able to decompose inequality by population subgroups. It can be defined as follows (Duclos & Araar, 2006):

$$I(\theta) = \begin{cases} \frac{1}{\theta(\theta-1)}\left(\int_0^1 \left(\frac{Q(p)}{\mu}\right)^{\theta} dp - 1\right) & \text{if} \quad \theta \neq 0,1 \\ \int_0^1 \ln\left(\frac{\mu}{Q(p)}\right) dp & \text{if} \quad \theta = 0 \\ \int_0^1 \frac{Q(p)}{\mu} \ln\left(\frac{Q(p)}{\mu}\right) dp & \text{if} \quad \theta = 1 \end{cases}$$

where μ is the mean income and the parameter θ represents the weight placed on distances between incomes at different parts of the income distribution. The latter can take any real value. The value of $I(\theta)$ varies from 0 to ∞. A zero value of $I(\theta)$ represents an equal distribution whereas a higher value of $I(\theta)$ indicates a higher degree of inequality.

143 For detailed discussion and derivation of Atkinson index, see de la Vega and Urrutia (2008).

8.6.1 Estimation of Inequality Indices

As with FGT poverty indices, inequality indices have been calculated using the software DAD, where the approach adopts the Kernel non-parametric density estimation method in specifying the probability density function. Calculations were made for the base year and for the after-simulation household income generated by the model. The indices were estimated for the aggregated rural, aggregated urban and total population of Bangladesh.

8.6.1.1 Base Case Inequality Scenario

To measure the extent of inequality among rural households, urban households and total households, the S-Gini coefficient has been used firstly based on the percentage changes in the nominal income resulting from the main CGE model. Tables 8.11 to Table 8.14 present the S-Gini coefficients under the benchmark and two different policy simulations for the short run and long run respectively. Values of the S-Gini indices for urban and rural areas suggest that people living in urban areas experience greater income inequality (0.3660) than people living in rural areas (0.2873). According to Khan (2006, p. 7), in rural Bangladesh, the increase in inequality over the decade 1991-2000 was driven by the growth of income from non-farm enterprises, salary from non-farm employment, remittances from abroad and property income. In 2000, these sources together accounted for about 45 per cent of income which is nearly double compared to their share of total income in 1991-92 (Khan, 2006, p. 8). [144], among these sources, the most important disequalising sources were property income, and non-agricultural salary income. Property income, most of which consists of rent for land, grew largely because of the rise in the amount of land rented out by the large farmer households. These facts can be verified by referring back to the factorial income composition (Table 6.8) and occupational composition of labour by household group (Table 6.9) in Chapter 6. Table 6.8 shows that in rural areas the large farmer household group received most capital income (59.71 per cent) and the largest share of land income. Moreover, this household group has the highest amount of male high-skilled labour (54.49 per cent) and female high-skilled labour (6.43 per cent) who contributes to the inequality situation by earning salary income.

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[144] The Household Income & Expenditure Survey (HIES) 2000 introduced the term "salary", different from wages for non-agricultural workers. According to Khan (2006), wage earning workers are paid daily or weekly while salaried workers are paid monthly. Wage earners are relatively low-skilled, while salaried workers are more- skilled workers who belong to higher income households.

Similarly in the urban areas, according to (Khan, 2006, p. 13), non-farm salary income had a strong disequalising effect during the period 1991-92 to 2000. Khan (2006, p. 13) added that in urban areas, the trend of employment in public and private enterprises and organisations such as NGOs and increasing non-farm enterprise income reached a higher proportion of total income in 2000 than in earlier years. The income share from non-farm salary which was only 20.40 per cent during the period 1991-92 rose to 29.11 per cent in the year 2000, a 43 per cent increase. In our model database, Table 6.8 (Chapter 6) shows that in urban areas, medium-educated and high-educated household groups receive the highest share of capital income, mainly from non-farm enterprises. Their income share from salary income was also higher in the year 2000. Table 6.9 shows the male high-skilled category is the main source of labour income for the medium-educated (about 90 per cent) and high-educated household (about 96 per cent). Members of these groups are mainly employed in various manufacturing industries (such as the leather industry, paper industry, petroleum refinery industry, chemical industry) and in various service sectors (such as education, public administration, defense, health, communication and information technology), which exacerbated the disequalising effect by increasing the salary income of these groups.

Table 8.11 shows that the base year values of the Atkinson index and the Entropy index confirm the outcome of the S-Gini index, suggesting that urban areas have a higher degree of inequality than rural areas.

8.6.1.2 Post Simulation Income Inequality

Table 8.11 and 8.12 show that under simulation 1, Gini coefficients increase in the short run in both rural and urban areas as well as the economy as a whole, although the magnitudes of the measures are small. This increase in inequality is a consequence of the returns to land and capital rising relative to the returns to labour as their supplies is fixed in the short run. Thus, in the short run in rural areas, most of the benefits go to those households who own capital and land, predominantly the large farmer household groups who already receive the highest incomes. Likewise, in the urban areas, the illiterate and low-educated households are the most disadvantaged group, while medium-educated and high-educated household groups benefit from their scarce capital helping to increase inequality in these areas. Furthermore, with respect to the derived demand for the various labour categories, in the short run along with the increased demand for the female low-skilled labour (2.53 per cent) and male low-skilled labour (1.18 per cent), the demand for male high-skilled (1.81 per cent) and female high-skilled (1.09 per cent)[145] also increased. This also contributed to increased inequality in the short run in both rural and urban areas. As discussed in the previous section, in Bangladesh, male high-skilled and female high-skilled labour categories are involved with various administrative, managerial, professional and technical works and earn salary income which in turn helps in widening the income gap between the poor and the rich.

However, under simulation 1 in the long run, inequality falls slightly after trade liberalisation. In the long run, reductions in the price of capital (Table 7.3) in turn create suffering for the household groups with major shares of capital income. On the other hand, the incomes of the poor household groups with major shares of unskilled labour increase as the demand for labour increases in the long run. This long-term distributional consequence of trade liberalisation is consistent with the Stolper-Samuelson theorem which is based on the traditional Heckscher-Ohlin trade model. According to this theory, trade flows are determined by comparative advantage. Since developing countries are relatively rich in low-skilled labour, these countries will export labour-intensive goods to the developed countries which in turn increases the demand for unskilled labour. Thus, as a result of trade, inequality between the rich and the poor will decline in developing countries. In our simulation, Bangladesh, as a country with abundant low-skilled labour, experiences this phenomenon.

When in simulation 2 trade liberalisation is accompanied by a compensatory consumption tax, inequality decreases in both the short run and long run (Tables 8.11 to 8.14). As noted in Chapter 7, full trade liberalisation with a replacement consumption tax decreases all factor returns except the nominal labour return. The nominal labour return increases slightly because of model closure. In our model, the assumption of full wage indexation bids the nominal labour returns up as the CPI increases because of the consumption tax. This helps in alleviating inequality in the first instance. In addition, the increase in the flow of government transfers to rural and urban poor households, as a result of the compensation for the consumption tax, is expected to have a positive effect on income distribution.

We used the Atkinson index and the Entropy index to check the robustness of the Gini coefficient. In the case of the Atkinson index and the Entropy index, we have used the value of $\varepsilon = 0.5$ and $\theta = 0.0$ respectively as a default values in DAD. These results are also

[145] Changes in labour demand have been discussed in Chapter 7.

presented in Tables 8.11 to 8.14. These results are consistent with those from the Gini coefficients, confirming that complete tariff removal brings a slight increase in overall inequality in both rural and urban area in the short run, and that inequality declines marginally for both rural and urban areas in the long run.

For simulation 2, where a compensatory consumption tax was replaced to neutralise the revenue loss effect from tariff liberalisation, the values of the Atkinson and the Entropy indices are also consistent with the values of Gini indices in both the short run and long run (Tables 8.11 to 8.14). These results also prove the robustness of these measures.

Table 8.11: Inequality measures for different policy simulations (Short run)

	S-Gini Index (ρ =2.0)				Atkinson Index (ε =0.5)				Entropy Index (θ =0.0)			
	Simulation 1		Simulation 2		Simulation 1		Simulation 2		Simulation 1		Simulation 2	
Households	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
All	0.3290	0.3295	0.3290	0.3286	0.0898	0.0901	0.0898	0.0896	0.1749	0.1755	0.1749	0.1745
Rural	0.2873	0.2877	0.2873	0.2871	0.0684	0.0686	0.0684	0.0683	0.1338	0.1342	0.1338	0.1336
Urban	0.3660	0.3665	0.3660	0.3654	0.1085	0.1088	0.1085	0.1082	0.2196	0.2202	0.2196	0.2189

Table 8.12: Percentage changes of inequality indices from the base case scenario (Short run)

	S-Gini Index		Atkinson Index		Entropy Index	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2	Simulation 1	Simulation 2
Households	**% change**	**% change**	**% change**	**% change**	**% change**	**% change**
All	0.15	-0.12	0.33	-0.22	0.34	-0.23
Rural	0.14	-0.07	0.29	-0.15	0.30	-0.15
Urban	0.14	-0.16	0.28	-0.28	0.27	-0.32

Table 8.13: Inequality measures for different policy simulations (Long run)

	S-Gini Index (ρ =2.0)				Atkinson Index (ε =0.5)				Entropy Index (θ =0.0)			
	Simulation 1		Simulation 2		Simulation 1		Simulation 2		Simulation 1		Simulation 2	
Households	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
All	0.3290	0.3280	0.3290	0.3283	0.0898	0.0893	0.0898	0.0894	0.1750	0.1740	0.1750	0.1743
Rural	0.2873	0.2867	0.2873	0.2869	0.0684	0.0681	0.0684	0.0682	0.1338	0.1332	0.1338	0.1334
Urban	0.3660	0.3651	0.3660	0.3654	0.1085	0.1080	0.1085	0.1082	0.2196	0.2185	0.2196	0.2189

Table 8.14: Percentage changes of inequality indices from the base case scenario (Long run)

	S-Gini Index		Atkinson Index		Entropy Index	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2	Simulation 1	Simulation 2
Households	% change	% change	% change	% change	% change	% change
All	-0.30	-0.21	-0.56	-0.45	-0.57	-0.40
Rural	-0.21	-0.14	-0.44	-0.29	-0.45	-0.30
Urban	-0.25	-0.16	-0.46	-0.28	-0.50	-0.32

8.7 Sensitivity Analysis

In this section, we examine how sensitive the poverty effects and inequality effects are to changes in Armington import elasticities[146] and the primary factor substitution elasticities[147]. These elasticities are changed by +50 per cent and -50 per cent from their base values. To test our results against these changes in model parameters, we ran some new simulations. The first considered a 100 per cent reduction of tariff rates for all commodities, with Armington elasticities 50 per cent lower. The second simulation considers the same level of trade liberalisation, but with Armington elasticities 50 per cent higher. The third and fourth simulations consider the same trade liberalisation but with primary factor substitution elasticities, 50 per cent higher and lower respectively and Armington elasticitiues maintained at original levels. These experiments are conducted for both the short run and the long run[148].

8.7.1 Sensitivity to the Armington Elasticities

An Armington substitution elasticity indicates the degree of substitutability between domestic and imported products for each sector. Thus, higher values for these elasticities imply greater substitution between imported and domestically produced goods in response to changes in relative prices. Hence real GDP, imports and exports are expected to show larger changes in response to effects of the tariff cuts on domestic prices, thereby amplifying the poverty impact of the tariff cuts. The reverse is true for lower values of elasticities. Figures 8.5 and 8.6 present the short run and long run effects of a 100 per cent tariff reduction across the board on the head count index (P_0), poverty gap index (P_1) and poverty severity (P_2) using the different Armington elasticities. These figures show that our estimates of the impact of the tariff cuts on poverty tend to be not very sensitive to the values of the Armington substitution elasticities between imports and domestic production.

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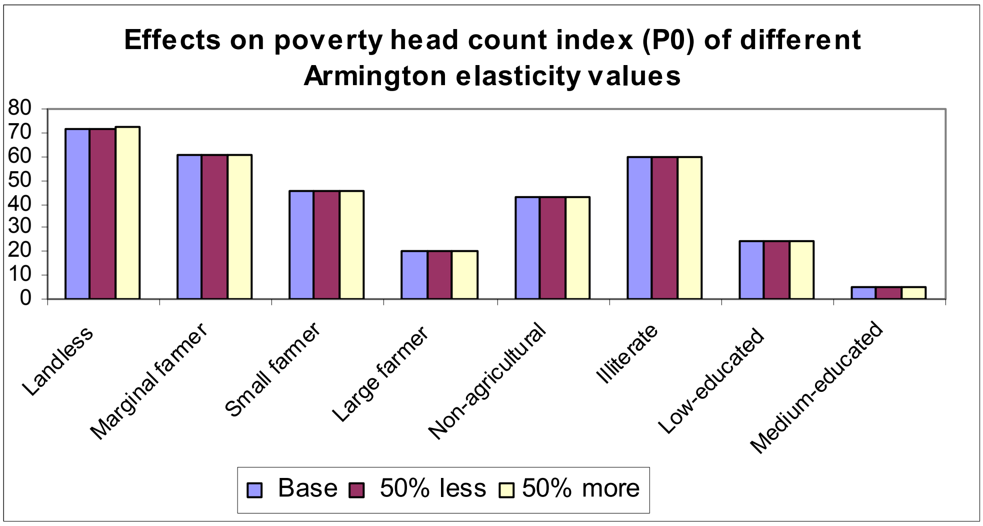
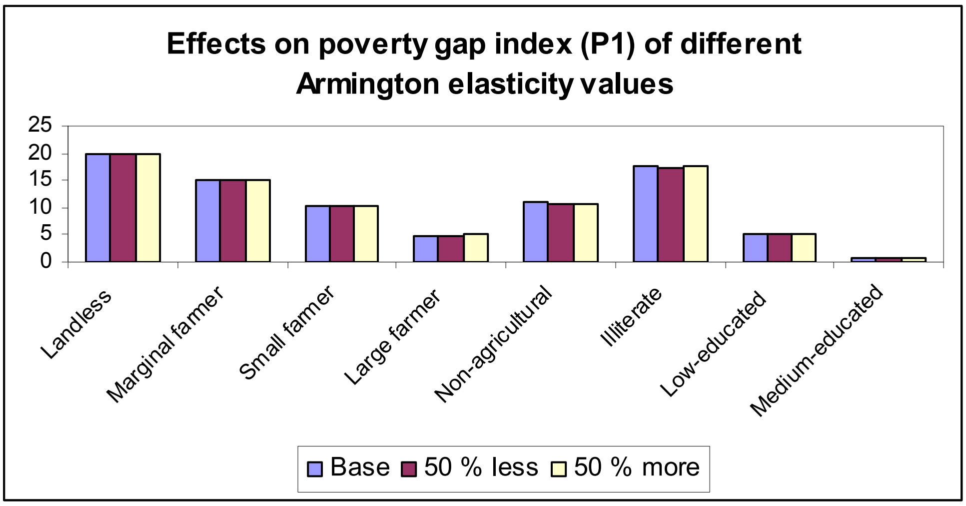
[146] Base elasticity values have been provided in Appendix Table C 6.3.

[147] The elasticity of substitution between primary factors is set at 0.5 for all sectors.

[148] These experiments have been conducted only for simulation 1.

Figure 8.5: Short run: Poverty effects of 100 per cent tariff reduction under different sets of Armington elasticities





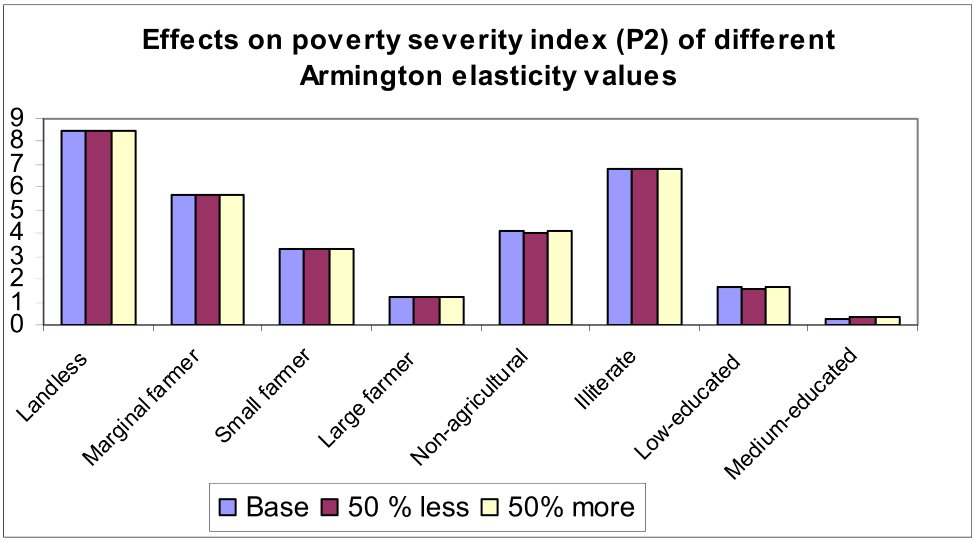
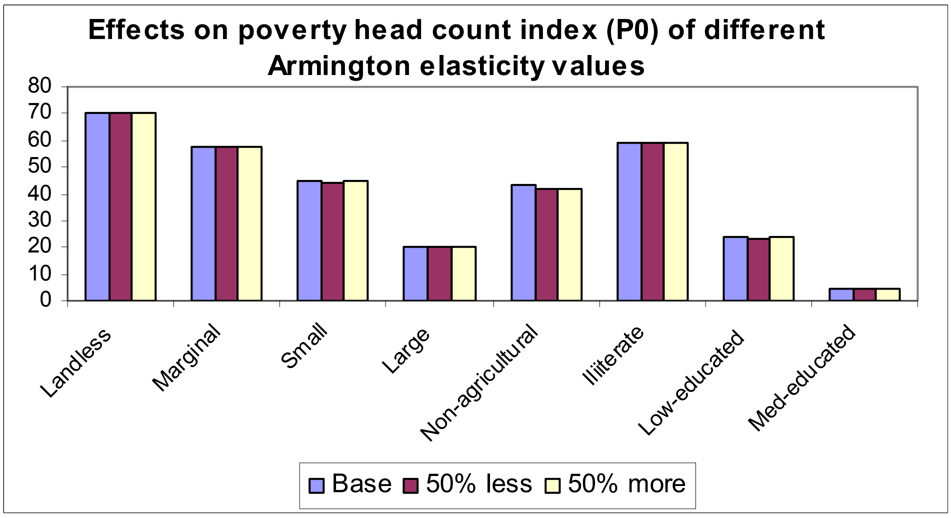
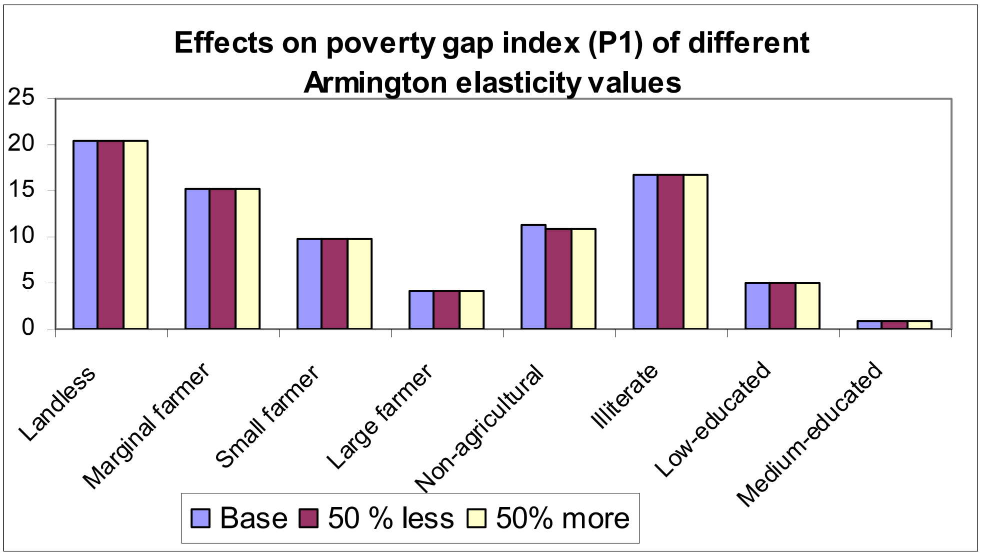
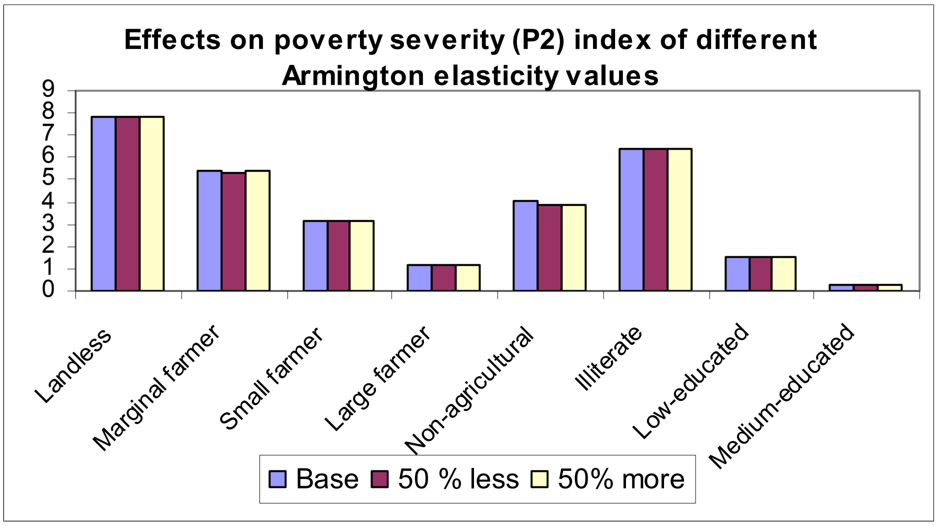


Figure 8.6: Long run: Poverty effects of complete tariff reduction under different sets of Armington elasticities





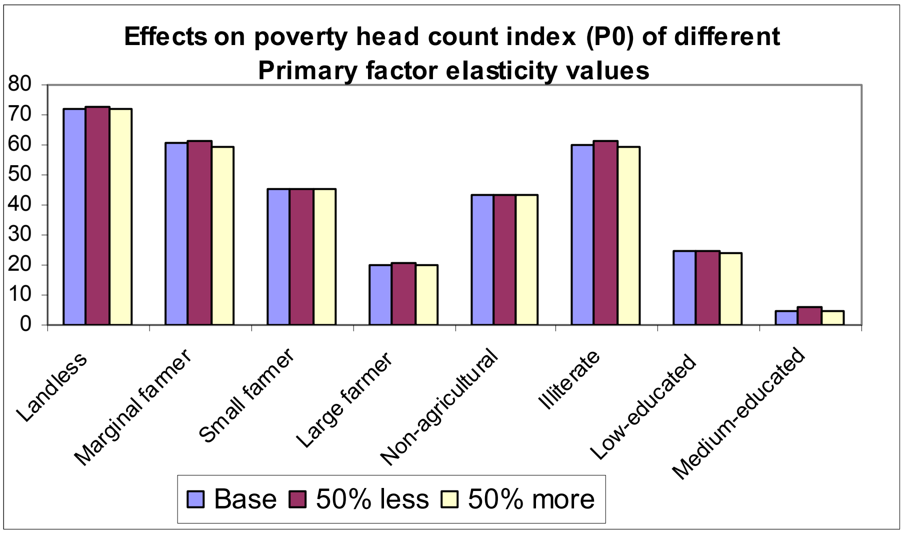


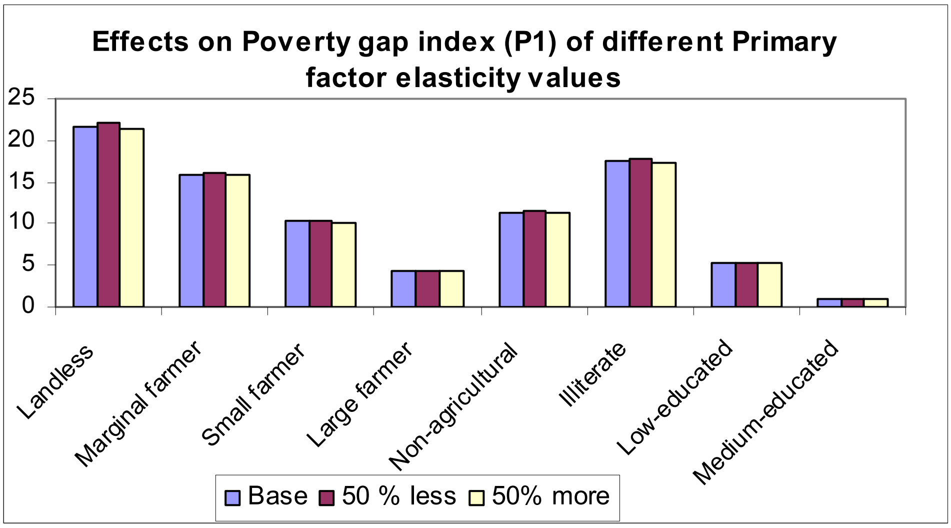
For most of the household groups, variations in the assumed Armington elasticities do not change the simulated poverty effects or increase incidences. The main reason may be that the imports of the commodities included in the basic needs consumption bundle constitute only a small share of the bundle. Generally, for all poverty indicators (P_0, P_1 and P_2), the qualitative effects are essentially insensitive to the size of the elasticities, so confirming that the original simulation results are relatively robust.

8.7.2 Sensitivity of the Primary Factor Elasticity

Figures 8.7 and 8.8 present the short run and long run effects of a 100 per cent tariff reduction across the board on the head count index (P_0), poverty gap index (P_1) and poverty severity (P_2) index using the different assumptions about primary factor elasticities. These figures show that the sensitivity of the household's poverty to changes in the primary factor elasticities is slightly larger than the sensitivity to changes in Armington elasticities. Higher elasticity for primary factors infers a higher degree of substitution between primary factors which can increase the impact of trade reform on production and household income. Figures 8.7 and 8.8 show that higher value for primary factor elasticities helps decrease the adverse poverty impacts, but only to a very small extent. Rural landless, marginal farmer, small farmer and illiterate household groups experience slightly increased benefits (Figures 8.7 and 8.8). As with the Armington elasticities, however, for all poverty indicators the qualitative effects are essentially insensitive to the size of the elasticities, which also confirms the robustness of the original tariff simulation results.

Figure 8.7: Short run: Poverty effects of 100 per cent tariff reduction under different sets of primary factor elasticities




Effects on Poverty gap index (P1) of different Primary factor elasticity values
25
20
15
10
5
0
Landless
Marginal farmer
Small farmer
Large farmer
Non-agricultural
Illiterate
Low-educated
Medium-educated
Base
50 % less
50% more

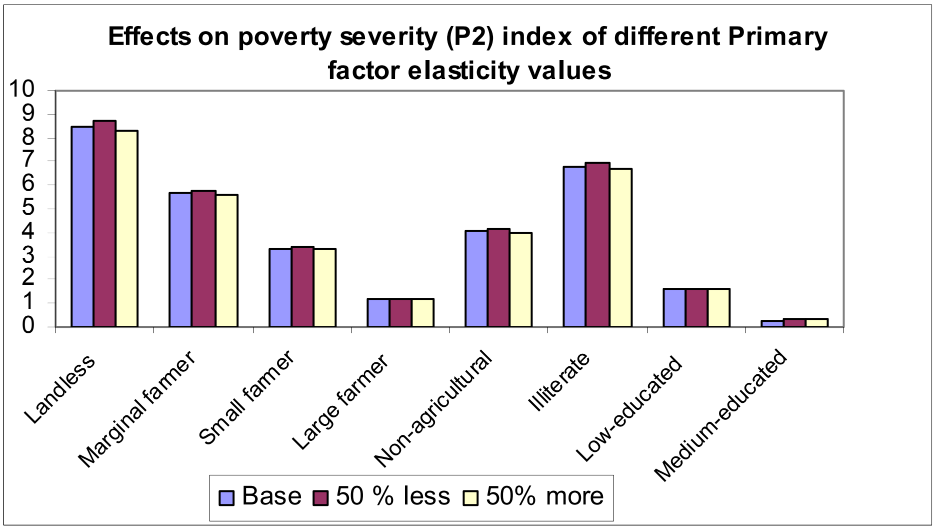
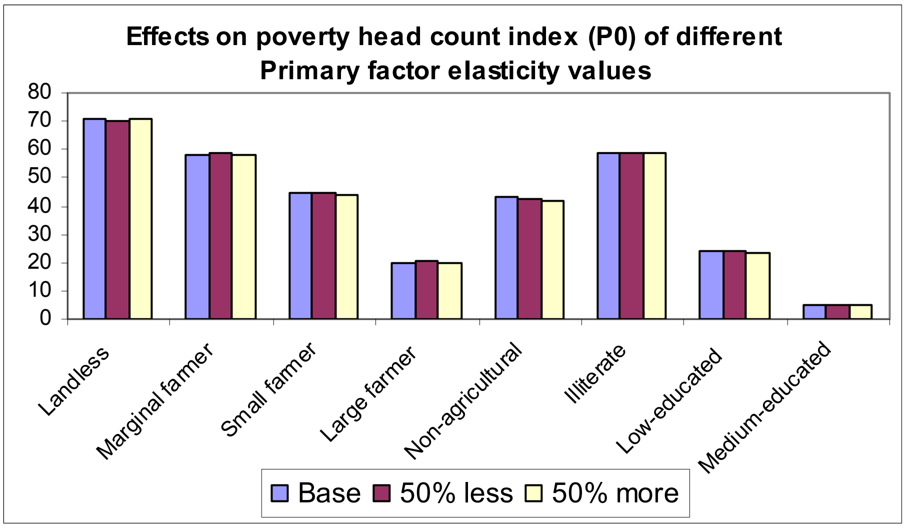
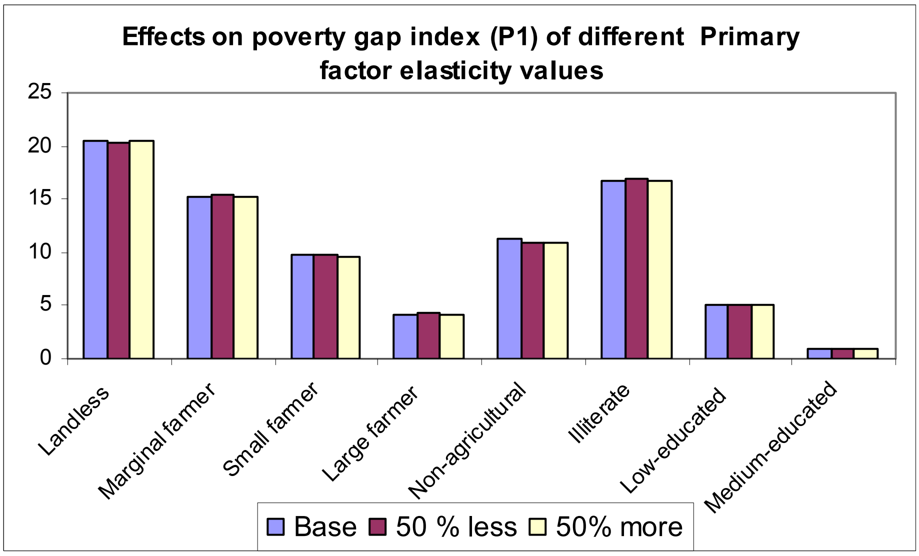
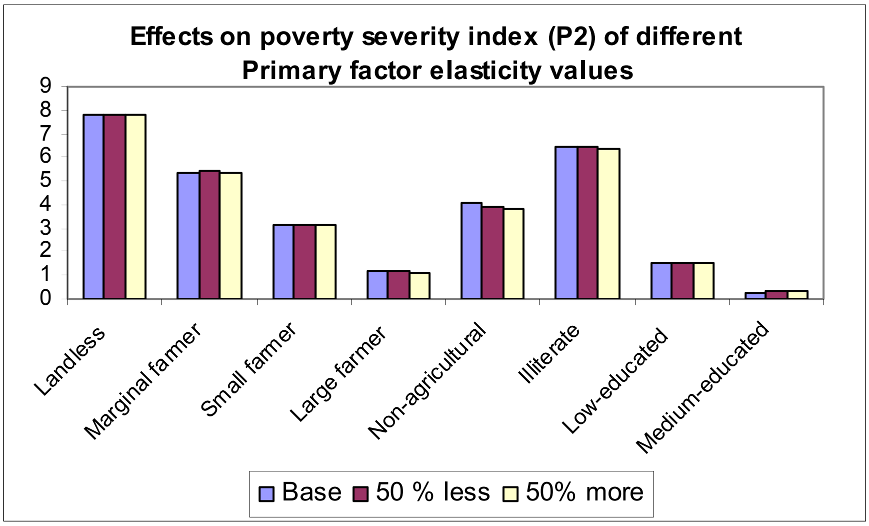

Effects on poverty severity (P2) index of different Primary factor elasticity values
10
9
8
7
6
5
4
3
2
1
0
Landless
Marginal farmer
Small farmer
Large farmer
Non-agricultural
Illiterate
Low-educated
Medium-educated
Base
50 % less
50% more

Figure 8.8: Long-run: Poverty effects of complete tariff reduction under different sets of primary factor elasticities







8.7.3 Income Inequality Sensitivity to Changes in Elasticities

Table 8.15 reports the results for the inequality measures with respect to various sets of values of the Armington and primary factor elasticities. This table shows that inequality in the distribution of income amongst households remains almost unchanged with respect to changes in the Armington elasticities. However, the sensitivity of the households' income distribution effect is slightly larger with respect to changes in primary factor elasticities. In the short run, decreasing the values of primary factor elasticities causes a marginal increase in inequality, whereas increased values of the elasticities help reduce inequality. In the long run, however, lowered elasticity values decrease income inequality, whereas increased elasticity values cause slightly increased inequality.

Table 8.15: Income inequality sensitivity to changes in elasticities

	S-Gini index (Short run)			S-Gini index (Long run)		
Armington elasticity	**All**	**Rural (All)**	**Urban (All)**	**All**	**Rural (All)**	**Urban (All)**
50% less*	0.3295	0.2877	0.3664	0.3280	0.2866	0.3651
Base	0.3295	0.2877	0.3664	0.3279	0.2866	0.3650
50 % more*	0.3295	0.2877	0.3664	0.3279	0.2866	0.3650
Primary factor elasticity						
50 % less*	0.3299	0.2879	0.3668	0.3273	0.2862	0.3645
Base	0.3295	0.2877	0.3664	0.3279	0.2866	0.3650
50% more*	0.3291	0.2874	0.3661	0.3284	0.2869	0.3654

* from base elasticities

Source: Author's own calculation from simulation results.

8.8 Conclusions

This chapter links the macro CGE results obtained in Chapter 7 with household survey data to analyse the impact of trade reform on poverty and income inequality in Bangladesh. Two experiments were undertaken: (1) trade liberalisation through tariff cuts without a compensatory consumption tax; and (2) trade liberalisation in the presence of a uniform consumption tax determined endogenously. The main findings are that in both the short run and long run, full tariff removal alleviates the poverty problem, but the degree of alleviation was higher in the long run than the short run. The degree of poverty reduction varies for various household groups. In the short run, the rural landless, urban illiterate and low-educated urban household groups experience some increase in poverty incidence, whereas in the long run, the marginal farmer and large farmer household group experience some decrease in the poverty head count index. In terms of the poverty gap index and poverty severity, the landless household group achieves most in the long run. By contrast, in the urban areas, the medium-educated household group experiences the largest gain in poverty reduction.

Gini coefficients which assess the effects on income inequality suggest that in the short run a tariff reduction will increase the income disparities slightly. In contrast, in the long run with free capital mobility, tariff reductions tend to reduce poverty and inequality through income benefits to poor households. This evidence is in line with the Stolper-Samuelson model which states that the most abundant factors benefit from tariff reductions. When full liberalisation is combined with a neutral consumption tax, in the short run the incidence of poverty increases but is reduced in the long run. In terms of income distribution, both in the short run and long run, there is a slight tendency towards more an equitable distribution.

With regard to sensitivity analysis, the simulation results of the effects of complete tariff liberalisation on the various poverty indices and income inequality can be said to be robust with respect to both Armington and primary factor elasticities. The reference tariff shock results do not vary substantially under different values of the elasticities in both the short run and long run. Moreover, the direction of changes in poverty and inequality also do not change with changing values in these elasticities.

Chapter 9

Summary, Conclusions and Directions for Further Research

9.1 Introduction

This chapter completes the study. Section 9.2 presents a general overview of the research. Section 9.3 provides a summary of the main findings. Section 9.4 discusses some implications of these findings. Section 9.5 outlines the limitations of the study and 9.6 suggests areas for further research.

9.2 Overview of the Study

The central concern of this study is the extent to which trade liberalisation mitigates poverty and inequality in Bangladesh. Specifically, the present study addresses the following questions. Which sectors will be most affected by tariff reductions? Which socio-economic groups, particularly among the poor, will be affected by trade liberalisation? What are the effects on income distribution among various household groups?

In order to attain the above mentioned objectives, a static, multi-sectoral, multi-household CGE model, termed the Bangladesh Model, was developed for Bangladesh. The model provides an analytical framework that includes an endogenised poverty line and a complete income mapping from the production sectors to the various household groups and institutions in the economy. The model was used to simulate the short run and long run effects of unilateral trade reform policies, including particularly the impacts on poverty and income inequality.

Chapter 1 presented an outline of the research problem, a statement of the research objectives, and a brief description of the method of analysis. Chapter 2 produced a review of Bangladesh trade liberalisation policies and macroeconomic performance over the last three decades.

Chapter 3 provided a review of poverty, inequality and labour market developments in Bangladesh over the same period.

After providing a theoretical overview of the links between trade, income distribution and poverty, Chapter 4 discussed a variety of methodologies that have been used to analyse the links. In doing so, the chapter mainly discussed different methodological aspects of the computable general equilibrium models used in developed and developing countries to analyse the impact of trade policies. It also provided a brief description of CGE models developed for Bangladesh.

Chapter 5 developed the Bangladesh Model, following IDC-GEM, a SAM based CGE model for the South African economy (Horridge *et al.*, 1995). Based on ORANI (Dixon *et al.*, 1997), IDC-GEM uses microeconomic theory to specify the behaviour of producers, consumers and investors. In addition, the model has a SAM extension by which the value added originated from the production process flows from factors of production to various household groups and other institutions as income flows. One important amendment in the Bangladesh model was to endogenise the poverty lines using consumer price variations from the model to capture the effect on absolute poverty.

Chapter 6 explained the compilation of data for the Bangladesh model. The main data sources were the input-output tables for Bangladesh for the year 2000, the Bangladesh Social Accounting Matrix for 2000, the GTAP database 6.0 and the Bangladesh Household Income and Expenditure Survey 2000. The compilation of the input-output database was conducted by using GEMPACK (Harrison and Pearson, 1996).

In Chapter 7 the Bangladesh model was used to simulate the effects of trade liberalisation on some key macroeconomic variables, industry level variables and household level variables. The reliance of the Bangladesh government on tariffs as one of its main sources of revenue implies that trade policy reform would have major implications for its budget. Thus, whereas the base simulation in this study (Simulation 1) consists of an across the board elimination of tariffs without any compensatory budgetary policy, in the second simulation (Simulation 2), an endogenously determined uniform consumption tax was implemented along with tariff liberalisation to maintain government budget neutrality.

In setting up the Bangladesh model to project the effects of trade liberalisation, allowance was also made for different time horizon, the short run and the long run. In the short run simulation, the capital stock in each industry was fixed but the rate of return in each industry varied. In contrast, in the long run capital stocks were free to adjust in such a way that fixed rates of return were maintained. In the labour market in the short run, there was perfectly elastic supply at a fixed real wage (nominal wages were indexed to the CPI) whereas in the long run, aggregate employment was assumed to be fixed with the average real wage determined endogenously. Finally, a sensitivity analysis for different elasticity values was performed to check the robustness of the results.

Chapter 8 presented the results and discussion of the effects of trade reform policies on poverty and income inequality in the Bangladesh economy. Starting with a brief discussion of various poverty indices and inequality measures, the chapter first explained how to incorporate poverty analysis into the CGE model by linking the model output and changes in the poverty line with the household survey data. Following Decaluwe *et al.*, (1999), the chapter estimated various FGT poverty indices and inequality measures during pre-and post-liberalisation periods for nine representative household groups. To compare base case and post-reform poverty situations for each household group, a probability density function was estimated using Kernel density estimates, and the money metric poverty lines were added to these graphs. A range of other poverty and inequality indices such as Watt's index, the Sen index, the Atkinson index and the Entropy index were also calculated to check the robustness of various FGT poverty indices and inequality indices. A sensitivity analysis with regard to various elasticity values was also performed.

9.3 Summary of Results

The results of the simulations presented in Chapter 7 reveal that in the short run, trade liberalisation without any compensatory consumption tax expands real GDP and aggregate employment. It also generates a substantial real exchange rate depreciation (a general measure of the improvement in international competitiveness) and an increase in export volume. The projected increase in the import volume was more than offset by the net effect of the increase in export volume, resulting in a movement towards surplus in the balance of trade. Trade liberalisation also helped reduce the consumer price index and poverty lines.

In the long run, with the same policy package, the percentage change in real GDP is slightly higher than that of the short run outcome. Mobility of capital across sectors leads to a more efficient allocation of resources which in turn enhances production. The long run simulation results also suggest that tariff removal would lead to increases in real aggregate private investment, the aggregate capital stock and real aggregate consumption. In the long run, the removal of tariffs induces an increase in real wages which reflects an increased demand for labour in the expanding labour-intensive manufacturing industries. As in the short run, tariff removal would produce a real exchange rate depreciation, and falls in the commodity prices of basic need consumption bundles.

The imposition of a uniform consumption tax to neutralise the revenue loss from an across-the-board tariff elimination reduces real GDP and aggregate employment in the short run. It is also observed that the country's international competitiveness decreases as a uniform consumption tax levied on a broad range of goods and services increases the costs of production through the effect on money wages. In contrast to the short run, the long run simulation results revealed that real GDP would increase slightly, which results mainly from growth in the capital stock and improved efficiency of factor allocation. The imposition of a compensatory consumption tax would directly increase consumer prices, which would lead to a fall in aggregate consumption as increases in consumer prices more than offset the impacts of nominal income gains in real purchasing power. This further suggests that tariff removal with a consumption tax is likely to play a negative role in terms of aggregate welfare. Simulation results also showed that in both the short run and long run, the monetary poverty line would rise.

The industry results revealed that trade liberalisation without any compensatory consumption tax induces export-oriented labour-intensive agricultural and manufacturing industries to expand, both in terms of output and employment, as tariff removal is likely to reduce the cost of production of industries. Thus, under simulation 1 in the short run, the agricultural export industries such as jute cultivation, tea cultivation and shrimp farming show an expansion in output and employment. Similarly, manufacturing export industries such as ready-made garments, knitting, jute fabrication, toiletries manufacturing and leather industries show a robust expansion in output. Further, because of inter-industry linkages, some mainly export-related industries, for example, the bailing industry and cloth milling, also benefit from expanding output in the jute fabrication and ready-made garments industries. Expansion in export-oriented industries also triggers a corresponding expansion in these export related industries. In addition, manufacturing industries such as the fish processing industry and the food processing industry, which are heavily dependent on imported intermediate inputs, also show expansion in output as a result of cheaper inputs.

In contrast, tariff elimination without a compensatory consumption tax leads to reduced output and employment in previously protected import-competing industries, as they face increased competition from imported goods. For example, in fruit cultivation, spice cultivation, the sweetener industry, the petroleum refining industry and the glass product industry, increased import penetration offsets the increase in local demand and a marginal increase in exports, resulting in declines in their output and in employment.

In the short run, under trade liberalisation without a compensatory consumption tax, service industries also expanded. Service sectors, especially air transport, water transport, other transport, retail and wholesale trade, public administration, defence and communication sectors show robust expansion, as they are interlinked with the expanding agricultural and manufacturing industries.

In the long run as in the short run, tariff removal alone enhances expansion in industries such as ready-made garments, knitting, toiletries manufacturing, miscellaneous industry, the fertiliser and insecticide industry and the cloth mill industry. However, the output and employment effects are more pronounced in the long run than in the short run as these industries reap the benefit of cheaper effective costs of capital in expanding their output. In addition, in the long run, trade liberalisation leads to expansion in the industries mainly selling to household sectors and investors because with the trade balance to GDP ratio fixed by assumption, real aggregate absorption increases. Thus, industries such as paddy, wheat, potato cultivation, tea cultivation, cigarette industry, handloom cloth industry, housing services, hotels and restaurants, and entertainment show marked increases in output and employment. Similarly, rural building, urban building, rural road building, port road railway building and canal dyke and other building show a tendency towards expansion in output as a consequence of increases in real aggregate investment.

Finally, in the long run as in the short run, the service industries which supplying intermediate inputs to trade sectors, for example, wholesale trade, retail trade, various transports, storage, bank and insurance, communication and information technology show significant growth with complete tariff removal.

The implication at industry level when a uniform compensatory consumption tax is associated with complete tariff removal is that output declines in most industries in both the short run and long run, with the greatest contraction in labour intensive sectors where households are the main customer. In the short run, the reduction in output in vegetable cultivation, fruit cultivation, spice cultivation, the sweetener industry, the food processing industry, housing service, hotel, restaurant, entertainment and communication industries can be considered as a result of reduced household demand for these commodities. Export volumes are also likely to be decreased as a consumption tax increases domestic costs relative to foreign prices. As a result, f.o.b export prices fall less than in Simulation 1. However, in the long run, faster growth in the fixed capital stock is likely to help expansion of output in the investment related sectors such as urban building, rural building, power plant building, rural road building, canal dyke and other building. Furthermore, inter-industry mobility of capital and labour in the long run offsets the increased production costs due to the consumption tax and enhances output growth in some exporting industries such as ready-made garments, knitting and toiletries manufacturing.

Simulation results also reveal that in both the short run and long run, under both Simulations 1 and 2, the largest increases in employment occur in export-related industries. Among occupational categories, the female low-skilled category of labour experiences the highest increase in both the short run and long run because of its high concentration in the ready-made garments and knitting industries and the growth of these export-oriented industries.

With respect to household income changes under Simulation 1, tariff liberalisation alone induces nominal income decreases for all household groups in the short run. The change in factor remuneration leads to a change in households' nominal income. In the short run, under the situation of tariff removal and without a consumption tax, the most substantial decline is experienced by the rural landless household group followed by the marginal farmer and small farmer household groups, who largely depend on labour income. Large farmer household groups followed by urban medium-educated and high-educated household groups experience smaller percentage declines in their income. In the short run, the contraction of output in the agricultural sectors such as paddy, wheat, sugarcane cultivation, and spice cultivation leads to a substantial loss of nominal income by rural household groups, as a large number of rural households are dependent on these sectors for their livelihood. In addition, the reduction in transfer income from the government, due to the decline in government revenue collection from tariffs, causes a decline in the income of rural landless and marginal farmer households. In contrast, expansion of the manufacturing and service sectors in the short run helped increase the gross operating surplus, which in turn results in a significant income increase for rural and urban rich households. In contrast, in Simulation 2 in the short run, all households experience smaller short run proportionate reductions in income compared to Simulation 1. Similarly with Simulation 1, tariff elimination with a consumption tax reduces factor returns for all factors except labour return.

In the long run, under complete tariff removal and without a compensatory consumption tax, the percentage changes in income are expected to be positive for all household groups. In addition, households affected unfavourably in the short run by tariff removal are likely to be relatively favourably affected in the long run. Increased labour returns in the long run were responsible for these results. In the long run, expanded output in most manufacturing (ready-made garments and knitting industries) and service sectors favoured rural and urban poor households as they are the main labour component in these industries. On the other hand, a decline in capital income in the long run was shown to hurt the urban rich household groups such as medium-educated and high-educated household groups, as income from capital occupies a major part of their total income. In Simulation 2 (tariff removal with an associated consumption tax), the income change results were broadly similar to those of Simulation 1, but smaller in magnitude.

The simulation results presented in Chapter 8 reveal that in the short run under Simulation 1, the three measures of FGT poverty indices decreased for rural groups as a whole, which implies that trade liberalisation has reduced rural poverty. In urban areas however, decreases in the overall head count index and increases in the poverty gap and poverty severity gap index imply that in the short run, fewer people experienced poverty but the severity of poverty increased. Decomposing poverty results among household groups, it was found that in the short run under Simulation 1, rural landless, urban illiterate and urban low-educated household groups experience increases in poverty incidence. For these household groups, a significant drop in post tax nominal income is not offset by the fall in consumer prices and hence in the monetary poverty line. In contrast, rural large farmer and urban medium-educated household groups enjoy impressive improvements in all poverty indicators. Despite a decrease in nominal income, these groups experience large decreases in poverty incidences as their consumption basket is dominated by goods whose prices fall as a result of tariff reform.

In the long run under Simulation 1, the removal of tariffs without a compensatory consumption tax leads to a reduction in all poverty incidences for the overall rural and urban groups. Decomposing the results among household groups, simulation results revealed that all poverty indicators declined for all household groups in both rural and urban areas. In rural areas, the effects are greatest for the marginal farmer household group followed by the large farmer group and the small farmer group, whereas in urban areas, medium-educated households experience the biggest decrease in poverty incidences. In all these cases, positive income effects dominated the price effects.

Tariff removal associated with a uniform consumption tax increases the incidence of poverty for all household groups, both in rural and urban areas in the short run. Along with decline in nominal income, increased consumer prices contribute to the poverty situation for all household groups, with the rural large farmer group suffering the most. These results imply that in the short run, trade liberalisation with a compensatory consumption tax worsens the poverty situation in Bangladesh. However, in the long run the situation improves. In the long run, despite increases in the monetary poverty line, poverty incidences decrease for all household groups as increased income offsets the increase in the monetary poverty line. A range of other poverty measures such as Watt's index, the Sen index and the S-Gini index was also calculated in this study to check the robustness of the FGT poverty indices. The results of these indices for a base case scenario and for different policy scenarios, in both the short run and the long run, were found to be consistent with those from the FGT indices, confirming that the latter are robust estimates.

The study also estimated various inequality indices such as the Gini index, Atkinson index and entropy index for the rural, urban and total population of Bangladesh. Simulation results revealed that in the short run, trade liberalisation without a compensatory consumption tax increases inequality slightly in both rural and urban areas, as well as in the economy as a whole. In the short run, the fall in labour returns, relative to capital and land, disadvantages rural and urban poor households such as landless households, marginal farmer households, illiterate and low-educated households, who are mainly dependent on labour income. In contrast, rural large farmer households, urban medium-educated and high-educated household groups mostly benefit from scarce capital and land and thus increase inequality. In the long run however, tariff removal without a consumption tax leads to slightly less inequality, a result consistent with the Stolper-Samuelson theory. In the long run, expanded output in labour-intensive manufacturing industries such as ready-made garments and knitting industries and service sectors favours rural and urban poor households by increasing the demand for unskilled labour. Bangladesh, with abundant unskilled labour, reaps the gains from trade liberalisation. Interestingly, when trade liberalisation is combined with an accompanying uniform consumption tax, there is a slight tendency towards a more equitable distribution in both the short and long run.

Sensitivity analysis of the impact of different values of Armington elasticities and primary factor elasticities on various macroeconomic variables and on the various poverty and inequality indices suggest that the simulation results of tariff removal, with or without a compensatory consumption tax, were robust. Both in the short run and long run, the simulation results of tariff shocks were relatively quantitatively insensitive to different elasticity values.

In terms of poverty, the Simulation 1 result generated from the present study suggesting that poverty reduction is small in the short run but significant in the long run is consistent with other CGE studies, such as Annabi *et al.*,(2005) for Senegal; Bibi and Chatti (2006) for Tunisia; and Naranpanawa (2005) for Sri Lanka. On the other hand, with respect to income inequality, the finding of the present study - that in the long run, trade liberalisation with or without any replacement tax reduces inequality - contradicts the studies of Naranpanawa (2005) for Sri Lanka; Vos and Jong (2003) for Ecuador; and Siddique, Kemal, Siddique, and Kemal (2008) for Pakistan, all of whom found that trade liberalisation widens the income gap between rich and poor. However, the conclusion of the present study, that combining a consumption tax with tariff elimination worsens the poverty situation in the short run, is similar to that of Emini, Cockburn, and Decaluwe (2006) for Cameroon.

9.4 Policy Implications

Even though an across-the-board complete tariff reduction may not be practical, the results of this study offer some useful policy insights.The results suggest that macroeconomic performance and the efficiency of resource allocation would be improved by the Bangladesh government pursuing more trade liberalisation efforts. However, Bangladesh has already implemented extensive liberalisation measures, with top tariff rates at a very low level and trade related quantitative restrictions nearly eliminated. In this situation, further trade liberalisation needs careful assessment of its likely benefits and adjustment costs, especially its revenue implications. Further restructuring of the import policy regime might result in a substantial reduction in government revenues (Hossain (2003), and Raihan (2008)). Policy-makers need to be careful in determining whether there is any avenue for possible expansion of the tax base, and in choosing an appropriate revenue replacement tax scheme. In view of the simulation results of a compensatory consumption tax, it can be concluded that in Bangladesh, using a consumption tax to replace lost tariff revenue would not be acceptable, as its economic costs are high. Despite the monetary benefits to the government's fiscal balance, negative output and employment effects in agricultural and manufacturing sectors and increased poverty impacts need to be addressed. Without a considerable amount of research on the likely impact of further reductions in import tariffs on the government's revenue structure and other possible sources of compensatory tax measures, it is difficult to generalise any conclusions regarding tariff reform measures.

Looking at the industry-wide output and employment effects, it appears that the removal of trade barriers offers opportunities for Bangladesh to develop its economy by focusing on sectors such as the ready-made garments and knitting industries which show a comparative advantage. As noted in Chapter 2, in Bangladesh in recent periods exports of ready-made garments and knitting exports account for about 75 per cent of total export earnings and 81 per cent of manufacturing export earnings. This very narrow export base needs to be enlarged because it leaves the export sector highly vulnerable to external shocks. For example, the abolition of the Multi-Fibre Agreement (MFA) from January 2005 in accordance with the provisions of the World Trade Organisation (WTO) Agreement on Textile and Clothing (ATC) has provided Bangladesh with a great challenge. The ready-made garment sector now faces increased competition from other producing countries such as China, India, Pakistan, Sri Lanka, Indonesia, Vietnam and Thailand, with a number of studies projecting negative consequences on household consumption and welfare (Arndt *et al.*,(2002), and Mlachila and Yongzheng (2004)). Although the actual export performance after the abolition of MFA quotas has revealed that both export value and market share in the USA market have increased (Ahmed, 2009). This may be only a short term effect, which could change in the long term depending on how Bangladesh copes with the increased competition by exploiting its comparative advantage in the labour-intensive ready-made garment sector.

Based on our findings, we can also suggest that care should be taken with other import-competing highly protected agricultural sectors, which tend to lose with of tariff liberalisation. In an agriculture based country like Bangladesh, despite its diminishing contribution to GDP, agriculture is still the dominant sector of food production and absorbs a large proportion of unskilled labour. Thus, there is a need to formulate appropriate strategies such as providing agricultural credit, promoting technology based modern agriculture, land reform, and creating opportunities for increased investment in agriculture. In addition, for the agricultural sector is still vulnerable to major production shocks, for example, heavy floods and droughts, the government should explore the social benefits and costs of implementing a flood rehabilitation programs by providing agricultural inputs to affected poor farmers free of cost and providing subsidies to the agricultural sector.

The simulation results also indicate that in the long run a reduction in tariffs leads to an increase real wages in a labour-abundant country, as predicted by Stolper and Samuelson. Liberalisation also results in a substantial increase in the participation of female labour especially in the ready-made garment industries. Increased employment in this industry definitely implies changing life styles and brings improved economic solvency. In terms of the gender dimension of poverty, the results are most welcome, however it also has to be remembered that within the Bangladesh perspective, where overall employment is not improving rapidly and still there is a large wage gap, this might create a major policy problem for the government.

Several policy suggestions about the poverty and inequality strategies can be suggested in light of the findings of the present study. Based on the findings we can suggest that Bangladesh should continue to pursue its trade liberalisation policy. Such a policy leads to poverty and inequality reductions in the long term, despite some short term adjustment costs in terms of poverty incidences for some household groups. As Dollar and Kraay (2001) argued, long-term economic growth enhances poverty reduction by providing greater employment and increasing real wages. However, the high concentration of poor in the rural areas and being a labour abundant country, the overall pace of economic growth, the performance of agriculture and the overall labour intensity of production in Bangladesh all matter for reducing income poverty (Ahmed, 2006). To reduce poverty, economic growth needs to be improved by raising productivity and efficiency through investment in physical and human capital.

Increased agricultural productivity is crucially important for pro-poor economic growth through higher real wages and higher farm yields (Datt and Ravallion, 1998). In a country like Bangladesh, with large rural populations and being predominantly dependent on agriculture, there is hardly any alternative but to develop the agricultural sector for alleviation of poverty through accelerated economic growth. Building up a modern agricultural system, based on appropriate technology and investment in agricultural research and extension, is essential to reducing poverty.

Furthermore, to overcome the short run poverty impacts, some welfare programs must be initiated to soften the transitory negative effects. Some short term targeted poverty reduction strategies and safety net programs can be considered as a policy option during the process of liberalisation, to protect poor households from the adverse effects of trade liberalisation. Measures have to be taken to ensure that a large section of the poor can improve their skills and productive capacity and so reap the benefit of enhanced growth. Along with these, some safety net programs such as Food for Works Program, old-age allowances, Vulnerable Group feeding programs, micro-credit programs, and social security should be initiated to mitigate the miseries of the hard core and underprivileged households. Even though these programs have been in place for quite a long time in Bangladesh, progress on this front has been too slow. Their coverage is too limited to make any significant impact on poverty levels. Thus, there is a need to make these programs effective in reaching the targeted groups.

Another key finding in our study was the increased inequality in the short run with tariff liberalisation without any replacement tax. As stated earlier, low endowments of human capital and physical assets, as well as entry barriers to productive employment for rural and urban poor households, are major contributory factors to the growing income inequality in Bangladesh. To offset the negative equity effect of a liberalised trade regime in Bangladesh, complementary policies that directly improve the income of comparatively poor household groups need to be implemented. Policies need to focus on creating an environment for the poor to obtain more remunerative jobs and to increase the returns to labour in both the agricultural and non-agricultural sectors. Providing the worse-off households with greater access to financial markets and investment in education and skill development for the poor will also contribute to more equitable growth.

9.5 Limitations of the Research

The present study embodies several limitations or weaknesses. First, the elasticity parameters used in this study have not been estimated econometrically by using time series and cross-sectional data for Bangladesh. Rather these values have been borrowed from other related studies. One major limitation of these borrowed elasticity values is that policy implications are likely to be changed with the varied values. Even though the present study has established the robustness of the simulation results with respect to elasticity values, one still needs to interpret the simulation results with caution.

Secondly, due to the unavailability of more recent information, the simulations were conducted using data from the Input-output table 2000, SAM 2000 and HIES of 2000 in Bangladesh. However, it is apparent that between 2000 and 2009 there was a considerable change in the economy's structure and trade pattern. As stated in Chapter 2, the contribution of agriculture to GDP has been decreasing, while the contributions of industry and services have been increasing. Also, the export sector has undergone significant changes through strong growth in non-traditional exports. These developments may reduce the usefulness of the analysis of the impacts of trade reform policies.

Thirdly, the analysis of trade reform policies undertaken in this study is comparatively static in nature, where the model results show the difference between two alternative future states (with and without the policy change). Such a model does not explicitly show the adjustment path to the new equilibrium state, even though by using detailed closures (assumptions about factor markets such as whether capital stocks are fixed or not) it is possible to differentiate between long run and short run equilibrium. Since this type of model does not track variables over time, it is unable to account for growth effects and excludes accumulation effects. In contrast, in a dynamic model all variables have time subscripts, thus the model explicitly traces each variable through time and is able track both the short run and long run impacts of trade reforms on the growth path through capital accumulation effects. Adopting a dynamic framework would allow for the transition path of changing income and expenditure patterns of households over time to be tracked and hence is able to predict poverty and inequality impacts appropriately. However, such a dynamic specification would call for a more detailed presentation of savings and investment and much supplementary time series data on various exogenous variables of the Bangladesh economy, for which it would be constrained to develop a viable model.

Fourthly, in predicting the poverty and inequality impacts of trade liberalisation, the present study follows the representative household approach where it is assumed that with policy shock, the mean income of household group changes, but not its variance. This assumption ignores the variations of intra-group distribution of income and thus might provide biased estimates. The ideal way to predict the poverty and inequality impacts of trade liberalisation would be to follow a micro-simulation approach that takes into account individual heterogeneities. However, this type of model needs econometric estimation of household behavioural equations, including for example equations for earnings and occupational choice of households, which in turn needs data at the household level that are not yet available for Bangladesh.

9.6 Areas for Further Research

In light of the above mentioned limitations, a number of extensions can be suggested for further research in this area.

As mentioned earlier, the present model has a comparative static framework, which captures the economic impact of trade liberalisation only for a single point in time, either short run or long run. The model could be extended by incorporating a dynamic structure that is extremely useful for simulating the overall economic development path of the economy in response to trade policy shocks. This would enable the model to predict long-term changes appropriately which in turn would assist policy makers' long term development plans.

In addition, regional poverty analysis/disparities need to be taken into consideration in the analysis of policy reform. As stated in Chapter 3, in Bangladesh there are substantial regional disparities in poverty incidence. For example, the incidence of poverty has been found to be much more severe in the Rajshahi and Khulna divisions than in other divisions. Thus a regional computable general equilibrium model would be useful in providing a regionally disaggregated analysis of the impact of trade policy on poverty and inequality. An analysis of this type would in turn help in identifying the regions with a greater incidence of poverty and accordingly would be useful in designing policies, such as transfers and taxes in specific regions to offset the distributional bias of policy reform.

Another area for further research is the analysis of poverty and inequality based on gender. According to Fontana and Rodgers (2005), taking gender inequality into consideration in CGE models could significantly improve our knowledge of the mechanisms through which macroeconomic policy affects poverty and how men and women experience poverty differently.

Even though the present model includes an aggregate treatment of the labour market, it lacks a micro analysis of industry and occupational labour markets such as labour participation rate, unemployment rate, shifts in employment structure and earning differentials among various occupational groups. Therefore, labour market modelling could be another improvement in this area. Moreover, in a developing country like Bangladesh there is abundant unskilled labour and continuing migration from rural to urban areas, by classifying labour by skills and geographical location, rural-urban migration can be better modelled to capture the real picture.

In the present study, no instrument of welfare adjustment reform was considered when trade barriers are lifted. Thus another modification could be to incorporate some ‘safety net’ policy options, specifically designed to protect the poorest groups in the population. In addition, given the desirability that trade liberalisation should be budget-neutral, it would be useful to explore the effects of some fiscal alternatives to a compensatory consumption tax on macroeconomic performance, resource allocation, poverty and inequality.

Finally, the development of a CGE-micro simulation top-down approach could provide a much more comprehensive analysis of poverty and inequality in Bangladesh. This kind of model gives a complete description of households’ real income generation behaviour by taking into account both households’ earnings and occupational determinants (Bourguignon *et al.*, 2003). Thus the model would capture individual heterogeneity in terms of sources of income, consumption preferences and endowment of human capital, and hence would be able to better capture the poverty and inequality effects of trade liberalisation.

Appendices

Appendix A

Table A 2.1: Effective Protection Rates (EPRs) in 40 sectors in Bangladesh (in percentages)

	Effective rates of protection							
Sector Name	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**	**1997/98**	**1998/99**	**1999/00**
01. Rice	-8.0	0.9	2.4	-5.8	-5.7	-5.4	-5.3	-4.7
02. Wheat	-3.9	8.5	11.0	2.0	2.2	2.6	2.8	0.2
03. Coarse Grains	-4.9	-4.1	-0.8	-0.2	-0.2	0.1	0.1	0.4
04. Jute	64.4	67.2	30.6	31.8	32.0	32.4	32.5	26.8
05. Sugar Cane	68.4	71.3	14.2	14.8	15.0	15.2	15.2	15.8
06. Cotton	4.8	5.4	-2.0	-1.7	-1.7	-1.5	-1.5	-1.4
07. Tobacco	12.5	-0.9	10.2	11.8	12.1	11.1	11.3	12.2
08. Potato	58.9	60.4	48.8	36.7	35.7	26.9	24.5	23.1
09. Other Vegetable	71.7	43.6	44.5	32.1	32.2	32.1	32.1	26.9
10. Pulses	19.9	18.1	17.4	16.9	17.0	18.2	11.3	8.3
11. Oil Seeds	53.8	42.7	35.6	24.6	24.7	22.8	22.8	19.7
12. Fruits	58.2	60.5	44.9	40.2	39.9	38.1	36.3	33.1
13. Tea	82.7	85.1	66.0	48.7	48.8	46.4	43.4	41.0
14. Other Crops	64.9	40.4	41.5	28.3	28.6	28.1	27.2	22.5
15. Livestock	74.3	54.0	42.0	33.2	32.8	28.8	28.0	24.8
16. Fish	78.4	45.3	45.1	28.4	28.5	27.9	28.0	23.2
17. Forestry	38.8	32.7	23.9	22.7	22.9	19.7	19.2	16.9
18. Other Fruits	489.2	327.4	88.5	88.3	86.0	76.7	68.3	66.9
19. Edible Oil	74.8	46.5	39.6	55.6	53.7	41.4	35.3	35.0
20. Sugar and Gur	96.3	42.3	52.3	51.1	51.4	40.0	38.5	31.1
21. Salt	51.4	61.6	43.5	37.2	34.6	30.7	29.1	29.6
22. Yarn	69.0	57.4	60.9	51.7	35.0	34.2	33.7	30.5
23. Cloth: Mill	189.7	147.5	131.6	98.0	110.2	86.2	78.2	72.7
24. Cloth: Handloom	157.7	128.5	114.6	87.6	94.9	75.5	68.8	64.6
25.Readymade Garments	237.2	130.0	84.1	53.7	57.4	65.4	60.5	58.9
26. Jute Textile	98.2	93.5	81.0	55.7	56.0	48.4	44.1	43.5
27. Paper	68.3	74.1	48.8	25.4	22.7	12.7	11.3	15.5
28. Leather and Leather Products	98.6	87.3	42.3	20.7	15.8	8.8	5.90	6.5
29. Chemical Fertilizer	-5.6	-2.2	-5.0	-3.6	-3.0	0.4	0.5	0.6
30. Pharmaceutical	1.5	-2.2	-2.5	-2.6	-1.4	0.7	0.6	-1.7
31. Chemical	30.3	15.4	14.9	12.5	13.8	15.2	16.1	9.7
32. Petroleum Products	40.2	32.8	45.7	35.5	35.7	32.3	31.2	27.3
33. Cement	56.0	30.6	21.4	18.5	19.1	19.0	20.3	21.2
34. Steel and Basic Metal	40.9	27.2	27.4	25.1	24.6	25.0	25.1	19.5
35. Metal Products	52.7	43.3	25.1	25.8	27.0	18.2	17.3	15.4
36. Machinery	47.5	28.9	15.1	12.6	12.3	9.3	9.6	5.2
37. Transport Equipment	69.9	49.1	41.9	38.0	22.8	21.8	19.8	17.9
38.Wood and Wood Products	124.0	81.0	48.1	47.3	47.3	32.9	32.9	31.8
39. Tobacco Products	133.6	69.9	89.7	85.0	86.7	81.9	74.7	68.5
Other Industries	72.7	65.1	38.5	37.3	29.6	21.9	21.0	19.9
a) Average ERP	75.7	56.7	40.6	33.0	32.4	28.6	26.8	24.5
b)Standard Deviation (SD)	84.4	57.0	31.2	25.7	26.9	23.0	20.9	20.0
c)Coefficient of Variation	111.5	100.6	76.9	77.7	82.6	80.4	78.2	81.6

Source World Bank (1999a)

Appendix B

Table B 5.1: List of Variables in the Bangladesh model

Variable	Set	Description
(Change)		
delV1TAX(c,s,i)	COMxSRCxIND	*Intermediate tax revenue*
delV2TAX(c,s,i)	COMxSRCxIND	*Investment tax revenue*
delV3TAXHOU(c,s,h)	COMxSRCxHOUS	*Household tax revenue*
delV4TAX(c)	COM	*Export tax revenue*
delV5TAX(c,s)	COMxSRC	*Government tax revenue*
delV1PTX(i)	IND	*Ordinary change in production tax revenue*
delV0TAR(c)	COM	*Ordinary change in tariff revenue*
delV1PRIM(i)	IND	*Ordinary change in cost of primary factors*
delV1CST(i)	IND	*Change in ex-tax cost of production*
delV1TOT(i)	IND	*Change in tax-inc cost of production*
delPTXRATE(i)	IND	*Change in rate of production tax*
delV6(c,s)	COMxSRC	*Value of inventories*
delx6(c,s)	COMxSRC	*Inventories demands*
Delsgovsav	1	*Government (income - expenditure)/GDP*
delSale(c,s,d)	COMxSRCxDEST	*Sales aggregates*
delV1tax_csi	1	*Aggregate revenue from indirect taxes on intermediate*
delV2tax_csi	1	*Aggregate revenue from indirect taxes on investment*
delV3tax_csh	1	*Aggregate revenue from indirect taxes on households*
delV4tax_c	1	*Aggregate revenue from indirect taxes on export*
delV5tax_cs	1	*Aggregate revenue from indirect taxes on government*
delV0tar_c	1	*Aggregate tariff revenue*
delV1PTX_i	1	*Ordinary change in all-industry production tax revenue*
delV0tax_csi	1	*Aggregate revenue from all indirect taxes*
delB		*(Balance of Trade)/GDP*
Scalar variables		
p3tot_h	1	*Consumer Price Index*
x3tot_h	1	*Real Household Consumption*
w3tot_h	1	*Nominal Total Household Consumption*
f1lab_io	1	*Overall Wage Shifter*
w1lab_io	1	*Aggregate Payments to Labour*
f1tax_csi	1	*Uniform % Change in Powers of Taxes on Intermediate Usage*
f2tax_csi	1	*Uniform % Change in Powers of Taxes on Investment*
f3tax_cs	1	*Uniform % Change in Powers of Taxes on Household Usage*
f4tax_ntrad	1	*Uniform % change in powers of taxes on nontraditional exports*
f4tax_trad		*Uniform % change in powers of taxes o n traditional exports*
f5tax_cs	1	*Uniform % Change in Powers of Taxes on "Other" Usage*
x4_ntrad	1	*Quantity, collective export aggregate*
f4p_ntrad	1	*Upward demand shift, collective export aggregate*
f4q_ntrad	1	*Right demand shift, collective export*
p4_ntrad		*Price, collective export aggregate*
f3tot_h	1	*Overall Shift Term For Consumption*
f5tot	1	*Overall Shift Term For "Other" Demands*
f5tot2	1	*Ratio between f5tot and x3tot*

p0cif_c	1	*Imports Price Index, CIF, Rand*
p0gdpexp	1	*GDP Price Index, Expenditure Side*
p0imp_c	1	*Duty - paid Imports Price Index, Rand*
x1prim_i	1	*Aggregate Output: Primary Factor Cost Weights*
p0realdev	1	*Real Devaluation*
p0toft	1	*Terms of Trade*
pLabEff		*Effective price of labour, inc. labour-saving technical change*
pLabEff_p1prim		*PLabEff / p1prim_i*
pLabEff_p3tot		*PLabEff / p3tot*
p3tot_p0GNE		*P3tot / p0GNE*
p0GNE_p0GDPExp		*P0GNE / p0GDPExp*
p0GDPExp_p1prim		*P0GDPExp / p1prim_i*
pCap_p1prim		*PCap / p1prim_i*
pCap_p2tot		*PCap_i / p2tot*
p2tot_p0GNE		*P2tot_i / p0GNE*
p1prim_i	1	*Primary Factor Cost Deflator*
w1prim_i	1	*Aggregate Primary Factor Payments*
employ_i	1	*Aggregate Employment - Wage Bill Weights*
Realwage		*Average real wage*
x1cap_i	1	*Aggregate Capital Stock, Rental Weights*
x1lnd_i		*Aggregate land stock, Rental Weights*
p1cap_i	1	*Average Capital Rental*
p2tot_i	1	*Aggregate Investment Price Index*
Phi	1	*Exchange Rate, Rand/$world*
p4tot	1	*Exports Price Index*
p5tot	1	*"Other" Demands Price Index*
p6tot	1	*Inventories Price Index*
x0gne	1	*Real GNE*
p0gne	1	*GNE price index*
w0gne	1	*Nominal GNE*
Xgdpfac	1	*Real GDP at factor cost (inputs) = x1prim_i*
x0gdpinc (change)	1	*Real GDP from the income side*
p1lab_io	1	*Average nominal wage*
p1lnd_i	1	*Average land rental*
x0gdpfac (change)	1	*Real GDP at factor cost*
contBOT	1	*Contribution of BOT to real expenditure-side GDP*
w0cif_c	1	*CIF Rand Value of Imports*
w0gdpexp	1	*Nominal GDP from Expenditure Side*
w0gdpinc	1	*Nominal GDP from Income Side*
w0imp_c	1	*Value of Imports plus Duty*
w0tax_csi	1	*Aggregate Revenue from All Indirect Taxes*
w1cap_i	1	*Aggregate Payments to Capital*
w1lnd_i	1	*Aggregate Payments to Land*
w1oct_i	1	*Aggregate Other Cost Ticket Payments*
w2tot_i	1	*Aggregate Nominal Investment*
w4tot	1	*Rand Border Value of exports*
w5tot	1	*Aggregate Nominal Value of "Other" Demands*
w6tot	1	*Aggregate Nominal Value of Inventories*
Invslack		*Investment slack variable for exogenising aggregate investment Economy–wide rate of return*
f2tot	1	*Ratio, investment/consumption*
Capslack	1	*Slack variable to allow fixing aggregate capital*
x0cif_c	1	*Import Volume Index, CIF Weights*
x0gdpexp	1	*Real GDP from Expenditure Side*
x0imp_c	1	*Import Volume Index, Duty - Paid Weights*
x2tot_i	1	*Aggregate Real Investment Expenditure*
x4tot	1	*Export Volume Index*
x5tot	1	*Aggregate Real "Other" Demands*
x6tot	1	*Aggregate Real Inventories*

q_h	1	*Total Number of Households*
Wgosgov	1	*GOS income to government + GOS transfers to government*
Wgosrow	1	*GOS income to ROW + GOS transfers to ROW*
Wgostax	1	*Corporation tax*
Wgovgos	1	*Interest on public debt*
Wgovrow	1	*GOV transfers to ROW*
Wrowgos	1	*GOS from ROW*
Wrowgov	1	*Transfers from ROW to government*
Wgossav	1	*Retained earnings*
Wgos	1	*Total GOS*
Wgos_posttax	1	*VGOS less VGOSTAX*
Fgostax	1	*Ad valorem rate of corporation tax*
Wgoshou_h	1	*Total GOS to households*
Whousinc_h	1	*Total pre-tax household income*
Wdispinc_h	1	*Total post-tax household income*
avetax_h	1	*Average tax factor : wdispwagerate-avewagerate*
f_inctaxrate_h	1	*Income tax shifter: overall*
f_gosinctax	1	*fgostax - f_inctaxrate_h*
Wincgov	1	*Government income*
Wgovcur	1	*Current government expenditure*
Wgovcap	1	*Investment government expenditure*
Wgovexp	1	*Total government expenditure*
Wgovsav	1	*Government (income - expenditure)*
Realgovsav	1	*Real government (income - expenditure)*
Wprivcap	1	*Investment private expenditure*
Wrowexp	1	*Total ROW expenditure*
Wincrow	1	*Total ROW income*
Wrowsav	1	*ROW (income - expenditure)*
pline_phr	1	*Aggregate poverty line*
pline_phu	1	*Aggregate poverty line*
Wsamcheck	1	*Global (income - expenditure)*
Vector variables		
x4(c)	COM	*Export*
t4(c)	COM	*Power of Export Tax*
p4(c)	COM	*Exports Rand*
x1cap(i)	IND	*Current Capital Stock*
p1cap(i)	IND	*Rental Price of Capital*
a1cap(i)	IND	*Capital Augmenting Technical Change*
x1lnd(i)	IND	*Use of Land*
p1lnd(i)	IND	*Rental Price of Land*
a1lnd(i)	IND	*Land Augmenting Technical Change*
x1oct(i)	IND	*Demand for "Other Cost" Tickets*
p1oct(i)	IND	*Price of "Other Cost" Tickets*
a1oct(i)	IND	*"Other Cost" Ticket Augmenting Technical Change*
f1oct(i)	IND	*Shifts in Price of "Other Cost" Tickets*
Ggro(i)	IND	*Gross growth rate of capital = Investment/capital*
Gret(i)	IND	*Gross rate of return = Rental/[Price of new capital]*
p1mat(i)	IND	*Intermediate cost price index*
p1var(i)	IND	*Short-run variable cost price index*
pliner(prh)		*Poverty line for rural*
plineu(puh)		*Poverty line for urban*
Finv1(i)	IND	*Shifter to enforce DPSV investment rule*
Finv2(i)	IND	*Shifter for "exogenous" investment rule*
Finv3(i)	IND	*Shifter for long run investment rule*
fgret(i)	IND	*Shifter to lock together industry rates of return*
t0imp(c)	COM	*Power of Tariffs*
p0imp(c)	COM	*Basic price of imported goods = p0(c,"imp")*
pe(c)		*Basic price of exportables*
p0dom(c)		*Basic price of domestic goods = p0(c,"dom")*

x0loc(c)	COM	*Real percent change in LOCSALES (dom+imp)*
p0com(c)	COM	*General output price of locally-produced commodity*
x0com(c)	COM	*Output of commodities*
qh(h)	HOUS	*Number of Households*
Utilityh(h)	HOUS	*Utility per Household*
w3luxh(h)	HOUS	*Nominal Supernumerary Expenditure*
w3tot(h)	HOUS	*Nominal Household Consumption*
f3tot(h)	HOUS	*Shift Term For Consumption*
p3tot(h)	HOUS	*Consumer Price Index*
x3tot(h)	HOUS	*Real Household Consumption*
f0tax_s(c)		*General Sales Tax Shifter*
f4p(c)	COM	*Price (upward) Shift in Export Demand Schedule*
f4q(c)	COM	*Quantity (right) Shift in Export Demands*
pf0cif(c)	COM	*C.I.F. Foreign Currency Import Prices*
x0dom(c)	COM	*Total Supplies of Domestic Goods*
x0imp(c)	COM	*Total Supplies of Imported Goods*
a1prim(i)	IND	*All Factor Augmenting Technical Change*
a1tot(i)	IND	*All Input Augmenting Technical Change*
a2tot(i)	IND	*Neutral Technical Change - Investment*
employ(i)		*Employment by industry*
p1prim(i)	IND	*Effective Price of Primary Factor Composite*
p1tot(i)	IND	*Average Input/Output Price*
p2tot(i)	IND	*Costs of Units of Capital*
a1lab_o(i)	IND	*Labour Technical Change*
f1lab_o(i)	IND	*Industry - Specific Wage Shifter*
p1lab_o(i)	IND	*Price of Labour Composite (B)*
p1lab_i(o)	OCC	*Average wage of occupation*
x1lab_o(i)	IND	*Effective Labour Input*
x1lab_i(o)	OCC	*Employment by occupation*
f1lab_i(o)	OCC	*Occupation - Specific Wage Shifter*
x1prim(i)	IND	*Primary Factor Composite*
x1tot(i)	IND	*Activity Level or Value - Added*
x2tot(i)	IND	*Investment by Using Industry*
p1cst(i)		*Index of production costs (for AnalyseGE)*
t0imp(c)		*Power of tariff*
Wgoshou(h)	HOUS	*GOS to households*
Wgovhou(h)	HOUS	*Government transfers to households*
Whougov(h)	HOUS	*Income tax + households transfers to government*
Whourow(h)	HOUS	*Household transfers to ROW*
Wrowhou(h)	HOUS	*ROW transfers to households*
w1labinc_o(h)	HOUS	*Total wages to households(h)*
whousinc(h)	HOUS	*Pre-tax household income*
wdispinc(h)	HOUS	*Post-tax household income*
f_inctaxrate(h)	HOUS	*Income tax shifter: by income*
Whousav(h)	HOUS	*Household saving*
f3tot(h)	HOUS	*Shift term for consumption (ratio,Consumption/GDP)*
w1lab_i(o)	OCC	*Total labour bills(o)*
labslack(o)	OCC	*Employment rate*
s2gov(i)	IND	*Government share of investment by industry*
contGDPexp(e)		*Contributions to real expenditure-side GDP*
contGDPinc(c)		*Income-side real GDP decomposition*
contGDPfac(c)		*Contributions to real GDP at factor cost:x0gdpfac*
Matrix variables		
x1(c,s,i)	COMxSRCxIND	*Intermediate basic demands*
x2(c,s,i)	COMxSRCxIND	*Investment basic demands*
x3(c,s,h)	COMxSRCxHOUS	*Household basic demands*
x5(c,s)	COMxSRC	*Government basic demands*
a3(c,s)	COMxSRC	*Household basic taste change*
x3_s(c,h)	COMxHOUS	*Household use of imp/dom composite*
a1(c,s,i)	CONxSRCxIND	*Intermediate basic technical change*

q1(c,i)	COMxIND	*Output by commodity and industry*
p0(c,s)	COMxSRC	*Basic price of commodity c, source s*
pq1(c,i)	COMxIND	*Price of commodity c produced by industry i*
f5(c,s)	COMxSRC	*Other Demand Shift*
x1mar(c,s,i,m)	COMxSRCxINDxMAR	*Intermediate margin demand*
x2mar(c,s,i,m)	COMxSRCxINDxMAR	*Investment margin demands*
x3mar(c,s,m,h)	COMxSRCxMARxHOUS	*Household margin demands*
x4mar(c,m)	COMxMAR	*Export margin demands*
x5mar(c,s,m)	COMxSRCxMAR	*Government margin demands*
a1mar(c,s,i,m)	COMxSRCxINDxMAR	*Intermediate margin technical change*
a2mar(c,s,i,m)	COMxSRCxINDxMAR	*Investment margin technical change*
a3mar(c,s,m)	COMxSRCxMAR	*Household margin technical change*
a4mar(c,m)	COMxSRC	*Export margin technical change*
a5mar(c,s,m)	COMxSRCxMAR	*Government margin technical change*
t1(c,s,i)	COMxSRCxIND	*Power of tax on intermediate*
t2(c,s,i)	COMxSRCxIND	*Power of tax on investment*
t3(c,s)	COMxSRC	*Power of tax on household*
t5(c,s)	COMxSRC	*Power of tax on government*
p1(c,s,i)	COMxSRCxIND	*Purchaser's price, intermediate*
p2(c,s,i)	COMxSRCxIND	*Purchaser's price, investment*
p3(c,s,h)	COMxSRCxHOUS	*Purchaser's price, household*
p5(c,s)	COMxSRC	*Purchaser's price, government*
fx6(c,s) (Change)		*Shifter on rule for stocks*
x1lab(i,o)	INDxOCC	*Employment by industry and occupation*
p1lab(i,o)	INDxOCC	*Wages by industry and occupation*
f1lab(I,o)	INDxOCC	*Wage shift variable*
x1_s(c,i)	COMxIND	*Intermediate use of imp/dom composite*
x2_s(c,i)	COMxIND	*Investment use of imp/dom composite*
x3lux(c,h)	COMxHOUS	*Household - supernumerary demands*
x3sub(c,h)	COMxHOUS	*Household - subsistence demands*
a3lux(c,h)	COMxHOUS	*Taste change, supernumerary demands*
a3sub(c,h)	COMxHOUS	*Taste change, subsistence demands*
p1_s(c,i)	COMxIND	*Price, intermediate imp/dom composite*
p2_s(c,i)	COMxIND	*Price, investment imp/dom composite*
p3_s(c,h)	COMxHOUS	*Price, household imp/dom composite*
a3_s(c,h)	COMxHOUS	*Taste change, household imp/dom composite*
a2(c,s,i)	COMxSRCxIND	*Investment basic technical change*
a1_s(c,i)	COMxIND	*Technical change, intermediate imp/dom composite*
a2_s(c,i)	COMxIND	*Technical change, investment imp/dom composite*
Fandecomp(c,f)	COM	*Fan decomposition*
SalesDecomp(c,d)	COMxDEST	*Sales decomposition*
Whouhou(hto,hfrom)	HOUSxHOUS	*intra-household transfers*
w1labinc(o,h)	OCCxHOUS	*Labour income from OCC to House*

Table B 5.2: List of Coefficients and Parameters in the Bangladesh model

Coefficients	Set	Description
V1BAS(c,s,i)	COMxSRCxIND	*Intermediate basic flows*
V2BAS(c,s,i)	COMxSRCxIND	*Investment basic flows*
V3BASHOU(c,s,h)	COMxSRCxHOUS	*Household basic flows*
V4BAS(c)	COM	*Export basic flows*
V5BAS(c,s)	COMxSRC	*Government basic flows*
V6BAS(c,s)	COMxSRC	*Inventories basic flows*
V1MAR(c,s,i,m)	COMxSRCxINDxMAR	*Intermediate margins*
V2MAR(c,s,i,m)	COMxSRCxINDxMAR	*Investment margins*
V3MARHOU(c,s,h,m)	COMxSRCxHOUSxMAR	*Household margins*
V4MAR(c,m)	COMxMAR	*Export margins*
V5MAR(c,s,m)	COMxSRCxMAR	*Government margins*
V1TAX(c,s,i)	COMxSRCxIND	*Taxes on intermediate*
V2TAX(c,s,i)	COMxSRCxIND	*Taxes on investment*
V3TAXHOU(c,s,h)	COMxSRCxHOUS	*Taxes on households*
V4TAX(c)	COM	*Taxes on export*
V5TAX(c,s)	COMxSRC	*Taxes on government*
V1LAB(i,o)	INDxOCC	*Wage bill matrix*
V1CAP(i)	IND	*Capital rentals*
V1LND(i)	IND	*Land rentals*
V1PTX(i)	IND	*Production tax*
V1OCT(i)	IND	*Other cost tickets*
V0TAR(c)	COM	*Tariff revenue*
V1PUR(c,s,i)	COMxSRCxIND	*Intermediate purchase. value*
V2PUR(c,s,i)	COMxSRCxIND	*Investment purchase. value*
V3PUR(c,s,h)	COMxSRCxHOUS	*Households purchase. value*
V4PUR(c)	COM	*Export purchase. value*
V5PUR(c,s)	COMxSRC	*Government purchase. value*
SIGMA1LAB(i)	IND	*CES substitution between skill types*
V1LAB_O(i)	IND	*Total labour bill in industry i*
SIGMA1PRIM(i)	IND	*CES substitution, primary factors*
V1PRIM(i)	IND	*Total factor input to industry i*
SIGMA1(c)	COM	*Armington elasticities: Intermediate*
V1PUR_S(c,i)	COMxIND	*Dom+imp intermediate purchase. value*
S1(c,s,i)	COMxSRCxIND	*Intermediate source shares*
V1MAT(i)	IND	*Total intermediate cost for industry i*
V1VAR(i)	IND	*Short-run variable cost for industry i*
V1CST(i)	IND	*Total cost of industry i*
V1TOT(i)	IND	*Total industry cost plus tax*
PTXRATE(i)	IND	*Rate of production tax*
SIGMA1OUT(i)	IND	*CET transformation elasticities*
MAKE(c,i)	COMxIND	*Multiproduction matrix*
MAKE_C(i)	IND	*All production by industry i*
MAKE_I(c)	COM	*Total production of commodities*
EXPSHR(c)	COM	*Share going to exports*
TAU(c)	COM	*1/Elast. of transformation, exportable/locally used*
SIGMA2(c)	COM	*Armington elasticities: Investment*
V2PUR_S(c,i)	COMxIND	*Dom+imp investment purchase. value*
S2(c,s,i)	COMxSRCxIND	*Investment source shares*
V2TOT(i)	IND	*Total capital created for industry i*
SIGMA3(c)	COM	*Armington elasticities: households*
V3PUR_S(c,h)	COMxHOUS	*Dom+imp households purchase. value*
S3(c,s,h)	COMxSRCxHOUS	*Household source shares*
V3TOTh(h)	HOUS	*Total purchases by households*
V3TOT_H		*Total purchases by households*
S3_S(c,h)	COMxHOUS	*Household average budget shares*
FRISCH(h)	HOUS	*Frisch LES 'parameter'= - (total/luxury)*

EPS(c,h)	COMxHOUS	*Household expenditure elasticities*
S3_H(h)	HOUS	*Household shares*
B3LUX(c,h)	COMxHOUS	*Ratio(supernumerary /total expenditure)*
S3LUX(c,h)	COMxHOUS	*Marginal household budget shares*
EXP_ELAST(c)	COM	*Export demand elasticities*
EXP_ELAST_NT		*Collective export demand elasticity*
V4NTRADEXP		*Total collective export earnings*
MARSALES(c)	COM	*Total usage for margins purposes*
SALE(c,s,d)	COMxSRCxDEST	*Sales aggregates*
V0IMP(c)	COM	*Total basic-value imports of good c*
SALES(c)	COM	*Total sales of domestic commodities*
DOMSALES(c)	COM	*Total sales to local market*
V1TAX_CSI		*Total intermediate tax revenue*
V2TAX_CSI		*Total investment tax revenue*
V3TAX_CSH		*Total households tax revenue*
V4TAX_C		*Total export tax revenue*
V5TAX_CS		*Total government tax revenue*
V0TAR_C		*Total tariff revenue*
V1CAP_I		*Total payments to capital*
V1LAB_IO		*Total payments to labour*
V1LND_I		*Total payments to land*
V1PTX_I		*Total production tax/subsidy*
V1OCT_I		*Total other cost ticket payments*
V1PRIM_I		*Total primary factor payments*
V0GDPINC		*Nominal GDP from income side*
V0TAX_CSI		*Total indirect tax revenue*
V0CIF(c)	COM	*Total ex-duty imports of good c*
V0IMP_C		*Total basic-value imports (includes tariffs)*
V2TOT_I		*Total investment usage*
V4TOT		*Total export earnings*
V5TOT		*Total value of government demands*
V6TOT		*Total value of inventories*
V0GNE		*GNE from expenditure side*
V0GDPEXP		*GDP from expenditure side*
V1LAB_I(o)	OCC	*Total wages, occupation o*
LOCSALES(c)	COM	*Total local sales of dom + imp good c*
V1LABINC(o,h)	OCCxHOUS	*Labour income from occupation to household*
V1LABINC_O(h)	HOUS	*Total wage income to households*
VGOSSAV		*Capital Account: Government*
VGOSGOV		*GOS income to government + GOS transfers to government*
VGOSROW		*GOS income to ROW + GOS transfers to ROW*
VGOSTAX		*Corporation tax*
VGOVGOS		*Interest on public debt*
VGOVROW		*GOV transfers to ROW*
VROWGOS		*GOS from ROW*
VROWGOV		*Transfers from ROW to government*
VGOSHOU(h)	HOUS	*GOS to households*
VGOVHOU(h)	HOUS	*Government transfers to households*
VHOUGOV(h)	HOUS	*Income tax + household transfers to government*
VHOUROW(h)	HOUS	*Household transfers to ROW*
VROWHOU(h)	HOUS	*ROW transfers to households*
VHOUHOU(hto,hfrom)	HOUSxHOUS	*Intra-household transfers*
GOVSHRINV(i)	IND	*Government share of investment by industry*
VGOS		*Total GOS*
VGOS_POSTTAX		*VGOS less VGOSTAX*
GOSTAXRATE		*Ad valorem GOS Tax*
VGOSHOU_H		*Total GOS to households*
VHOUSINC(h)	HOUS	*Pre-tax household income*
VDISPINC(h)	HOUS	*Post-tax household income*

VHOUSAV(h)	HOUS	*Household saving*
VINCGOV		*Government income*
VGOVCUR		*Current government expenditure*
VGOVCAP		*Investment government expenditure*
VGOVEXP		*Total government expenditure*
VGOVSAV		*Government (income - expenditure)*
VPRIVCAP		*Investment private expenditure*
VROWEXP		*Total ROW expenditure*
VINCROW		*Total ROW income*
VROWSAV		*ROW (income - expenditure)*
VSAMCHECK		*Global (income - expenditure)*
INCTAXRATE(h)	HOUS	*Tax rates*
INITVGDPfac		*Initial factor cost GDP at current prices*
EXPGDP(e)	EXPMAC	*Expenditure Aggregates*
INCGDP(i)	INCMAC	*Income Aggregates*
TAX(t)	TAXMAC	*Tax Aggregates*
IMPSHR(c)	COM	*Share of imports in local market*
TARFRATE(c)	COM	*Ad valorem tariff rate*
PRVSHRINV(i)	IND	*Private share of investment by industry*
DOMINV(i)	IND	*Investment use of domestic goods*
DOMUSE(u)	USER	*Total domestic use*
IMPUSE(c,u)	COMxUSER	*Imports at basic prices*
IMPDUTY(u)	USER	*Duty paid, by user*
IMPCIF(u)	USER	*Imports CIF*
V2TAX_CS(i)	IND	*Total investment tax*
SAM(i,j)	CASHDESTxSPENDER	*Social accounting matrix*
INCTOT(i)	CASHDEST	*Total income*
EXPTOT(j)	SPENDER	*Expenditure totals*
V3TOT_phr		*Aggregate monetary poverty line for rural areas*
V3TOT_phu		*Aggregate monetarypPoverty line for urban areas*
BPOVLINE		*Base year poverty line*

B 5.3: Derivation of consumer demand for a composite commodity

The Stone-Geary utility function is

utility per household = $\frac{1}{Q}\prod_{c}\{X3\_S(c) - X3SUB(c)\}^{S3LUX(c)}$ (1)

where $X3SUB$ and $S3LUX$ are behavioural coefficients; Q is the number of households and $\sum_{c} S3LUX(c)$=1. The household's problem is to choose $X3\_S(c)/Q$ to maximise utility subject to the budget constraint:

$$\sum_{c} X3\_S(c)/Q * P3\_S(c) = V3TOT/Q \quad (2)$$

The Lagrangian function is

$$L = \frac{1}{Q}\prod_{c}\{X3\_S(c) - X3SUB(c)\}^{S3LUX(c)} - \lambda[V3TOT/Q - \frac{\sum X3\_S(c)}{Q} * P3\_S(c)] \quad (3)$$

The first order condition is,

$$\partial L / \partial(X3\_S(c)/Q) = \prod_{c} S3LUX(c)\{\frac{X3\_S(c)}{Q} - X3SUB(c)\}^{S3LUX(c)-1} - \lambda P3\_S(c) \quad (4)$$

$$= S3LUX(c).U.\{X3\_S(c) - X3SUB(c)\}^{-1} - \lambda P3\_S(c)$$

$$\lambda P3\_S(c) = S3LUX(c).U.\{\frac{X3\_S(c)}{Q} - X3SUB(c)\}^{-1} \quad (5)$$

Manipulating the above equation we obtain,

$$P3\_S(c).X3\_S(c) - p3\_S(c).X3SUB(c) = S3LUX(c).Q.\frac{U}{\lambda} \quad (6)$$

Now summing over c and by using equation (2) we obtain,

$$\frac{Q.U}{\lambda}.\sum_{c} S3LUX(c) = V3TOT - \sum_{c} P3\_S(c).X3SUB(c) \quad (7)$$

Substituting this result back into equation (6) we get the following Linear Expenditure System (LES) which shows that expenditure on each good is a linear function of prices (P3_S) and expenditure (V3TOT).

$$P3\_S(c).X3\_S(c) = P3\_S(c).X3SUB(c) - V3TOT - \sum_{c} P3\_S(c).X3SUB(c) \quad (8)$$

By definition, $V3TOT - \sum_{c} X3SUB(c).P3\_S(c) = V3LUX\_C$ (9)

i.e. households' 'supernumerary' expenditures ($V3LUX\_C$) are determined after subsistence expenditures are deducted from total expenditure ($V3TOT$).

Substituting equation (9) in equation (8) we obtain the following demand equation

$$X3\_S(c) = X3SUB(c) + S3LUX(c).V3LUX\_C / P3\_S(c) \quad (10)$$

Appendix C

Table C 6.1: Commodity and industry classification in the Bangladesh model

No.	I-O table industries	Model industry code	I-O table commodities	Model commodity code
1	Paddy Cultivation	Paddy	Paddy	Paddy
2	Wheat Cultivation	Wheat	Wheat	Wheat
3	Other Grain Cultivation	Othergrain	Other Grains	Othergrain
4	Jute Cultivation	JuteCultiv	Jute	JuteCultiv
5	Sugarcane Cultivation	SugcaneCulti	Sugarcane	SugcaneCulti
6	Potato Cultivation	PotatoCulti	Potato	PotatoCulti
7	Vegetable Cultivation	VegCulti	Vegetables	VegCulti
8	Pulses Cultivation	PulseCulti	Pulses	PulseCulti
9	Oilseed Cultivation	OilseedCulti	Oilseeds	OilseedCulti
10	Fruit Cultivation	FruitCulti	Fruits	FruitCulti
11	Cotton Cultivation	CottonCulti	Cotton	CottonCulti
12	Tobacco Cultivation	TobaccoCulti	Tobacco	TobaccoCulti
13	Tea Cultivation	TeaCulti	Tea	TeaCulti
14	Spice Cultivation	SpiceCulti	Major Spices	SpiceCulti
15	Other Crop Cultivation	OthcropCulti	Other Crops	OthcropCulti
16	Livestock Rearing	LivstockRear	Meat	Meat
17	Poultry Rearing	PoultryRear	Milk and Fat	MilkFat
18	Shrimp Farming	ShrimFarming	Animal draft	Animaldraft
19	Fishing	Fishing	Manure	Manure
20	Forestry	Forestry	Hides and Skins	HidesSkins
21	Rice Milling	RiceMilling	Poultry Meat	PoultryMeat
22	Grain Milling	GrainMilling	Poultry Eggs	PoutryEggs
23	Fish Process	FishProcess	Shrimp	Shrimp
24	Oil Industry	OilIndustry	Fish	Fish
25	Sweetener Industry	SweetenerInd	Forestry	Forestry
26	Tea Product	TeaProduct	Riceflour Bran	RiceflorBran
27	Salt Refining	SaltRefining	Flour Bran Feed	FlourBrafeed
28	Food Process	FoodProcess	Fish and Seafood	FishSeafood
29	Tanning and Finishing	TannFishing	Edible-Nonedible Oil	EdiNoedOil
30	Leather Industry	LeatherInd	Sugar Gur Molasses	SugGuMolass
31	Baling	Baling	Tea Product	TeaProduct
32	Jute Fabrication	JuteFabricat	Salt	Salt
33	Yarn Industry	YarnIndustry	Processed Food	ProcessFood
34	Cloth Milling	ClothMill	Tanning and Leather	TaningLethr
35	Handloom Cloth	HandloomClot	Leather Product	LethrProdt
36	Dyeing and Bleaching	DyeingBlech	Baling	Baling
37	Ready-made garments (RMG)	RMG	Jute Product	JuteProduct
38	Knitting	Knitting	Yarn	Yarn
39	Toiletries Mfg.	ToiletrieMfg	Mill Cloth	MillCloth
40	Cigarette Industry	CigarettInd	Handloom Cloth	HandlmCloth
41	Bidi Industry	BidiIndustry	Dyed Bleach Yarn Fabrics	DyeingBlech
42	Saw and Plane	SawPlane	Ready Made Garments	RMG
43	Furniture Industry	Furniturind	Knitted RMG and Hosiery	Knitting
44	Paper Industry	PaperInd	Toiletries	ToiletrieMfg
45	Printing and Publishing	PrintPub	Cigarettes	CigarettInd

46	Pharmaceuticals Mfg.	PharmaMfg	Bidi	BidiIndustry
47	Fertiliser Industry	FertiliseInd	Basic Wood Product	BasicWProdt
48	Basic Chemical	BasiChemical	Wooden Furniture	WoodnFur
49	Petroleum Ref.	PetroleumRef	Pulp Paper and Board	PulpPaBoard
50	Earth ware Industry	EarthwareInd	Printing and Publishing	PrintPub
51	Chemical Industry	ChemicalInd	Medicines	Medicines
52	Glass Industry	GlassInd	Fertilizer, Insecticides	FertzerInsec
53	Clay Industry	ClayInd	Chemicals	Chemicals
54	Cement Mfg.	CementMfg	Petroleum Product	PetroProduct
55	Basic Metal Mfg.	BasicMetaMfg	China Pottery	Chinapottery
56	Metal Mfg.	MetalMfg	Chemical Products	ChemProdt
57	Machinery and Equipment	MachineEquip	Glass Products	GlassProdt
58	Transport Equipment	TranspoEquip	Bricks, Tiles and Clay Products	BricTCProdt
59	Miscellaneous Industry	MiscellaInd	Cement	Cement
60	Urban Building	Urbanbuild	Iron Steel Basic	IronStBasic
61	Rural Building	RuralBuild	Fabricated Metal Products	FabMetProdt
62	Power Plant Building	PPlantBuild	Machinery	Machinery
63	Rural Road Building	RuRoadBuild	Transport Equipment	TransEquipmt
64	Port Road Railway Building	PoRoadBuild	Miscellaneous Industry Products	MiscellaInd
65	Canal Dyke Other Building	CaDyothBuild	Urban Buildings	UrbanBuild
66	Electricity and Water Generation	ElectWatGene	Rural Buildings	RuralBuild
67	Gas Extraction and Distribution	GasExtDist	Building Maintenance	BldgMantence
68	Mining and Quarrying	MinQuarring	Plants for construction	PlantConst
69	Wholesale Trade	WholeTrade	Rural Roads	RuRoads
70	Retail Trade	RetailTrade	Ports, Airports Railways	PortAirRlwy
71	Air Transport	AirTransport	Canal, Dyke, Other Buildings	CaDyothBuild
72	Water Transport	WatTransport	Infrastructure Maintenance	InfrastrMtn
73	Land Transport	LanTransport	Electricity and Water	ElectWater
74	Railway Transport	RaiTransport	Gas Extraction and Distribution	GasExtDist
75	Other Transport	OthTransport	Mining and Quarring	MinQuarring
76	Housing Service	HousingServ	Trade Wholesale	WholeTrade
77	Health Service	HealthServ	Trade Retail	RetailTrade
78	Education Service	EducatServ	Air Transport	AirTransport
79	Public Administration and Defense	PubAdDefence	Water Transport	WatTransport
80	Bank Insurance and Real Estate	BanInsRestat	Land Transport	LanTransport
81	Professional Service	ProfessioServ	Railway Transport	RaiTransport
82	Hotel and Restaurant	HotelRest	Warehousing	Warehousing
83	Entertainment	Entertainmen	Housing Service	HousingServ
84	Communication	Communicatio	Health Services	HeathServ
85	Other Services	OthServices	Education Services	EducatServ
86	Information Technology and ECom	InfotechEcom	Public Administration and Defense	PubAdDefence

	Bank Insurance	BanInsurance
	Proffessional Services	ProfesioServ
	Hotels and Restaurants	HotelRest
	Entertainments	Entertainmen
	Communications	Communica
	Other Services	Othservices
	Information Technology and Services	InfTechServ
	Waste	Waste

Table C 6.2: Sectoral mapping of I-O table 2000 and SAM 2000 for Bangladesh

Industry in model	2000 SAM Industry	Commodity in model	2000 SAM Commodity
Paddy	Paddy	Paddy	Paddy
Wheat	Grains	Wheat	Grains
Othergrain	Grains	Othergrain	Grains
JuteCultiv	Jute	JuteCultiv	Jute
SugcaneCulti	CommCrop	SugcaneCulti	CommCrop
PotatoCulti	OthCrop	PotatoCulti	OthCrop
VegCulti	OthCrop	VegCulti	OthCrop
PulseCulti	OthCrop	PulseCulti	OthCrop
OilseedCulti	OthCrop	OilseedCulti	OthCrop
FruitCulti	OthCrop	FruitCulti	OthCrop
CottonCulti	CommCrop	CottonCulti	CommCrop
TobaccoCulti	CommCrop	TobaccoCulti	CommCrop
TeaCulti	Tea	TeaCulti	Tea
SpiceCulti	OtherFood	SpiceCulti	OthCrop
OthcropCulti	OtherFood	OthcropCulti	OthCrop
LivstockRear	Livestock	Meat	Livestock
PoultryRear	Poultry	MilkFat	Livestock
ShrimFarming	OtherFish	Animaldraft	Livestock
Fishing	OtherFish	Manure	Livestock
Forestry	Forestry	HidesSkins	Livestock
RiceMilling	RiceMill	PoultryMeat	Poultry
GrainMilling	AtaMill	PoutryEggs	Poultry
FishProcess	OtherFood	Shrimp	OtherFish
OilIndustry	OtherFood	Fish	OtherFish
SweetenerInd	OtherFood	Forestry	Forestry
TeaProduct	TeaProd	RiceflorBran	RiceMill
SaltRefining	OtherFood	FlourBrafeed	AtaMill
FoodProcess	OtherFood	FishSeafood	OtherFood
TannFishing	OtherFood	EdiNoedOil	OtherFood
LeatherInd	LeatherProd	SugGuMolass	OtherFood
Baling	JuteText	TeaProduct	TeaProd
JuteFabricat	JuteText	Salt	OtherFood
YarnIndustry	Yarn	ProcessFood	OtherFood
ClothMill	MillCloth	TaningLethr	LeatherProd
HandloomClot	Clothing	LethrProdt	LeatherProd
DyeingBlech	Clothing	Baling	JuteText
RMG	ReadymadeGar	JuteProduct	JuteText
Knitting	ReadymadeGar	Yarn	Yarn
ToiletrieMfg	Chemical	MillCloth	MillCloth
CigarettInd	TobbaProd	HandlmCloth	Clothing
BidiIndustry	TobbaProd	DyeingBlech	Clothing
SawPlane	WoodProd	RMG	ReadymadeGar
Furniturind	WoodProd	Knitting	ReadymadeGar
PaperInd	PrintPub	ToiletrieMfg	Chemical
PrintPub	PrintPub	CigarettInd	TobbaProd
PharmaMfg	Chemical	BidiIndustry	TobbaProd
FertiliseInd	Fertiliser	BasicWProdt	ForestProd
BasiChemical	Chemical	WoodnFur	ForestProd
PetroleumRef	PetroProd	PulpPaBoard	MiscIndus
EarthwareInd	ClayProd	PrintPub	PrintPub

ChemicalInd	Chemical	Medicines	Chemical
GlassInd	MiscIndus	FertzerInsec	Fertiliser
ClayInd	ClayProd	Chemicals	Chemical
CementMfg	Cement	PetroProduct	PetroProd
BasicMetaMfg	IronSteelBas	Chinapottery	ClayProd
MetalMfg	IronSteelBas	ChemProdt	Chemical
MachineEquip	Machinery	GlassProdt	MiscIndus
TranspoEquip	TransSer	BricTCProdt	ClayProd
MiscellaInd	MiscIndus	Cement	Cement
Urbanbuild	UrbBuild	IronStBasic	IronSteelBas
RuralBuild	RuBuild	FabMetProdt	IronSteelBas
PPlantBuild	Construction	Machinery	Machinery
RuRoadBuild	Construction	TransEquipmt	Machinery
PoRoadBuild	Construction	MiscellaInd	MiscIndus
CaDyothBuild	Construction	UrbanBuild	UrbBuild
ElectWatGene	Utility	RuralBuild	RuBuild
GasExtDist	Utility	BldgMantence	Construction
MinQuarring	utility	PlantConst	Construction
WholeTrade	TradSer	RuRoads	Construction
RetailTrade	TradSer	PortAirRlwy	Construction
AirTransport	TransSer	CaDyothBuild	Construction
WatTransport	TransSer	InfrastrMtn	Construction
LanTransport	TransSer	ElectWater	Utility
RaiTransport	TransSer	GasExtDist	Utility
OthTransport	TransSer	MinQuarring	Utility
HousingServ	Housing	WholeTrade	TradSer
HealthServ	Health	RetailTrade	TradSer
EducatServ	Education	AirTransport	TransSer
PubAdDefence	PubAdm	WatTransport	TransSer
BanInsRestat	OthServ	LanTransport	TransSer
ProfesioServ	OthServ	RaiTransport	TransSer
HotelRest	HotetRest	Warehousing	TransSer
Entertainmen	OthServ	HousingServ	Housing
Communicatio	Communicat	HeathServ	Health
OthServices	OthServ	EducatServ	Education
InfotechEcom	InfoTechnSer	PubAdDefence	PubAdm
		BanInsurance	OthServ
		ProfesioServ	OthServ
		HotelRest	HotetRest
		Entertainmen	OthServ
		Communica	Communicat
		Othservices	OthServ
		InfTechServ	InfoTechnSer
		Waste	OthServ

Table C.6.3: Elasticity of Substitution

Commodities	Elasticity values	Commodities	Elasticity values
1 Paddy	1.8	48 WoodnFur	1.3
2 Wheat	1.8	49 PulpPaBoard	1.3
3 Othergrain	1.8	50 PrintPub	1.3
4 JuteCultiv	1.61	51 Medicines	1.2
5 SugcaneCulti	1.8	52 FertzerInsec	1.2
6 PotatoCulti	1.8	53 Chemicals	1.2
7 VegCulti	1.8	54 PetroProduct	1.2
8 PulseCulti	1.8	55 Chinapottery	1.3
9 OilseedCulti	1.8	56 ChemProdt	1.2
10 FruitCulti	1.8	57 GlassProdt	1.2
11 CottonCulti	1.61	58 BricTCProdt	1.2
12 TobaccoCulti	1.61	59 Cement	1.2
13 TeaCulti	1.61	60 IronStBasic	1.2
14 SpiceCulti	1.8	61 FabMetProdt	1.2
15 OthcropCulti	1.8	62 Machinery	1.2
16 Meat	1.8	63 TransEquipmt	1.2
17 MilkFat	1.8	64 MiscellaInd	1.2
18 Animaldraft	1.8	65 UrbanBuild	1.2
19 Manure	1.8	66 RuralBuild	1.2
20 HidesSkins	1.8	67 BldgMantence	1.2
21 PoultryMeat	1.8	68 PlantConst	1.2
22 PoutryEggs	1.8	69 RuRoads	1.2
23 Shrimp	1.8	70 PortAirRlwy	1.2
24 Fish	1.8	71 CaDyothBuild	1.2
25 Forestry	1.61	72 InfrastrMtn	1.2
26 RiceflorBran	1.8	73 ElectWater	1.2
27 FlourBrafeed	1.8	74 GasExtDist	1.2
28 FishSeafood	1.8	75 MinQuarring	1.2
29 EdiNoedOil	1.8	76 WholeTrade	1.2
30 SugGuMolass	1.8	77 RetailTrade	1.2
31 TeaProduct	1.8	78 AirTransport	1.2
32 Salt	1.8	79 WatTransport	1.2
33 ProcessFood	1.61	80 LanTransport	1.2
34 TaningLethr	1.3	81 RaiTransport	1.2
35 LethrProdt	1.3	82 Warehousing	1.2
36 Baling	1.3	83 HousingServ	1.2
37 JuteProduct	1.3	84 HeathServ	1.2
38 Yarn	1.3	85 EducatServ	1.2
39 MillCloth	1.3	86 PubAdDefence	1.2
40 HandlmCloth	1.3	87 BanInsurance	1.2
41 DyeingBlech	1.3	88 ProfesioServ	1.2
42 RMG	1.3	89 HotelRest	1.2
43 Knitting	1.3	90 Entertainmen	1.2
44 ToiletrieMfg	1.2	91 Communica	1.2
45 CigarettInd	1.61	92 Othservices	1.2
46 BidiIndustry	1.61	93 InfTechServ	1.2
47 BasicWProdt	1.3	94 Waste	1.2

Table C 6.4: Household expenditure elasticities

Commodities	Landless	Marg-farmer	Small-farmer	Large-farmer	Non-agricul	Illi-terate	Low-edu	Medium-edu	High-edu
1 Paddy	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
2 Wheat	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
3 Othergrain	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
4 JuteCultiv	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
5 SugcaneCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
6 PotatoCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
7 VegCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
8 PulseCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
9 OilseedCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
10 FruitCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
11 CottonCulti	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
12 TobaccoCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
13 TeaCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
14 SpiceCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
15 OthcropCulti	0.449	0.449	0.448	0.445	0.444	0.444	0.439	0.433	0.429
16 Meat	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
17 MilkFat	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
18 Animaldraft	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
19 Manure	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
20 HidesSkins	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
21 PoultryMeat	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
22 PoutryEggs	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
23 Shrimp	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
24 Fish	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
25 Forestry	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
26 RiceflorBran	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
27 FlourBrafeed	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
28 FishSeafood	1.327	1.326	1.323	1.314	1.314	1.312	1.298	1.279	1.269
29 EdiNoedOil	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
30 SugGuMolass	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
31 TeaProduct	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
32 Salt	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
33 ProcessFood	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
34 TaningLethr	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
35 LethrProdt	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
36 Baling	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
37 JuteProduct	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
38 Yarn	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
39 MillCloth	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
40 HandlmCloth	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
41 DyeingBlech	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
42 RMG	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
43 Knitting	1.044	1.044	1.041	1.034	1.034	1.032	1.021	1.006	0.998
44 ToiletrieMfg	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
45 CigarettInd	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
46 BidiIndustry	0.82	0.819	0.817	0.812	0.812	0.81	0.802	0.79	0.784
47 BasicWProdt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
48 WoodnFur	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
49 PulpPaBoard	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278

50 PrintPub	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
51 Medicines	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
52 FertzerInsec	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
53 Chemicals	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
54 PetroProduct	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
55 Chinapottery	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
56 ChemProdt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
57 GlassProdt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
58 BricTCProdt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
59 Cement	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
60 IronStBasic	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
61 FabMetProdt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
62 Machinery	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
63 TransEquipmt	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
64 MiscellaInd	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
65 UrbanBuild	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
66 RuralBuild	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
67 BldgMantence	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
68 PlantConst	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
69 RuRoads	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
70 PortAirRlwy	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
71 CaDyothBuild	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
72 InfrastrMtn	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
73 ElectWater	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
74 GasExtDist	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
75 MinQuarring	1.337	1.336	1.333	1.324	1.324	1.321	1.308	1.289	1.278
76 WholeTrade	1.073	1.073	1.07	1.063	1.063	1.061	1.05	1.035	1.026
77 RetailTrade	1.073	1.073	1.07	1.063	1.063	1.061	1.05	1.035	1.026
78 AirTransport	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
79 WatTransport	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
80 LanTransport	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
81 RaiTransport	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
82 Warehousing	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
83 HousingServ	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
84 HeathServ	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
85 EducatServ	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
86 PubAdDefence	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
87 BanInsurance	1.366	1.365	1.362	1.353	1.353	1.35	1.336	1.317	1.306
88 ProfesioServ	1.2	1.2	1.197	1.189	1.188	1.186	1.174	1.157	1.147
89 HotelRest	1.073	1.073	1.07	1.063	1.063	1.061	1.05	1.035	1.026
90 Entertainmen	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
91 Communica	1.347	1.346	1.343	1.334	1.333	1.331	1.317	1.298	1.287
92 Othservices	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
93 InfTechServ	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
94 Waste	1.034	1.034	1.031	1.024	1.024	1.022	1.012	0.997	0.989
Total	102.6	102.5	102.3	101.62	101.59	101.40	100.3	98.896	98.08

Appendix D

Table D 7.1: Base case tariff rates, import share and export share (expressed as ratios)

Commodity	Import share	Tariff rate	Export share	Industry	Trade category
Paddy	0	0	0	Paddy	NT
Wheat	0.342	0.032	0	Wheat	IC
Othergrain	0.007	0	0	Othergrain	NT
JuteCultiv	0	0	0.1966	JuteCultiv	E
SugcaneCulti	0	0	0	SugcaneCulti	NT
PotatoCulti	0.003	0.05	0	PotatoCulti	NT
VegCulti	0.275	0.038	0.0324	VegCulti	IC
PulseCulti	0	0	0	PulseCulti	NT
OilseedCulti	0.303	0.047	0	OilseedCulti	IC
FruitCulti	0.069	0.211	0	FruitCulti	IC
CottonCulti	0.658	0	0	CottonCulti	IC
TobaccoCulti	0.174	0.107	0.0283	TobaccoCulti	IC
TeaCulti	0	0	0.4493	TeaCulti	E
SpiceCulti	0.115	0.232	0	SpiceCulti	IC
OthcropCulti	0.104	0.027	0.003	OthcropCulti	NT
Meat	0.026	0	0	LivstockRear	NT
MilkFat	0.509	0.316	0	PoultryRear	IC
Animaldraft	0.016	0.003	0	ShrimFarming	NT
Manure	0.016	0	0	Fishing	NT
HidesSkins	0.022	0.006	0	Forestry	NT
PoultryMeat	0.01	0	0	RiceMilling	NT
PoutryEggs	0.004	0.101	0	GrainMilling	NT
Shrimp	0	0	0.3487	FishProcess	E
Fish	0	0.114	0	OilIndustry	NT
Forestry	0.001	0.08	0	SweetenerInd	NT
RiceflorBran	0.018	0.016	0	TeaProduct	NT
FlourBrafeed	0.012	0.118	0	SaltRefining	IC
FishSeafood	0.034	0.162	0.0955	FoodProcess	IC
EdiNoedOil	0.508	0.059	0	TannFishing	IC
SugGuMolass	0.055	0.182	0	LeatherInd	IC
TeaProduct	0.012	0.205	0	Baling	ER
Salt	0.028	0.114	0	JuteFabricat	IC
ProcessFood	0.11	0.172	0	YarnIndustry	IC
TaningLethr	0	0.016	0	ClothMill	ER
LethrProdt	0.008	0.144	0.3465	HandloomClot	E
Baling	0	0	0	DyeingBlech	NT
JuteProduct	0	0.097	0.5611	RMG	E
Yarn	0.317	0.034	0	Knitting	IC
MillCloth	0.29	0.019	0	ToiletrieMfg	IC
HandlmCloth	0	0	0	CigarettInd	NT
DyeingBlech	0.029	0	0	BidiIndustry	NT
RMG	0.389	0.004	0.7585	SawPlane	E
Knitting	0.063	0.078	0.7529	Furniturind	E
ToiletrieMfg	0.209	0.121	0.2532	PaperInd	E
CigarettInd	0.009	0.02	0	PrintPub	NT
BidiIndustry	0	0	0	PharmaMfg	NT
BasicWProdt	0.028	0.176	0	FertiliseInd	NT
WoodnFur	0.008	0.233	0	BasiChemical	NT

PulpPaBoard	0.423	0.073	0	PetroleumRef	IC
PrintPub	0.128	0.031	0	EarthwareInd	NT
Medicines	0.258	0.012	0	ChemicalInd	IC
FertzerInsec	0.45	0.009	0.224	GlassInd	IC
Chemicals	0.795	0.085	0	ClayInd	IC
PetroProduct	0.611	0.244	0.0198	CementMfg	IC
Chinapottery	0.091	0.268	0.064	BasicMetaMfg	IC
ChemProdt	0.521	0.048	0	MetalMfg	IC
GlassProdt	0.647	0.167	0	MachineEquip	IC
BricTCProdt	0.022	0.076	0	TranspoEquip	NT
Cement	0.674	0.166	0	MiscellaInd	IC
IronStBasic	0.357	0.053	0	Urbanbuild	IC
FabMetProdt	0.288	0.153	0	RuralBuild	IC
Machinery	0.711	0.059	0.0266	PPlantBuild	IC
TransEquipmt	0.478	0.089	0	RuRoadBuild	IC
MiscellaInd	0.504	0.067	0.4618	PoRoadBuild	IC
UrbanBuild	0	0	0	CaDyothBuild	NT
RuralBuild	0	0	0	ElectWatGene	NT
BldgMantence	0	0	0	GasExtDist	NT
PlantConst	0	0	0	MinQuarring	NT
RuRoads	0	0	0	WholeTrade	NT
PortAirRlwy	0	0	0	RetailTrade	NT
CaDyothBuild	0	0	0	AirTransport	NT
InfrastrMtn	0	0	0	WatTransport	NT
ElectWater	0	0	0	LanTransport	NT
GasExtDist	0.022	0.073	0	RaiTransport	NT
MinQuarring	0.1	0.08	0	OthTransport	NT
WholeTrade	0	0	0	HousingServ	NT
RetailTrade	0	0	0	HealthServ	NT
AirTransport	0	0	0.0411	EducatServ	NT
WatTransport	0	0	0.1242	PubAdDefence	E
LanTransport	0	0	0	BanInsRestat	NT
RaiTransport	0	0	0	ProfesioServ	NT
Warehousing	0	0	0	HotelRest	NT
HousingServ	0	0	0	Entertainmen	NT
HeathServ	0	0	0	Communicatio	NT
EducatServ	0	0	0	OthServices	NT
PubAdDefence	0.041	0	0.2513	InfotechEcom	E
BanInsurance	0.02	0	0.0146		NT
ProfesioServ	0.014	0	0.0208		NT
HotelRest	0	0	0		NT
Entertainmen	0	0	0.001		NT
Communica	0.021	0	0.1276		NT
Othservices	0	0	0		NT
InfTechServ	0.016	0	0.0356		NT
Waste	0.717	0.07	0		NT

Table D 7.2: Fan Decomposition (Simulation 1) (percentage changes)

	Short run				Long run			
Commodity	Output	Local market	Domestic share	Export	Output	Local market	Domestic Share	Export
1 Paddy	-0.0568	-0.0568	0	0	0.117	0.117	0	0
2 Wheat	-0.2253	-0.2627	0.0375	0	0.213	0.312	-0.099	0
3 Othergrain	-0.2013	-0.2154	0.0141	0	0.365	0.363	0.002	0
4 JuteCultiv	2.2785	1.8776	0	0.4009	-0.261	-0.227	0	-0.034
5 SugcaneCulti	-0.8556	-0.8556	0	0	-1.02	-1.02	0	0
6 PotatoCulti	-0.0329	-0.0283	-0.0046	0	0.138	0.156	-0.018	0
7 VegCulti	0.3332	-0.0756	-0.2596	0.6684	-0.92	0.15	-1.169	0.1
8 PulseCulti	-0.0506	-0.0506	0	0	0.177	0.177	0	0
9 OilseedCulti	-0.5122	-0.37	-0.1423	0	-1.969	-1.563	-0.406	0
10 FruitCulti	-1.2799	0.11	-1.3901	0.0002	-1.799	0.06	-1.859	0
11 CottonCulti	0.6945	0.3079	0.3866	0	0.503	0.25	0.253	0
12 TobaccoCulti	-0.2446	-0.106	-0.7232	0.5847	-0.575	0.252	-0.914	0.087
13 TeaCulti	2.1614	-0.3946	0	2.556	0.48	-0.085	0	0.565
14 SpiceCulti	-2.3006	-0.1044	-2.1961	0	-3.541	-0.439	-3.102	0
15 OthcropCulti	0.0306	-0.0646	0.0326	0.0626	-0.201	0.102	-0.313	0.009
16 Meat	0.0159	-0.0784	0.0943	0	0.842	0.848	-0.007	0
17 MilkFat	-3.8463	5.7594	-9.6056	0	-3.995	6.892	-10.887	0
18 Animaldraft	-0.0559	-0.1438	0.0879	0	0.25	0.235	0.015	0
19 Manure	-0.0615	-0.1373	0.0758	0	-0.441	-0.476	0.035	0
20 HidesSkins	1.4811	1.4584	0.0227	0	1.284	1.324	-0.04	0
21 PoultryMeat	-0.169	-0.2201	0.051	0	0.327	0.319	0.008	0
22 PoutryEggs	-0.2072	-0.1706	-0.0367	0	0.298	0.352	-0.055	0
23 Shrimp	2.6833	0.2192	0	2.4641	2.113	0.54	0	1.573
24 Fish	-0.2106	-0.2091	-0.0015	0	0.458	0.46	-0.002	0
25 Forestry	-0.0885	-0.0855	-0.003	0	0.703	0.708	-0.006	0
26 RiceflorBran	-0.0571	-0.1059	0.0487	0	0.041	0.079	-0.039	0
27 FlourBrafeed	-0.2859	-0.1834	-0.1025	0	0.291	0.422	-0.131	0
28 FishSeafood	0.6189	-0.5162	-0.8337	1.9688	0.172	0.733	-0.855	0.294
29 EdiNoedOil	-0.4986	0.0215	-0.5201	0	-2.65	0.162	-2.812	0
30 SugGuMolass	-0.8414	0.0581	-0.8996	0	-0.996	0.177	-1.174	0
31 TeaProduct	-0.6125	-0.3397	-0.2728	0	-0.145	0.163	-0.308	0
32 Salt	-0.0113	-0.0082	-0.0031	0	0.513	0.505	0.009	0
33 ProcessFood	-1.0779	0.3419	-1.4198	0	-1.418	0.485	-1.903	0
34 TaningLethr	1.5161	1.5163	-0.0002	0	1.265	1.266	0	0
35 LethrProdt	1.7389	-0.8299	-0.071	2.6398	1.501	0.104	-0.07	1.468
36 Baling	7.1983	7.1983	0	0	-0.595	-0.595	0	0
37 JuteProduct	4.9274	-0.5017	-0.0012	5.4303	-0.515	0.013	-0.001	-0.527
38 Yarn	0.9823	1.3196	-0.3374	0	0.821	1.813	-0.992	0
39 MillCloth	2.7018	2.352	0.3497	0	3.031	2.634	0.397	0
40 HandlmCloth	-0.3755	-0.3755	0	0	0.253	0.253	0	0
41 DyeingBlech	-0.3315	-0.3967	0.0651	0	0.309	0.305	0.003	0
42 RMG	4.854	-0.017	-0.0324	4.9034	5.371	0.048	-0.04	5.363
43 Knitting	5.41	-0.0393	-0.0507	5.5	8.809	0.07	-0.059	8.798
44 ToiletrieMfg	2.4478	0.0551	-1.2437	3.6364	10.56	2.234	-1.027	9.354
45 CigarettInd	0.1079	0.0812	0.0267	0	0.691	0.685	0.005	0
46 BidiIndustry	0.0101	0.0101	0	0	0.458	0.458	0	0
47 BasicWProdt	0.1047	0.1285	-0.0238	0	0.317	0.344	-0.027	0
48 WoodnFur	0.4555	0.4691	-0.0136	0	0.559	0.574	-0.016	0

49 PulpPaBoard	-0.6403	0.1442	-0.7845	0	-2.46	-0.115	-2.345	0
50 PrintPub	0.4487	0.4651	-0.0164	0	-0.148	0.179	-0.327	0
51 Medicines	0.3149	-0.0993	0.4141	0	0.512	0.538	-0.026	0
52 FertzerInsec	0.6486	-0.0856	-0.3649	1.0991	3.469	-0.042	-0.088	3.599
53 Chemicals	-0.5219	0.0824	-0.6043	0	-1.038	0.218	-1.257	0
54 PetroProduct	-2.8049	1.1731	-4.3865	0.4084	-7.013	0.548	-7.622	0.061
55 Chinapottery	0.0497	0.2919	-1.5632	1.3211	-0.775	0.74	-1.712	0.197
56 ChemProdt	-0.1106	-0.1065	-0.0041	0	-0.059	0.09	-0.149	0
57 GlassProdt	-1.9923	4.0718	-6.0641	0	-4.182	4.944	-9.125	0
58 BricTCProdt	0.116	0.1248	-0.0088	0	0.995	1	-0.006	0
59 Cement	-2.1979	-0.2598	-1.9381	0	-4.938	-0.287	-4.651	0
60 IronStBasic	-0.3625	-0.2117	-0.1508	0	-0.526	-0.233	-0.293	0
61 FabMetProdt	-0.6411	0.8074	-1.4485	0	-0.633	1.331	-1.964	0
62 Machinery	-0.724	0.2296	-1.5026	0.5491	-3.488	0.793	-4.363	0.082
63 TransEquipmt	-0.2052	0.2999	-0.505	0	-0.936	0.648	-1.583	0
64 MiscellaInd	1.5561	0.4631	-1.3366	2.4296	5.049	0.526	-1.147	5.671
65 UrbanBuild	0	0	0	0	1.123	1.123	0	0
66 RuralBuild	-0.0003	-0.0003	0	0	1.122	1.122	0	0
67 BldgMantence	0.819	0.819	0	0	0.843	0.843	0	0
68 PlantConst	0	0	0	0	1.123	1.123	0	0
69 RuRoads	0	0	0	0	1.123	1.123	0	0
70 PortAirRlwy	0.4348	0.4348	0	0	1.133	1.133	0	0
71 CaDyothBuild	0	0	0	0	1.123	1.123	0	0
72 InfrastrMtn	0	0	0	0	1.123	1.123	0	0
73 ElectWater	0.2917	0.2917	0	0	0.764	0.764	0	0
74 GasExtDist	-0.1449	-0.0952	-0.0497	0	0.405	0.491	-0.086	0
75 MinQuarring	-0.1636	0.0188	-0.1824	0	-0.048	0.316	-0.365	0
76 WholeTrade	0.6215	0.6215	0	0	1.024	1.024	0	0
77 RetailTrade	0.5338	0.5338	0	0	1.01	1.01	0	0
78 AirTransport	1.4355	0.5886	0	0.8468	1.104	0.977	0	0.126
79 WatTransport	2.9812	0.4199	0	2.5613	1.274	0.892	0	0.382
80 LanTransport	0.5787	0.5787	0	0	1.073	1.073	0	0
81 RaiTransport	0.6287	0.6287	0	0	1.016	1.016	0	0
82 Warehousing	1.9052	1.9052	0	0	0.707	0.707	0	0
83 HousingServ	0.0272	0.0272	0	0	0.505	0.505	0	0
84 HeathServ	0.1157	0.1157	0	0	0.551	0.551	0	0
85 EducatServ	-0.0127	-0.0127	0	0	0.196	0.196	0	0
86 PubAdDefence	5.3249	0.1611	-0.019	5.1829	1.221	0.452	-0.004	0.773
87 BanInsurance	0.713	0.368	0.0437	0.3014	0.569	0.523	0.001	0.045
88 ProfesioServ	0.8927	0.4396	0.0246	0.4285	0.667	0.598	0.005	0.064
89 HotelRest	0.2582	0.2582	0	0	0.479	0.479	0	0
90 Entertainmen	0.0571	0.0344	0.0013	0.0214	0.238	0.235	0	0.003
91 Communica	1.8664	-0.7499	-0.0149	2.6312	0.506	0.116	-0.003	0.393
92 Othservices	0.2009	0.2009	0	0	0.096	0.096	0	0
93 InfTechServ	1.4269	0.6615	0.0311	0.7343	0.551	0.438	0.003	0.11
94 Waste	-0.4698	1.0125	-1.4823	0	-0.846	2.249	-3.095	0

Table D 7.3: Decomposing total imports to various usage categories

Commodity	1 Interm	2 Invest	3 HouseH	4 Export	5 GovGE	6 Stocks	7 Margins	Total
1 Paddy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Wheat	-56.47	0.00	0.00	0.00	0.00	0.00	0.00	-56.47
3 Othergrain	-0.21	0.00	0.00	0.00	0.00	0.00	0.00	-0.21
4 JuteCultiv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 SugcaneCulti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 PotatoCulti	0.21	0.00	0.88	0.00	0.00	0.00	0.00	1.08
7 VegCulti	7.64	0.00	51.38	0.00	0.00	0.00	0.00	59.02
8 PulseCulti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 OilseedCulti	-2.87	0.00	0.00	0.00	0.00	0.00	0.00	-2.87
10 FruitCulti	40.02	0.00	445.67	0.00	0.00	0.00	0.00	485.69
11 CottonCulti	21.63	0.00	0.00	0.00	0.00	0.00	0.00	21.63
12 TobaccoCulti	23.28	0.00	8.55	0.00	0.00	0.00	0.00	31.83
13 TeaCulti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 SpiceCulti	21.01	0.00	106.65	0.00	0.00	0.00	0.00	127.66
15 OthcropCulti	-3.45	0.00	-9.78	0.00	0.00	0.00	0.00	-13.22
16 Meat	-94.91	-25.59	-4.25	0.00	0.00	0.00	0.00	-124.74
17 MilkFat	14.34	0.00	638.74	0.00	0.00	0.00	0.00	653.08
18 Animaldraft	-49.36	0.00	0.00	0.00	0.00	0.00	0.00	-49.36
19 Manure	-7.04	0.00	0.00	0.00	0.00	0.00	0.00	-7.04
20 HidesSkins	2.08	0.00	0.00	0.00	0.00	0.00	0.00	2.08
21 PoultryMeat	-0.75	0.00	-9.88	0.00	0.00	0.00	0.00	-10.63
22 PoutryEggs	0.75	0.00	5.95	0.00	0.00	0.00	0.00	6.70
23 Shrimp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 Fish	0.33	0.00	3.09	0.00	0.00	0.00	0.00	3.42
25 Forestry	0.91	0.96	0.42	0.00	0.00	0.00	0.00	2.29
26 RiceflorBran	-12.71	0.00	-171.17	0.00	0.00	0.00	0.00	-183.88
27 FlourBrafeed	33.50	0.00	7.96	0.00	0.00	0.00	0.00	41.45
28 FishSeafood	11.42	0.00	159.41	0.00	0.00	0.00	0.00	170.83
29 EdiNoedOil	47.28	0.00	144.53	0.00	0.00	0.00	0.00	191.82
30 SugGuMolass	8.03	0.00	426.09	0.00	0.00	0.00	0.00	434.11
31 TeaProduct	1.12	0.00	10.55	0.00	0.00	0.00	0.00	11.67
32 Salt	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
33 ProcessFood	33.88	0.00	361.76	0.00	0.00	0.00	0.00	395.64
34 TaningLethr	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
35 LethrProdt	1.72	0.00	24.16	0.00	0.00	0.00	0.00	25.88
36 Baling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37 JuteProduct	0.03	0.00	0.29	0.00	0.00	0.00	0.00	0.32
38 Yarn	263.23	0.00	0.00	0.00	0.00	0.00	0.00	263.23
39 MillCloth	186.33	0.00	0.00	0.00	0.00	0.00	0.00	186.33
40 HandlmCloth	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41 DyeingBlech	-4.04	0.00	0.00	0.00	0.00	0.00	0.00	-4.04
42 RMG	41.95	0.00	-24.45	0.00	0.00	0.00	0.00	17.50
43 Knitting	6.57	0.00	4.05	0.00	0.00	0.00	0.00	10.62
44 ToiletrieMfg	17.69	0.00	97.28	0.00	0.00	0.00	0.00	114.96
45 CigarettInd	-0.17	0.00	-2.32	0.00	0.00	0.00	0.00	-2.49
46 BidiIndustry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47 BasicWProdt	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.88
48 WoodnFur	0.22	0.00	1.85	0.00	0.00	0.00	0.00	2.06
49 PulpPaBoard	116.66	0.00	36.70	0.00	0.00	0.00	0.00	153.36
50 PrintPub	5.89	0.00	0.00	0.00	0.00	0.00	0.00	5.89
51 Medicines	0.52	0.00	-61.90	0.00	0.00	0.00	0.00	-61.38

52 FertzerInsec	44.54	0.00	-1.90	0.00	0.00	0.00	0.00	42.64
53 Chemicals	59.41	0.00	0.00	0.00	0.00	0.00	0.00	59.41
54 PetroProduct	723.39	0.00	1097.06	0.00	0.00	0.00	0.00	1820.45
55 Chinapottery	50.37	0.00	88.21	0.00	0.00	0.00	0.00	138.58
56 ChemProdt	-10.62	0.00	-4.10	0.00	0.00	0.00	0.00	-14.72
57 GlassProdt	1.22	0.00	187.84	0.00	0.00	0.00	0.00	189.06
58 BricTCProdt	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.88
59 Cement	93.40	0.00	0.00	0.00	0.00	0.00	0.00	93.40
60 IronStBasic	18.46	0.00	0.00	0.00	0.00	0.00	0.00	18.46
61 FabMetProdt	27.12	0.00	606.60	0.00	0.00	0.00	0.00	633.72
62 Machinery	429.38	127.54	47.94	0.00	0.00	0.00	0.00	604.86
63 TransEquipmt	41.74	162.04	0.00	0.00	0.00	0.00	0.00	203.78
64 MiscellaInd	461.80	0.00	3.52	0.00	0.00	0.00	0.00	465.32
65 UrbanBuild	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66 RuralBuild	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
67 BldgMantence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68 PlantConst	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69 RuRoads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70 PortAirRlwy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
71 CaDyothBuild	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72 InfrastrMtn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
73 ElectWater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74 GasExtDist	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.84
75 MinQuarring	32.63	0.00	26.17	0.00	0.00	0.00	0.00	58.80
76 WholeTrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77 RetailTrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78 AirTransport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79 WatTransport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80 LanTransport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81 RaiTransport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82 Warehousing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
83 HousingServ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84 HeathServ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85 EducatServ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
86 PubAdDefence	32.08	0.00	-3.91	0.00	0.00	0.00	0.00	28.17
87 BanInsurance	0.74	0.00	-23.16	0.00	0.00	0.00	0.00	-22.42
88 ProfesioServ	-1.44	0.00	-30.30	0.00	0.00	0.00	0.00	-31.74
89 HotelRest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90 Entertainmen	0.00	0.00	-0.19	0.00	0.00	0.00	0.00	-0.19
91 Communica	3.00	0.00	-3.26	0.00	0.00	0.00	0.00	-0.26
92 Othservices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93 InfTechServ	0.00	0.00	-0.85	0.00	0.00	0.00	0.00	-0.84
94 Waste	0.25	0.00	11.60	0.00	0.00	0.00	0.00	11.86

Table D 7.4: Sales structure

SALE MATRICES	Intermediate	Investment	Household	Export	GovGE	Stocks	Total
1 Paddy	116.04	0.00	0.00	0.00	0.00	-16.04	100.00
2 Wheat	150.39	0.00	0.00	0.00	0.00	-50.39	100.00
3 Othergrain	115.53	0.00	0.00	0.00	0.00	-15.53	100.00
4 JuteCultiv	52.20	0.00	43.44	19.66	0.00	-15.30	100.00
5 SugcaneCulti	103.27	0.00	8.36	0.00	0.00	-11.63	100.00
6 PotatoCulti	31.22	0.00	66.38	0.00	0.00	2.40	100.00
7 VegCulti	7.58	0.00	87.01	3.24	0.00	2.17	100.00
8 PulseCulti	36.04	0.00	62.14	0.00	0.00	1.82	100.00
9 OilseedCulti	74.74	0.00	0.00	0.00	0.00	25.26	100.00
10 FruitCulti	8.60	0.00	100.84	0.00	0.00	-9.44	100.00
11 CottonCulti	61.16	0.00	0.00	0.00	0.00	38.84	100.00
12 TobaccoCulti	127.46	0.00	5.69	2.84	0.00	-35.98	100.00
13 TeaCulti	72.84	0.00	5.92	44.93	0.00	-23.70	100.00
14 SpiceCulti	34.75	0.00	65.65	0.00	0.00	-0.40	100.00
15 OthcropCulti	44.78	0.00	48.76	0.30	0.00	6.16	100.00
16 Meat	7.13	72.35	25.30	0.00	0.00	-4.77	100.00
17 MilkFat	72.52	0.00	28.42	0.00	0.00	-0.94	100.00
18 Animaldraft	100.00	0.00	0.00	0.00	0.00	0.00	100.00
19 Manure	100.05	0.00	0.00	0.00	0.00	-0.05	100.00
20 HidesSkins	115.80	0.00	0.00	0.00	0.00	-15.80	100.00
21 PoultryMeat	21.41	0.00	75.87	0.00	0.00	2.72	100.00
22 PoutryEggs	0.84	0.00	94.98	0.00	0.00	4.17	100.00
23 Shrimp	39.33	0.00	28.75	34.87	0.00	-2.95	100.00
24 Fish	11.53	0.00	88.62	0.00	0.00	-0.15	100.00
25 Forestry	71.57	17.11	18.86	0.00	0.00	-7.53	100.00
26 RiceflorBran	3.07	0.00	88.01	0.00	0.00	8.91	100.00
27 FlourBrafeed	65.34	0.00	48.37	0.00	0.00	-13.70	100.00
28 FishSeafood	75.29	0.00	37.73	9.55	0.00	-22.56	100.00
29 EdiNoedOil	71.55	0.00	38.88	0.00	0.00	-10.43	100.00
30 SugGuMolass	11.15	0.00	88.46	0.00	0.00	0.39	100.00
31 TeaProduct	8.43	0.00	78.91	0.00	0.00	12.66	100.00
32 Salt	124.58	0.00	0.00	0.00	0.00	-24.58	100.00
33 ProcessFood	21.35	0.00	70.91	0.00	0.00	7.75	100.00
34 TaningLethr	86.86	0.00	0.00	0.00	0.00	13.14	100.00
35 LethrProdt	0.06	0.00	66.00	34.65	0.00	-0.71	100.00
36 Baling	136.34	0.00	0.00	0.00	0.00	-36.34	100.00
37 JuteProduct	4.29	0.00	51.88	56.11	0.00	-12.28	100.00
38 Yarn	102.14	0.00	0.00	0.00	0.00	-2.14	100.00
39 MillCloth	74.41	0.00	0.00	0.00	0.00	25.59	100.00
40 HandlmCloth	0.08	0.00	109.31	0.00	0.00	-9.39	100.00
41 DyeingBlech	118.59	0.00	0.00	0.00	0.00	-18.59	100.00
42 RMG	0.07	0.00	3.66	75.85	0.00	20.42	100.00
43 Knitting	0.22	0.00	6.21	75.29	0.00	18.28	100.00
44 ToiletrieMfg	19.25	0.00	51.34	25.32	0.00	4.10	100.00
45 CigarettInd	0.28	0.00	94.70	0.00	0.00	5.02	100.00
46 BidiIndustry	0.00	0.00	78.21	0.00	0.00	21.79	100.00
47 BasicWProdt	80.50	0.00	0.00	0.00	0.00	19.50	100.00
48 WoodnFur	110.72	0.00	1.90	0.00	0.00	-12.62	100.00
49 PulpPaBoard	96.12	0.00	3.01	0.00	0.00	0.88	100.00
50 PrintPub	97.99	0.00	0.00	0.00	0.00	2.01	100.00
51 Medicines	78.65	0.00	19.47	0.00	0.00	1.88	100.00

52 FertzerInsec	91.29	0.00	0.00	22.40	0.00	-13.69	100.00
53 Chemicals	48.08	0.00	0.00	0.00	0.00	51.92	100.00
54 PetroProduct	96.51	0.00	0.00	1.98	0.00	1.51	100.00
55 Chinapottery	45.72	0.00	46.99	6.41	0.00	0.89	100.00
56 ChemProdt	10.92	0.00	8.87	0.00	0.00	80.22	100.00
57 GlassProdt	50.71	0.00	46.05	0.00	0.00	3.24	100.00
58 BricTCProdt	94.50	0.00	0.00	0.00	0.00	5.50	100.00
59 Cement	67.67	0.00	0.00	0.00	0.00	32.33	100.00
60 IronStBasic	88.28	0.00	0.00	0.00	0.00	11.72	100.00
61 FabMetProdt	54.48	0.00	30.94	0.00	0.00	14.59	100.00
62 Machinery	85.98	28.01	19.62	2.66	0.00	-36.27	100.00
63 TransEquipmt	60.85	25.50	0.00	0.00	0.00	13.66	100.00
64 MiscellaInd	95.83	0.00	0.00	46.18	0.00	-42.01	100.00
65 UrbanBuild	0.00	100.00	0.00	0.00	0.00	0.00	100.00
66 RuralBuild	0.08	99.92	0.00	0.00	0.00	0.00	100.00
67 BldgMantence	67.77	32.24	0.00	0.00	0.00	0.00	100.00
68 PlantConst	0.00	100.00	0.00	0.00	0.00	0.00	100.00
69 RuRoads	0.00	100.00	0.00	0.00	0.00	0.00	100.00
70 PortAirRlwy	21.37	78.63	0.00	0.00	0.00	0.00	100.00
71 CaDyothBuild	0.00	100.00	0.00	0.00	0.00	0.00	100.00
72 InfrastrMtn	0.00	100.00	0.00	0.00	0.00	0.00	100.00
73 ElectWater	55.66	0.00	44.34	0.00	0.00	0.00	100.00
74 GasExtDist	13.46	0.00	86.54	0.00	0.00	0.00	100.00
75 MinQuarring	62.26	0.00	28.71	0.00	0.00	9.03	100.00
76 WholeTrade	0.00	0.00	0.00	0.00	0.00	-0.26	100.00
77 RetailTrade	0.00	0.00	0.00	0.00	0.00	-0.02	100.00
78 AirTransport	0.00	0.00	2.33	4.11	0.00	0.00	100.00
79 WatTransport	0.00	0.00	2.28	12.42	0.00	0.00	100.00
80 LanTransport	0.00	0.00	11.24	0.00	0.00	0.00	100.00
81 RaiTransport	0.00	0.00	2.93	0.00	0.00	0.00	100.00
82 Warehousing	95.27	0.00	4.73	0.00	0.00	0.00	100.00
83 HousingServ	47.05	0.00	52.95	0.00	0.00	0.00	100.00
84 HeathServ	70.45	0.00	10.80	0.00	18.75	0.00	100.00
85 EducatServ	0.00	0.00	48.13	0.00	51.87	0.00	100.00
86 PubAdDefence	20.26	0.00	3.11	25.13	51.51	0.00	100.00
87 BanInsurance	91.44	0.00	7.10	1.46	0.00	0.00	100.00
88 ProfesioServ	87.45	0.00	10.47	2.08	0.00	0.00	100.00
89 HotelRest	11.37	0.00	88.63	0.00	0.00	0.00	100.00
90 Entertainmen	0.00	0.00	99.90	0.10	0.00	0.00	100.00
91 Communica	23.23	0.00	64.01	12.76	0.00	0.00	100.00
92 Othservices	43.79	0.00	56.21	0.00	0.00	0.00	100.00
93 InfTechServ	60.78	0.00	35.66	3.56	0.00	0.00	100.00
94 Waste	32.33	0.00	67.66	0.00	0.00	0.01	100.00

Table D 7.5: Ranked Fan decomposition (Simulation 2) (percentage changes)

Short run					Long run				
Commodity	Local Market	Domestic Share	Export	Total	Commodity	Local Market	Domestic Share	Export	Total
1 MilkFat	5.94	-10.47	0.00	-4.53	1 PetroProduct	-0.03	-7.54	0.07	-7.51
2 PetroProduct	0.69	-4.63	0.12	-3.82	2 GlassProdt	4.00	-8.27	0.00	-4.26
3 GlassProdt	4.23	-7.31	0.00	-3.08	3 MilkFat	6.01	-10.05	0.00	-4.04
4 SpiceCulti	-0.29	-2.53	0.00	-2.83	4 SpiceCulti	-0.92	-3.09	0.00	-4.01
5 Machinery	-0.14	-2.85	0.16	-2.83	5 Cement	1.07	-4.47	0.00	-3.40
6 Cement	-0.39	-2.42	0.00	-2.82	6 EdiNoedOil	-0.50	-2.75	0.00	-3.25
7 FruitCulti	0.08	-1.61	0.00	-1.53	7 PulpPaBoard	-0.84	-2.40	0.00	-3.24
8 Waste	1.25	-2.74	0.00	-1.49	8 Machinery	1.93	-5.01	0.09	-2.99
9 ProcessFood	0.23	-1.69	0.00	-1.46	9 FruitCulti	-0.35	-1.87	0.00	-2.22
10 PulpPaBoard	-0.28	-1.11	0.00	-1.39	10 OilseedCulti	-1.90	-0.31	0.00	-2.21
11 SugcaneCulti	-1.26	0.00	0.00	-1.26	11 ProcessFood	-0.18	-1.90	0.00	-2.08
12 Chemicals	-0.16	-1.10	0.00	-1.26	12 SugcaneCulti	-1.70	0.00	0.00	-1.70
13 SugGuMolass	-0.15	-1.07	0.00	-1.22	13 Chinapottery	-0.18	-1.71	0.21	-1.67
14 OilseedCulti	-0.80	-0.34	0.00	-1.14	14 SugGuMolass	-0.44	-1.16	0.00	-1.61
15 FabMetProdt	0.77	-1.83	0.00	-1.07	15 TobaccoCulti	-0.61	-0.98	0.09	-1.49
16 EdiNoedOil	-0.01	-1.02	0.00	-1.02	16 Waste	1.26	-2.74	0.00	-1.48
17 IronStBasic	-0.63	-0.36	0.00	-0.99	17 Chemicals	0.17	-1.33	0.00	-1.16
18 TobaccoCulti	-0.28	-0.87	0.17	-0.98	18 VegCulti	-0.19	-1.07	0.11	-1.15
19 Yarn	-0.16	-0.80	0.00	-0.96	19 GasExtDist	-0.96	-0.09	0.00	-1.04
20 TransEquipmt	-0.10	-0.83	0.00	-0.93	20 Baling	-0.94	0.00	0.00	-0.94
21 Wheat	-0.64	-0.23	0.00	-0.87	21 FishSeafood	-0.40	-0.85	0.32	-0.92
22 Chinapottery	0.40	-1.57	0.38	-0.78	22 FabMetProdt	0.92	-1.83	0.00	-0.91
23 VegCulti	-0.06	-0.79	0.19	-0.66	23 Entertainmen	-0.88	0.00	0.00	-0.88
24 Manure	-0.67	0.03	0.00	-0.64	24 Othergrain	-0.81	0.00	0.00	-0.81
25 TeaProduct	-0.31	-0.30	0.00	-0.61	25 Wheat	-0.53	-0.28	0.00	-0.81
26 PrintPub	-0.35	-0.24	0.00	-0.59	26 EducatServ	-0.80	0.00	0.00	-0.80
27 MinQuarring	-0.22	-0.32	0.00	-0.53	27 DyeingBlech	-0.77	0.00	0.00	-0.77
28 Othservices	-0.51	0.00	0.00	-0.51	28 TeaProduct	-0.46	-0.31	0.00	-0.77
29 OthcropCulti	-0.27	-0.23	0.02	-0.48	29 JuteProduct	-0.46	0.00	-0.26	-0.72
30 Othergrain	-0.48	0.00	0.00	-0.47	30 PoutryEggs	-0.66	-0.05	0.00	-0.72
31 GasExtDist	-0.38	-0.07	0.00	-0.45	31 PoultryMeat	-0.70	0.01	0.00	-0.69
32 PoutryEggs	-0.38	-0.05	0.00	-0.43	32 Manure	-0.75	0.07	0.00	-0.68
33 CottonCulti	-0.24	-0.19	0.00	-0.42	33 JuteCultiv	-0.66	0.00	-0.01	-0.68
34 DyeingBlech	-0.44	0.01	0.00	-0.42	34 HandlmCloth	-0.65	0.00	0.00	-0.65
35 Salt	-0.41	-0.01	0.00	-0.42	35 HotelRest	-0.59	0.00	0.00	-0.59
36 Entertainmen	-0.43	0.00	0.01	-0.42	36 RiceflorBran	-0.52	-0.04	0.00	-0.55
37 EducatServ	-0.40	0.00	0.00	-0.40	37 Othservices	-0.52	0.00	0.00	-0.52
38 PoultryMeat	-0.41	0.02	0.00	-0.39	38 PrintPub	-0.15	-0.34	0.00	-0.49
39 Paddy	-0.38	0.00	0.00	-0.38	39 Communica	-0.88	0.00	0.43	-0.46
40 HandlmCloth	-0.37	0.00	0.00	-0.37	40 HousingServ	-0.46	0.00	0.00	-0.46
41 FlourBrafeed	-0.24	-0.12	0.00	-0.36	41 Fish	-0.45	0.00	0.00	-0.45
42 FishSeafood	-0.12	-0.81	0.57	-0.36	42 TransEquipmt	2.20	-2.62	0.00	-0.43
43 Animaldraft	-0.35	0.02	0.00	-0.33	43 FlourBrafeed	-0.29	-0.13	0.00	-0.42
44 RiceflorBran	-0.30	-0.02	0.00	-0.32	44 Paddy	-0.41	0.00	0.00	-0.41
45 Fish	-0.29	0.00	0.00	-0.29	45 BasicWProdt	-0.23	-0.03	0.00	-0.26
46 BasicWProdt	-0.25	-0.03	0.00	-0.28	46 ElectWater	-0.22	0.00	0.00	-0.22
47 Forestry	-0.26	0.00	0.00	-0.26	47 PotatoCulti	-0.20	-0.02	0.00	-0.22
48 WoodnFur	-0.24	-0.02	0.00	-0.26	48 OthcropCulti	0.05	-0.28	0.01	-0.21

49 HeathServ	-0.24	0.00	0.00	-0.24	49 Yarn	0.84	-1.03	0.00	-0.19
50 HotelRest	-0.23	0.00	0.00	-0.23	50 WoodnFur	-0.17	-0.02	0.00	-0.19
51 PulseCulti	-0.20	0.00	0.00	-0.20	51 Animaldraft	-0.22	0.09	0.00	-0.13
52 Medicines	-0.21	0.02	0.00	-0.19	52 BidiIndustry	-0.12	0.00	0.00	-0.12
53 ElectWater	-0.16	0.00	0.00	-0.16	53 TeaCulti	-0.56	0.00	0.49	-0.07
54 BanInsurance	-0.25	0.01	0.09	-0.16	54 CottonCulti	-0.03	-0.03	0.00	-0.06
55 Meat	-0.17	0.02	0.00	-0.15	55 CigarettInd	-0.03	0.00	0.00	-0.03
56 ChemProdt	-0.01	-0.13	0.00	-0.14	56 InfTechServ	-0.13	0.00	0.12	0.00
57 PotatoCulti	-0.12	-0.02	0.00	-0.13	57 ChemProdt	0.10	-0.09	0.00	0.00
58 HousingServ	-0.12	0.00	0.00	-0.12	58 PulseCulti	0.12	0.00	0.00	0.12
59 ProfesioServ	-0.23	0.01	0.12	-0.10	59 Warehousing	0.16	0.00	0.00	0.16
60 InfTechServ	-0.27	0.01	0.21	-0.04	60 Salt	0.18	0.00	0.00	0.18
61 Communica	-0.79	0.00	0.76	-0.03	61 Medicines	0.09	0.11	0.00	0.21
62 FertzerInsec	-0.40	-0.36	0.76	-0.01	62 MinQuarring	0.58	-0.33	0.00	0.25
63 BricTCProdt	0.01	-0.02	0.00	0.00	63 BanInsurance	0.24	0.01	0.05	0.30
64 RuralBuild	0.00	0.00	0.00	0.00	64 ProfesioServ	0.39	0.01	0.07	0.47
65 RuRoads	0.00	0.00	0.00	0.00	65 LanTransport	0.52	0.00	0.00	0.52
66 CaDyothBuild	0.00	0.00	0.00	0.00	66 IronStBasic	0.59	-0.06	0.00	0.53
67 InfrastrMtn	0.00	0.00	0.00	0.00	67 RetailTrade	0.55	0.00	0.00	0.55
68 PlantConst	0.00	0.00	0.00	0.00	68 RaiTransport	0.57	0.00	0.00	0.57
69 UrbanBuild	0.00	0.00	0.00	0.00	69 WholeTrade	0.61	0.00	0.00	0.61
70 BldgMantence	0.02	0.00	0.00	0.02	70 AirTransport	0.55	0.00	0.14	0.69
71 BidiIndustry	0.04	0.00	0.00	0.04	71 PubAdDefence	-0.06	0.00	0.84	0.78
72 RetailTrade	0.05	0.00	0.00	0.05	72 HeathServ	0.91	0.00	0.00	0.91
73 WholeTrade	0.05	0.00	0.00	0.05	73 WatTransport	0.50	0.00	0.41	0.92
74 RaiTransport	0.05	0.00	0.00	0.05	74 FertzerInsec	-0.49	-0.31	1.73	0.93
75 LanTransport	0.05	0.00	0.00	0.05	75 Shrimp	-0.10	0.00	1.52	1.42
76 Warehousing	0.06	0.00	0.00	0.06	76 TaningLethr	1.65	0.00	0.00	1.65
77 JuteCultiv	0.03	0.00	0.07	0.10	77 BldgMantence	1.65	0.00	0.00	1.65
78 PortAirRlwy	0.10	0.00	0.00	0.10	78 MillCloth	1.61	0.23	0.00	1.83
79 MiscellaInd	-0.13	-1.56	1.80	0.11	79 HidesSkins	1.90	-0.02	0.00	1.88
80 CigarettInd	0.17	0.01	0.00	0.18	80 LethrProdt	-0.40	-0.07	2.43	1.96
81 HidesSkins	0.23	-0.01	0.00	0.22	81 Forestry	2.28	-0.01	0.00	2.27
82 TeaCulti	-0.44	0.00	0.69	0.25	82 MiscellaInd	0.35	-1.28	3.20	2.27
83 AirTransport	0.05	0.00	0.25	0.29	83 Meat	2.76	-0.04	0.00	2.72
84 TaningLethr	0.29	0.00	0.00	0.29	84 RMG	0.00	-0.02	3.47	3.45
85 LethrProdt	-0.43	-0.07	0.84	0.34	85 PortAirRlwy	3.57	0.00	0.00	3.57
86 MillCloth	0.39	0.02	0.00	0.41	86 BricTCProdt	3.62	0.02	0.00	3.64
87 Shrimp	-0.16	0.00	0.84	0.68	87 RuralBuild	4.33	0.00	0.00	4.33
88 JuteProduct	-0.40	0.00	1.15	0.74	88 RuRoads	4.33	0.00	0.00	4.33
89 WatTransport	0.00	0.00	0.74	0.75	89 UrbanBuild	4.33	0.00	0.00	4.33
90 ToiletrieMfg	0.27	-1.31	1.90	0.86	90 PlantConst	4.33	0.00	0.00	4.33
91 RMG	-0.01	-0.01	0.95	0.92	91 CaDyothBuild	4.33	0.00	0.00	4.33
92 Baling	1.09	0.00	0.00	1.09	92 InfrastrMtn	4.33	0.00	0.00	4.33
93 PubAdDefence	-0.04	-0.01	1.50	1.46	93 Knitting	0.02	-0.06	7.57	7.53
94 Knitting	-0.02	-0.04	1.57	1.52	94 ToiletrieMfg	1.40	-1.05	8.26	8.61

Table D 7.6: Occupation wise employment in industries (base year)

Industry	Male low-skilled	Male high-skilled	Female low-skilled	Female high-skilled	Total
1 Paddy	101181.20	8136.84	5982.85	1082.91	116383.80
2 Wheat	1869.90	150.37	110.57	20.01	2150.86
3 Othergrain	297.16	23.90	17.57	3.18	341.81
4 JuteCultiv	9118.94	733.33	539.20	97.60	10489.07
5 SugcaneCulti	4879.65	392.41	288.53	52.23	5612.83
6 PotatoCulti	3924.27	315.58	232.04	42.00	4513.90
7 VegCulti	6814.30	548.00	402.93	72.93	7838.16
8 PulseCulti	5222.16	419.96	308.79	55.89	6006.79
9 OilseedCulti	379.58	30.53	22.44	4.06	436.62
10 FruitCulti	4479.60	360.24	264.88	47.94	5152.66
11 CottonCulti	1027.39	82.62	60.75	11.00	1181.75
12 TobaccoCulti	597.70	48.07	35.34	6.40	687.50
13 TeaCulti	654.32	52.62	38.69	7.00	752.63
14 SpiceCulti	1111.56	250.28	71.13	0.54	1433.52
15 OthcropCulti	3362.48	757.09	215.18	1.64	4336.39
16 LivstockRear	18740.82	1507.11	1108.15	200.58	21556.65
17 PoultryRear	3987.48	320.67	235.78	42.68	4586.61
18 ShrimFarming	9881.96	596.88	124.24	0.00	10603.08
19 Fishing	25380.71	1533.02	319.10	0.00	27232.84
20 Forestry	6608.91	3935.37	700.66	0.00	11244.94
21 RiceMilling	5426.64	1221.86	1289.75	9.85	7948.10
22 GrainMilling	1017.23	229.04	65.10	0.50	1311.87
23 FishProcess	823.69	185.46	52.71	0.40	1062.26
24 OilIndustry	1343.58	302.52	85.98	0.66	1732.73
25 SweetenerInd	10302.89	2319.79	659.32	5.04	13287.03
26 TeaProduct	574.16	129.28	95.20	0.73	799.36
27 SaltRefining	453.22	102.05	29.00	0.22	584.49
28 FoodProcess	3664.51	825.10	234.50	1.79	4725.91
29 TannFishing	1383.91	311.60	88.56	0.68	1784.75
30 LeatherInd	1465.09	1123.75	36.98	15.85	2641.67
31 Baling	233.67	50.69	2.64	0.23	287.24
32 JuteFabricat	6996.31	1517.77	79.18	6.82	8600.08
33 YarnIndustry	4284.98	929.58	97.98	8.44	5320.98
34 ClothMill	6404.92	1389.48	377.71	32.53	8204.63
35 HandloomClot	7457.12	1617.74	1248.50	107.51	10430.87
36 DyeingBlech	1204.30	261.26	201.63	17.36	1684.55
37 RMG	6240.90	1944.28	14776.90	424.16	23386.24
38 Knitting	1880.54	585.86	4452.66	127.81	7046.87
39 ToiletrieMfg	746.84	1276.78	9.22	97.29	2130.13
40 CigarettInd	86.26	4.41	12.36	0.00	103.03
41 BidiIndustry	81.58	4.17	11.69	0.00	97.45
42 SawPlane	394.64	54.42	23.63	0.00	472.69
43 Furniturind	2459.04	339.12	147.27	0.00	2945.44
44 PaperInd	595.32	882.58	9.45	20.72	1508.06
45 PrintPub	872.36	1293.29	13.84	30.36	2209.85
46 PharmaMfg	1183.24	2022.84	14.61	154.13	3374.83
47 FertiliseInd	1074.91	1837.64	10.51	110.85	3033.91
48 BasiChemical	209.85	358.75	2.59	27.34	598.53
49 PetroleumRef	233.18	726.10	0.01	0.09	959.38
50 EarthwareInd	423.00	302.88	13.35	1.47	740.69

51 ChemicalInd	491.50	840.26	6.07	64.02	1401.85
52 GlassInd	318.42	53.16	19.67	2.16	393.41
53 ClayInd	650.06	465.47	20.51	2.25	1138.30
54 CementMfg	640.82	458.85	20.22	2.22	1122.12
55 BasicMetaMfg	4061.02	581.12	0.05	0.00	4642.19
56 MetalMfg	5734.94	820.66	0.07	0.00	6555.67
57 MachineEquip	8328.17	1390.50	511.51	0.00	10230.18
58 TranspoEquip	2976.71	492.42	11.96	4.04	3485.13
59 MiscellaInd	6019.88	1005.10	371.88	40.80	7437.66
60 Urbanbuild	12363.70	2549.63	802.43	0.00	15715.77
61 RuralBuild	37837.67	7802.86	2455.76	0.00	48096.29
62 PPlantBuild	1510.85	311.57	98.06	0.00	1920.48
63 RuRoadBuild	2186.50	450.90	141.91	0.00	2779.31
64 PoRoadBuild	8058.00	1661.72	522.98	0.00	10242.70
65 CaDyothBuild	1040.35	214.54	67.52	0.00	1322.41
66 ElectWatGene	2344.53	1676.27	195.46	0.00	4216.25
67 GasExtDist	129.10	92.31	10.76	0.00	232.17
68 MinQuarring	2893.92	2069.07	241.26	0.00	5204.26
69 WholeTrade	30724.09	11530.17	1206.66	127.67	43588.59
70 RetailTrade	62589.88	23488.80	2458.15	260.09	88796.93
71 AirTransport	10139.60	1677.33	40.73	13.76	11871.43
72 WatTransport	6701.81	1108.64	26.92	9.09	7846.46
73 LanTransport	27379.97	4529.30	110.00	37.15	32056.42
74 RaiTransport	1655.16	273.80	6.65	2.25	1937.86
75 OthTransport	22199.24	3672.28	89.18	30.12	25990.83
76 HousingServ	6735.31	6798.51	0.00	418.57	13952.39
77 HealthServ	4652.24	13999.48	2533.51	3227.33	24412.56
78 EducatServ	2243.95	29596.54	560.78	6827.69	39228.95
79 PubAdDefence	15768.98	39159.83	844.44	1156.36	56929.60
80 BanInsRestat	9800.82	13780.70	8461.34	0.00	32042.86
81 ProfesioServ	17001.40	23905.25	14677.82	0.00	55584.46
82 HotelRest	5797.46	330.77	397.10	93.08	6618.42
83 Entertainmen	1594.25	2241.64	1376.37	0.00	5212.26
84 Communicatio	612.94	4956.71	116.03	502.82	6188.50
85 OthServices	17525.69	24642.44	15130.45	0.00	57298.58
86 InfotechEcom	137.39	1189.66	0.00	37.78	1364.84

Table D 7.7: Consumption shares for 94 commodities by household groups

Commodity	Landless	Marg-farmer	Small-farmer	Large-farmer	Non-agricul	Illi-terate	Low-edu	Medium-edu	High-edu
1 Paddy	0	0	0	0	0	0	0	0	0
2 Wheat	0	0	0	0	0	0	0	0	0
3 Othergrain	0	0	0	0	0	0	0	0	0
4 JuteCultiv	0.54	0.56	0.58	0.71	0.59	0.5	0.63	0.79	0.85
5 SugcaneCulti	0.15	0.15	0.15	0.14	0.14	0.13	0.12	0.1	0.09
6 PotatoCulti	1.29	1.28	1.24	1.18	1.18	1.12	1.01	0.86	0.77
7 VegCulti	2.46	2.44	2.38	2.26	2.25	2.15	1.93	1.65	1.47
8 PulseCulti	1.6	1.59	1.55	1.47	1.47	1.4	1.26	1.07	0.96
9 OilseedCulti	0	0	0	0	0	0	0	0	0
10 FruitCulti	3.05	3.03	2.95	2.8	2.79	2.66	2.39	2.04	1.82
11 CottonCulti	0	0	0	0	0	0	0	0	0
12 TobaccoCulti	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
13 TeaCulti	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
14 SpiceCulti	0.37	0.36	0.35	0.34	0.34	0.32	0.29	0.25	0.22
15 OthcropCulti	1.47	1.46	1.42	1.35	1.35	1.29	1.15	0.99	0.88
16 Meat	2.64	2.62	2.55	2.42	2.41	2.3	2.06	1.77	1.58
17 MilkFat	0.46	0.45	0.44	0.42	0.42	0.4	0.36	0.31	0.27
18 Animaldraft	0	0	0	0	0	0	0	0	0
19 Manure	0	0	0	0	0	0	0	0	0
20 HidesSkins	0	0	0	0	0	0	0	0	0
21 PoultryMeat	1.23	1.22	1.19	1.13	1.13	1.08	0.97	0.83	0.74
22 PoutryEggs	1.43	1.42	1.38	1.31	1.31	1.25	1.12	0.96	0.85
23 Shrimp	1.21	1.2	1.17	1.11	1.1	1.05	0.95	0.81	0.72
24 Fish	17.1	16.98	16.53	15.69	15.65	14.93	13.39	11.46	10.21
25 Forestry	0.85	0.75	0.75	0.64	0.96	1.16	1.19	1.23	1.39
26 RiceflorBran	26.16	25.98	25.29	24	23.94	22.84	20.49	17.53	15.63
27 FlourBrafeed	1.62	1.61	1.57	1.49	1.48	1.41	1.27	1.09	0.97
28 FishSeafood	0.7	0.69	0.67	0.64	0.64	0.61	0.55	0.47	0.42
29 EdiNoedOil	2.5	2.48	2.42	2.3	2.29	2.18	1.96	1.68	1.49
30 SugGuMolass	3.62	3.59	3.5	3.32	3.31	3.16	2.84	2.43	2.16
31 TeaProduct	0.21	0.18	0.2	0.18	0.25	0.3	0.29	0.21	0.21
32 Salt	0	0	0	0	0	0	0	0	0
33 ProcessFood	1.79	1.77	1.73	1.64	1.63	1.56	1.4	1.2	1.07
34 TaningLethr	0	0	0	0	0	0	0	0	0

35 LethrProdt	1.71	1.7	1.83	1.98	1.88	1.72	1.85	1.92	1.71
36 Baling	0	0	0	0	0	0	0	0	0
37 JuteProduct	0.9	0.94	0.97	1.19	0.98	0.84	1.06	1.32	1.42
38 Yarn	0	0	0	0	0	0	0	0	0
39 MillCloth	0	0	0	0	0	0	0	0	0
40 HandlmCloth	3.41	3.39	3.63	3.93	3.75	3.42	3.67	3.82	3.41
41 DyeingBlech	0	0	0	0	0	0	0	0	0
42 RMG	0.38	0.38	0.41	0.44	0.42	0.38	0.41	0.43	0.38
43 Knitting	0.09	0.09	0.1	0.11	0.1	0.09	0.1	0.1	0.09
44 ToiletrieMfg	0.39	0.42	0.4	0.49	0.42	0.38	0.42	0.51	0.48
45 CigarettInd	0.57	0.49	0.53	0.49	0.67	0.8	0.77	0.56	0.56
46 BidiIndustry	0.12	0.1	0.11	0.1	0.14	0.17	0.16	0.12	0.12
47 BasicWProdt	0	0	0	0	0	0	0	0	0
48 WoodnFur	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02
49 PulpPaBoard	0.16	0.17	0.18	0.22	0.18	0.15	0.19	0.24	0.26
50 PrintPub	0	0	0	0	0	0	0	0	0
51 Medicines	0.43	0.47	0.45	0.54	0.47	0.42	0.46	0.57	0.53
52 FertzerInsec	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
53 Chemicals	0	0	0	0	0	0	0	0	0
54 PetroProduct	0.87	0.76	0.77	0.65	0.98	1.19	1.22	1.26	1.42
55 Chinapottery	0.27	0.29	0.3	0.36	0.3	0.26	0.32	0.4	0.44
56 ChemProdt	0.21	0.22	0.21	0.26	0.22	0.2	0.22	0.27	0.25
57 GlassProdt	0.19	0.2	0.21	0.25	0.21	0.18	0.23	0.28	0.3
58 BricTCProdt	0	0	0	0	0	0	0	0	0
59 Cement	0	0	0	0	0	0	0	0	0
60 IronStBasic	0	0	0	0	0	0	0	0	0
61 FabMetProdt	1.31	1.37	1.42	1.74	1.43	1.22	1.55	1.93	2.08
62 Machinery	0.57	0.6	0.62	0.76	0.62	0.53	0.67	0.84	0.91
63 TransEquipmt	0	0	0	0	0	0	0	0	0
64 MiscellaInd	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.05	0.05
65 UrbanBuild	0	0	0	0	0	0	0	0	0
66 RuralBuild	0	0	0	0	0	0	0	0	0
67 BldgMantence	0	0	0	0	0	0	0	0	0
68 PlantConst	0	0	0	0	0	0	0	0	0
69 RuRoads	0	0	0	0	0	0	0	0	0
70 PortAirRlwy	0	0	0	0	0	0	0	0	0
71 CaDyothBuild	0	0	0	0	0	0	0	0	0
72 InfrastrMtn	0	0	0	0	0	0	0	0	0

73 ElectWater	0.76	0.67	0.68	0.58	0.86	1.05	1.07	1.11	1.25
74 GasExtDist	0.09	0.08	0.08	0.07	0.1	0.12	0.13	0.13	0.15
75 MinQuarring	0.61	0.53	0.54	0.46	0.69	0.83	0.85	0.88	1
76 WholeTrade	0	0	0	0	0	0	0	0	0
77 RetailTrade	0	0	0	0	0	0	0	0	0
78 AirTransport	0.04	0.04	0.05	0.06	0.06	0.05	0.06	0.08	0.08
79 WatTransport	0.05	0.05	0.06	0.08	0.08	0.07	0.08	0.1	0.11
80 LanTransport	0.72	0.78	0.95	1.21	1.27	1.11	1.29	1.61	1.71
81 RaiTransport	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
82 Warehousing	0.13	0.14	0.17	0.22	0.23	0.2	0.23	0.29	0.31
83 HousingServ	3.82	4.15	4.53	4.73	5.29	9.35	11.5	15.27	16.99
84 HeathServ	0.45	0.51	0.45	0.53	0.49	0.46	0.43	0.52	0.36
85 EducatServ	0.53	1.03	1.39	1.93	1.66	1.31	2.59	4.45	6.99
86 PubAdDefence	0.21	0.22	0.23	0.28	0.23	0.2	0.25	0.31	0.33
87 BanInsurance	0.31	0.31	0.32	0.38	0.34	0.32	0.37	0.42	0.45
88 ProfesioServ	1.17	1.18	1.22	1.44	1.29	1.2	1.41	1.6	1.71
89 HotelRest	2.1	1.8	1.93	1.79	2.47	2.92	2.81	2.04	2.06
90 Entertainmen	0.9	0.91	0.94	1.11	1	0.92	1.09	1.23	1.32
91 Communica	0.62	0.65	0.67	0.83	0.68	0.58	0.74	0.92	0.99
92 Othservices	3.22	3.24	3.38	3.96	3.57	3.3	3.9	4.41	4.71
93 InfTechServ	0.09	0.09	0.1	0.12	0.1	0.08	0.1	0.13	0.14
94 Waste	0.06	0.06	0.06	0.07	0.06	0.06	0.07	0.08	0.08
Total	100	100	100	100	100	100	100	100	100

References

Adams, P., M. Horridge, B. R. Parmenter, and X. Zhang (2000). Long-run effects on China of APEC trade liberalisation. *Centre of Policy Studies, Monash University, Australia, General paper No. G-130*.

ADB (2003). Quarterly economic update Bangladesh. *Asian Development Bank, also available in http://www.adb.org*.

ADB and Government of Japan (2004). *Economic Growth and Poverty Reduction in Bangladesh*. Dhaka: Copublished by the Asian Development Bank Bangladesh Resident Mission and the Embassy of Japan in Bangladesh.

Adelman, I., and C. T. Morris (1973). *Economic Growth and Social Equity in Developing Countries*. Standford, California: Standford University Press.

Adelman, I., and S. Robinson (1978). *Income Distribution in Developing Countries: A Case Study of Korea*: Oxford University Press.

Adelman, I., and S. Robinson (1989). Income Distribution and Development. In H. Chenery and T. N. Srinivasan (Eds.), *Handbook of Development Economics*. Amsterdam: Elsevier Science Publishers B.V.

Agrawal, N. (1989). Tariff reform and the distribution of household incomes. *IMPACT Research Centre and Industries Assistance Commission, Melbourne, Preliminary Working Paper No. IP-42*.

Ahammad, H. (1995). *Foreign Exchange and Trade Policy Issues in a Developing Economy: The Case of Bangladesh*. England: Avebury.

Ahluwalia, M. (1976). Income distribution and development : Some stylized facts. *American Economic Review, 66*(2), 128-135.

Ahmed, A. U., H. A. Khan, and R. K. Sampath (1991). Poverty in Bangladesh: Measurement, decomposition, and intertemporal comparison. *Journal of Development Studies, 27*(4), 48-63.

Ahmed, N. (2001). *Trade Liberalization in Bangladesh: An Investigation into Trends*. Dhaka: The University Press Limited.

Ahmed, N. (2005). External sector: Performance and prospect. *Paper Presented at the Seminar on National Budget for 2005-06 and PRSP Organised by The Bangladesh Institute of Development Studies on 29th May 2005.*

Ahmed, N. (2009). Sustaining ready-made garment exports from Bangladesh. *Journal of Contemporary Asia, 39*(4), 597-618.

Ahmed, S. (2006). The Political Economy of Development Experience in Bangladesh. In S. Ahmed and W. Mahmud (Eds.), *Growth and Poverty: The Development Experience of Bangladesh*. Dhaka: The University Press Limited.

Ahmed, S., and Z. Sattar (2004). Trade liberalisation, growth and poverty reduction: The case of Bangladesh. *World Bank Policy Research Working Paper 34204, Washington, D.C., The World Bank*.

Aka, B. F. (2004). Fiscal adjustment, poverty, inequality and welfare in Cote d'Ivoire: A computational general equilibrium model analysis. *available at http://www.csae.ox.ac.uk/conferences/2004-GPRaHDiA/papers/2m-Aka-CSAE2004.pdf. accessed on September, 2008*.

Alam, M. (1995). *Trade and Financial Liberalisation in Bangladesh*. Dhaka: Desh Prakasan.

Andriamananjara, S., and J. Nash (1997). Have trade policy reforms led to greater openness in developing countries? *World Bank Policy Research Working Paper No.1730.*

Annabi, N., F. Cisse, J. Cockburn, and B. Decaluwe (2005). Trade liberalisation, growth and poverty in Senegal: A dynamic microsimulation CGE model analysis. *CIRPEE Working Paper No. 05-12*.

Annabi, N., B. Khondker, S. Raihan, J. Cockburn, and B. Decaluwe (2005). Implications of WTO aggrements and unilateral trade policy reforms for poverty in Bangladesh: Short-versus long-run impacts. In T. W. Hertel and L. A. Winters (Eds.), *Poverty and The WTO: Impacts of the Doha Development Agenda*. Washington: A copublication of Palgrave Macmillan and the World Bank.

Armington, P. S. (1969). A theory of demand for products distinguished by place of production. *IMF Staff Papers, 16*, 159-178.

Armington, P. S. (1970). Adjustment of trade balances: Some experiments with a model of trade among many countries. *IMF Staff Papers, 16* , 176-199.

Arndt, C., P. Dorosh, M. Fontana, S. Zohir, M. EI-Said, and C. Lungren (2002). Opportunities and challenges in agriculture and garments: A general equilibrium analysis of the Bangladesh economy. *Trade and Macroeconomics Division, International Food Policy Research Institute, TMD Discussion Paper No. 107*.

Bairam, E. (1991). Capital-Labour substitution in sectors of a less developed economy: The case of Bangladesh. *The Bangladesh Development Studies, 21*(4), 87-91.

Baldwin, R. E. (1989). Measuring nontariff trade policies. *NBER Working Paper No. 2978*.

Bandara, J. S. (1989). *A Multi Sectoral General Equilibrium Model of the Sri Lankan Economy with an Application to the Analysis of the Effects of External Shocks.* Unpublished Ph.D Dissertation, La Trobe University, Melbourne.

Bandara, J. S. (1991). Computable general equilibrium models for development policy analysis in lDCs. *Journal of Economic Surveys, 5*(1), 3-69.

Bannister, G. J., and K. Thugge (2001). International trade and poverty alleviation. *International Monetary Fund Working Paper No. WP/01/54*

Barrett, G. F., and S. G. Donald (2009). Statistical inference with generalised Gini indices of inequality, poverty, and welfare. *Journal of Business & Economics Statistics, 27*(1), 1-16.

Bautista, R. M., and M. Thomas (1997). Income effects of alternative trade policy adjustments on Phillippine rural households: A general equilibrium analysis. *Trade and Macroeconomics Division, International Food Policy Research Institute, TMD Discussion Paper No. 22*.

Bayes, A., and A. Muhammad (1998). *Bangladesh at 25: An Analytical Discourse on Development*. Dhaka: The University Press Limited.

BBS (1988). Report of the Bangladesh Household Expenditure Survey 1985-86. *Bangladesh Bureau of Statistics (BBS), Dhaka.*

BBS (2004). *Report of the Poverty Monitoring Survey 2004*. Dhaka: Bangladesh Bureau of Statistics.

BBS (2004a). *Bangladesh Statistical Yearbook, Bangladesh Bureau of Statistics*.

BBS (2006). *Preliminary Report on Household Income and Expenditure Survey-2005*. Dhaka: Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

Ben-David, D. (1999). Trade, Growth and Disparity Among Nations. *Trade, Income Disparity and Poverty*. Geneva: Special Studies 5, World Trade Organisation.

Ben-David, D., H. Nordstrom, and L. A. Winters (1999). Trade, income disparity and poverty. *World Trade Organization Special Studies No. 5*.

Berry, A., F. Bourgguignon, and C. Morrison (1983). Changes in the world distribution of income between 1950 and 1977. *The Economic Journal, 93*(370), 331-350.

Bhagwati, J. (1959). Protection, real wages, and real incomes. *Economic Journal, 69*(276), 733-748.

Bhagwati, J. N. (1988). Export-promoting trade strategies: Issues and evidence. *The World Bank Research Observer, 3*(1), 27-57.

Bhattacharya, D., and T. A. Chowdhury (2003). Financial sector reforms in Bangladesh: The next round. *CPD Occasional Paper Series No 22, Centre for Policy Dialogue, Bangladesh*.

Bhuya, A. R., and M. A. Rashid (1993). *Trade Regimes and Industrial Growth: A Case Study of Bangladesh*. Dhaka: Bureau of Economic Research, University of Dhaka.

Bibi, S., and R. Chatti (2006). Trade liberalisation and the dynamics of poverty in Tunisia: A layered microsimulation analysis. *MPIA Working Paper 2006-07, Poverty and Economic Policy (PEP) network, Dakar, Senegal.*

Boccanfuso, D., B. Decaluwe, and L.Savard (2002). Poverty, income distribution and CGE modeling: Does the functional form of distribution matter? *Cahiers de recherche 0332, CIRPEE*.

BOI (2005). *FDI in Bangladesh during 2004: The 4th FDI Inflow Survey*. Dhaka: Board of Investment, Bangladesh.

Bourguignon, F., J. de Melo, and A. Suwa (1991). Distributional effects of adjustment policies: Simulations for two archetype economics. *The World Bank Policy Research Working Paper Series No. 674*.

Bourguignon, F., F. Ferreira, and N. Lusting (1998). The microeconomic of income distribution dynamics: A research proposal. *The Inter-American Development Bank and the World Bank, Washington.*

Bourguignon, F., M. Fournier, and M. Gurgand (2001). Fast development with a stable income distribution: Taiwan,1979-1994. *Review of Income and Wealth, 47*(2), 139-163.

Bourguignon, F., L. Pereira da Silva, and N. Stern (2006). Evaluating the Poverty Impact of Economic Policies: Some Analytical Challenges. In A. Mody and C. Pattiloo (Eds.), *Macroeconomic Policies and Poverty Reduction*. London, UK: Routledge Publications.

Bourguignon, F., A.-S. Robilliard, and S. Robinson (2003). Representative versus real households in the macro-economic modelling of inequality. *DELTA Working Papers, 2003-05, DELTA (Ecole normale superieure)*.

Bussolo, M., and J. Lay (2003). Globalisation and poverty changes in Columbia. *OECD Development Centre Working Paper No. 226.*

Bussolo, M., and J. J. Round (2002). *Redistribution and poverty: Experience with a CGE model for Ghana*. Paper presented at the XIII International Conference on Input-Output Techniques held on 21-25 August, 2000 at Macerata, Italy.

Butt, S., and J. S. Bandara (2008). *Trade Liberalisation and Regional Disparity in Pakistan*. London and New York: Taylor and Francis Group.

Caddy, V. (1976). Empirical estimation of the elasticities of substitution: A review. *IMPACT Preliminary Working paper, No. OP-09, mimeo*, pp. 43.

Case, A. (1998). Income distribution and expenditure patterns in South Africa. *available at http://www.princeton.edu/rpds/papers/pdfs/IncomeDistribution.pdf, accessed on January, 2008*.

Centre for Policy Dialogue (2004). State of the Bangladesh economy in FY2004: A macroeconomic overview. *Regional Cooperation in South Asia: A Review of Bangladesh's Development 2004*. Dhaka: Centre for Policy Dialogue and The University Press Limited.

Champernowne, D. G. (1953). A model of income distribution. *Economic Journal, 63*(249), 318-351.

Chan, N., D. H. Dao, H. M. Hai, and N. T. Dung (1998). Evaluating tax reform in Vietnam using general equilibrium methods. *UWO Department of Economics Working Papers No 9906, University of Western Ontario*

Chen, S., and M. Ravallion (2004). Welfare impacts of China's accession to the World Trade Organization. *The World Bank Economic Review, 18*(1), 29-57.

Chia, N., S. Wahba, and J. Whalley (1994). Poverty-reduction targeting programs: A general equilibrium micro-simulation analysis. *CREFA, Laval University, Working Paper No. 01-18*.

Chipman, J. S. (1969). Factor price equalization and the Stolper-Samuelson theorem. *International Economic Review, 10*(3), 399-406.

Chotikapanich, D. (1994). *Techniques for Measuring Income Inequality*. England: Avebury, Ashgate Publishing Limited.

Chowdhury, A. (2000). Politics, society and financial sector reform in Bangladesh. *World Institute for Development Economics Research, Working Paper No. 197.*

Chowdhury, A. R. (2001). The impact of financial reform on private savings in Bangladesh. *World Institute for Development Economics Research, Helsinki, Discussion Paper No. 2001/78*.

Chowdhury, O. H. (1982). Complete consumer model: A preliminary estimate for Bangladesh. *The Bangladesh Development Studies, 10*(1), 91-104.

Chowdhury, O. H. (1990). *Tax Policy Analysis in Bangladesh: A Computable General Equilibrium Approach.* Unpublished Ph.D Dissertation, University of the Philippines, Diliman, Quezon City.

Chowdhury, O. H. (2005). Domestic resource generation and public expenditure. *Paper Presented at the Seminar on National Budget for 2005-06 and PRSP held on May 2005 at NEC building, Dhaka.*

Chung, J. W. (1994). *Utility and Production Functions: Theory and Applications*. Cambridge: Blackwell Publishers.

Cicowiez, M., C. Diaz-Bonilla, and E. Diaz-Bonilla (2008). The impact of global and domestic trade liberalisation on poverty and inequality in Argentina. *Agricultural Distortions Working Paper 527931, The World Bank.*

Cline, R. W. (2004). *Trade Policy and Global Poverty*. Washington, D.C.: Centre for Global Development, Institute for International Economics.

Cloutier, M., J. Cockburn, B. Decaluwe, S. Raihan, and B. H. Khondker (2008). Welfare, Poverty and Distribution Effects of Trade Liberalisation: A Review of the CGE Literature. In J. Cockburn, B. Decaluwe and V. Robichaud (Eds.), *Trade Liberalization and Poverty: A CGE Analysis of the 1990s Experience in Africa and Asia*: Poverty and Economic Policy (PEP) Research Network.

Cockburn, J. (2002). Trade liberalisation and poverty in Nepal: A computable general equilibrium micro simulation analysis. *CREFA, Laval University , CSAE WPS/2002-11*.

Codsi, G., and K. R. Pearson (1988). GEMPACK: General-purpose software for applied general equilibrium and other economic modellers. *Computer Science in Economics and Management, 1*(3), 189-207.

Cogneau, D., and A. Robilliard (2000). Growth, distribution and poverty in Madagascar: Learning from a microsimulation model in a general equilibrium framework. *Trade and Macroeconomics Division, International Food Policy Research Institute, TMD Discussion Paper No. 61*.

Collier, P., and D. Dollar (2001). Can the world cut poverty in half? How policy reform and effective aid can meet international development goals. *World Development, 29*(11), 1787-1802.

Cooper, R., K. McLaren, and A. Powell (1985). Macroeconomic Closure in Applied General Equilibrium Modelling: Experiences from ORANI and Agenda for Further Research.

In J. Piggot and J. Whalley (Eds.), *New Development in Applied General Equilibrium Analysis*. New York: Cambridge University Press.

Corden, W. M. (1997). *Trade Policy and Economic Welfare*. New York: Oxford University Press.

Cornia, G. A. (2002). The impact of liberalisation and globalisation on income inequality in the developing and transitional economies. *Centre for Household, Income, Labour and Demographic Economics (ChilD) Working Paper NO. 13*.

Cororaton, C. B., J. Cockburn, and E. Corong (2006). Doha Scenarios, Trade Reforms, and Poverty in the Philippines: A CGE Analysis. In T. W. Hertel and L. A. Winters (Eds.), *Poverty and The WTO: Impacts of the Doha Development Agenda*. Washington: A copublication of Palgrave Macmillan and the World Bank.

Coxhead, I. A. (1989). *Technical Change in Agriculture, Income Distribution and Economic Policy: The Philippines.* Unpublished PhD Dissertation, The Australian National University, Canberra.

Croser, J. (2002). Impacts of trade policy reform on income distribution and poverty in Indonesia. *ACIAR Indonesia Research Project, Working Paper No. 02.01.*

Datt, G., and M. Ravallion (1998). Farm productivity and rural poverty in India. *Journal of Development Studies, 34*(4), 62-85.

Davies, J. B. (2004). Microsimulation, CGE and macro modelling for transition and developing economies. *World Institute for Development Economics Research Discussion Paper No. 2004/08*.

de Janvry, A., E. Sadoulet, and A. Fargeix (1991). Politically feasible and equitable adjustment: Some alternatives for Ecuador. *World Development, 19*(11), 1577-1594.

de la Vega, C. L., and A. Urrutia (2008). The extended Atkinson family: The class of multiplicatively decomposable inequality measures, and some new graphical procedures for analysis. *Journal of Economic Inequality, 6*(2), 211-225.

De Silva, I. (2008). Micro-level determinants of poverty reduction in Sri Lanka: A multivariate approach. *International Journal of Social Economics, 35*(3), 140-158.

Dean, J. M., S. Desai, and J. Riedel (1994). Trade policy reform in developing countries since 1985: A review of the evidence. *Discussion Paper No. 267, The World Bank, Washington D.C.*

Deardorff, A. V., and R. M. Stern (1994). *The Stolper-Samuelson Theorem: A Golden Jubilee*: The University of Michigan Press.

Deaton, A. (1997). *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. Maryland, USA: The Johns Hopkins University Press.

Decaluwe, B., A. Party, L. Savard, and E. Thorbecke (1999). Poverty analysis within a general equilibrium framework. *Working Paper 9909, CREFA 99-06, Laval University*.

Decaluwe, B., L. Savard, and E. Thorbecke (2006). General equilibrium approach for poverty analysis: With an application to Cameroon. *African Development Review, 17*(2), 213-243.

Demery, L., and H. Jahangir (1975). Adjustment dynamics and the elasticity of substitution: The case of manufacturing activity in Bangladesh. *The Bangladesh Development Studies, 2*(3), 725-731.

Dervis, K., J. D. Melo, and S. Robinson (1982). *General Equilibrium Models for Development Policy*. Cambridge, UK: Cambridge University Press.

Dimaranan, V. B. (2001). *The GTAP 6 Data Base*: Center for Global Trade Analysis, Purdue University.

Dixon, P. B., S. Bowles, and D. Kendrick (1980). *Notes and Problems in Microeconomic Theory*. Amsterdam: North-Holland Publishing Company.

Dixon, P. B., B. R. Parmenter, G. J., R., and J. Sutton (1977). ORANI, a genaral equilibrium model of the Australian economy: Current specification and illustrations of use for policy analysis. *First Progress Report of the IMPACT Project, Australian Government Publishing Service, Canberra, 2*, xii + 297.

Dixon, P. B., B. R. Parmenter, A. A. Powell, and P. J. Wilcoxen (1992). *Notes and Problems in Applied General Equilibrium Economics*. Amsterdam, London: North-Holland Publishing Company.

Dixon, P. B., B. R. Parmenter, J. Sutton, and D. P. Vincent (1997). *ORANI: A Multisectoral Model of the Australian Economy*: North-Holland Publishing Company.

Dollar, D. (1992). Outward-oriented developing economies really do grow more rapidly: Evidence from 95 LDCs, 1976-1985. *Economic Development and Cultural Change, 40*(3), 523-544.

Dollar, D., and A. Kraay (2001). Trade, growth, and poverty. *Policy Research Working Paper Series 2615, The World Bank*.

Dollar, D., and A. Kraay (2002). Growth is good for the poor. *Journal of Economic Growth, 7*(3), 195-225.

Dorosh, P., B. E. Nash, and O. Samba-Mamadou (1994). Terms of trade and the real exchange rate in the CFA zone: Implications for income distribution in Niger. *Working Paper, Cornell Food and Nutrition Policy Program (CFNPP), Cornell University, Ithaka, NY.*

Dorosh, P. A., and D. E. Sahn (2000). A general equilibrium analysis of the effect of macroeconomic adjustment on poverty in Africa. *Journal of Policy Modeling, 22*(6), 753-776.

Duclos, J.-Y., and A. Araar (2006). Poverty and equity : Measurement, policy and estimation with DAD. *Available at: http:// www.mimap.ecn.ulaval.ca, accessed on June, 2009*.

Duclos, J.-Y., A. Araar, and C. Fortin (2000). DAD: A software for distributive analysis/ Analyse distributive. *MIMAP, International Research Centre, Government of Canada and CREFA, Laval University, available at www.mimap.ecn.ulaval.ca*.

Edwards, S. (1998). Openness, productivity and growth: What do we really know? *The Economic Journal, 108*(447), 383-398.

Either, W. J. (1974). Some of the theorems of international trade with many goods and factors. *Journal of International Economics, 4*(2), 199-206.

Emini, C. A., J. Cockburn, and B. Decaluwe (2006). The Poverty Impacts of the Doha Round in Cameroon: The Role of Tax Policy. In T. W. Hertel & L. A. Winters (Eds.), *Poverty & The WTO: Impacts of the Doha Development Agenda*. New York: A copublication of Palgrave Macmillan and the World Bank.

Essama-Nssah, B. (2005). The poverty and distributional impact of macroeconomics shocks and policies: A review of modeling approaches. *World Bank Policy Research Working Paper, No. 3682.*

Fekadu, B. (2007). Trade liberalisation, poverty and inequality in Ethiopia: A CGE microsimulation analysis. *6th PEP Research Network General Meeting, Lima, Peru*.

Ferreira-Filho, J. B., and M. Horridge (2005). The Doha Round, poverty and regional inequality in Brazil. *World Bank Policy Research Working Paper, No. 3701*.

Firebaugh, G. (1999). Empirics of world income inequality. *American Journal of Sociology, 104*(6), 1597-1630.

Fontana, M., and Y. V. D. M. Rodgers (2005). Gender dimensions in the analysis of macro-poverty linkages. *Development Policy Review, 23*(3), 333-349.

Fontana, M., P. Wobst, and P. Dorosh (2001). Macro policies and the food sector in Bangladesh: A general equilibrium analysis. *International Food Policy Research Institute, TMD Discussion Paper No. 73*.

Foster, J., Greer, J., and E. Thorbecke (1984). A class of decomposable poverty measures. *Econometrica, 52*(3), 761-766.

Francois, J. F., and C. R. Shiells (1994). AGE Models of North American Free Trade *Modelling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*. Cambridge: Cambridge University Press.

Frankel, J. A., and D. Romer (1999). Does trade cause growth? *American Economic Review, 89*(3), 379-399.

Friedman, J. (2001). *Differential impacts of trade liberalisation on Indonesia's poor and non-poor*. Paper presented at the Conference on Poverty and the International Economy, Organised by World Bank and Swedish Parliamentary Commission on Global Development, Stockholm.

Frisch, R. (1959). A complete scheme for computing all direct and cross price elasticities in a model with many sectors. *Econometrica, 27*(2), 177-196.

Ganuza, E., R. Paes de Barros, and R. Vos (2002). Labour Market Adjustment, Poverty and Inequality during Liberalisation. In R. Vos, L. Taylor and R. Paes de Barros (Eds.), *Economic Liberalisation, Distribution and Poverty: Latin America in the 1990s*. Cheltenham: Edward Elgar.

Garrett, J., and S. Chowdhury (2004). Urban-Rural links and transformation in Bangladesh: A review of the issues. *Discussion Paper prepared for Rural Livelihoods Program (RLP) CARE-Bangladesh, International Food Policy Research Institute (IFPRI) Washington, D.C. U.S.A.*

Geary, R. C. (1949-50). A Note on 'a constant utility index of the cost of living'. *Review of Economic Studies, 18*(1), 65-66.

Gilbert, J. (2008). Trade policy, poverty, and income distribution in CGE models: An application to SAFTA. *Working Papers 200802, Utah State University, Department of Economics and Finance*.

GOB (1998). *The Fifth Five Year Plan*. Dhaka: Planning Commission, Government of the People's Republic of Bangladesh.

GOB (2003a). *Bangladesh Economic Review 2003*. Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

GOB (2003b). *Supplementary Document, Input-output Table 2000 for Bangladesh*. Dhaka, Bangladesh: SHD Unit, Planning Commission.

GOB (2004). *Bangladesh Economic Review 2004*: Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

GOB (2005). *Bangladesh Economic Review 2005*: Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

GOB (2006). *Bangladesh Economic Review 2006*: Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

GOB (2008). *Bangladesh Economic Review 2006*: Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

Golleti, F. (1993). Food consumption parameters in Bangladesh. *International Food Policy Research Institute, Dhaka, Bangladesh. Bangladesh Food Policy Project Manuscript No 29.*

Greenaway, D. (1993). Liberalising foreign trade through rose tinted glasses. *The Economic Journal, 103*(416), 208-222.

Gunter, B. G., M. J. Cohen, and H. Lofgren (2005). Analysing macro-poverty linkages: An overview. *Development Policy Review, 23*(3), 243-265.

Gunter, B. G., and R. Van der Hoeven (2004). The social dimension of globalisation: A review of the literature. *International Labour Review, 143*(1-2), 7-43.

Harris, R. L. (1999). The distributional impact of macroeconomic shocks in Mexico: Threshold effects in a multi-region CGE model. *Trade and Macroeconomics Division, International Food Policy Research Institute, TMD Discussion Paper No. 44*.

Harrison, J., and M. Horridge (2006). Preparing data files for a CGE model using GEMPACK. *Material prepared for the constructing of a CGE database program, 10-11 July, 2006, Monash University, Australia.*

Harrison, W. J., and K. R. Pearson (1996). Computing solutions for large general equilibrium models using GEMPACK. *Computational Economics, 9*(2), 83-127.

Helpman, E. (2004). *The Mystery of Economic Growth*. Cambridge: Harvard University Press.

Herault, N. (2007). Trade liberalisation, poverty and inequality in South Africa: A computable general equilibrium microsimulation analysis. *The Economic Record, 83*(262), 317-328.

Hertel, T. W. (1997). *Global Trade Analysis*: Cambridge University Press.

Hertel, T. W., and M. Ivanic (2006). World Market Impacts of Multilateral Trade Reforms. In T. W. Hertel & L. A. Winters (Eds.), *Poverty & The WTO: Impacts of the Doha Development Agenda*: A copublication of Palgrave Macmillan and the World Bank.

Hertel, T. W., M. Ivanic, P. V. Preckel, and J. A. L. Cranfield (2004). The earnings effects of multilateral trade liberalisation. *World Bank Economic Review, 18*(2), 205-236.

Hertel, T. W., and J. Reimer (2005). Predicting the poverty impacts of trade reform. *World Bank Policy Research Working Paper No. 3444*.

Hertel, T. W., and L. A. Winters (2006). *Poverty & the WTO: Impacts of the Doha Development Agenda*. Washington: A copublication of Palgrave Macmillan and the World Bank.

Hoque, S. (2006). *A Computable General Equilibrium Model of Bangladesh for Analysis of Policy Reforms.* Unpublished Ph.D Dissertation, Monash University, Melbourn, Australia.

Horridge, J. M. (2000). ORANI-G: A general equilibrium model of the Australian economy. *Centre for Policy Studies and the Impact Project Preliminary Working Paper No. OP-93, Available at http://www.monash.edu.au/policy, accessed on April, 2006.*

Horridge, J. M. (2001a). MINIMAL: A simplified general equilibrium model. *Centre for Policy Studies and the Impact Project, Available at http://www.monash.edu.au/policy , accessed on April, 2006.*

Horridge, J. M. (2001b). ORANI-G: A generic single-country computable general equilibrium model *Centre for Policy Studies and the Impact Project, Edition prepared for the practical GE Modelling course, Available at http://www.monash.edu.au/policy, accessed on April, 2006.*

Horridge, J. M. (2003). ORANI-G: A generic single-country computable general equilibrium model. *Centre for Policy Studies and the Impact Project, Edition Prepared for the Practical GE Modelling Course, Monash University, Australia. Available at http://www.monash.edu.au/policy/oranig.htm, accessed on April, 2006.*

Horridge, J. M. (2004). Multiple households version of ORANIGO3. *Centre for Policy Studies and the Impact Project, Available at http://www.monash.edu.au/policy, accessed on April, 2006.*

Horridge, J. M. (2006). ORANI-G: A generic single-country computable general equilibrium model. *Centre for Policy Studies and the Impact Project, Edition prepared for Practical GE Modelling Courses, Available at http://www.monash.edu.au/policy/oranig.htm, accessed on May, 2006.*

Horridge, J. M., and W. J. Harrison (2004). Using analyseGE to examine an ORANI-G tariff cut simulation. *Centre of Policy Studies and Impact Project, Monash University, Australia*.

Horridge, J. M., B. R. Parmentar, M. Cameron, R. Joubert, A. Suleman, and D. de Jong (1995). The macroeconomic, industrial, distributional and regional effects of government spending programs in South Africa. *The Centre of Policy Studies, Monash University, Melbourne, Working Paper No.G-109*.

Horridge, J. M., B. R. Parmenter, and K. R. Pearson (1993). ORANI-F: A general equilibrium model of the Australian economy. *Economic and Financial Computing, Summer, 3*(2), 71-140.

Horridge, J. M., B. R. Parmenter, and K. R. Pearson (1998). ORANI-G: A general equilibrium model of the Australian economy, *Edition prepared for course in practical GE Modelling Centre for Policy Studies and the Impact Project, Monash University, Australia. Available at http://www.monash.edu.au/policy, accessed on April, 2006*.

Hossain, A. (1995). *Inflation, Economic Growth and the Balance of Payments in Bangladesh*. Delhi: Oxford University Press.

Hossain, A. (2000). *Exchange Rates, Capital Flows and International Trade: The Case of Bangladesh*. Dhaka: The University Press Limited.

Hossain, A. (2003). *Trade Liberalisation and Export Performance: Analytics and Empirics from Bangladesh.* Unpublished PhD Dissertation, The University of Queensland, Brisbane, Australia.

Hossain, A. (2006). Overview of the Bangladesh economy. In A. Hossain, F. Khan & T. Akram (Eds.), *Economic Analyses of Contemporary Issues In Bangladesh*. Dhaka: The University Press Limited.

Hossain, M. (2003). Promoting rural non-farm economy of Bangladesh. *CPD-IRRI Policy Brief -3, available at http://www.cpd-bangladesh.org/publications/cpdiri/cpdiri_3.pdf, accessed on April, 2006*.

Hossain, M., F. Naher, and Q. Shahabuddin (2005). Food security and nutrition in Bangladesh: Progress and determinants. *Journal of Agricultural and Development Economics, 2*(2), 103-132.

Hossain, M., and B. Sen (1992). Rural poverty in Bangladesh: Trends and determinants. *Asian Development Review, 10*(1), 1-34.

Hossain, Z. (1989). *Analysis of the Restrictive Trade Policies in Bangladesh: An Applied General Equilibrium Approach.* Unpublished Ph.D Dissertation, University of The Philippines, Diliman, Quezon City.

Ianchovichina, E., and W. Martin (2002). Economic Impacts of China's Accession to the WTO http://siteresources.worldbank.org/INTRANETTRADE/Resources/IanchovichinaMartin061202.pdf, *accessed on August, 2007*.

Ianchovichina, E., A. Nicita, and I. Soloaga (2002). Trade reform and poverty: The case of Mexico. *The World Economy, 25*(7), 945-972.

IFS (International Financial Statistics) (Various issues). International Monetary Fund.

IMF (2003). *Public Information Notices*: http://www.imf.org/publications, accessed on March, 2007.

IMF (2005). *Bangladesh: Poverty reduction strategy paper*: International Monetary Fund, IMF Country Report No. 05/410.

Islam, I., and H. Khan (1986). Income inequality, poverty and socio-economic development in Bangladesh: An empirical investigation. *The Bangladesh Development Studies, 14*(2), 75-92.

Islam, R. (2004). The nexus of economic growth, employment and poverty reduction: An empirical analysis. *Issues in Employment and Poverty Discussion Paper No. 14, Recovery and Reconstruction Department, International Labour Office, Geneva*.

Johansen, L. (1960). *A Multi-Sectoral Study of Economic Growth*. Amsterdam.: North-Holland Publishing Company.

Jones, R. W. (1965). The structure of simple general equilibrium models. *Journal of Political Economy, 73*(6), 557-572.

Jones, R. W. (1971). A Three-Factor Model In Theory, Trade, and History. In J. N. Bhagwati, R. W. Jones, R. A. Mundell and J. Vanek (Eds.), *Trade, Balance of Payments and Growth*. Amsterdam: North-Holland Publishing Company.

Jones, R. W. (2006). "Protection and real wages": The history of an idea. *The Japanese Economic Review, 57*(4), 457-466.

Jones, R. W., and J. Scheinkman (1977). The relevance of the two-sector production model in trade theory. *Journal of Political Economy, 85*(5), 909-935.

Kakwani, N. (1980). On a class of poverty measures. *Econometrica, 48*(2), 437-446.

Kemal, A. R., R. Siddiqui, and R. Siddiqui (2001). Tariff reduction and income distribution: A CGE-based analysis for urban and rural households in Pakistan. *Pakistan Institute of Development Economics, MIMAP Technical Paper Series No. 11*.

Kennes, W. (1984). Food demand systems for Bangladesh. *Centre for World Food Studies, Amsterdam, Staff Working Paper SOW-84-15*.

Keyzer, M. A. (1986). Short-run Impact of Trade Liberalisation Measures on the Economy of Bangladesh: Exercises in Comparative Statics for the Year 1977. In T. N. Srinivasan and J. Whalley (Eds.), *General Equlibrium Trade Policy Modeling*. Cambridge, Massachusetts: MIT Press.

Khan, A. R. (1990). Poverty in Bangladesh: A consequences of and a constraint on growth. *The Bangladesh Development Studies, 18*(3), 19-33.

Khan, A. R. (2006). Rising Inequality in Bangladesh: An Analysis of Sources and Policies for Containment. In S. Ahmed and W. Mahmud (Eds.), *Growth and Poverty: The Development Experience of Bangladesh*. Dhaka: The University Press Limited.

Khan, A. R., and M. Hossain (1989). *The Strategy of Development in Bangladesh*. London: The Macmillan Press Ltd.

Khan, H. A. (2004). Using macroeconomic CGE models for assessing poverty impact of structural adjustment policies. *Asian Development Bank Institute Discussion Paper No. 12.*

Khondker, B. H. (1999). A manual for social accounting matrix (SAM) construction. *Centre on Integrated Rural Development for Asia and the Pacific, MAP Technical Paper Series No. 10*.

Khondker, B. H., M. Mujeri, M., and S. Raihan (2006). Welfare and poverty impacts of tariff reforms in Bangladesh: A general equilibrium approach. *Poverty and Economic Policy (PEP), MPIA Working Paper 2006-05*.

Khondker, B. H., and S. Raihan (2004). *Welfare and poverty impacts of policy reforms in Bangladesh: A general equilibrium approach*. Paper presented at the The Northwest Universities Development Consortium Conference (NEUDC), HEC Montreal, Canada, 1-3 October 2004.

Khundker, N., M. Mahmud, B. Sen, and M. N. Ahmed (1994). Urban poverty in Bangladesh: Trends, determinants and policy issues. *Asian Development Review, 12*(1), 1-31.

Korzeniewicz, R. P., and T. P. Moran (1997). World-economic trends in the distribution of income, 1965-1992. *American Journal of Sociology, 102*(4), 1000-1039.

Krueger, A. O. (1978). *Foreign Trade Regimes and Economic Development: Liberalisation Attempts and Consequences*. Cambridge: MA: Ballinger Pub.Co. for NBER.

Lambert, S., H. Schneider, and A. Suwa (1991). Adjustment and equity in Cote d'Ivoire: 1980-86. *World Development, 19*(11), 1563-1576.

Leamer, E. E. (1988). Measures of openness. In R. E. Baldwin (Ed.), *Trade Policy Issues and Empirical Analysis*. Chicago: University of Chicago Press for National Bureau of Economic Research.

Levinsohn, J., B. Steven, and J. Friedman (1999). *Impacts of the Indonesian economic crisis: price changes and the poor*. Paper presented at the Conference on Poverty and the International Economy, organised by the World Bank and Swedish Parliamentary Commission on Global Development.

Lewis, J. D. (1990). The macroeconomics of policy reform: Experiments with a CGE model of Bangladesh. *The Bangladesh Development Studies, 18*(1), 1-35.

Li, H., L. Squire, and H. Zou (1998). Explaining international and intertemporal variations in income inequality. *Economic Journal, 108*(1), 26-43.

Lofgren, H., R. L. Harris and S. Robinson (2001). A standard CGE model in GAMS. *International Food Policy Research Institute, TMD Discussion Paper No. 75.*

Lofgren, H., S. Robinson, and M. El-Said (2003a). The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools: A copublication of the World Bank and Oxford University Press.

Lofgren, H., S. Robinson, and M. El-Said (2003b). Poverty and Inequality Analysis in a General Equilibrium Framework: The Representative Household Approach. In F. Bourguignon & L. A. P. da Silva (Eds.), *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*: A copublication of the World Bank and Oxford University Press.

Maasland, A. (1990). Methods for measuring the effect of adjustment policies on income distribution. *Policy, Research, and External Affairs Working Papers WPS 474, Country Economics Department, The World Bank*.

Mahmud, W. (1979). Foodgrain demand elasticities of rural households in Bangladesh: An analysis of pooled cross-section data. *The Bangladesh Development Studies, 7*(1), 59-70.

Mahmud, W. (2006). Employment, Incomes and Poverty. In S. Ahmed and W. Mahmud (Eds.), *Growth and Poverty: The Development Experience of Bangladesh*. Dhaka: The University Press Limited.

Mahmud, W., S. Ahmed, and S. Mahajan (2008). Economic Reforms, Growth and Governance: The Political Economy Aspects of Bangladesh's Development Surprise. *Commission on Growth and Development, The International Bank for Reconstruction and Development/World Bank Working Paper No. 22*.

McCulloch, N., L. A. Winters, and X. Cirera (2001). *Trade Liberalisation and Poverty: A Handbook*. London: Centre for Economic Policy Research.

Meade, J. E. (1964). *Efficiency, Equality and the Ownership of Poverty*. London: Allen and Unwin Ltd.

Meagher, G. A. (1993). Forecasting Changes in the Income Distribution: An Applied General Equilibrium Approach. In A. Harding (Ed.), *Microsimulation and Public Policy*: Amsterdam: Elsevier.

Metzler, L. A. (1949). Tariffs, the terms of trade, and the distribution of national income. *Journal of Political Economy, 57*(1), 1-29.

Michaely, M., D. Papageorgiou, and A. Choksi (1991). *Liberalising Foreign Trade: Lessons of Experience in the Developing World*. Oxford: Basil Blackwell.

Milanovic, B. (2002). True world income distribution, 1988 and 1993: First calculation based on household surveys alone. *Economic Journal, 112*(1), 51-92.

Minot, N., and M. Goletti (2000). Rice market liberalisation and poverty in Viet Nam. *IFPRI Research Report No. 114, Washington, D.C.*

Mitra-Kahn, B. H. (2008). Debunking the myths of computable general equilibrium models *SCEPA Working Paper 2008-1 available at http://www.newschool.edu/cepa/publications/workingpapers/SCEPA%20Working%20Paper%202008-1%20Kahn.pdf, accessed on August, 2008.*

Mlachila, M., and Y. Yongzheng (2004). The end of textiles quotas: A case study of the impact on Bangladesh. *IMF Working Paper No 108, International Monetary Fund, Washington, D.C.*

Morrison, C. (1991). Adjustment, income and poverty in Morocco. *World Development, 19*(11), 1633-1651.

Mujeri, M., and B. H. Khondker (2002). Poverty implications of trade liberalisation in Bangladesh: A general equilibrium approach. *available at http://www.bgw-info.net/DMS/member/files/rmg%20sector/poverty_implications_of_trade.pdf, accessed on September, 2008.*

Mujeri, M. K. (2004). Bangladesh decent work statistical indicators: A fact-finding study. *Decent Work Pilot Progarm, National Policy Group, International Labour Organisation, available at http://www.ilo.org/public/english/bureau/dwpp/countries/Bangladesh/index.htm, accessed on August, 2007.*

Naranpanawa, R. M. A. K. B. (2005). *Trade Liberalisation and Poverty in a Computable General Equilibrium (CGE) Model: The Sri Lankan Case.* Unpublished Ph.D Dissertation, Griffith University, Queensland, Australia.

Nicita, A. (2004). Who benefited from trade liberalisation in Mexico? Measuring the effects on household welfare. *World Bank Policy Research Working Paper No. 3265*.

Noman, A. N. K. (2001). External shocks to a liberalised economy: Simulations with a CGE model of Bangladesh. *Bank Parikrama, 26*(3 & 4), 33-55.

Noman, A. N. K. (2002). *The Impact of Foreign Trade Policies and External Shocks on the Agricultural Sector of Bangladesh* (Vol. 45): Margraf Verlag, Weikersheim, Zermany.

Oktaviani, R. (2000). *The Impact of APEC Trade Liberalisation on the Indonesian Economy and Its Agricultural Sector.* Unpublished Ph.D Dissertation, University of Sydney, Sydney, Australia.

Orcutt, G. (1957). A new type of socio-economic system. *Review of Economics and Statistics, 39*(2), 116-123.

Osmani, S. R. (1990). Structural change and poverty in Bangladesh: The case of a false turning point. *The Bangladesh Development Studies, 18*(3), 55-74.

Osmani, S. R. (2005). The impact of globalization on poverty in Bangladesh. *Working Paper No. 65, Policy Integration Department, National Policy Group, International Labour Office, Geneva.*

Osmani, S. R., W. Mahmud, B. Sen, H. Dagdeviren, and A. Seth (2003). *The Macroeconomics of Poverty Reduction: The Case Study of Bangladesh*: The Asia-Pacific Regional Programme on Macroeconomics of Poverty Reduction, United Nations Development Programme, Dhaka, Bangladesh.

Oxfam (2002). *Oxfam, rigged rules and double standards: Trade, globalisation, and the fight against poverty*. Oxford: Oxfam International.

Paukert, F. (1973). Income distribution at different levels of development: A survey of evidence. *International Labour Review, 108*(2&3), 97-125.

Pearson, K. R. (1986). Automating the computation of solutions of large economic models. *Economic Modelling, 5*(4), 385-395.

Peter, W. M., M. Horridge, G. A. Meagher, F. Naqvi, and B. R. Parmenter (1996). The theoretical structure of MONASH-MRF. *Preliminary Working Paper No. OP-85, Centre of Policy Studies, Monash University.*

Pitt, M. (1983). Food preferences and nutrition in rural Bangladesh. *Reveiw of Economics and Statistics, 65*(1), 105-114.

Porto, G. G. (2003). Trade reforms, market access, and poverty in Argentina. *Development Economics Research Group, World Bank, Washington, D.C., Policy Research Working Paper No. 3135*.

Powell, A. A., and F. H Gruen (1967). The estimation of production frontiers: The Australian livestock/cereals complex. *Australian Journal of Agricultural Economics, 11*(June), 63-81.

Powell, A. A., and F. H. Gruen (1968). The constant elasticity of transformation frontier and linear supply system. *International Economic Review, 9*(October), 315-328.

Pradhan, B. K., and A. Sahoo (2001). Impact of trade liberalisation on household welfare and poverty. *Poverty and Economic Policy (PEP) Networks Project, MPIA Working Paper 2006-01*.

Pritchett, L. (1991). Measuring outward orientation in developing countries: Can it be done? *Policy Research and External Affairs Working Paper No. 566, Country Economics Department, Washington, D.C., The World Bank.*

Radetzki, M., and B. Jonsson (2001). The expanding global income gap: How reliable is the evidence? *European Journal of Development Research, 14*(1), 243-263.

Rahman, A., and T. Haque (1988). Poverty and inequality in Bangladesh in the eighties: An analysis of some recent evidence *Research Report No. 91, Bangladesh Institute of Development Studies*.

Rahman, A. N. M. A. (1973). Elasticities of substitution in manufacturing industries in Bangladesh: An international comparison. *Bangladesh Development Studies, 1*(2), 173-185.

Rahman, M. (2007). Policy and prospect of Jute and allied fibers with special reference to Bangladesh. *Available at* *www.jute.org/Documents_Seminar_Workshop_Meeting/Paper%20by%20Secretary%20MOTJ,%20Ban_myn.doc, accessed on September 2008.*

Rahman, R. I., and K. M. N. Islam (2003). Employment poverty linkages: Bangladesh. *Issues in Employment and Poverty, Recovery and Reconstruction Department, International Labour Office, Geneva., Discussion Paper No. 10.*

Rahman, S. H. (1992). Structural adjustment and macroeconomic performance in Bangladesh in the 1980s. *The Bangladesh Development Studies, 20*(2 & 3), 89-125.

Raihan, S. (2008). Trade liberalisation, growth employment and poverty in Bangladesh. Retrived 16th November from http://www.gtap.agecon.purdue.edu/resources/download/3941.pdf.

Rajan, R. S., and G. Bird (2002). Trade liberalisation and poverty: Where do we stand? *University of Adelaide, Centre for International Economic Studies Discussion Paper No. 0230*.

Rashid, M. A. (2000). *Impact of Trade Policy Reforms on Industrial Capacity and Employment in Bangladesh*: Report Prepared for Structural Adjustment Participatory Review Initiative (SAPRI) and Presented at the Second National Forum on 13-15 March, 2001 in Dhaka, Bangladesh.

Ravallion, M. (1994). Agricultural wages in Bangladesh: What do the figures really show? *Journal of Development Studies, 31*(2), 334-345.

Ravallion, M., and B. Bidani (1994). How robust is a poverty profile? *World Bank Economic Review, 8*(1), 75-102.

Ravallion, M. and B. Sen (1996). When method matters: Monitoring poverty in Bangladesh. *Economic Development and Cultural Change, 44*(4), 761-792.

Reimer, J. (2002). Estimating the poverty impacts of trade liberalisation. *World Bank Policy Research Working Paper No. 2790.*

Reinert, K. A., and D. W. Ronald-Holst (1997). Social Accounting Matrices. In J. F. Francois and K. A. Reinert (Eds.), *Applied Methods for Trade Policy Analysis: A Handbook*. Cambridge, United Kingdom: Cambridge University Press.

RIS (2004). *South Asia Development and Cooperation Report 2004*. New Delhi, India.: Research and Information System for the Non-Aligned and Other Developing Countries.

Robilliard, A., F. Bourguignon, and S. Robinson (2001). Crisis and income distribution: A micro-macro model for Indonesia. Available at http://siteresources.worldbank.org/INTPSIA/Resources/490023-1171549810534/14988_Indonesia_Crisis.pdf, *accessed on September 2008.*

Robilliard, A., and S. Robinson (2005). The social impact of a WTO agreement in Indonesia. *World Bank Policy Research Working Paper No. 3747*.

Rodrigues, F., and D. Rodrik (2000). Trade policy and economic growth: A skeptic's guide to the cross-national evidence. In B. Bernanke and K. S. Rogoff (Eds.), *NBER Macroeconomic Annual*. Cambridge: MA: MIT Press.

Romer, D. (1993). Openness and inflation: Theory and evidence. *Quarterly Journal of Economics, 108*(4), 869-903.

Rosenblatt, M. (1956). Remarks on some non-parametric estimates of a density function. *The Annals of Mathematical Statistics, 27*(3), 832-835.

Round, J. I. (1981). Income distribution within a social accounting matrix: A reveiw of some experience in Malaysia and other L.D.C.s. *Development Economics Research Centre, University of Warwick, Discussion Paper no 3*.

Roy, D. K. (1996). Poverty alleviation and trade policy reform in Bangladesh: Some selected issues. *The Bangladesh Development Studies, 26*(1&2).

Rushdi, A. A. (1982). Factor substitutability in the manufacturing industries of Bangladesh: An application of the translog cost model. *Bangladesh Development Studies, 10*(2), 85-106.

Rutherford, T., D. Tarr, and O. Shepotylo (2006). Poverty effects of Russia's WTO acccession: Modeling "real" household and endogenous productivity effects *World Bank Policy Research Working Paper No. 3473*.

Sachs, J., and A. Warner (1995). Economic reform and the process of global integration. *Brookings Papers on Economic Activity, 26*(1995-1), 1-118.

Sala-i-Martin, X. (2002). The disturbing "rise" in global income inequality. *National Bureau of Economic Research, Inc, NBER Working Paper 8904*.

Saleh, K., and K. Mangiri (2000). Supplement to the estimation of GDP of Indonesia (Data report). *Asian Development Bank, Joint ADB/ESCAP Workshop on rebasing and linking of National Accounts Series, Bangkok, Thailand*.

Salma, U. (1992). *Agricultural Price Policy in Bangladesh: General Equilibrium Effects on Growth and Income Distribution.* Unpublished Ph.D Dissertation, Australian National University, Canberra, Australia.

Salmon, C. (2002). Performance of the Bangladesh labour market during the nineties. *Mimeo, Background Paper for the Asian Development Bank and the World Bank, Manilla and Washington D.C.*

Santos-Paulino, A. U. (2005). Trade liberalisation and economic performance: Theory and evidence for developing countries. *The World Economy, 28*(6), 783-821.

Savard, L. (2003). Poverty and income distribution in a CGE-household micro-simulation model: Top-down /bottom up approach. *CIRPEE Working Paper No. 03-43*.

Savard, L. (2005). Poverty and inequality analysis within a CGE framework: A comparative analysis of the representative agent and microsimulation approaches. *Development Policy Review, 23*(3), 313-331.

Scarf, H. E. (1967). The approximation of fixed points of a continuous mapping. *SIAM Journal of Applied Mathematics, 15*(5), 328-343.

Scarf, H. E. (1973). *The Computation of Economic Equilibria*. New Haven and London: Yale University Press.

Schultz, T. (1998). Inequality in the distribution of personal income in the world: How it is changing and why? *Journal of Population Economics, 11*(3), 307-344.

Sen, A. (1976). Poverty: An ordinal approach to measurement. *Econometrica, 44*(2), 219-230.

Sen, A. (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Oxford University Press.

Sen, B., and D. Hulme (2006). *Chronic Poverty in Bangladesh: Tales of Ascent, Descent, Marginality and Persistence*. Dhaka: Bangladesh Institute of Development Studies (BIDS) and Chronic Poverty Research Centre (CPRC), University of Manchester, Manchester, UK.

Sen, B., K. Mujeri, and Q. Shahabuddin(2004). Operationalizing pro-poor growth: Bangladesh as a case study. *available at* *http://siteresources.worldbank.org/INTPGI/Resources/342674-1115051237044/oppgbangladesh(Nov).pdf, accessed on August, 2007*.

Siddique, R., A. R. Kemal, R. Siddique, and M. A. Kemal (2008). Tariff Reduction, Fiscal Adjustment and Poverty in Pakistan: A CGE-Based Analysis. In J. Cockburn, B. Decaluwe and V. Robichaud (Eds.), *Trade Liberalisation and Poverty: A CGE Analysis of the 1990s Experience in Africa and Asia*. Quebec, Canada: Poverty & Economic Policy Research Network 2008, available at www.pep-net.org/NEW-PEP/PDFFiles/TradeLiberalization&Poverty-final.pdf, *accessed* on February, 2009.

SNA (1993). *System of National Accounts, United Nations publications sales no. E.94*. New York: United Nations.

Stifel, D. C., and E. Thorbecke (2003). A dual-dual CGE model of an archetype African economy: Trade reforms, migration and poverty. *Journal of Policy Modeling, 25*(3), 207-235.

Stolper, W. F., and P. A. Samuelson (1941). Protection and real wages. *The Review of Economic Studies, 9*(1), 58-73.

Stone, R. (1954). Linear expenditure systems and demand analysis: An application to the pattern of British demand *The Economic Journal, 64*(255), 511-527.

Summers, R., and A. Heston (1988). A new set of international comparisons of real product and price levels: Estimates for 130 countries, 1950-1985. *Review of Income and Wealth, 34*(1), 1-25.

Svedberg, P. (2004). World income distribution: Which way? *Journal of Development Economics, 40*(5), 1-32.

Taylor, S., and S. L. Black (1974). Practical general equilibrium estimation of resource pulls under trade liberalisation. *Journal of International Economics, 4*(April), 35-58.

Thorbecke, E. (1991). Adjustment, growth and income distribution in Indonesia. *World Development, 19*(11), 1595-1614.

Thorbecke, E. (1997). A dual-dual framework to analyze the process of development. *Paper Prepared for a Conference in Memory of John C.H. Fei on The Economics and Political Economy of Development at the Turn of the Century, Taipei*.

Tran, H. N. (2007). *Monash-VN: Development of a Dynamic CGE Model for the Vietnamese Economy and Analysis of Structural Changes During 1996-2003*. Unpublished Ph.D Dissertation, Monash University, Melbourne, Australia.

UNDP (1999a). *Human Development Report 1999*. Vienna: UNDP.

UNDP (1999b). *Human Development Report 1999: Globalization with a Human Face*. New York: The United Nations Development Programme.

UNDP (2005a). *Human Development Report 2005, International cooperation at a crossroads: Aid, trade, and security in an unequal world*. New York: The United Nations Development Programme.

UNDP (2005b). *Millennium Development Goals (MDG) Progress Report 2005: Bangladesh*: Government of Bangladesh and United Nations Country Team in Bangladesh.

UNDP (2006). *Human Development Report 2006*: Oxford University Press for the United Nations Development Program.

United Nations (1999). *Hand book of Input-Output Table Compilation and Analysis* (Vol. F, No.74). New York.

United Nations (2007). *The Millennium Development Goals Report*. New york: United Nations.

Valenzuela, E. T., T. W. Hertel, M. Ivanic, and A. N. Pratt (2004). *Evaluating poverty impacts of globalisation and trade policy changes on agricultural producers*. Paper presented at the 2004 Annual meeting, August 1-4, Denver, CO 20242, American Agricultural Economics Association.,

Vincent, D. P. (1985). Exchange rate devaluation, monetary policy and wages: A general equilibrium analysis for Chile. *Economic Modelling, 2*(1), 17-32.

Vos, R., and N. D. Jong (2003). Trade liberalisation and poverty in Ecuador: A CGE macro-microsimulation analysis. *Economic Systems Research, 15*(2), 211-232.

WDR (2000/01). *World Development Report: Attacking Poverty*. Washington D.C.: The World Bank.

Winters, L. A. (2000). Trade, trade policy and poverty: What are the links? *Centre for Economic Policy Research (CEPR) Discussion Paper No. 2382*.

Winters, L. A. (2002). Trade liberalisation and poverty: What are the links? *World Economy, 25*(9), 143-171.

Winters, L. A., N. McCulloch, and A. McKay (2004). Trade liberalization and poverty: The evidence so far. *Journal of Economic Literature, 42*(1), 72-115.

Wittwer, G. (1999). WAYANG: A general equilibrium model adapted for the Indonesian economy. *ACIAR Indonesia Working Paper 99.10 CIES, University of Adelaide*.

Wobst, P. (2001). Structural adjustment and intersectoral shifts in Tanzania: A computable general equilibrium analysis. *International Food Policy research Institute, Washington, D.C., Research Report no. 117*.

Wodon, Q. T. (1997). Food and energy intake and cost of basic needs: Measuring poverty in Bangladesh. *Journal of Development Studies, 34*(2), 66-101.

Wodon, Q. T. (1999). Microdeterminants of consumption, poverty, growth, and inequality in Bangladesh. *Policy Research Working Paper No. 2076, Poverty Reduction and Economic Management Sector Unit, South Asia Region, The World Bank*.

World Bank (1987a). Bangladesh: Promoting higher growth and human development. *World Bank Country Study*.

World Bank (1987b). *World Development Report, 1987*. Oxford: The World Bank.

World Bank (1995). Bangladesh Recent Economic Developments and Priority Reform Agenda for Rapid Growth. *Country Operation Division, South Asia Region, Report No. 13875-BD, The World Bank*.

World Bank (1998). Bangladesh: From counting the poor to making the poor count. *Report No. 17534-BD, Poverty Reduction and Economic Management Network, South Asia Region, The World Bank*.

World Bank (1999a). Bangladesh trade liberalisation: Its pace and impacts. *Poverty Reduction and Economic Management Unit, South Asia Region, The World Bank Report No. 19591-BD*.

World Bank (1999b). Foreign direct investment in Bangladesh: Issues of long-run sustainability http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2000/02/03/000094946_00011505355643/Rendered/PDF/multi_page.pdf, *accessed on February, 2007*.

World Bank (2000/01). *World Development Report 2000/01: Attacking Poverty*. New York: Oxford University Press: The World Bank.

World Bank (2002a). *2002 World Development Indicators*. Washington, D.C: The World Bank.

World Bank (2002b). Poverty in Bangladesh: Building on progress. *Poverty Reduction and Economic Management Sector Unit, South Asia Region, The World Bank Report No. 24299-BD*.

World Bank (2004). *Global Economic Prospects 2004 - Realizing the Development Promise of the Doha agenda*. Washington, D.C: The World Bank.

World Bank (2005). *Attaining the Millennium Development Goals in Bangladesh*. Dhaka: Human Development Unit, South Asia Region, The World Bank.

World Bank (2006a). *Country Assistance Strategy for the Peoples Republic of Bangladesh for the Period FY06-09*: Bangladesh Country Management Unit, South Asia Region, Report No. 53193, The World Bank.

World Bank (2006b). India-Bangladesh Bilateral Trade and Potential Free Trade Agreement. *Poverty Reduction and Economic Management Unit, The World Bank Office, Bangladesh Development Series Paper No. 13*.

World Bank (2007a). Bangladesh and Nigeria Development Indicators Database. *http://www.devdata.worldbank.org/external/cpprofite.asp, . accessed on January, 2007.*

World Bank (2007b). *World Development Indicators 2007*. Washington D.C: The World Bank Publications.

WTO (2006). *Third Trade Policy Review of Bangladesh*. Dhaka: Report by the Secretariat of Bangladesh, WT/TPR/S/168.

Younus, S., and M. N. Chowdhury (2006). An analysis of Bangladesh's transition to flexible exchange rate regime. *Policy Unit Analysis, Working Paper Series No. WP 0706, Research Department, Bangladesh Bank*.

Zhai, F., and T. W. Hertel (2006). Impacts of the DDA on China: The Role of Labour Markets and Complementary Education Reforms In T. W. Hertel and L. A. Winters (Eds.), *Poverty & The WTO: Impacts of the Doha Development Agenda*: A copublication of Palgrave Macmillan and the World Bank.

Zheng, B. (1993). An axiomatic characterization of the Watts poverty index. *Economics Letters, 42*(1), 81-86.