1. Introduction

1.1 Research Background

Agriculture in Kenya accounts for about a third of Gross Domestic Product (GDP); more than 80 per cent of the labour force is engaged in agriculture; 70 per cent of merchandise exports are agricultural; and 33 per cent of the manufacturing sector's output is based on agricultural inputs (Pearson et al. 1995). Consequently, the agricultural sector has been central to Kenya's economic development strategy. A point noted in Pearson et al. (1995) is that, because of its prominence in total output, employment, and trade, planners in Kenya have long considered growth of agricultural incomes as crucial to a successful development strategy. This is evident from the development plans prepared by the Kenyan government over different periods.

The many development plans implemented so far by the Kenyan government notwithstanding, the Kenyan economy has experienced macroeconomic disequilibria at different times since the country became independent in 1963. These disequilibria have been exacerbated by the vulnerability of the economy to both external and internal shocks. Some of the main conditions that act or have previously acted as sources or catalysts for these imbalances as identified in Little et al. (1993) include: predominance of the agricultural sector in GDP; the agricultural sector's predominance in exports; and the low marginal efficiency of investment.

Other conditions have included: Kenya's strong dependence on external sources of funding, considering the virtual halt in commercial bank lending that occurred in the early 1980s because of conditions beyond the control of the Kenyan government; a large and inefficient public sector that controls large amounts of capital in the modern formal sector yet does not produce commensurate value-added; severe droughts; fluctuations in export commodity prices; increases in the value of the US dollar and other major currencies in which Kenyan exports and imports are traded; increases in international interest rates which caused the debt servicing costs expressed as a proportion of export earnings to rise; oil price fluctuations, since oil is a major source of energy in the Kenyan economy; and the dependence on foreign trade resulting from high imports and

undiversified exports during world recessions that reduce the demand for and prices of traditional exports.

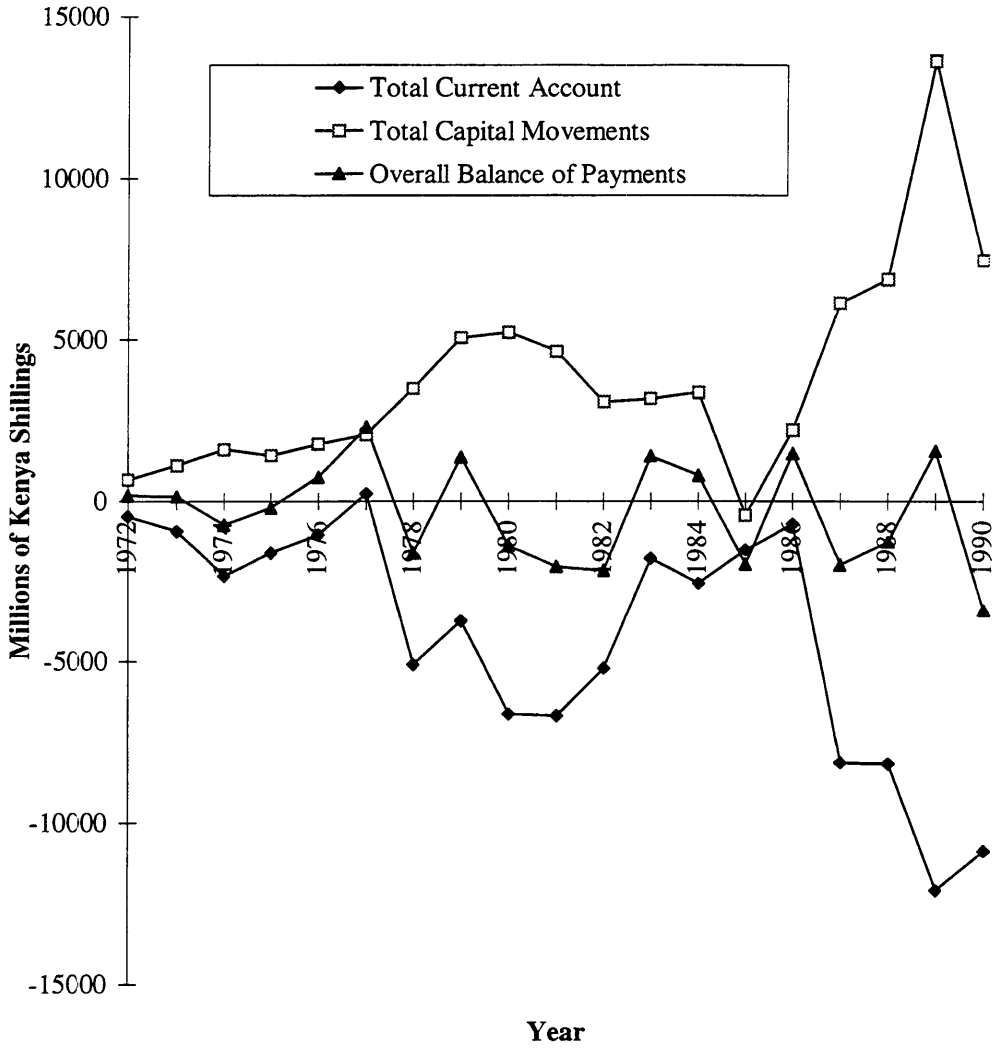
Given the above conditions, some key events in the world and domestic economy have led to economic disequilibria in Kenya. These have included among others: emergence in the 1970s of a world money and capital market to which Kenya had ready access; moves from fixed to floating exchange rates that was started in 1973 by major industrialised countries and others; two sharp increases in oil prices in 1974 and in the 1979-80 period and one sharp fall in 1983; dramatic movements in prices of several primary commodities, notably a major coffee price boom between 1975 and 1978 following a severe frost in Brazil, a mini-coffee price boom in 1986, a tea price boom in 1984; a mild world recession and two deep ones in 1975 and 1981-82; a large appreciation of the US dollar against other lending currencies followed by a larger fall in the 1985-86 period; and the debt crises in the mid-1980s resulting from accumulated debt, recession and high interest rates used to curb inflation in developed countries followed by virtual cessation of voluntary external lending (Little et al. 1993).

The macroeconomic disequilibria caused by the events described above have been characterised by large movements in the current account of the balance of payments. For instance, large current account deficits can be seen in Figure 1.1. In addition, these macroeconomic imbalances have been accompanied by relatively large movements in the fiscal balance as evident from the deficits shown in Figure 1.2, stagnant or slow economic growth, high inflation, unemployment, continuing poverty and rising foreign debt. Most of these imbalances have led to deterioration in Kenya's international terms of trade. This is particularly so with the imbalances that have resulted from events such as oil price shocks and international interest rate rises.

However, some imbalances have led to temporary improvements in the terms of trade. These are disequilibria experienced as a result of high world commodity prices such as the coffee boom of the 1970's and the mini-coffee boom of the mid-1980's. Other more subtle price and demand booms have occurred in the tea (1984) and pyrethrum sub-sectors.

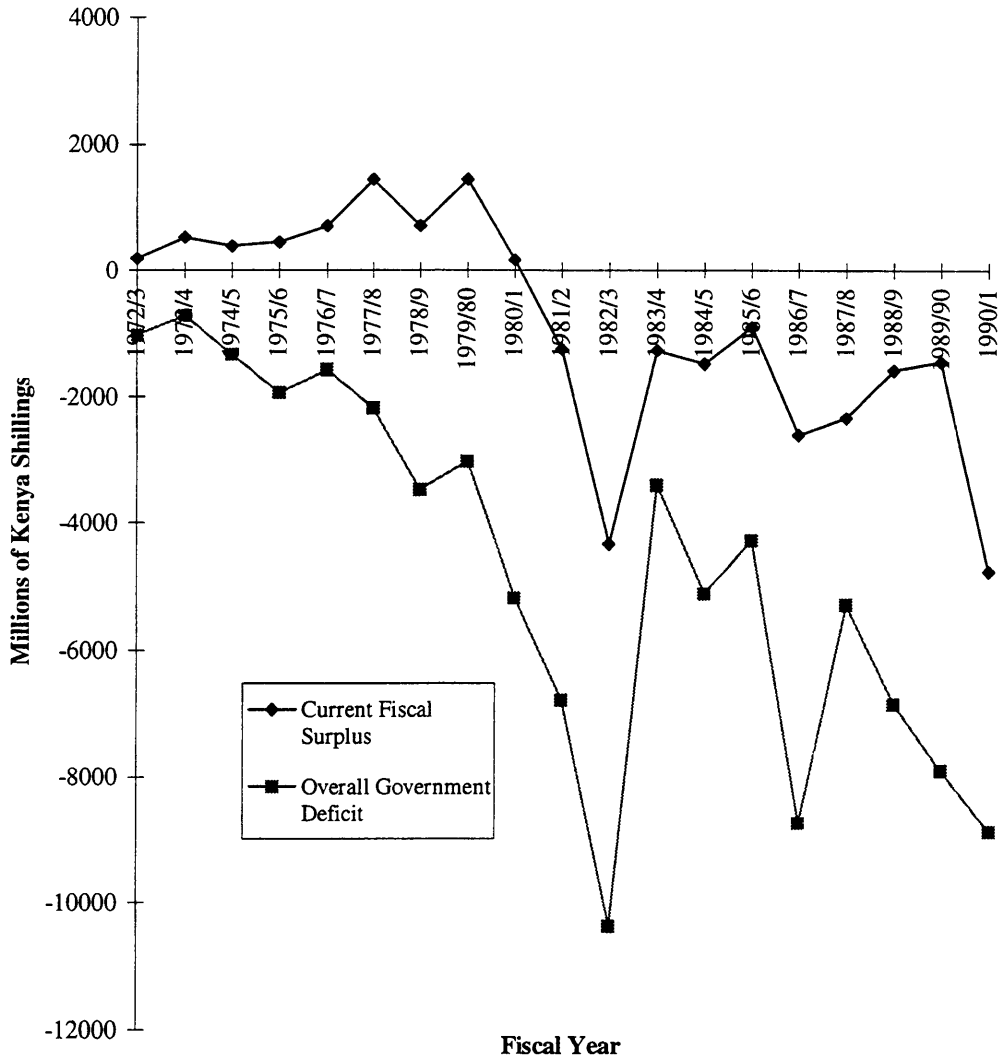
While Kenya had no control over most of these events, the government was forced to respond to them in its monetary, fiscal, exchange rate and trade policies. These responses affected specific sectors in the economy like agriculture.

Figure 1.1: Kenya's Balance of Payments: 1972-1990



Source: Ministry of Planning and National Development, 1991.

Figure 1.2: Central Government Finance Balances



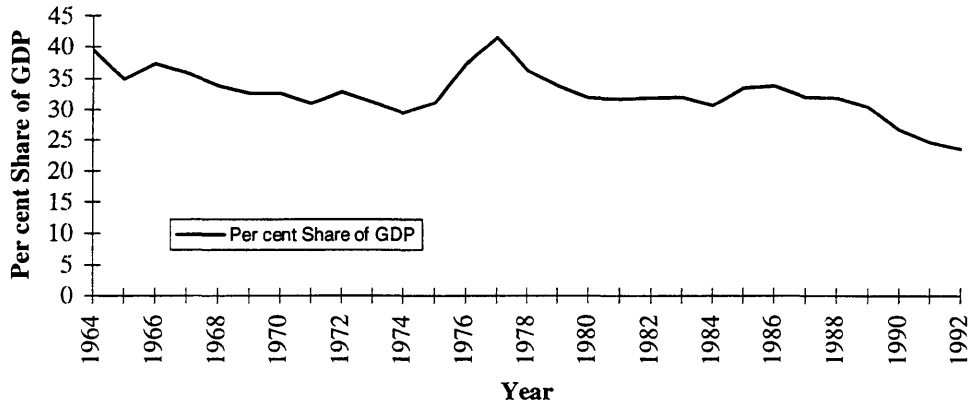
Source: Ministry of Planning and National Development, 1991.

1.2 The Research Problem

As noted above, the agricultural sector holds an important position in the Kenyan economy as the main stimulant of economic growth. It is the mainstay of the economy in terms of its dominant contribution to GDP. The sector is also dominant in export earnings and generation of employment. It has consistently maintained a substantially

high GDP share and an even higher percentage of visible export earnings as indicated by Figures 1.3 and 1.4.

Figure 1.3: Agricultural Sector's Share of GDP (Current Prices)



Source: Kenya, Republic of, *Economic Survey and Statistical Abstracts*, various issues.

The agricultural sector also employs a large proportion of the labour force and is expected to continue being a major employer since a high percentage of the total population still lives in rural areas where agricultural production takes place. Agriculture generates employment extending from actual wage and non-wage employment in agricultural production to agricultural dependant sectors such as manufacturing and trading of agricultural products. The sector also provides nearly all the national food requirements.

Taking into account the contribution of the agricultural sector to GDP, its growth has remained a key factor in stimulating rapid economic growth and in attaining higher income and employment opportunities for the majority of Kenya's population. As a consequence, its important position in the Kenyan economy is recognised by policy makers who expect it to play a leading role in enhancing economic growth. This expectation is evident, as previously mentioned, in all development plans that have been

prepared by the Kenyan government in which economic policies outlining the development strategy are formulated.

Figure 1.4: Agricultural Sector's Share of Total Domestic Exports

Source: Kenya, Republic of, *Economic Survey and Statistical Abstracts,* various issues.

In the plans since independence, important roles have been assigned to the agricultural sector and have revolved around the following objectives: food security; generation of farm family incomes; absorbtion of new farm workers with rising labour productivity; increasing agricultural export earnings; and stimulating growth of productive off-farm activities in rural areas so that off-farm job opportunities can grow. The roles designated to the sector exemplify the desire of government to alleviate poverty. Economic growth through agricultural development has been and is considered one way through which poverty can be alleviated. Consequently, economic planners believe that poverty alleviation cannot be accomplished in Kenya without self-sufficiency in food production,

expanded export earnings, increased employment opportunities, and higher rural incomes.

Therefore, accelerated growth in the agricultural sector remains as a means through which employment opportunities can be increased, foreign exchange earnings enhanced and internal self-sufficiency in basic foods with adequate strategic reserves can be achieved. Achievement of rural industrialisation also looks possible with accelerated growth of agro-industrial raw materials production while surplus domestic production of agricultural products presents opportunities for foreign exchange savings.

Njuguna (1994) has argued that the real GDP share of the agricultural sector has not always grown at a rate that would enable it to meet its identified objectives. The sector needs a growth rate well beyond five per cent for it to be a stimulant to growth in the economy. Evidence shows that the sector registered an annual growth rate in its share of GDP of 4.7 per cent in the decade following independence (FAO 1992). The growth slowed after 1972 to an annual average rate of 3.7 per cent during the 1970s. The growth rate further dropped to 3 per cent during the 1980s with a short-lived recovery between 1986 and 1989 when it grew at 4.1 per cent. The recovery quickly faded and growth declined to 3.5 per cent and 3.4 per cent in 1990 and 1991, respectively (FAO 1992). The poor performance continued unabated and the sector recorded negative 4 per cent growth in 1992 (Kenya, Republic of 1993).

Therefore, while government has continued to direct resources in an attempt to improve agriculture and accorded high priority to agricultural development the agricultural growth rate has been poor in comparison to the expectations of Kenyan policy makers. Is it possible that the economic environment created by government economic policies contributed to this performance? Moreover, problems such as unfavourable weather conditions and low world prices for the major agricultural exports did not help. The effects of external shocks and different economic policies become an important issue if the roles and performance of the agricultural sector in Kenya are to be reconciled.

Pearson et al. (1995) have the same concern as Njuguna (1994) when they note that despite the strategy adopted for agricultural development there has been little improvement in sectoral performance. Pearson et. al. (1995) argue that growth rates of

agricultural output slowed markedly in the 1960s and 1970s from nearly five per cent per year to less than three per cent. Recent rates of agricultural sector growth have been less than the rate of population growth and, as a result, food production per capita declined around 15 per cent during the 1980s. Pearson et. al. (1995) conclude that the government's three part strategy—to introduce changes in farming input intensities, agricultural technologies and cropping patterns—have not yet been implemented successfully.

This performance of the agricultural sector raises fundamental questions about the role agriculture is expected to play in the economy. These are questions raised by Njuguna (1994). The national food security objective has at times been threatened and has sometimes not been achieved, requiring relief food imports. The ability of the sector to employ part of the country's increasing labour force is also uncertain due to the agricultural sector's unstable growth. This diminishes the prospects of lowering unemployment in the country. Another important question that emerges from this performance is whether the growth targets set for the other sectors thought to have macroeconomic linkages with agriculture will be attained. This question arises in view of the foreign exchange constraints that agriculture is expected to ease and its expected provision of agro-industrial raw materials. Implicit in the foreign exchange constraint are problems of poor balance of payments and difficulties in servicing foreign debt with the latter affecting the economy's credit rating.

The inability of the sector to maintain reasonable growth rates, and the frightening scenario that Kenya faces if the failure persists, brings into focus the effects of different external shocks and economic policies that have been implemented when these shocks took place. More specifically, questions are raised about the government's past and present agricultural, monetary, fiscal, exchange rate and trade policies. The policies that have been pursued and their likely implications for agriculture are important points of departure in understanding how they affect the sector's performance. Hence, it is important to seek a better understanding of both the direct and indirect effects of external shocks and the prevailing monetary, fiscal, exchange rate and trade policies effects on agriculture. This is through an explicit consideration of the relationships between agriculture, external shocks and these various policies.

The understanding that results from this kind of empirical analysis will help to address the type of concerns raised by Pearson et al. (1995). They argue that the lack of success in Kenya's agricultural sector means that strategy statements (that is defining roles) are not sufficient to change economic performance. To be successful, strategies must be accompanied with new policies and provide incentives for producers and consumers to change. Hence, the effects of the economic environment created by different external shocks and economic policies must be understood first.

Therefore, there is need for a theoretical and empirical analysis of agricultural performance resulting from external shocks in the context of different policy regimes. The analysis should focus on the effects of external shocks and specific economic policies on agriculture in Kenya. The analysis should acknowledge that external shocks and economy-wide policies accompanying these shocks are as important as sector specific policies in affecting agricultural performance. The empirical results are not only important in explaining the past and present performance of the agricultural sector but should also be useful in assessing the likely sustainability of agriculture given the policy environment created under the current on-going macroeconomic stabilisation and structural adjustment programs.

The desire for this kind of analysis is consistent with the generally accepted notion that external shocks and government policies have impacts on the economic environment and therefore economic performance. Changes in the economic environment have different effects on different sectors and the economic environment affects sectoral growth through its effects on factor productivity and resource allocation. Therefore, in this study, an attempt is made to analyse the agricultural sector's performance under the economic environment created by external shocks and different economic policies.

Bearing the importance of the agricultural sector in mind, it is recognised that the Kenyan government had to implement macroeconomic stabilisation and structural adjustment policies at different times to deal with economic imbalances. These policies are likely to have had impacts on the agricultural sector. This is in line with observation from Pearson et al. (1995) that Kenyan planners have targeted three principal economic variables in their strategy for raising agricultural productivity—agricultural income, food crop output and agricultural employment. They go on to suggest that the first item on

the agenda for policy analysis is to understand how a set of policies affects agricultural income, output, and employment. This study hopes to look at the question raised by Pearson et. al. (1995) about how different policies might have affected the Kenyan economy with special reference to the agricultural sector. However, the study will first try to show how external shocks impacted on the economy before analysing the policy effects.

Therefore, it is hoped that the effects of external shocks and the actual and alternative economic adjustment policies on the Kenyan agricultural economy can be quantified in this study. The analysis covers two periods. The first period, whose base year is 1976, includes the oil shock and the coffee boom episodes. The second period, with 1986 as the base year, deals with some of the policy recommendations made by the World Bank and International Monetary Fund (IMF) to the Kenyan government under structural adjustment programs. The external shocks and policies will be evaluated by analysing the impacts they had on various macroeconomic variables, agricultural output, agricultural employment, rural incomes, agricultural prices and agricultural exports.

1.3 Objectives of the Study

In line with the research problem described above, specific objectives to guide the study are:

1. To develop an economic model for the Kenyan economy that can be used for evaluation of the effects of external shocks and policy analysis.

2. To use the model to explain the effects of external shocks between 1973-1978 (oil-price increase and export boom) individually and jointly on the Kenyan economy.

3. To analyse how particular government policies affected the outcome of the external shocks.

4. To analyse how alternative economic policies could have affected the impact of external shocks.

5. To analyse the effects on the economy of some of the structural adjustment policies recommended by the World Bank and the IMF since the mid-1980s.

1.4 Research Methodology

Studies undertaking policy analysis need an analytical framework of the economy's structure that allows evaluation of the effects of a wide variety of policies on indicators of economic growth and structural change. The main interest in this study is to see how external shocks and the effects of different policy measures impacted on the agricultural sector. The policy measures are likely to have had an impact on the agricultural sector in various ways. The impacts include among other things: effects on the sector's growth and structural change; agricultural exports; agricultural employment; investment allocation in the sector; income distribution among the different rural household groups; and the structural adjustment of the sector to external shocks.

It would be difficult to analyse external shocks and policy effects in a partial setting. This is because there are substantial indirect effects on other sectors of the economy that have linkages with the agricultural sector. Hence an economy-wide analysis in the form of a multi-agent, multi-commodity model, that is, a general equilibrium model, is needed.

This kind of framework means that a computable general equilibrium (CGE) model is the appropriate method of analysis for this study. The use of a CGE model to undertake this study has advantages in the sense that the general equilibrium effects are taken into account. Also, the interaction of different policy variables, as implemented in Kenya, can be understood. In cases where the policies refer to the past, as will be the case in this study, the model can be used for counterfactual simulation of policies other than those actually adopted to see whether a better performance would have resulted.

1.5 Organisation of the Study

The study is organised as follows. Chapter 2 describes the role of agriculture in Kenya's development strategy. The chapter outlines agricultural development efforts, policy initiatives by the Kenya government and looks at some of the sector's performance indicators. Chapter 3 gives more details on external shocks that affected the Kenyan

economy and illustrates how these shocks create macroeconomic imbalances by looking at how they affect the balance of payments. It also explains some policy measures that the government pursued at the time of those shocks in addition to outlining the kind of policies that have been recommended to government by the World Bank and the IMF.

Chapter 4 discusses the rationale and development of CGE models for policy analysis, highlighting some of the theoretical underpinning of these models. This is followed in Chapter 5 by a review of some applications of CGE models to policy analysis in some developing countries. In this chapter, the CGE models that have so far been developed for the Kenyan economy and the kind of policies they have been used to analyse are reviewed.

The research methodology chapters lead to Chapter 6 which describes the theoretical framework of the Kenyan general equilibrium model (KEGEM) developed in this study. Chapter 7 describes the data used in implementing KEGEM and how implementation was undertaken. The chapter also discusses how some parameters in KEGEM were calibrated to the initial solution given the benchmark data.

Three chapters with results then follow. Chapter 8 discusses results from simulation of terms of trade shocks that affected the Kenyan economy. The chapter also discusses results from simulations that analyse effects of particular government policies on the outcome of the external shocks. Chapter 9 discusses results from the simulation of alternative policies to those the government employed at the time of the shocks, analysing how such alternative policies would have affected outcomes.

Looking beyond the events in the 1970s analysed in Chapters 8 and 9, Chapter 10 presents results from simulations analysing effects of some policies recommended by the World Bank and the IMF on the Kenyan economy in the 1980s. The study concludes with Chapter 11 which presents a summary of the study, outlining the main conclusions and also discussing the policy implications of the empirical findings.

2. Agriculture in the Kenyan Economy

2.1 Introduction

Chapter 1 has emphasised the central position occupied by the agricultural sector in the Kenyan economy. This chapter discusses in more detail the Kenyan agricultural sector and underscores its importance in the economy. The chapter is organised as follows. Section 2.2 discusses the roles assigned to agriculture over the years as policy makers have tried to stimulate growth and development in the economy. This is undertaken through a brief review of the first six five-year development plans prepared by the Kenya government in the period 1965-1993. Section 2.3 expands on some of the roles identified in the development plans and discusses some of the actual agricultural development efforts and policy initiatives that were a result of the plans for the sector. In order to see how the agricultural sector has performed, and to understand how effective the agricultural policy initiatives in Section 2.3 have been, Section 2.4 analyses some of the performance indicators of the sector. Section 2.5 concludes the chapter.

2.2 Role of Agriculture in Kenya's Development Strategy

It was briefly mentioned in the previous chapter that planners in Kenya have long considered growth of agricultural sector as imperative to a successful development strategy. This is evident from some of the development plans reviewed below that have been prepared by the Kenyan government over different plan periods. The roles assigned to the agricultural sector show the high expectation for the sector as the driving force in economic development for the country. The reviews presented in this section highlight the nature of the goals and objectives that the agricultural sector has been expected to achieve as the 'engine of growth'.

2.2.1 First development plan

The first development plan covered the period 1965-1970, and was prepared soon after Kenya's independence in 1963, a time when it was a typical dual economy. It was then considered imperative to break the barriers between modern and traditional sectors in

order to distribute any benefits of development to rural areas. This led to emphasis on agricultural development in the first plan period. Rising rural incomes were identified from this early stage as a potential stimulus for industrialisation. Growth in the agricultural sector in post-independence Kenya was to establish the basis for a much broader development throughout the economy (Kenya, Republic of 1965).

This initial development plan stressed development of small-scale farming into a modern and productive economic activity to ensure a better living for farmers, their family members and hired labour. The government emphasised the development of agriculture and, in particular, the expansion of output, productivity and employment on small farms. The development of agriculture was also intended to make it possible for the concurrent growth of agricultural processing industries.

The government hoped to generate employment opportunities by having a bias when introducing capital into agriculture in favour of labour intensive techniques. It also intended to have a wage policy designed to increase employment in rural agricultural areas. Productivity in the peasant farming sector was to be improved through economic incentives such as agricultural credit and extension services.

2.2.2 Second development plan

The objective of the second plan, covering the period 1970-1974, was development of the country's economic resources to achieve the goal of economic independence, together with social justice and a steadily improving standard of living for all (Kenya, Republic of 1970). With the overall objective of accelerating the rate of growth of the economy as a whole, the second plan proposed that an increasing share of development should be directed towards the rural areas.

In fact, rural development was the basic strategy for the second plan. The government believed that it was only through accelerated growth in rural areas that balanced economic development could be achieved. Rural areas comprised well over 98 per cent of Kenya and contained more than 90 per cent of the population and contributed the greater part of the production of the country.

As in the first plan, agriculture continued to receive a very high priority on the development agenda. The major reason still being that a high proportion of the population was to continue depending on it for their livelihood. In addition, because it was an important component of the economy, its rapid development had a major role to play in the growth of the whole economy. In particular, increased agricultural incomes were seen to mean higher savings, more foreign exchange and an expanded market for goods produced in non-agricultural sectors.

2.2.3 Third development plan

In line with the first two development plans, the third development plan covering the period 1974-1978 further emphasised rural development, creation of more employment opportunities, more equitable distribution of income, better educational opportunities, and increased participation of people (Kenya, Republic of 1974). However, this plan emerged in a period of worldwide economic uncertainty. High inflation in industrialised countries meant high import prices for Kenya. It was also the start of the so called oil crisis and turmoil in international money markets.

In spite of the economic uncertainty, agriculture continued to be the main source of employment. Labour intensive crops were encouraged and irrigation was expanded. Income distribution was to be improved through more expenditure on less developed agricultural areas.

Agricultural outputs were still expected to provide inputs for agro-based industries. Principal constraints to agriculture of knowledge, technology and credit were to be removed through a development strategy that concentrated on extension, training, research, credit, improved input supplies and improved markets.

The agricultural goals in the plan were as follows: achieve a reasonable growth rate of marketed production through intensified land use; improve distribution of rural incomes by obtaining a significant increase in the proportion of farmers who obtain a cash income from their land; devise methods of developing less favoured areas and promote more even development among different areas of the country; increase opportunities for employment in the sector; improve standards of nutrition in the rural areas; increase

agricultural exports; complete Kenyanisation of large-scale mixed farms, ranches and plantations and more than double development expenditures in agriculture (Kenya, Republic of 1974).

2.2.4 Fourth development plan

Improvement of the well-being of the people remained the dominant aim of economic planning of the fourth plan period of 1979-1983. The fourth plan focused more attention on measures to deal with poverty through emphasis on continued growth, raising household incomes through the creation of more income-earning opportunities, increasing the output and quality of services provided by government and improving income distribution throughout the nation (Kenya, Republic of 1979a).

As in the previous three plans, the agricultural sector was to be the key foundation for the success of the fourth development plan. The agricultural development strategy entailed: more intensive land use and development; development of appropriate technologies; small-holder development; arid and semi-arid land development; a poverty alleviation focus; market incentives; and increased access to land and land based employment (Kenya, Republic of 1979a).

The plan was to be implemented under some severe constraints similar to those in the third development plan. The most severe of these was the balance of payments and the plan was launched at a time of international uncertainty. Prices of major export items were falling and there were anticipated increases in prices of capital, intermediate goods and oil. The other closely related constraints were the widening budget deficit and the gap between domestic savings and investment.

2.2.5 Fifth development plan

To appreciate the centrality of the agricultural sector in Kenya's development strategy, note that even after the implementation of the four plans the agricultural sector objectives in the fifth plan for the period 1984-1988 did not change significantly. These included: increased food production; growth in agricultural employment; expansion of agricultural exports; resource conservation; and poverty alleviation (Kenya, Republic of

1984a). The key policies to be formulated were to give attention to: small farms; more intensive resource use through improved crop and livestock husbandry practices; technology improvement; market incentives to provide fair prices and ensure prompt payments; resource use efficiency; and price reviews in line with export parities (Kenya, Republic of 1984a).

2.2.6 Sixth development plan

Unlike the other plans noted so far, the sixth development plan for the period 1989-1993 was the first plan to adopt an integrated rather than sectoral approach to planning. However, the agricultural sector remained the key to the attainment of objectives as reflected in its objectives. The major objectives of this plan in order of priority included: the economy expand in such a way as to create productive employment and the growth was to come from agriculture, revitalised industry and small-scale enterprises; greater foreign exchange generation through industrial diversification into exports in support of the traditional exports of agriculture and tourism; moderation in government provision of basic services that called for cost-sharing; government to play a more prominent role in caring for the environment; the private sector to have a greater role in the economy; due regard for judicious management of public debt, stability of the currency and the balance of payments and, while growth and employment generation were critical in the on-going structural adjustment process, certain safeguards were to be taken to ensure equitable distribution of the benefits of growth (Kenya, Republic of 1989).

2.3 Agricultural Development Efforts and Policy Initiatives

It is by now clear that the agricultural sector has been looked upon as central in the growth of the economy in successive development plans. Its importance is also discernible from development efforts and policy initiatives taken by the government over the years to develop a strong agricultural sector. Some of the notable development efforts and policy initiatives that have been directed at the sector since independence in 1963 as suggested in the various development plans are discussed in this section.

2.3.1 Small-holder development programs

Development of small-holder farms was the most important initiative at independence, in line with the government policy of subdivisions of large farms into small-holdings. Pearson et al. (1995) support this point when they observe that although the large-farm sector remained, the structure of Kenyan agriculture changed fundamentally after independence. They observed that small-scale farms accounted for less than a quarter of the value of agricultural production in 1960 yet produced over half of the value of agricultural output in 1967.

Small-holder development programs were started and implemented through land settlement schemes. Some of these were initiated for the sole purpose of promoting agricultural development in specific areas such as sugarcane, tea, coffee and dairying. This small-holder agricultural development can be attributed in part to specific agricultural objectives set originally at independence such as: expansion of crop areas through settlement schemes; increase in yields of crops such as coffee, tea, sugarcane, and maize; use of more disease resistant varieties and a switch to higher valued crops.

The programs offered the agricultural sector an opportunity to perform its role as a leading sector in stimulating economic growth. Hence, because of the labour-intensive nature of many of the cultivation practices, small-holdings were used to create job opportunities within the agricultural sector and in the economy generally. Small-holder producers were also to be major contributors to the country's food supplies and foreign exchange earnings.

Their contribution to foreign exchange earnings is clear from Table 2.1. By 1991, the share of small-holders in production had increased to over 75 per cent of hectarage and two-thirds of national production. To put this into a foreign exchange earnings perspective, over 95 per cent of the crop is exported and between 1975 and 1988, coffee accounted for 28 per cent of the value of all exports.

Table 2.1: Small-holders Contribution in Export Earnings through Coffee

Year	National area (hectares)	Exports (Metric Tonnes)	Small-holders as per cent of total area	Small-holders as per cent of total production
1975	86,389	67,615	66.9	52.4
1976	86,389	77,546	65.5	46.6
1977	84,421	94,314	67.0	50.5
1978	87,488	85,392	64.7	55.9
1979	92,569	72,241	52.5	63.8
1980	102,404	80,066	69.5	64.8
1981	117,591	86,108	72.0	74.3
1982	131,108	100,968	74.3	52.0
1983	134,572	90,444	75.0	58.0
1984	149,946	96,902	76.2	77.1
1985	152,039	104,668	76.5	64.7
1986	156,304	126,486	75.3	54.1
1987	155,354	99,967	74.5	67.9
1988	153,100	90,762	75.3	65.5
1989	156,000	97,500	76.0	67.0
1990	156,000	115,053	73.0	66.9
1991	159,000	82,291	75.5	59.4

Source: Pearson et al. (1995).

The contribution of small-holders to foreign exchange earnings as the government planned in terms of tea production, is evident from Table 2.2. Tea has been strongly promoted as a small-holder crop since independence and growth in Kenyan tea production has mainly taken place in the small-holder sector. In 1991, it produced more than 50 per cent of total output and contributed strongly to foreign exchange earnings.

Table 2.2: Small-holders Contribution in Export Earnings through Tea

Year	National area (Hectares)	Exports (Metric tonnes)	Small-holders as per cent of total area	Small-holders as per cent of total production
1975	61,541	52,550	60.0	34.0
1976	65,951	58,267	63.0	37.0
1977	68,500	70,220	64.0	49.0
1978	72,069	84,968	65.0	41.0
1979	74,300	94,023	66.0	40.0
1980	76,541	74,799	66.0	45.0
1981	78,896	75,350	67.0	47.0
1982	81,082	80,413	67.0	50.0
1983	81,536	99,938	67.0	51.0
1984	83,372	91,198	68.0	58.0
1985	83,837	126,303	67.0	56.0
1986	84,400	116,456	67.0	58.0
1987	87,400	134,627	67.0	49.0
1988	90,397	138,201	68.0	52.0
1989	93,394	163,279	69.0	56.0
1990	96,391	196,586	69.0	56.0
1991	99,830	175,555	69.0	55.0

Source: Pearson et al. (1995).

2.3.2 Some early agricultural export subsidy schemes

The need for intensive production among small-holder producers and improved performance among the commercial producers has been one of the main driving forces behind various instruments employed in wider agricultural policy. The main instruments have been pricing policy and development of agricultural marketing organisations. Kenya's agricultural policy has always emphasised the need to improve producer incentives through an integrated approach to agricultural development and increased public investment in the sector. However, Lele (1989) notes that with respect to output price policy, both implicit and explicit subsidies to the agricultural sector were nonexistent from the mid-1970's, even though at the same time, no export taxes were levied that could have discouraged agricultural development and growth.

Lele's observation notwithstanding, after initiating small-holder development programs, the government diverted its focus to more broadly based agricultural policy and

programs in the early years of independence between the mid 1960's and early 1970's. In some of these programs a substantial amount of government expenditure went into agricultural subsidies intended to support long-term growth in the sector and to maintain farmer incomes in the short-run.

The two main crops that received agricultural subsidies at this time were maize and wheat. In the case of maize, subsidy payments met losses incurred from exporting maize which had a higher domestic price than export price. Export subsidies were justified on the basis that maize production for export was expected to be a major source of growth for agriculture. The subsidies were meant to help farmers maintain production, have more widespread use of hybrid seeds and to adopt improved agricultural practices that were eventually to make unsubsidised exports possible. The export subsidies in the case of wheat were, on the other hand, supported by the argument that there was no prospect for Kenya being competitive in world markets without subsidies.

2.3.3 Agricultural price reviews and marketing boards

Annual price reviews were aimed at assisting farmers to meet the steady rise in costs of agricultural inputs and sustain and increase agricultural production. This was in accordance with the domestic policy that called for periodic revisions of producer prices in a bid to ensure consistent increases in producer prices to cover increasing costs of production.

To the extent that domestic demand was met fully by domestic farm supply, agricultural prices were based more on the prices at which those products could be sold in international markets. In reviewing agricultural prices, when there was underproduction of basic food or if agricultural incomes were reduced relative to other incomes, farm prices were adjusted upwards. Government policy was to continue improving the terms of trade of farmers to the extent that they were subject to government control and not dependent on the vagaries of international markets.

The development of an intricate marketing system for agricultural products through various regulatory boards and authorities involved in Kenya's agricultural sector was another method employed by government to promote agriculture. The boards were

initiated with the mandate to provide better marketing strategies and explore new export markets. Government policies targeted specific agricultural commodities and were also implemented through the boards.

Statutory marketing bodies were in two categories. The first category dealt with export commodities. Through these boards, Kenya hoped to gain an advantage in international pricing through centralised contracts rather than by allowing each farmer to compete. The second category of boards dealt with important domestic food commodities such as maize, wheat, rice, sugar and others. Without centralised marketing arrangements, the government thought that these products could be subject to severe price fluctuations. Purchase, storage and sale through statutory boards was meant to smooth out fluctuations and stabilise prices to the advantage of both consumers and producers.

Put another way, boards have been used to enforce pricing, production and marketing policies. The government has used them to control marketing arrangements to provide secure sales outlets and secure supply of agricultural output; stabilise food supply to both deficit and surplus areas; maintain strategic reserves for basic grains and prevent the exploitation of producers by traders. The argument in favour of price determination and state trading through the boards was justified by the government in the main elements of the National Food Policy (NFP). The NFP aims are to: ensure broad self-sufficiency in primary food commodities; ensure food supply security for each region in the country; and make sure that food distribution gives every Kenyan an adequate diet (Kenya, Republic of 1981).

Hence, agricultural pricing policy and marketing organisations tried to ensure that producers received attractive and stable prices and that consumers were supplied with food at reasonable prices. They were also employed to protect domestic markets through production of import-substituting crops and control of production and marketing of export crops. The government argued that official producer prices ensured higher incomes and more stable prices. Consumer price policies, on the other hand, were meant to safeguard consumers from unmanageable food price rises. The Kenyan government, as late as 1993, consistently defended the main instruments of its agricultural policy by insisting that control of prices was centred on national welfare requirements (Njuguna 1994).

2.3.4 Agricultural credit, extension, education and research

Producer credit schemes for the purchase of inputs have also been used to subsidise the agricultural sector. Provision of credit has been an integral component of general agricultural policy. This service has even been used to lend money for the development of specific crops. One example of the provision of credit facilities is the short-term credit scheme that was made available under the guaranteed minimum return program to finance wheat and maize production in the early 1980s.

Together with pricing policy, agricultural credit schemes and marketing boards, other agricultural services have been provided. Thus, there has been continuous direct government capital expenditure on agricultural education necessary for providing quality agricultural extension services. The economic rationale for expanding extension services was the presumed positive relationship between intensity in extension services and agricultural production.

Expenditure devoted to research has been complementary to the government's expenditures on agricultural education and extension services. Research funding has been geared towards making results as relevant as possible to those farming in different ecological zones, contributing to the diversification of agriculture (especially in marginal areas), developing crops and products which could earn foreign exchange, and developing local varieties of seeds which had been imported, thus saving foreign exchange.

2.3.5 Other agricultural development programs

Other important agricultural development services have included bringing idle and under-utilised land into production through irrigation schemes, squatter settlements, land registration and road development, including feeder roads for rural areas. Development of irrigation schemes was mainly undertaken in the late 1960's and 1970's and, due to frequent drought conditions and growing pressure on land, existing irrigation and land reclamation, became very important in the Kenyan agricultural sector. Considerable progress was made in the early 1970's in the provision of these agricultural development services. Major advances were recorded in adjudication and registration of land, range

development, provision of credit for farmers, expansion of irrigation schemes, development of schemes for resettling small-holders and investment in agricultural research to enlarge opportunities available to small-holders for increasing output and incomes.

The cooperative movement has also been a major and important development in Kenya's agricultural sector. Cooperatives have played a significant part in the management, choice and state of production technology as well as providing an incentive structure for producers. Benefits have accrued to members in the form of credit facilities, produce marketing and price determination. The cooperatives have acted as a useful and meaningful way of promoting the government policy of increased participation and mobilisation of rural communities. This has been possible because they have the ability to mobilise domestic savings and generate employment. This makes them an effective vehicle for fostering economic activity while intensifying efficient resource utilisation in the agricultural sector.

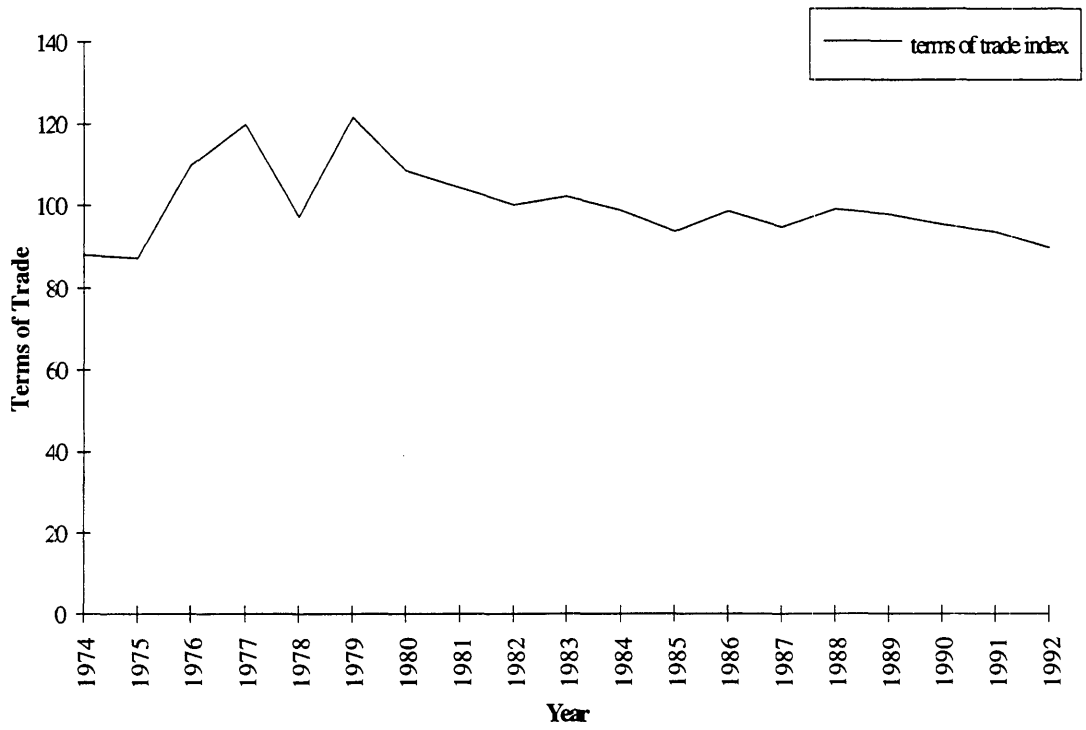
2.4 Performance Indicators for the Agricultural Sector

Given the important role of agriculture in Kenya's development strategy, how have the associated development efforts and policy initiatives affected the sector's performance? To answer this question requires evidence of how the agricultural sector has performed over the years. Conclusions about the effects of microeconomic policy initiatives and the various development efforts discussed in the previous section on the agricultural sector can be reached by appraising some of its performance indicators. However, it must be recognised that the policy initiatives and development efforts that resulted in the performance that will be seen in the various indicators operated in the existing general economic environment. It is the external events and economic policies (discussed in the next chapter) that created this environment and how they could have affected both agriculture and general economic performance that are the main focus in this study.

2.4.1 Agricultural terms of trade

The sector's terms of trade, as shown in Figure 2.1, have been erratic with a declining trend. They moved strongly in favour of the sector in 1976 and 1977, following continued deterioration in the previous two years. The improvement can possibly be attributed to the substantial rise in the prices of export crops, mainly the price of coffee during the coffee boom of the mid 1970's.

Figure 2.1: Terms of Trade of the Agricultural Sector (1982=100)



Source: Kenya, Republic of, *Economic Survey,* various issues.

As measured by prices received by farmers for their products relative to the prices they pay for inputs and their consumption needs, the terms of trade in Kenyan agriculture worsened in the early 1980's. One likely cause of the unfavourable terms of trade at this time might have been domestic inflation, which affects input costs and the rural cost of

living. This observation suggests a link between the agricultural sector's performance and economic factors that determine the level of inflation.

The terms of trade index, in addition to showing how prices paid and prices received by agricultural producers have varied over time, also reflects the impact of domestic agricultural support policies on the sector's profitability. The index has fallen below parity on some occasions, probably because support policies were not very effective. The questions that arise concern the causes of this ineffectiveness and whether it could be explained by factors outside the agricultural sector.

The observation that the agricultural terms of trade have sometimes fallen below parity makes it imperative to investigate the impact of domestic inflation on both farm input and consumer prices. Whereas the agricultural output price index has consistently been higher than the agricultural purchased input price index as shown in Figure 2.2, the terms of trade index for the agricultural sector has on average been falling.

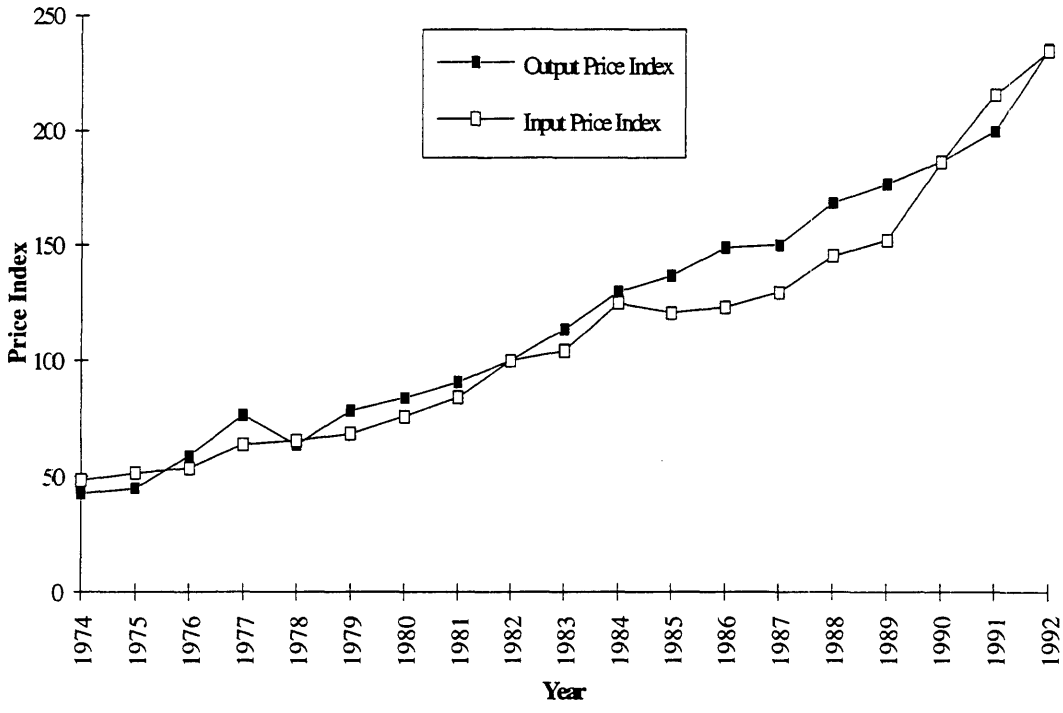
Therefore, the agricultural policy objective of ensuring acceptable price incentives for agricultural producers appears to have been compromised. Further, it is not clear whether the various non-agricultural focussed stabilisation and structural adjustment policies put in place to deal with macroeconomic imbalances (as discussed in the next chapter) can be associated with the worsening agricultural terms of trade.

World commodity prices are also pertinent to the agricultural sector's terms of trade through their effect on prices received by agricultural producers. Falling world prices, or a general stagnation in world prices, have a negative impact on the agricultural terms of trade and reduce returns to producers. Apart from the reduction in prices received domestically, the links between variability in agricultural commodity prices and the agricultural sector's terms of trade require further insight into exchange rate and trade policies used to deal with shocks introduced by the variability of commodity prices.

Such insights can be attained through analysis of the linkages between the agricultural sector and non-agricultural policies. For instance, exchange rate policies may have had a negative impact on agricultural performance by erasing positive effects of sector-specific policies. Trade polices such as high tariffs may have had combined effects that

discouraged agricultural production and exports and may have led to a decline in the agricultural terms of trade.

Figure 2.2: General Indices of Agricultural Output and Input Prices (1982=100)



Source: Kenya, Republic of, *Economic Survey,* various issues.

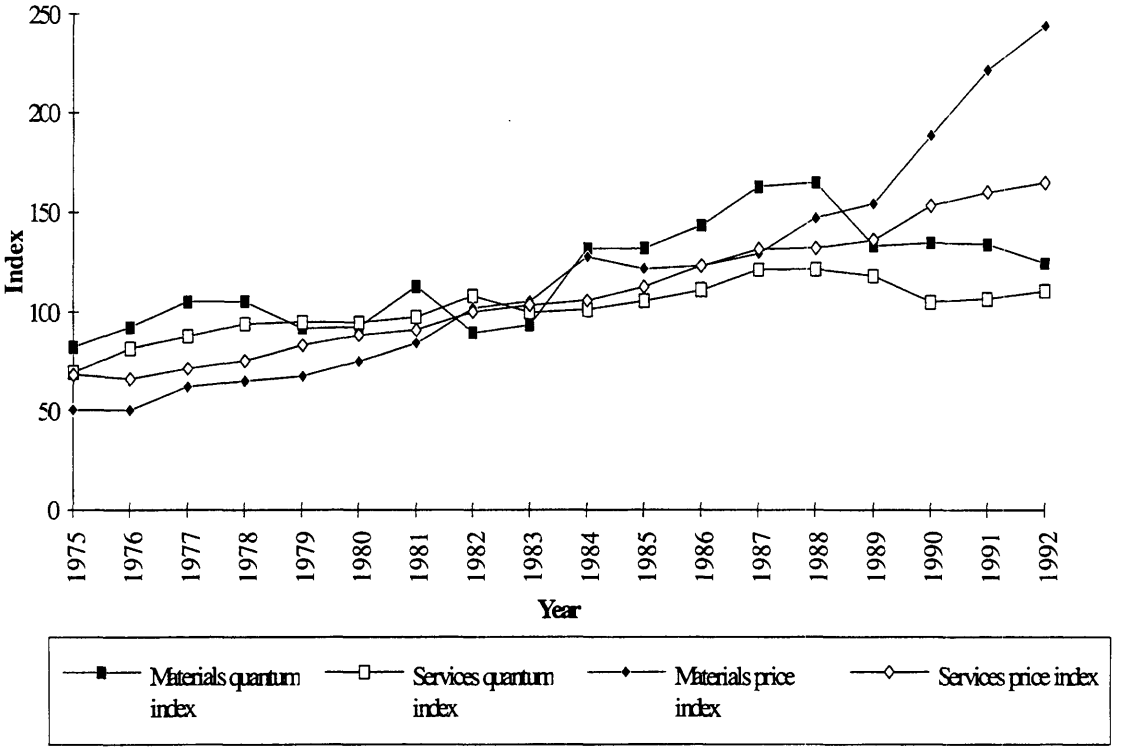
2.4.2 Agricultural inputs usage: a quantum measure appraisal

The quantum (quantity) index of agricultural inputs provides yet another performance indicator for the agricultural sector. The index indicates that stagnation occurred in some years as shown in Figure 2.3. This may reflect unavailable inputs, misuse of inputs or high input prices. These suggestions are implicitly supported by the quantum and price indices of the inputs plotted in Figure 2.3. The materials price index seems to have overtaken the services price index and this may in part explain the slowing down of agricultural performance. Material inputs are the most important of all agricultural inputs and include, fertilisers, chemicals, seeds, fuel and other forms of energy. As seen

in Figure 2.3, the rise in the input price index has been accompanied by stagnation and sometimes falls in the quantum indices as in the late 1980s and early 1990s.

In Kenya, structural changes in agricultural production and the use of agricultural inputs would be observed since official policy has been to increase returns from agriculture by ensuring that the input price index increases at a lower rate than the output price index. Therefore, immediate questions arise about how effective policies seeking to maximise agricultural production through input mix optimisation have been. Can the fluctuations and declines in the input quantum index seen in Figure 2.3 be explained simply by rapid increases in the price of inputs and the effects of shortages of foreign exchange on imported supply? Establishing sectoral and economy-wide factors causing fluctuations in the input quantum index addresses the two questions above which are important, given that the cost of essential agricultural inputs will continue to be a major source of concern to farmers.

Figure 2.3: Quantum and Price Indices of Agricultural Inputs (1982=100)



Source: Kenya, Republic of, *Economic Survey,* various issues.

2.4.3 Total agricultural output and food production indices

The government's agricultural policies of achieving food self-sufficiency, enhancing investment in agriculture, increasing incomes to farmers, promoting consistency between income growth and food security, given the constraint of a fixed land base and unstable prices for exports have continuously been reviewed. The impact of the policies with regard to food security through maize production is shown in Table 2.3.

Table 2.3: Food Security and Maize Production.

Year	Area ('000 Ha)	Production ('000 MT)	Net exports (imports) ('000 MT)	Apparent utilisation ('000 MT)
1975	779	1,692	120	1,572
1976	853	1,745	113	1,632
1977	1,002	2,079	8	2,071
1978	874	1,737	23	1,714
1979	938	1,602	120	1,482
1980	1,120	1,773	(324)	2,097
1981	1,203	2,502	(76)	2,578
1982	1,236	2,340	(88)	2,428
1983	1,200	2,133	123	2,010
1984	1,130	1,422	(358)	1,780
1985	1,240	2,430	(108)	2,538
1986	1,200	2,898	227	2,671
1987	1,200	2,416	248	2,168
1988	1,230	2,761	167	2,594
1989	1,260	2,631	0	2,631
1990	1,380	2,286	0	2,286
1991	1,310	2,520	0	2,520

Source: Pearson et al. (1995)

Maize, the 'backbone' of Kenyan agriculture, provides 40 per cent of the population's calorie needs and 85 per cent of the crop is grown on smallholdings. National food security through self-sufficiency in maize has been erratic. In some years, domestic production of this crop has been below apparent utilisation as indicated in Table 2.3. The food self-sufficiency performance can be illustrated further by looking at the production and utilisation of two other important food items in Kenya, wheat and milk. In the case of wheat (Table 2.4), which is the second staple in the country, the initial objective of self-sufficiency has not been met.

Table 2.4: Wheat Production and Food Self-Sufficiency.

Year	Area ('000 Ha)	Production ('000 MT)	Imports ('000 MT)	Apparent utilisation ('000 MT)
1975	117	180	n.a	180
1976	120	201	31	201
1977	138	184	40	184
1978	119	175	n.a	175
1979	87	172	75	172
1980	100	216	105	216
1981	99.7	214	154	214
1982	118.8	248	140	248
1983	120	144	140	285
1984	110	149	n.a	n.a
1985	118	225	150	375
1986	136	252	115	367
1987	145	207	218	425
1988	148	234	76	310
1989	153	303	124	362
1990	138	249	323	513
1991	143	264	n.a	n.a

n.a. = not available

Source: Pearson et al. (1995).

A pattern of production similar to that of maize occurs with milk production which is important on most Kenyan farms. There have been years when the country met its domestic needs and retained some for export, but most years the country imported milk to cover domestic demand. This is illustrated in Table 2.5.

A shortage of land combined with uncertainties in farming has discouraged growth in agricultural production. Policies are needed to reverse this. The need for such policies is evident from the trend in Figure 2.4. The performance of the agricultural sector in terms of aggregate food production is shown in Figure 2.4 where a declining trend in per caput food production is discernible. Therefore, in spite of price incentives to encourage farmers to produce more, the agricultural sector has failed to maintain output growth in line with population growth.

Table 2.5: Milk Production and Self-Sufficiency in Kenya.

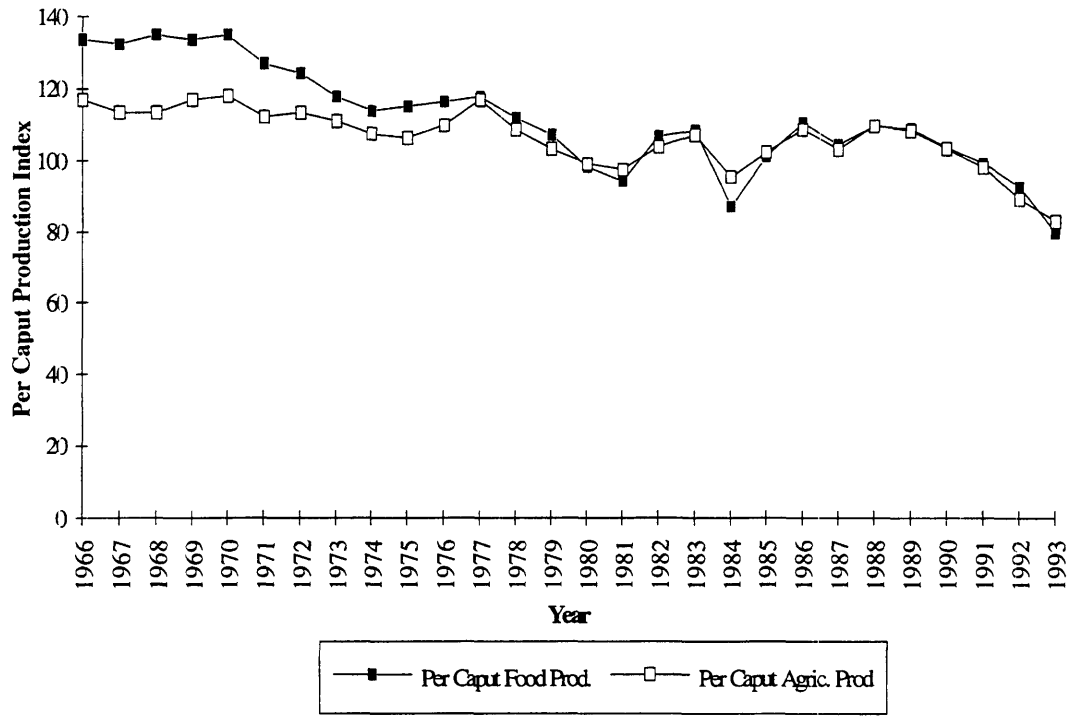
Year	Recorded production ('000 lt)	Net exports (imports) (MT powder)	Per capita consumption (lt/yr)
1971	220,400	(512)	18.9
1972	268,400	2,317	19.5
1973	279,700	3,821	18.4
1974	249,800	1,359	17.5
1975	230,600	(584)	17.0
1976	208,658	117	14.4
1977	259,450	(183)	17.5
1978	269,796	1,489	16.3
1979	240,559	1,330	14.0
1980	186,885	(12,805)	19.6
1981	222,895	(11,179)	19.9
1982	260,336	(4,190)	17.0
1983	274,200	(4,502)	17.3
1984	189,900	(11,092)	16.0
1985	231,400	(6,582)	15.1
1986	316,200	(1,300)	15.8
1987	347,300	110	15.9
1988	358,900	1,841	15.0
1989	351,200	1,129	15.0
1990	360,263	n.a.	14.7

n.a. = not available

Source: Pearson et al. (1995).

The self-sufficiency objective has been under threat given the trends shown in Tables 2.3, 2.4, and 2.5, and Figure 2.4. Scarce foreign exchange has been used to supplement domestic food production with imports. This raises questions about the effectiveness of agricultural policy.

Figure 2.4: Per Caput Food and Agricultural Output Production Indices (1981=100)



Source: Food and Agricultural Organisation (FAO), *Production Yearbook*, various issues.

2.5 Concluding Remarks

In this chapter, the role that agriculture is expected to play in various economic development strategies formulated by the Kenyan government is discussed. Some examples of the development efforts and policy initiatives that have been taken to improve the sector have been provided and performance indicators for agriculture have been discussed. Questions were also raised about how effective the sector specific policy initiatives have been judging from the outcomes reflected in some of the performance indicators. As expressed by Pearson et al. (1995), the first agenda item when the effectiveness of agricultural policy is being questioned would be to understand the economic environment in which the policy operates. This is because the agricultural policy works in an environment created by external events and macroeconomic policies pursued by the government. Hence, this study does not address the agricultural policy effects *per se*, but, rather, the effects external events and general economic policy have

on the environment affecting the agricultural sector in accordance to recommendations of Pearson et. al. (1995).

The next chapter explains the scope of the research problem which is defined around external shocks that have hit the Kenyan economy. The research problem is restricted to the effects of external shocks and some of the adjustment policies that were used (or not used) to address macroeconomic imbalances created by external shocks.

3. External Shocks on the Kenyan Economy and the Policy Responses

3.1 Introduction

In the previous chapter, the important roles the agricultural sector has been assigned in Kenya's economic development strategy were discussed. Prima-facie evidence of the performance of the agricultural sector since the beginning of the 1970s was presented and questions were raised given the importance of the sector in the overall economic development of Kenya. Those questions underlined the observation by Pearson et al. (1995) that defining a feasible strategy is a necessary first step in agricultural development. However, Pearson et al. (1995) note that most farmers and marketers in Kenya will not respond to government rhetoric, no matter how sensible and well presented. Instead, producer behaviour changes only in response to incentives. Hence, there is a need to focus on the effects of external shocks and government policies in dealing (or not dealing) with the shocks on incentives faced by agricultural producers. This important issue concerning the effects of external shocks, adjustment and stabilisation policies on the agricultural sector forms the scope of this study. It is on this same matter that Pearson et al. (1995) wrote: 'Despite the central role of agriculture in the Kenyan economy, policymakers rarely, if ever, decide macro policies to benefit this sector alone. But the effects of macro policies on agriculture need to be well understood even if this set of policies has to be taken as given in deciding agricultural incentives.'

In this chapter, more details of the external shocks discussed briefly in Chapter 1 are provided. It is shown how they affected the economy and how the need was created for government to put in place appropriate economic adjustment policies to rectify the economic impact of the shocks. It is the effects of these shocks on agriculture and the policies implemented (or not implemented) that are investigated in this study. The chapter is organised as follows. Section 3.2 describes the external shocks that have affected the Kenyan economy. This is followed by a brief illustration of the effects of two of these disequilibria on the balance of payments in Section 3.3. Section 3.4 outlines the various policies put in place to deal with each macroeconomic imbalance between the mid-1970s and early 1980s. This is then followed by another outline of the adjustment

and stabilisation policies recommended to the government by World Bank and IMF in Section 3.5. The chapter concludes with some remarks in Section 3.6.

3.2 External Shocks

This section describes the external shocks that have affected the economy and how they occurred. Disaggregated growth rates for GDP capture the impact of different macroeconomic disequilibria created by the external shocks on the performance of both the aggregate economy and on different sectors. Table 3.1 shows the growth rate (per cent) of real GDP in Kenya and includes the years when the imbalances discussed in this study took place.

3.2.1 The first oil-price shock

The first major terms of trade shock to hit independent Kenya occurred during the first oil crisis. Petroleum prices more than quadrupled from under US$3 to over US$12 a barrel in 1973-4. The oil price rises led to a significant deterioration in the balance of trade. Import prices rose more swiftly than those of exports. At this time, the balance of payments situation was relatively weak because of rapid expansion in government spending and associated heavy borrowing from abroad. As a result, the economy suffered a large terms of trade deterioration from the oil-price shock given that it was already fighting a balance of payments problem arising from an earlier public investment boom (Little et al. 1993).

The consequences of the terms of trade shock resulting from the oil crisis were: deterioration in the balance of payments; an acceleration of inflation; the recession that the industrial market economies went into in 1974-5 and hence a fall in demand for exports from Kenya; and a fall in demand for domestic output. Due to the oil-price shock, maintaining the level of growth achieved in the first nine years after independence became a difficult task. Substantial and progressive falls in real GDP growth from a high of 6.7 per cent in 1964-72 to only 3.1 per cent in 1975 occurred as shown in Table 3.1. This decline is linked to the steep increase in the price of crude oil and the prices of other imported goods.

Table 3.1: Growth Rates of Real GDP

Year	Agriculture	Manufacturing	Government services	Others	Total GDP
1964-71[1]	4.2	8.2	9.8	6.9	6.5
1972	7.6	7.3	12.8	3.6	6.8
1973	4.4	14.4	6.3	1.0	4.1
1974	-0.2	5.9	6.8	1.0	3.1
1975	4.6	4.0	8.5	-0.01	3.1
1976	3.7	14.0	5.1	2.0	4.2
1977	9.5	16.0	5.1	6.1	8.2
1978	8.9	12.5	6.4	8.4	7.9
1979	-0.3	7.6	7.1	7.7	5.0
1980	0.9	5.2	5.6	5.2	3.9
1981	6.1	3.6	5.3	6.9	6.0
1982	11.2	2.2	3.8	1.4	4.8
1983	1.6	4.5	4.2	1.5	2.3
1984	-3.9	4.3	2.9	2.7	0.8
1985	3.7	4.5	4.2	1.5	4.8
1986	4.9	5.8	6.3	5.4	5.5
1987	3.8	5.7	5.7	4.9	4.8

Source: Kenya, Republic of, *Economic Survey*, various issues.

The external situation created by the first oil-price crisis generated three interrelated 'squeezes': a price 'squeeze'—caused by import prices rising more swiftly than export prices; a commodity 'squeeze'—caused by the need to increase exports to pay for the same quantity of imports which in turn reduced the volume of goods available for domestic consumption; and a credit 'squeeze'—caused by a decline in flow of funds from abroad to finance balance of payments deficits.

The price 'squeeze' was reflected in the worsening of the terms of trade which deteriorated between 1972 and 1975 (Figure 3.1). However, late in 1976 and in the first half of 1977 coffee prices rose very rapidly and the switch from coffee to tea by consumers also caused increases in the price of tea. As a result, the terms of trade recovered in 1976 and even more in 1977.

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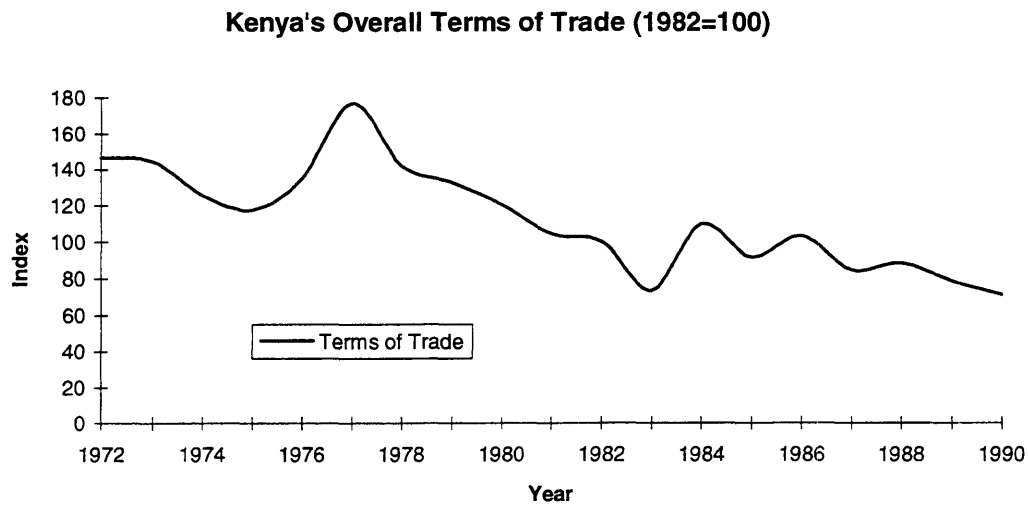
[1] For the years 1964-71, 1972 prices are used and for 1972-1987, the 1982 prices are used.

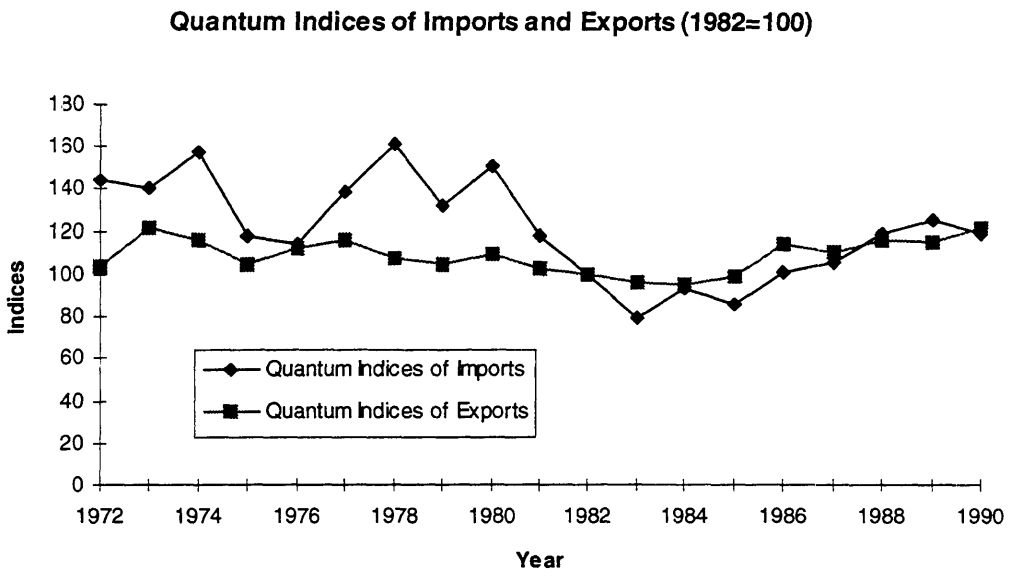
The impact of the commodity 'squeeze' is best illustrated by the effects it had on the volume of external trade as shown in Figure 3.2. In terms of index numbers, the volume of exports had risen by 1974 compared with 1972. Exports then declined in 1975, but picked up steadily and by the end of 1977 had reached the 1974 level. Although there was an increase in the volume of imports, the index by 1977 had only risen slightly.

Figure 3.1: Kenya's Overall Terms of Trade: 1972-90



Source: Author's computation from data contained in Kenya's *Economic Surveys*.

Figure 3.2: Quantum Indices of the Volume of Kenya's External Trade



Source: Kenya, Republic of, *Economic Survey,* various issues.

The third aspect of the impact of external events concerns the credit 'squeeze'. There was a large reduction in the country's international reserves in 1974 that occurred despite an increase in net capital inflow. This was because of the sharp increase in the deficit on the current account of the balance of payments. This caused the money supply to fall in real terms, credit was restricted, and the Kenyan shilling was devalued by 14 per cent in September 1975. There was a turnaround in 1976 and 1977 following the boom in commodity prices which resulted in a significant swing in the balance of payments and restoration of a reasonable rate of growth in the economy as a whole.

3.2.2 The main coffee boom

In late 1975 a severe frost affected the Brazilian coffee crop. This led to an unexpected boom in the price of coffee and tea in late 1976 and during 1977. Average coffee export prices quadrupled from Kenya shillings 10.40 per kilogram in 1975 to Kenya shillings 43.33 per kilogram in 1977 (Kenya, Republic of 1978). Over the same period, the price of tea rose rapidly from Kenya shillings 8.70 per kilogram to Kenya shillings 20.44 per

kilogram.

The immediate impact of the boom in prices of coffee and tea was reflected in the balance of trade which registered substantial surpluses in 1977. The negative balance of payments from the oil crisis was reversed. The boom lasted for three years between 1976 and 1978 inclusive, offset the oil shock, and led to an improvement in the terms of trade.

3.2.3 Commodity prices collapse, interest rate and second oil-price shocks

The onset of the second oil crisis saw the world price of crude oil increase from US$13 per barrel in 1978 to US$27 in 1979. This increase was much larger than the rise of US$6 in 1973/74 which generated the first crisis. The developed countries responded by adopting inward-looking protectionist measures and restrictive fiscal and monetary policies to control inflation. Consequently, high international interest rates, payments imbalances and slow growth were dominant in the world economy in 1981. The sluggish growth in developed countries resulted in reduced demand for imports from developing countries and stagnation in world trade. This meant that Kenya's terms of trade and purchasing power remained very weak. The growth rate of GDP at constant prices fell from 8.2 per cent in 1977 to about 5 per cent in 1979 and to 3.9 per cent in 1980 (Table 3.1).

Hence the negative effect on the terms of trade resulting from the second oil-price shock in 1978-9 after the coffee boom died away in late 1970s was made worse because Kenya had inadequately adjusted to the oil price shock of 1973-4. In fact, the current account deficit increased in the 1970s along with foreign debt. This placed the economy in a precarious situation for the period 1979-83 when it experienced shocks resulting from the second oil-price shock. The shock was further worsened by a fall in the price of coffee; a rise in international interest rates between 1979 and 1981 and slow growth in the Organisation for Economic Co-operation and Development (OECD) countries. These factors had a negative effect on the volume of exports from developing countries including Kenya. The lower growth in income and consumption in the industrialised countries meant low growth in demand for primary products and also downward pressure on prices of primary commodities worsening the terms of trade of a primary

commodity exporting country like Kenya. The interest rate shock that followed the use of restrictive monetary policies to combat inflation in the leading OECD countries had serious ramifications, given Kenya's foreign debt.

3.2.4 Tea and coffee price booms and fall in oil prices

The year 1983 was one of changing economic fortunes for Kenya and the world. In this year, crude oil prices dropped from US$34.52 per barrel in 1981 to US$28.40 (Kenya, Republic of 1984b). At the same time, the world economy began to recover from recession.

Despite lower inflation rates, interest rates remained high and Kenya's debt servicing burden became acute. The government responded by improving the management of foreign exchange reserves through a tight monetary policy. Around this time, prices of coffee and tea increased respectively from Kenya shillings 28.64 per kilogram and Kenya shillings 19.30 per kilogram in 1982 to Kenya shillings 35.40 per kilogram and Kenya shillings 24.70 per kilogram in 1983. GDP grew in real terms by 2.3 per cent in 1983. The deficit on the current account of the balance of payments fell to its lowest level since 1977 and inflation fell from 22.3 per cent in 1982 to 14.5 per cent (Kenya, Republic of 1984b).

3.3 Disequilibrium Effects on the Balance of Payments: 1972-1981

To illustrate the nature and effects of the disequilibria described so far, a further discussion of the balance of payments shocks following the oil crisis and the coffee boom follows. The trends that caused the balance of payments deterioration over the 1972-1981 decade are analysed. This analysis is summarised from the 1982 *Economic Survey* (see Kenya, Republic of 1982).

In a relatively small country like Kenya, which has a very open economy, imports and exports are of central importance to total economic activity. The central government budget is strongly influenced by the balance of trade, not only because its revenues are sensitive to the general state of the economy, which in turn is affected by the balance of payments, but also because a substantial percentage of total tax revenues is from import

duties. Consequently, when the balance of payments deteriorates, the whole economy is affected. Large deficits depress both the money supply and incomes while stagnant exports depress the domestic economy. The budget is also adversely affected, making it difficult for the government to balance its budget without increasing taxation, cutting back on spending or generating inflation by borrowing from banks (Kenya, Republic of 1982).

Kenya's balance of payments first ran into serious difficulties in 1974 during the first oil crisis (Table 3.2). In fact, the decrease in the rate of economic growth dates from that year (refer back to Table 3.1). Fortunately, there was an economic revival in 1976-78 when the coffee boom took the pressure off the balance of payments. The annual current account deficit rose substantially in 1974-75 and then diminished temporarily due to the coffee boom in 1976-77 and increased sharply after 1978. The surpluses on the basic balance in 1972-73, 1976-77 and 1979 indicate that Kenya was able to finance its current account deficits. However, the large deficits in the basic balance in 1974-75, 1978 and 1980-81 indicate that Kenya could not comfortably finance its current account deficit in these years. These deficits in the basic balance may explain the large capital inflows recorded. These long-term capital inflows greatly increased Kenya's external indebtedness. By 1981, the long-term external debt servicing cost was absorbing a significant share of export earnings. Thus, the large debt and its servicing cost became part of the balance of payments problem. By 1981, it was not possible to sustain the rate of expansion of foreign debt that had occurred in preceding years.

The overall balance is another indicator of the health of a country's balance of payments and it essentially indicates trends in the country's international reserves. Deficits on the overall balance can only be paid for by borrowing from international organisations or by reducing reserves. The last column of Table 3.2 (recording change over the decade) shows that the deteriorations in the basic and overall balances during the decade were considerably smaller than for the current account. This implies that increased inflows of long and short-term capital permitted Kenya to finance a large part of its current deficits and thus to soften the impact on reserves.

Table 3.2: Summary of Balance of Payments Indicators (Kenya Pounds in Millions).

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	81 - 72
Exports (1)	120.5	164.5	207.5	232.4	312.1	468.0	369.4	385.5	461.0	462.8	342.3
Imports (2)	191.1	215.8	366.4	314.5	389.4	529.3	724.9	684.9	976.8	995.3	804.2
Balance of trade (3)=(1)-(2)	-70.6	-51.2	-158.9	-82.2	-77.3	-61.3	-355.5	-299.4	-515.8	-532.5	-461.9
Net services and transfers (4)	32.1	-6.4	32.9	-24.9	13.0	46.6	71.3	83.0	142.4	198.9	166.8
Current account (5)=(3)+(4)	-38.4	-51.6	-126.1	-107.0	-64.3	-14.7	-284.2	-216.4	-373.4	-333.6	-295.2
Net inflows of long term capital (6)	44.7	58.9	82.9	80.5	103.1	111.0	196.9	219.6	257.3	182.0	137.3
Basic balance (7)=(5)+(6)	6.3	1.3	-43.2	-26.5	38.8	96.3	-87.3	3.2	-116.1	-151.6	-157.9
Movements of short term capital (8)	2.2	6.2	11.6	8.9	-3.2	16.4	9.7	67.4	43.9	52.5	50.3
Overall balance (9)=(7)+(8)	8.5	7.5	-31.5	-17.6	35.6	112.7	-77.6	70.6	-72.2	-99.1	-107.6
Reserves (10)	66.6	76.6	68.5	70.6	114.0	208.6	133.3	234.5	187.0	126.4	-
Months of imports by reserves (11)	4.3	4.5	3.1	3.2	4.1	6.5	2.9	4.4	2.8	1.7	-
Proportion of import bill covered by export earnings (12)	63%	76%	57%	74%	80%	88%	51%	56%	47%	46%	-

Source: Kenya, Republic of, 1982 *Economic Survey*.

The components of the current account reported in Table 3.2 indicate that there were substantial increases in receipts from exports. The worsening of the balance of payments can therefore be linked to imports, which increased more than five-fold over the period. Therefore, the most obvious source of Kenya's difficulties was the huge increase that occurred since 1972 in the world price of oil. Since import costs were going up more rapidly than export earnings the latter were paying for a diminishing share of the former. The proportion of the import bill covered by export earnings by 1981 was equivalent to less than half the cost of imports having fallen from 63 per cent cover in 1972 (Table 3.2). The situation seems to have worsened after the second-oil shock in 1979 which resulted in a further three-fold oil price increase. This would indicate that the Kenyan government had not been able to deal with the balance of payments problem.

The adverse effects on Kenya's terms of trade from developments in world prices of non-oil trade are reproduced in Table 3.3. In principle, the terms of trade index is obtained by dividing the export by the import price index and multiplying by 100. It is thus an index of the import purchasing power of a unit of exports.

Table 3.3: Indices of Export and Import Prices and Terms of Trade, 1972-1981

	1973	1974	1975	1976	1977	1978	1979	1980	1981
(A) Total Trade									
Export prices	114	152	175	238	338	286	405	367	379
Import prices	114	178	225	261	282	298	345	451	571
Terms of trade	100	85	78	91	120	96	88	81	66
(B) Trade excluding petroleum and petroleum products									
Export prices	115	139	150	241	321	263	265	289	270
Import prices	115	158	194	225	245	268	297	353	405
Terms of trade	100	88	79	95	131	98	89	82	67

Source: Kenya, Republic of, *Economic Survey*, various issues

Taking overall trade first, both export and import prices increased dramatically over the period, however at varying rates. The terms of trade deteriorated sharply in 1973-75 during the first oil crisis, recovered dramatically in 1976-77 because of the coffee boom and then fell until 1981 following the second oil shock and the fall in international

commodity prices. In 1981, a unit of export was worth only two-thirds of the quantity of imports that it would have bought in 1972. With import prices rising so rapidly and export prices generally failing to keep pace, the balance of payments moved further into deficit.

That the worsening terms of trade can only be attributed partly to the impact of higher oil prices is shown in the lower half of Table 3.3 which excludes petroleum products from both import and export indices. Import prices generally rose faster than export prices, except for the coffee/tea boom years of 1976/77. During these two years the world prices of the two principal staple exports reached unprecedented levels and the country experienced windfall gains. Thereafter, the deterioration in terms of trade continued.

In general, changes in the terms of trade were negative in the decade under review. This reduced the benefits Kenya could obtain from international trade and had the effect of slowing economic growth and redistributing income from Kenya to the Organisation for Petroleum Exporting Countries (OPEC) and OECD countries in particular.

The behaviour of export earnings determines a country's ability to import. When exports are 'doing well', more imports are possible without creating balance of payments difficulties. The performance of Kenya's export sector was one of the chief underlying sources of difficulty over the decade under review. In the context of export incentives, exchange rate adjustment is important. In most cases Kenya is a price taker on world markets (although pyrethrum is a partial exception). What most determines the real return obtained by the export industries are the exchange rate and the rate of domestic inflation.

Given the poor past performance of the export sector and the difficult payment situation during the decade, the balance of payments deteriorated because of poor export sales. The incentives that were available then probably needed to be examined to establish how changes in them could have improved performance.

3.4 Adjustment and Stabilisation Policies: Mid-1970s to Early 1980s

The external shocks described in Section 3.2 led to instability in the balance of payments illustrated in Section 3.3. The disequilibrium in the balance of payments is only one example of how the external shocks affected the economy. There were other disequilibrium effects on macro variables such as inflation and government fiscal balances, among others. These disequilibrium effects needed economic policies to be set in place to deal with the terms of trade shocks creating them. The policies, like the external shocks themselves, are likely to impact on specific sectors in the economy. In this section, the various responses by the Kenyan government to different economic shocks are outlined. This is clarified by briefly considering how the Kenya government responded to the unfavourable 1974 and 1979 terms of trade shocks that arose from oil price increases. Moreover, the government's response to the favourable terms of trade shocks from the coffee booms of 1976-78 and 1986 is considered.

3.4.1 Policy response to the first oil-price crisis

The difficulties arising from the oil crises and world recession led to a severe balance of payments problem in Kenya which could only be contained by curtailing domestic demand for foreign goods and services. Thus, direct restraint of imports and promotion of exports was advocated. This strategy required domestic production be further stimulated to promote import substitution and to encourage export industries. It was believed that the longer term objectives of promoting growth, employment and an improved distribution of income could still be attained.

In the wake of the global recession that followed the oil price increases and the credit 'squeeze' caused by reduced external funds, the rate of growth in overall real GDP in 1974 was only 3.1 per cent. The government responded by introducing a comprehensive program to restrain both public and private consumption.

All forecasts for 1975 were subject to great uncertainty and the course chosen to deal with this exceptional situation had to gauge the relative dangers of inflation and recession. The government endeavoured to broaden the tax base by imposing higher rates of duty on non-essential and luxury consumer goods. It also sought to induce

industry to adopt more labour intensive techniques by raising duties on imported capital goods. In addition to these measures, the government endeavoured to reduce the consumption of petroleum products. Income tax was also made more progressive.

Expansion of total domestic credit was limited to 16 per cent, although the agricultural sector was to be allowed to raise its share of total credit to 17 per cent of net deposits of commercial banks. In July 1976, the liquidity ratio of commercial banks was raised from 15 to 18 per cent. These restrictions together with the fiscal measures noted above were aimed at reducing the exceptional deficit in the balance of payments.

These policies were not particularly successful in terms of controlling inflation. However, in 1976 there was evidence of a return to a more normal balance of payments situation. Consequently, credit restrictions were eased in 1977, a risk taken to secure a higher domestic rate of growth in the economy despite problems that could arise with inflation.

In summary then, in response to the terms of trade shock emanating from the first oil-price crisis, the government tightened restrictions on imports and credit controls. There was also a devaluation of the shilling by 14 per cent in 1975. In addition, government investment was reduced. Other investment fell as a result of the credit 'squeeze'. However, government consumption rose. It was supported by foreign borrowing from the International Monetary Fund (IMF), the World Bank and from commercial sources. The question is, what effects did these policies have on the impact of the external shocks on the economy? More specifically, how did these policies affect the agricultural sector?

3.4.2 Policy response to the major coffee boom

The government response to the main coffee boom can be documented as follows. The price rise in coffee accrued to producers since there was no export tax. Despite the lack of any serious attempt to tax the boom directly, government revenue did rise and the coffee boom was followed by rapid expansion in government spending. The bulk of the increased spending was in the form of consumption rather than capital formation. However, there was a private investment boom starting in 1976 as a consequence of the coffee boom. Consumption proved hard to restrain when coffee prices fell.

Immediately before the coffee boom, in September 1975, the Kenyan government had devalued the shilling by 14 per cent. Thereafter, the nominal exchange rate was held constant throughout the boom period. The exchange rate was not seen as a policy instrument and remained fixed. At this time, between 1975 and 1980, the exchange rate did not change and was fixed to Special Drawing Rights.

Exchange controls on capital movements were vigorously enforced during the coffee boom. Private savings could not be invested abroad and private agents faced a restricted choice as to which assets they might acquire with their savings from the boom. They were denied access to foreign financial assets even via the banking system. Hence, exchange controls proved to be a powerful disincentive to invest in financial assets.

In Kenya, trade restrictions existed since independence and took the form of quotas and tariffs. Given the coffee boom, the government was faced with an influx of foreign exchange and had the choice of relaxing the controls partially or completely or maintaining them as they were. Since the exchange rate was fixed, trade policy took a very significant role and import restrictions through quotas were relaxed and tariff revenues rose.

The government used two instruments to control the banking system; the cash-to-deposits ratio and interest rate ceilings. Nominal interest rate ceilings were imposed so that real interest rates were negative which reduced the flow of savings to the banks. The banks were also constrained by a minimum cash-to-deposits ratio requirement set by the Central Bank of Kenya. This restricted their capacity to make loans, despite their deposit inflow. As a result of these controls, only a very small percentage of private sector capital formation was financed through the banking system. In a credit-constrained economy like Kenya, many private agents wished to borrow more than was available before the coffee boom. The government did try to allocate bank loans to favoured sectors. However, the allocations were not enforced. This implied that acquisition of financial assets was an unattractive form of savings and only real investments could grow. Perhaps with freer markets the coffee windfall would have been spread over a longer period and investment may have been more efficient. One side effect of the foreign exchange controls is that increased asset demand for domestic money meant a temporary financial liberalisation.

Thus, the government's response to the terms of trade shock from the coffee boom can be summarised as follows: the government allowed the benefits to accrue to the producers; the fixed exchange rate was held constant; exchange controls were maintained; nominal interest rates were unaltered; there was some relaxation of import quotas and only small modifications of the cash ratio requirement for commercial banks took place. Once again the question that immediately comes to mind is what effects did this policy stance have on the impact of the external shocks. Would the outcome have been different if the government pursued a different policy direction?

3.4.3 Policy response to second oil-price shock and the fall in commodity prices

In the case of the terms of trade shock from the second oil-price shock, the Kenyan government was slow to react. Government investment and consumption had risen as a result of rising revenues that accrued from the coffee boom, but fiscal discipline had been lost and expenditure was rising faster than revenue. Foreign and domestic borrowing rose, the former mainly from the World Bank and the IMF. This was in spite of the fact that by 1979 there was need for adjustment due to large external debt and a large unsustainable current account deficit that was rapidly adding to that debt.

Import controls were tightened. The government's resistance to an earlier IMF recommendation to devalue in 1979 eventually led to devaluations of 16 per cent in 1981 and 24 per cent in 1982. There was also fiscal retrenchment, mainly cuts in public investment in 1981-82. Controlled interest rates were raised.

3.5 Adjustment and Stabilisation Policies: Since Mid-1980's

The stabilisation and adjustment policies that have been discussed above were put in place to tackle specific terms of trade shocks. These were the oil-price shocks of 1973-74 and 1978-79 together with associated recessions in the developed countries; the rapid increases in international interest rates between 1979 and 1981; the effects of the two coffee booms; and the virtual halts in commercial bank lending which meant that Kenya could not get easy access to money that could be used for balance of payments purposes.

Following the first oil price shock of the early 1970s, the pace of growth of Kenya's

economy slowed down. The economy has never completely recovered because of the exacerbation of this by: declines in prices of domestic primary exports; increases in interest rates; foreign debt repayment obligations; declines in official development aid; and partial withholding and pegging of aid to economic and political reforms.

The experience of the 1970s and the early 1980s called for action to halt the economic stagnation, revitalise growth prospects and restore internal and external macroeconomic equilibria. In response to this need, and especially since 1986, the government, with assistance from international aid donors, initiated a structural adjustment program with the long-term objectives of redressing economic imbalances, stimulating growth and restoring sustainable development. In other words, the persisting imbalances of the late 1970's and early 1980's and the recognition that something needed to be done if future terms of trade effects are to be handled in a better way that benefits the Kenyan economy, prompted the Kenyan government to lay down policies to address them starting in the mid-1980's. Hence, unlike in the past when stabilisation and structural adjustment policies addressed particular events, the policies from the mid-1980s have been implemented with the overall objective of enabling the economy to cope with the new international environment and also to be prepared to withstand shocks similar to those in the past.

The policies put in place were introduced as part of a bigger policy reform program in the developing countries under the auspices of the World Bank and the IMF. This has continued ever since with major policy changes taking place in the period between 1992 and 1994. The aid embargo on Kenya by the developed nations in 1990 and other shocks described above, all contributed to convincing policy makers of the need for Kenya to embrace the policy packages of structural adjustment and economic policy reforms advocated by the two Bretton Woods institutions.

The policies pursued, as in most other sub-Saharan countries, have been in two categories. The macroeconomic stabilisation policies supported by the IMF and the structural adjustment policies supported by the World Bank. In fact, the adjustment experience aimed at addressing past and future macroeconomic disequilibria has involved a combination of macroeconomic stabilisation policies and structural reforms that have economy-wide implications.

3.5.1 Stabilisation policies

Stabilisation policies have been required to address both large external and internal imbalances and, where possible, they have aimed to reduce the vulnerability of the economy to external and internal shocks. Stabilisation policies have mainly been through fiscal and monetary policy reform.

Under the fiscal reforms, various policy instruments have been implemented through a fiscal austerity program which, among other things, reduced public investment, froze wages in the public sector (including promotions and employment), introduced a value-added tax, cut other government expenditures even in essential services like education, health and agriculture, put credit ceilings on the public sector, froze short-term external borrowing and set ceilings on long-term borrowing.

Under the monetary policy reforms, the stabilisation instruments included policies such as: slower monetary growth by carefully controlling the money supply; revamped use of Treasury bonds to strengthen control over monetary policy; seeking positive real interest rates from the previous implicit negative ones; market-determination of interest rates; and imposition of credit 'squeeze's, whenever required through the Central Bank of Kenya.

3.5.2 Structural adjustment policies

The principal components of the structural adjustment program pursued since 1986 were: a reduction in the fiscal deficit; gradual liberalisation of the trade sector; progressive removal of internal price controls; implementation of favourable monetary policies; and implementation of a conducive exchange rate policy. Structural adjustment programs have been implemented with the aim, among other things, of moving the economy toward a greater reliance on the market.

Under the programs, government has implemented economy liberalising policies. Among them are trade liberalising policies which have included tariff reductions, removal of import licensing, lifting of import restrictions, relaxation of investment restrictions and dismantling of quantitative restrictions on imports. In the long run, it is expected that the trade liberalisation programme will be financed from increased export revenue and

additional foreign direct investment. However, in the short and medium terms, the costs of liberalisation have been met through a considerable increase in external loans and grants.

Another major structural adjustment program has entailed the liberalisation of financial markets. This has mainly been through reform of the banking sector which has been undertaken to increase the role of market forces in attracting deposits and allocating credit. Other changes in the financial sector have entailed removal of ceilings on deposit and lending rates, hence market determination of interest rates, lifting of sectoral credit ceilings, abandoning subsidised liquidity credits, and development of capital markets to strengthen the financial sector. This last change has led to removal of exchange controls that prevented foreign investors from participating in the Nairobi Stock Exchange.

The majority of the policy measures centred on liberalisation of interest rates, establishment of new and modernised legislation in the banking and security markets, closure of insolvent financial institutions, and introduction of money market instruments for management of liquidity and other monetary transactions.

Other major stabilisation and adjustment policies that have been undertaken are the exchange rate devaluation, removal of price controls including the freeing of agricultural prices, self-restraint in agricultural subsidies, higher production prices in agriculture and privatisation of public enterprises.

In pursuing these policies the government made substantial foreign exchange available to domestic industries to import plant machinery and equipment, raw materials and spare parts. This was done to allow local industries to produce and sell at prices that are competitive in world markets, a strategy intended to diversify exports. The SAPs (as the structural adjustment policies are popularly known), it was hoped, would allocate available resources in a better way and effect a gradual shift in the economy towards competition, openness and disciplined market operations.

3.6 Concluding Remarks

In this chapter the different external shocks that have affected the Kenyan economy have

been described. The policies that the government pursued at the time these shocks occurred have also been outlined. Moreover, the macroeconomic stabilisation and structural adjustment policies recommended by the World Bank and the IMF for implementation since the mid-1980s have also been described. In the discussion, it was mentioned that the policies that the government used to deal with external shocks were likely to have had effects on the impact of the shocks on the economy. This defines the scope of this study which is to analyse the effects of the different external shocks on the Kenyan economy and the analysis of the effects of the implementation (or non-implementation) of various economic policies discussed by the government. The study's scope also includes analysing the effects of some of the macroeconomic stabilisation and structural adjustment policies that were recommended for introduction in the mid-1980s on the Kenyan economy.

4. CGE Models for Policy Analysis: Rationale and Development

4.1 Introduction

The previous three chapters have outlined the scope of this study. Chapter 1 briefly mentioned the research methodology to be followed in attaining the study's objectives. A general equilibrium framework implemented through a CGE model was identified as the appropriate method of analysis. In this chapter, the rationale and development of CGE models for policy analysis are discussed. Section 4.2 gives the rationale for general equilibrium models and offers justification for a CGE model application in this study. Section 4.3 looks at the differences between CGE models, input-output models and econometric models. This is followed in Section 4.4 with a discussion of the two main theoretical paradigms employed in CGE modelling. Section 4.5 expounds further on the various approaches that are used in developing neoclassical CGE models. Section 4.6 then briefly discusses two issues in neoclassical CGE models set up highlighting key theoretical underpinnings: model choice and functional forms. Section 4.7 addresses some key issues that need to be considered in the implementation of CGE models. Concluding remarks are presented in Section 4.8.

4.2 Rationale for a General Equilibrium Model for the Study

As indicated in Chapter 1, studies undertaking policy analysis require an analytical framework of the economy's structure that allows them to evaluate the effects of a wide variety of policies on economic indicators. Chowdhury and Kirkpatrick (1994) argue that assembling a consistent and integrated set of relationships for the whole economy allows one to identify the direct and indirect effects of particular policy changes.

Given the mixed nature of economies, Chowdhury and Kirkpatrick (1994) argue that it is necessary to formulate models that allow analysis and exploration of questions about policy trade-offs and effectiveness. Such models should not only capture quantity adjustments but should incorporate market mechanisms and policy instruments that work through price incentives.

As mentioned in Chapter 1, given the nature of the problem at hand and the theoretical and empirical analysis required, a general equilibrium model is the most appropriate framework. A general equilibrium model is an appropriate method to evaluate the wide range of external shocks and policy issues raised in previous chapters. These are the external shocks that have affected the Kenyan economy and the policies that have been used by the Kenyan government which have typically involved changes in variables under its control. The model can be used to show how such policies impacted on the agricultural sector.

Due to its structural and multi-sectoral specification, a general equilibrium model can capture the interdependent production, demand and trade linkages in the Kenyan economy. The economy-wide framework also permits explicit structural specification through the interdependent components: firms, households, government, importers and exporters. Furthermore, economy-wide modelling makes it possible for causality in the Kenyan economy to be traced through the price system in different markets.

In addition to capturing the interrelatedness of production that arises from the flow of intermediate goods among sectors, a general equilibrium model includes the feedbacks through which the price mechanism achieves an equilibrium between the optimisation objectives of both producers and consumers. With disaggregation into different sectors, the theoretical and analytical framework of a general equilibrium model also allows the agricultural sector's factor productivity and shares to vary in response to the prevailing economic environment. Hence, it is possible under the framework to understand the major developments in agriculture resulting from changes in economy-wide policies.

Therefore, this empirical analysis is not only useful for assessing the performance of the agricultural sector, but can also show how it has become increasingly integrated within the rest of the economy and the world economy. In addition, due to the need to sustain agricultural as well as general economic growth, this theoretical and empirical analysis can show how development outside agriculture might have affected the ability of the agricultural sector to compete for resources and change its productivity.

In other words, this kind of analysis can look at the extent to which changes in the economic environment affect the agricultural sector's performance. This is because

intuitively, changes in the economic environment should have a differential effect on various sectors which ought to be reflected in changes in sectoral resource allocation and productivity growth. These in turn lead to changes in the sectoral composition of output, employment and capital.

Since a general equilibrium model looks at the Kenyan economy through appropriately defined sectors, it can also be used to explain any differential sectoral responses to changing economic conditions and policies. A general equilibrium model also allows for an explicit link between policy instruments and different sectoral growth paths. Thus, agricultural, macroeconomic and trade policies, working through the price system, can be analysed to show how they determine the overall pace and composition of economic growth. The effectiveness of agricultural policies given the implementation of specific macroeconomic and trade policies can also be investigated.

Hence, through a general equilibrium model the relationship between different policies and market responses can be explored. The way these policies affect both the allocation of resources and the structure of economic growth can be addressed with particular emphasis on the agricultural sector. Also, using a general equilibrium model, a set of experiments including changes in world markets, economic reforms such as tariff reduction and variation in macroeconomic policies can be undertaken. Through these experiments, a general equilibrium model can be used to analyse the effects of changes in economic policy on economic performance while paying special attention to the agricultural sector.

Different policy scenarios of agricultural, macroeconomic and trade policies can be analysed and the performance of the agricultural sector under each policy scenario discussed. Experiments, where necessary, can be carried out to isolate the effect of specific causal factors within the different policy regimes that affect the agricultural sector. An analysis of the behaviour of sectoral prices and their dependence on international prices and macroeconomic and trade policies can also be included.

It is clear that the policy concerns of this study require the use of an economy-wide multi-sector model that incorporates interrelationships between productive activities, factors of production, households, government and the rest of the world in a general

equilibrium framework. This kind of framework inevitably leads to a CGE model as the appropriate method of analysis for this study.

Questions facing policy makers over the years led to the development of a variety of models that deal with the issues of appropriate policy choice. CGE models are one class of economic models that have evolved in the last four decades for use in economic policy analysis. Their development has made general equilibrium theory operational as far as empirically oriented economic policy analysis is concerned.

CGE models introduce the possibility of factor substitution and productivity increases and allow planners to be in a position to simulate the effects of specific policy instruments (Chowdhury and Kirkpatrick 1994). They are regarded as the empirical consequence of pure general equilibrium theory based on neoclassical microeconomic foundations (Robinson 1989). This is because in CGE models' development, economic modellers have concentrated on specifying a general equilibrium model consistent with neoclassical[1] theory that can be used to conduct experiments (Wong 1990).

Bergman (1990) concurs with Wong (1990) by noting that these models have formalised analysis of general equilibrium systems by providing fundamental insights into factors determining the allocation of resources and the distribution of incomes in market economies. Bergman (1990) offers further clarification adding that CGE modelling is an extension of theoretical general equilibrium analysis with their numerical[2] characteristic being the all important characteristic of adding quantitative estimates to the insights already gained from qualitative models.

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1 As mentioned in a section below, not all CGE modellers use neoclassical theory holistically. Some of the CGE modellers introduce additional structural features in their models on the premise that such features make their models more realistic.

2 Bergman (1990) addresses the question why numerical CGE models should be chosen rather than analytical models. Bergman's (1990) answer is rooted in the literature on CGE models where it is argued that there is not really a choice between numerical and analytical models. Rather, numerical models should be seen as complements to and extensions of analytical models. Two examples are cited to illustrate this point. In the first, it is noted that due to the relevant and adequate size and complexity of some models, analytical solutions are difficult or even impossible to obtain. Use of a CGE model in such a situation gives useful insights into economic problems. In the second example, CGE models are seen as tools for adding quantitative information to qualitative results when the order of magnitude of various effects matters.

Bergman (1990) observes that most CGE models are intended for quantitative comparative static[3] analysis of the impact of non-marginal changes in conditions which are exogenous to the modelled economy. They are particularly useful because they reflect the actual structure of the economy and as a result the comparative statics results obtained from them reflect the existing distortions in the economy that are likely to be missed by large and complex analytical econometric models.

In comparative statics exercises, the models elucidate equilibrium resource allocation patterns and the mechanisms by which policy measures affect the economy. As extensions and complements to other economic policy analysis techniques, CGE models make it possible to gain useful insights into economic problems. In addition, they give the order of magnitude of various policy effects. Hence they add quantitative information to qualitative results. The endogenous price structure adds realism to the market behaviour specified in a multi-sectoral model.

Johansen's (1960) model of the Norwegian economy is regarded by most applied general equilibrium modellers as the starting point of today's CGE models which seek to establish the feedback between demand and supply, thereby endogenising both relative prices and quantities (Dixon and Parmenter 1994; Chowdhury and Kirkpatrick 1994). Unlike previous multi-sectoral models, the CGE models stress general equilibrium feedback mechanisms and autonomous decision-making by economic agents.

With regard to this study, a CGE model can be based on Kenya's input-output (I-O) tables and social accounting matrix (SAM). The I-O tables and the SAM bring together the accounts of the different economic actors whose behaviour needs to be modelled in the CGE model. This method of analysis seems plausible and appealing because I-O tables and SAM are usually designed to reflect an economy as it is modelled in a CGE model (Dervis et. al. 1982). In addition, by basing the CGE model on a synthesised I-O and SAM framework, internal consistency ensures that the national accounting identities such as the supply of commodities being equal to their demand and, the income earned

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[3] There is an emerging literature which incorporates dynamic issues in CGE models. However, the framework for incorporating dynamic analysis in CGE models is not as fully developed as for comparative static analysis.

being used to pay for factors of production, among other identities, can be maintained (Dervis et. al. 1982).

The use of a CGE model to undertake this study has other advantages. The general equilibrium effects are taken into account. Also, the interaction of different policy variables as have been implemented in Kenya can be understood. In the cases where the policy packages refer to the past, as will be the case in much of this study, the model can be used for alternative simulations. Questions about whether policies other than those actually adopted would have led to a better performance of the agricultural sector can be answered.

4.3 CGE Model Differences with Input-output and Econometric Models

In order to show where CGE models fit in the array of the options available to policy makers for economic policy analysis, it is worthwhile to dwell briefly on the differences they have with input-output and econometric models, their closest peers. Like CGE models, input-output and econometric models have been widely used to undertake policy analysis.

4.3.1 CGE models' differences with input-output models

Input-output models are the point of departure in multi-sector models. CGE models are regarded as the next generation of multi-sectoral models. There are major differences between these two types of models as discussed in this sub-section.

Prices are fixed in input-output models but are endogenous in CGE models. Therefore, input-output analysis cannot trace the effect on outputs when there is a cost or price change, because of the use of fixed technological coefficients of production. The strength of CGE models in this regard is that it is possible to include more flexible production technologies such as the Cobb-Douglas or constant elasticity of substitution (CES) production functions allowing for more substitution among the intermediate as well as primary inputs.

Input-output models are planning models where a planner optimises some unknown

objective function while CGE models incorporate a market economy where different agents have different objective functions (Wong 1990). In input-output models, there is an unlimited endowment since demand is always met whereas in CGE models there is limited endowment and prices move to clear markets (Wong 1990). In other words, in the conventional input-output model, industrial outputs are determined only by final demands. There is no linkage between prices and outputs. This problem is overcome in CGE models through the endogenous price mechanism. Output is determined not only by the final demand but also by equilibrium prices.

Input-output models do not allow substitutability among inputs as well as goods while there is a varying degree of substitution allowed in CGE models. Another difference is that input-output models are mainly linear and additive while CGE models are usually non-linear and may or may not be additive (Wong 1990).

For each of the differences between these two approaches, the input-output model comes out as being very restrictive and unrealistic compared to the actual nature of economies. Hence, CGE models can be taken as the remedy to the limitations found in input-output models. They are more flexible and powerful. The absence of price effects in input-output models is a very restrictive assumption especially in market economies where the price system is an important adjustment mechanism. With prices fully endogenous in CGE models, this limitation is eliminated (Wong 1990).

4.3.2 CGE models' differences with econometric models

As in the case of input-output models, there are some fundamental differences between econometric and CGE models. Econometric models are stochastic while CGE models are deterministic. Econometric models are usually macroeconomic in structure while CGE models are based on microeconomic foundations (Wong 1990). CGE models provide for a considerably more convincing incorporation of linkages between industries, commodities and primary factors within the domestic economy and between the domestic economy and the rest of the world than that afforded by an econometric approach. In the latter, degrees of freedom and time series data limitations severely curtail the extent to which intersectoral linkages can be incorporated (Dick et al. 1983).

Wong (1990) further notes that econometric models demand large data requirements while CGE models require only the benchmark year's data[4]. There is statistical testing of the model in econometric modelling. This approach can also discriminate among alternatives whereas there is no statistical testing or discrimination in CGE models. Econometric models are mainly used for forecasting while CGE models are for policy analysis through comparative statics.

From these fundamental differences, a CGE model can be viewed as being concerned with equilibrium points whereas an econometric model is used to capture the entire loci of behavioural relationships (Wong 1990). In terms of data requirements, CGE models have a low data requirement, a phenomenon useful for developing countries since econometric models with low degrees of freedom are unreliable. However, from a usage point of view, it is difficult and possibly erroneous to conclude that either of these models is better than the other (Wong 1990).

4.4 Theoretical Paradigms for CGE Models

Robinson (1989) describes four different ways to classify economic models. The description outlines the general criteria that can be used to determine where to place any given economic model. One classification is by mathematical structure or methodology: optimisation or simulation, static or dynamic, and linear or non-linear. Another is according to policy focus. Models can also be classified by theoretical type: analytic, stylised or applied. The fourth classification is the nature of the underlying theoretical paradigm.

With regard to CGE models, Bandara (1991) identifies three ways in which the classification can be done. Two of them are similar to the general classes identified by Robinson (1989), that is, the theoretical structure and policy issues addressed. The third criterion identified by Bandara (1991) is a classification based on the solution technique used to solve them. Looking at the abundant literature on CGE modelling, one cannot

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[4] For CGE models, one also needs econometrically estimated elasticities which are derived from cross-sectional or time series data.

fail to notice that it is the classification based on the theoretical paradigm that appears to be most significant. This is a result of the different views that economists hold with regard to assumptions invoked when dealing with economic systems. In this sub-section the two major classes of CGE models that have been developed based on two different theoretical paradigms are briefly explained.

4.4.1 Neoclassical CGE models

This class is the one that Robinson (1991) refers to as neoclassical structuralist CGE models. These models are based on microeconomic foundations where demands are derived from optimising behaviour of agents. Aggregate relationships are consistent with individual relationships and there are no ad hoc rules. The underlying motivation in this class is their foundation in neoclassical microeconomic theory. They mainly follow Johansen's approach and focus on the microeconomic aspects of the economy. They lean towards neoclassical real trade theory, Walrasian general equilibrium and derive the demand and supply functions from economic agents' constrained optimisation behaviour. Their consistency with optimising behaviour gives them added credibility that is sometimes missing in macro models and causality in the economic system can easily be traced.

Being neoclassical models, all that matters is relative prices, hence they assume that output is always at full-employment. In other words, as long as relative prices remain unaffected, any change in the absolute price level cannot affect equilibrium in the real sector. However, the models become partly 'structuralist' since they usually replace the neoclassical assumption of market-clearing brought about by wage-price flexibility with non-market clearance as would be found at the micro level due to structural rigidities in the economy (Chowdhury and Kirkpatrick 1994). Nevertheless, these models are mainly neoclassical and its only when necessary that they violate the neoclassical assumptions to allow for structuralist ideas. As Taylor (1990) observes, neoclassical authors start from hypotheses of optimising agents and full employment and their moves toward incorporating social classes and market power come as afterthoughts at best.

4.4.2 Macro-structuralist CGE models

This class of CGE models is referred to as macro-structuralist or structuralist CGE models as in Taylor (1990). Unlike the neoclassical models, they do not derive macroeconomic relations from microeconomic foundations. Their evolution is hinged on the recognition that economic models do not necessarily deal with perfectly competitive economies depicted in the neoclassical paradigm where markets clear instantaneously and governments do not interfere, but that there is need to handle imperfectly competitive behaviour such as markup pricing and widespread government interventions. They adopt a non-Walrasian approach where the existence of both market and institutional rigidities is recognised so that certain markets may not clear at equilibrium. However, the structuralist approach does follow neoclassical ideas although not entirely. As a result, ad hoc rules are occasionally introduced in the CGE models to reflect constraints (Wong 1990). This class of CGE models takes its roots in the Kalecki-Kaldor-Keynes tradition as argued in Taylor (1990) and further in Chowdhury and Kirkpatrick (1994). Hence, they are considered to be driven by macroeconomic relationships such as aggregate saving and investment functions which may not necessarily have microeconomic foundations in constrained optimisation behaviour.

The macro-structuralist models are concerned with the consequence of macroeconomic disequilibria and are macro in nature but structuralist at the same time in so far as they allow nominal variables to affect real variables. They disagree with the neoclassical assumption of neutrality[5] between the nominal and real sectors. For example, in macro-structuralist models, equilibrium is achieved through quantity adjustment rather than by changes in relative prices emphasised in neoclassical models. The reason for giving prominence to quantity adjustment is that factors such as monopolistic industrial structure, markup pricing, segmented formal and informal capital markets, fixed interest and exchange rates create pertinent structural rigidities that may make neoclassical assumptions too unrealistic or rigid.

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[5] There is a growing body of literature where this neutrality in models that apply the neoclassical paradigm is considered. This is being done by adding financial sub-models into wholly neoclassical real CGE models resulting in financial CGEs (see Bourguignon et al. 1991 and Bourguignon et al. 1992).

The classification notwithstanding, it is a misnomer to conclude that either the neoclassical model or the macro-structuralist CGE model is superior. This is particularly so if one has to take into consideration the heterogenous nature of economic agents and the possibility of different firms within the same industry having different approaches to working towards the same objective. It should therefore be expected that there will be development of CGE models that will attempt to find the middle-ground between the two extremes discussed above. Robinson (1989) observes that:

> While multi-sector models applied to developing countries are Walrasian and neoclassical in spirit, most modellers quickly abandoned many of the strong assumptions of neoclassical theory when faced with the problem of capturing the stylised facts characterising these economies. The assumptions of perfect competition, perfectly functioning markets with flexible prices, and free mobility of products and factors are not sustainable in actual economies. Instead, modellers have incorporated a variety of structuralist rigidities into their models that seek to capture non-neoclassical behavioural relations, macro imbalances, and institutional rigidities characteristic of developing countries.

Indeed efforts have been made to have CGE models that have both neoclassical and macro structuralist characteristics as exemplified in what Robinson (1991) refers to as financial CGE models. Robinson's (1991) model is not the first attempt to include nominal flows in real CGE models. Ad hoc procedures have previously been employed in attempts to integrate short-term macro-models with multi-sectoral CGE models that are mainly real.

Chowdhury and Kirkpatrick (1994) agree with Robinson (1991) that a common analytical framework is needed to harmonise long- to medium-term issues relating to such real variables as growth and production structure with short-term stabilisation. The framework should be in a position to address supply and demand management issues in the economy. Hence, CGE models with micro and macro sub-models would be appropriate for coordinating short-term stabilisation and long-term structural adjustment programs. As yet, there is no acceptable reconciliation of micro and macro theory that would allow the neoclassical model to be a host for macro phenomena without leading to methodological problems. As such, most models have followed the neoclassical

paradigm, avoiding the ad hoc features in structuralist models that are not rooted in neoclassical theory.

4.5 Approaches to Modelling Neoclassical CGE Models

The major differences that have stemmed from the different schools of thought mentioned above notwithstanding, various approaches to CGE modelling even within a given a theoretical paradigm have emerged. In this sub-section, approaches to modelling neoclassical CGE models are briefly described. They serve to illustrate that the approach taken may ultimately depend not only on the assumptions made about the structure of the economy but also on the objective of the modelling endeavour. Nevertheless, most CGE models that are neoclassical in spirit will endeavour to meet particular constraints. Consequently, before outlining the various approaches, a summary is provided of the characteristics[6] that any neoclassical CGE model would seek to satisfy. These characteristics are discussed in Bergman (1990) and are as follows:

- Both quantities and relative prices are endogenously determined within the models.

- In general, the models can be numerically solved for market clearing prices on all product and factor markets.

- The models are generally focused on the real side of the economy, although some models include financial instruments and financial markets.

- The models are aimed at elucidating equilibrium resource allocation patterns rather than business cycle phenomena, and the mechanisms by which policy measures affect the economy rather than the exact outcome of a certain government intervention.

- As mentioned previously, most CGE models are intended for quantitative comparative statics analysis.

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[6] A close look at these characteristics shows that they refer to neoclassical CGE models. Due to the ad hoc nature of macro structuralist CGE models, it would be difficult to come up with such a precise list of the characteristics to be met by this class's models.

- In a standard neoclassical CGE model all product and factor markets are taken to be fully competitive and excess demand functions are homogenous of degree zero in prices and satisfy Walras' law.

- Household product demand functions are specified to be consistent with utility maximisation subject to a budget constraint, while the product supply and factor demand functions of the producers in the same spirit are specified to be consistent with profit maximisation (or cost minimisation) subject to technology constraints.

4.5.1 Johansen's type of model

The first approach takes Johansen's (1960) multi-sector growth model[7] as its point of departure. In this approach, the models emphasise consistency with standard general equilibrium and international trade theory. As would be expected, the household demand functions in stylised Johansen's CGE models are derived on the assumption of utility maximisation under a budget constraint. They also assume profit maximising behaviour on the part of producers. The solution is obtained for these models through log-linear approximation to the general equilibrium solution with the resulting linear equations being solved for changes in endogenous variables as functions of changes in exogenous variables. However, whereas the procedure is simple and not costly to employ, it suffers from approximation errors[8] that may arise from the linearisation (Bergman 1990).

Johansen's type of models usually include the following steps as summarised by Huang (1989). Firstly, a theoretical structure must be developed consisting of: a series of equations representing household and other final demands for commodities; a series of demand equations for intermediate and primary inputs; a series of price equations that allow relationships between commodity prices and production costs or commodity output and factor prices; and a series of market clearing conditions for both primary

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[7] Dixon et. al. (1992) have created a small teaching stylised model in the spirit of Johansen. They recognise the pioneering contribution in Johansen (1960).

[8] Development in computer technology has made it possible in recent times to reduce the linearisation errors. At present, the ability of computer packages such as GEMPACK (see Harrison and Pearson 1994) to find multi-step solutions to specified simulations using more accurate algorithms means that there is not much concern about the errors. However, the error issue was dealt with satisfactorily long before 1994 (see Dixon et. al. 1982, Chapter 5 and section 47).

inputs and commodities. Secondly, the model equations are linearised[9] so that variables are percentage changes for computational purposes. Thirdly, input-output data are used to estimate production costs and sales shares. Finally, a computer program must be developed to solve the system of excess demand equations. A good example of a Johansen type model is ORANI, a model for the Australian economy (Dixon et al. 1982).

4.5.2 Harberger-Scarf-Shoven-Whalley models

The second approach follows what Bergman (1990) calls the Harberger-Scarf-Shoven-Whalley[10] approach. This is the same approach that Bandara (1991) refers to as the 'Yale Tradition'. Models that use this approach incorporate different types of households and their aim of evaluating policy changes in terms of efficiency and income distribution effects roots them deeply in applied welfare analysis. They are also regarded as numerical counterparts of Walrasian general equilibrium models. The models have followed the tradition of tax policy modelling in developed countries (Bandara 1991). These models also assume profit and utility maximising behaviour for producers and households respectively leading to demand and supply relations that are homogenous of degree zero and hence only relative prices are important. However, the models are solved in the levels of endogenous variables.

4.5.3 World Bank approach to CGE modelling

Another approach to CGE modelling is what Bandara (1991) has labelled as the 'World Bank Tradition'. This approach to CGE modelling has followed the early work of Dervis et. al. (1982). This approach is also neoclassical in spirit. Models following this approach have mainly been developed for developing countries. They have been extensively used in applications that deal with several different types of policy issues identified in Bandara (1991) which include: trade policy issues, income distribution,

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[9] Linearisation of the level equations is now an option for it is now possible to solve the model in its non-linear levels form (see Harrison and Pearson 1994).

[10] In fact, this classification captures the extension to the original Harberger's tax model documented in Harberger (1962).

issues related to external shocks and structural adjustments, government fiscal policy related issues and choice of development strategy, long-term growth and structural changes.

4.5.4 Econometric approach to CGE modelling

Another approach identified in Bergman (1990) is the econometric approach to CGE modelling. This approach seeks to present a stochastic specification of the model and the parameters[11] are estimated using econometric methods. The proponents of this approach argue that the simple calibration procedure of the other approaches implies that the observed values of the endogenous variables are determined only by factors explicitly included in the CGE models. In addition, the non-econometric models lack accuracy in their predictions.

However, there are difficulties related to the level of disaggregation that can be obtained in an econometric system and also the complexity of the simultaneous estimation of a general equilibrium model. Hudson and Jorgenson (1975) tried to overcome these difficulties through implementation of stochastically specified submodels of production and consumption, using them as building blocks in a general equilibrium model. But in the world of economic modelling, it has not been possible to integrate econometrically estimated production and consumption models within a consistent general equilibrium framework. An integration that would then be followed by an evaluation of how well the model based on the notions of Walrasian general equilibrium theory can explain relative price determination and resource allocation in a market economy. In the final analysis, enormous gains stand to be achieved through econometric modelling of CGE models as they become more empirically relevant and make general equilibrium theory an operational tool in practical economic analysis as argued by Bergman (1990).

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[11] The traditional procedure for most CGE modellers is to estimate model parameters through the calibration method. In this econometric approach to CGE modelling, traditional econometric estimation to determine share and substitution parameters in the model is used (e.g. Jorgenson 1984).

4.6 CGE Model Set Up: Model Choice and Functional Forms

It is evident from the foregoing discussion that CGE models differ according to the theoretical paradigm that they follow and the approach used in formulating them within a given paradigm. This inevitably makes it difficult to give a fixed set up procedure. In this section, two issues that must be addressed in setting up a CGE model are discussed. These are the questions of model choice and the functional forms to use in describing the behaviour of the economic actors.

4.6.1 Model choice

Theoretically, a general equilibrium model consists of a set of endowments, a set of economic actors, each with preferences, a group of commodities, and primary factors needed to produce those commodities (Wong 1990). Chowdhury and Kirkpatrick (1994) summarise the procedure for setting up a CGE model as being: specification of the various actors in the economy, such as, firms, households, governments, and rest of the world; describing their motivation and behaviour, for example, utility or profit maximisation; specification of the institutional structure including nature of market interactions such as competitiveness of markets; and solving for equilibrium values of endogenous variables.

When it comes to setting up a CGE model, the essence is to construct one that is not only manageable but captures the crucial focus of the problem under investigation. Thus, one consideration of model choice in CGE modelling is its actual size and hence the level of disaggregation required (Wong 1990). As Wong (1990) elaborates with an example:

> In the study of international trade and protection, one would want to design a model that has substitution features between the imported good and the domestic good. In this regard, a Leontief-type set up is clearly inappropriate. Similarly, if the object is to analyse income distribution effects of a particular economic policy, the household sector needs to be sufficiently disaggregated to reflect different income groups with different expenditure patterns. In such a case, the "representative consumer" concept is not suitable.

Therefore, the model chosen may be large and highly disaggregated which is necessary

for a multi-purpose application or it may be just a small general equilibrium model with only a few sectors and used to address specific policy issues. Wong (1990) identifies three factors that must be borne in mind in determining the level of aggregation: the chosen sectoral level should capture the actual economic problem being investigated; data availability must be considered; and the ease and cost of obtaining the solution must also be considered thoughtfully and realistically.

4.6.2 The representation of production technology in CGE models

In theory, the features of the economy being modelled and the problem being addressed play important roles in choice of functional form of the production technology. In this part of the model, explicit specification of all behavioural relationships is required. The structural specification of these relationships must be consistent with economic theory and with the overall general equilibrium framework. The functional forms should also be manageable. In most CGE models, the production function chosen falls into the generalised Leontief, generalised Cobb-Douglas, nested Cobb-Douglas, generalised constant elasticity of substitution (CES), nested CES, or nested constant ratio of elasticities of substitution homothetic (CRESH) form. Table 4.1 summarises the different production technologies applied in studies using CGE models in developing countries. This summary is derived mainly from two exhaustive surveys by Bandara (1991) and Decaluwe and Martens (1988).

A few observations need to be noted about some of the production types which are widely used, these are: Leontief, Cobb-Douglas and CES technologies. When the Leontief function is chosen, it assumes that inputs are combined in fixed proportions in equilibrium at all levels of outputs and prices. The relative prices are constant with no substitution of inputs. Therefore, despite the simplicity and convenience of a Leontief functional form, the models are not able to capture price effects, making them output driven which is unrealistic (Wong 1990).

The drawbacks of Leontief technology are partially overcome through the specification of Cobb-Douglas type production technology. This functional form allows substitution between inputs with a unitary elasticity. Relative price effects are also allowed. The limitations associated with the Cobb-Douglas functional forms are its unitary own-price

and income elasticities and zero cross-price elasticity (Wong 1990).

The restrictions of the Leontief and Cobb-Douglas technologies are further minimised through the choice of constant elasticity of substitution functions. They have non-unitary elasticities of substitution as well as non-unitary price elasticities. Cross-price elasticities are also non-zero. They are therefore more flexible even though they still exhibit unitary income elasticities and may have a problem with their additive nature (Wong 1990).

Linear homogeneity is inherent in CES functions. At the same time, CES functions exhibit constant returns to scale. The linear homogeneity inherent in CES functions imply that if the price of a given input rises relative to a cost-share weighted index of all input prices then the use of the concerned input falls relative to output. There would then be substitution away from the input. The magnitude of this substitution effect depends on the elasticity of substitution between inputs in the concerned sector.

Table 4.1: Production Technologies in Developing Countries CGE Models

Production Structure	Model	Country
Leontief	Feltenstein (1980; 1983)	Argentina
	Keyser (1986)	Bangladesh
	Ahluwalia and Lysy (1981)	Malaysia
	Gibson et al. (1986)	Mexico
Generalised C-D	Taylor and Black (1974)	Chile
	Kehoe & Serra-Puche (1986)	Mexico
	Taylor et al. (1983)	Nigeria
	Clarette and Whalley (1985)	Philippines
Nested C-D	Benjamin and Devarajan (1984)	Cameroon
	de Melo (1977)	Colombia
	Eckaus et al. (1979)	Egypt
	Gelb (1985)	Indonesia
	Kehoe et al. (1984)	Mexico
Generalised CES	Dick et al. (1984)	Chile
	Blomqvist and Mohammad (1986)	India
	Blomqvist and McMahon (1984)	Kenya
	McMahon (1986)	Kenya
	Taylor et al. (1983)	Nigeria
	Taylor and Rosensweig (1984)	Thailand
	Dervis (1975)	Turkey
Nested CES	Lewis (1985)	Turkey
	Grais et al. (1986)	Turkey
	Dervis et al. (1982)	Turkey
	Amranand and Grais (1984)	Thailand
	Adelman and Robinson (1987)	Brazil
	Mohan (1984)	India
	Condon et al. (1985)	Chile
	Taylor et al. (1980)	Brazil
	Taylor and Black (1974)	Chile
Nested CRESH	Mayer (1983)	Colombia
	Dick et al. (1983)	Colombia, Ivory Coast, Kenya
	Gupta and Togan (1984)	India, Turkey, Kenya

Sources: Bandara (1991) and Decaluwe and Martens (1988)

Under the CES specification, the elasticity of substitution between any pair of inputs is allowed to differ from one but maintains equality between all pair-wise substitution elasticities. Hence, the elasticity of substitution between any pair of inputs is the same as that between any other pair (Dixon et al. 1980). The equality of the pair-wise substitution elasticities must have contributed to the development of CRESH functions.

Under CRESH, partial pair-wise elasticities of substitution can differ between pairs of factors. CRESH therefore allows for more additional substitution flexibility than with CES when more than two factors are involved (Dick et al. 1982).

It is clear that there are limitations associated with the different production technologies. These limitations have at times been minimised through nested production functions in some CGE models. The nested functions allow for different levels of substitutability and elasticities among various categories of inputs (Wong 1990).

The ease with which demand functions for factors of production are derived depends on the simplicity of the functional form of the production technology used. Therefore, there is usually a trade-off in most CGE models between tractability and more realistic technical assumptions.

4.6.3 Product demand in CGE models

On the demand side, the final demand might be based on utility functions with different functional forms. Applied CGE models for developing countries have incorporated five main types of utility function specifications. These are summarised in Table 4.2 and include the indirect addilog utility functions and Cobb-Douglas expenditure systems. The non-linear and the constant elasticity of substitution expenditure systems are the other key inclusions in consumer demand that have been applied. The most common of all has been the Stone-Geary linear expenditure system.

Other specifications that have been used include translog specifications and Almost Ideal Demand Systems (AIDS). In some models, weakly separable utility functions have been employed which have allowed a two-stage budgeting process whereby the consumer first decides the expenditures on categories, like, food, clothing, manufacturing etcetera, through an AIDS model, and then allocates his or her budget within each of these groups on the basis of only the prices in that group through a linear expenditure system.

Table 4.2: Demand Specification in Developing Countries CGE Models

Utility Function	Model	Country
Indirect addilog	Taylor et al. (1980)	Brazil
	Taylor and Black (1974)	Chile
	Dick et al. (1984)	Chile
	Mayer (1983)	Colombia
Cobb-Douglas	Feltenstein (1980)	Argentina
	Keyser (1986)	Bangladesh
	Condon et al. (1985)	Chile
	Kehoe and Serra-Puche (1986)	Mexico
	Clarette and Roumasset (1987)	Philippines
	Amranand and Grais (1984)	Thailand
	Lewis (1985)	Turkey
CES	Feltenstein (1983)	Argentina
	Dick et al. (1983)	Colombia, Ivory Coast, Kenya
	Narayana et al. (1987)	India
	Bovenberg (1986)	Thailand
NLES	Drud and Grais (1983)	Thailand
	Blitzer and Eckaus (1986)	Sri Lanka
Stone-Geary LES	Grais et al. (1986)	Turkey
	Taylor and Rosensweig (1984)	Thailand
	de Melo (1982)	Sri Lanka
	Clarette and Whalley (1985)	Philippines
	Taylor et al (1983)	Nigeria
	Gibson et al. (1986)	Mexico
	Blomqvist and McMahon (1984)	Kenya
	Gupta and Togan (1984)	India, Kenya, Turkey
	McCarthy (1983)	Egypt

Sources: Bandara (1991) and Decaluwe and Martens (1988)

4.6.4 Trade with the rest of the world in CGE models

Traditionally, imports have been included in CGE models for developing countries in three main ways. In some cases, imports are exogenous. In other cases, imports have been treated as being perfectly substitutable for domestic products. In the models where perfect substitution between domestic and foreign products is assumed, the imports adjust to the difference between domestic demand and supply. In other models, imports are treated as being perfect complements of the domestic goods that are linked to output by fixed coefficients. However, as Decaluwe and Martens (1988) explain, these three

treatments have been rejected in favour of the one that was initially proposed by Armington (1969) where one assumes a constant elasticity of substitution between domestic and imported commodities. In this treatment, the commodity users equate their marginal-substitution ratio to the domestic price ratio of locally produced and imported commodities (Decaluwe and Martens 1988).

Modelling of exports in CGE models, like in the case of imports, have taken different forms. In some models, only the export demand function is modelled such as those following the ORANI tradition (see Siriwardana 1997). In other models, only an export supply function is used in determination of exports. Where only the export supply function is used, the underlying assumption is that the export demand for a given country's output by the rest of the world is infinitely elastic. This means that a country's export prices are fixed in the world market independently of the volume it exports. Since export prices are fixed, the implication is that the small country assumption still holds. The only problem with this assumption is that it is inconsistent with the view that products are differentiated by country of origin and imperfect substitutes for one another (Dervis et. al. 1982). The assumption of product differentiation leads to less than infinitely elastic demand functions for a country's exports. This less than infinitely elastic export demand function has been introduced in a uniform way in most CGE models. It assumes that the world as a whole behaves in a manner similar to a single country and consumes products according to the rules of cost-minimisation subject to a generalised CES formulation that specifies composite world commodities (Dervis et. al. 1982). However, as Dervis et. al. (1982) have argued, for some very homogenous products, where style, quality, brand names, durability, and so on, do not count, the strict small country assumption may in fact hold. This means that an export supply function can be introduced without necessarily having to recognise the existence of a downward-sloping demand curve for a country's exports. This treatment of exports is acceptable where the market share of a given country's exports is very small and with the underlying assumption being that export prices are fixed independently of quantities exported.

Even then, incorporation of the export supply function varies from one CGE model to another. Export supply have been treated differently in different CGE models for developing countries. Exports have at times been treated as exogenous as suggested in

Dervis et al. (1982) in place of logistic supply functions. Dervis et al. (1982) argued that export supply can be derived residually by subtracting domestic demand from total domestic production. They also justified the use of an asymmetric logistic supply function where exports differ substantially from domestic production in the same sector. Their justification was that under the broad sector classification, some sector's export products in a given commodity category are of a different nature from those it supplies to the domestic market. Logistic supply curves for exports have therefore been used in some studies. Table 4.3 summarises some of the common specifications of trade in developing countries CGE models.

In other models, foreign trade is included in the form of fixed shares in total export volumes. One other framework that has been employed in models entails deriving the export supply functions from an explicit optimising framework which assumes a constant elasticity of transformation (CET) between domestic and exported commodities as initially proposed by Powell and Gruen (1968). Dixon et. al. (1980) explain how the CET framework can be applied to derive the export supply functions.

Table 4.3: Trade Specification in Developing Countries CGE Models

Imports Specification	Model	Country
Exogenous imports	Blomqvist and Mohammad (1986)	India
	Narayana et al. (1987)	India
Perfect substitutes	Taylor and Black (1974)	Chile
	de Melo (1978)	Colombia
	Gelb (1985)	Indonesia
	Gibson et al. (1986)	Mexico
	Gibson (1985)	Nicaragua
	Clarette and Whalley (1985)	Philippines
	Adelman et al. (1979)	South Korea
	Blitzer and Eckaus (1986)	Sri Lanka
Perfect complements	Dervis (1975)	Turkey
	Chao et al. (1982)	South Korea
	McCarthy and Taylor (1980)	Pakistan
	Serra-Puche (1984)	Mexico
	Eckaus et al. (1979)	Egypt
	Keyser (1986)	Bangladesh
Armington CES	Dorosh (1996)	Madagascar
	Subramanian (1996)	Cameroon
	Dorosh et. al. (1996)	Niger
	Benjamin (1994)	Cameroon
Exports Specification	Model	Country
Exogenous	Caballero and Corbo (1985)	Chile
	Eckaus et al. (1979)	Egypt
	McCarthy (1981)	Brazil
	Gibson et al. (1986)	Mexico
Fixed shares	Ahmed et al. (1985)	Egypt
	Kehoe and Serra-Puche (1986)	Mexico
	McCarthy and Taylor (1980)	Pakistan
Logistic supply	Benjamin and Devarajan (1984)	Cameroon
	de Melo and Robinson (1980)	Colombia
	Michel and Noel (1984)	Ivory Coast
	Kubo et al. (1984)	South Korea
CET	Adelman and Robinson (1987)	Brazil
	Condon et al. (1985)	Chile
	Grais et al. (1986)	Turkey
	Lewis (1985)	Turkey

Sources: Decaluwe and Martens (1988) and author review

4.7 CGE Model Implementation: Some Issues for Consideration

4.7.1 Non-linearity in CGE models

CGE modellers always find themselves at a critical position when looking for the solution to a model that may be non-linear. The non-linearity may be due to some variables that do not appear in additive form and have a power other than unity. In some cases, especially those following Johansen's approach, the problem is resolved by expressing the equations in linear percentage change forms. This leads to an additional advantage since most parameters required for the CGE model can be obtained from either an input-output table or a social accounting matrix (SAM). However, with advances in computing technology it is now possible for CGE models to be solved in their non-linear levels form without going through the linearisation process.

4.7.2 Calibration of CGE models

Once the model set up is complete and a decision made whether to solve it in its linear or levels form, there is need to select values for the parameters specified. This is done before any policy experiments. The values of the parameters in the model consist of coefficients of the various endogenous variables such as relative factor shares in production functions, and exogenous parameters, such as elasticities. Calibration is the commonest method of parameter values selection in CGE analysis. Calibration in itself entails selection of parameter values such that the calibrated values are consistent with the benchmark data for the economy.

Benchmark data assumes the existence of an observed equilibrium in the economy in the presence of different economic policies and market distortions. Hence, the first task in CGE model implementation is to determine parameter values so that the completely specified model is consistent with such a benchmark. This benchmark equilibrium is satisfied in neoclassical CGE models if excess demands for every factor and product are zero, firms make no supernormal profits, budget constraints are binding and the rest of the world sector balances.

Different calibration techniques exist but the most commonly applied (at least in

developing countries) is the construction of a benchmark data set based on a social accounting matrix (SAM). The input-output tables database can also be used to arrive at the parameter estimates as in the case of models such as ORANI (see Dixon et. al. 1982). This ensures consistency with equilibrium conditions. In general, the calibration procedure is seen as a weakness in CGE modelling. This is more so when there is little available information. Since the generated solutions are often fairly sensitive to these values, the model tends to be non-robust, therefore, the numerical results of CGE models should not be taken as precise point estimates but as indicative.

4.7.3 Normalisation of CGE models and closure rules

The solution of a CGE model entails finding equilibrium values. For purely neoclassical models, where there is total neutrality between the real and nominal sectors of the economy the solution establishes only relative prices and not absolute ones. This requires, as would be expected from general equilibrium theory and Walrasian equilibrium analysis, using an appropriate numeraire for the normalisation of the model, recognising that the relevant functions of the CGE model should be homogenous of degree zero.

In addition to the normalisation issue, the solution of a CGE model requires that the number of independent and consistent equations be equal to the number of variables. This raises the issue of 'closure' rules that entail the determination of which variables to be considered as exogenous. Model closure in general equilibrium modelling refers to the means that are chosen to complete the model (Wong 1990). Since a general equilibrium framework takes into account interactive effects from various sectors and agents in the economy, the model needs appropriate closure rules. Sometimes the number of equations is less than the number of variables in the model, since some of the variables are not explained within the model. Thus, a modeller must choose the variables to be explained (endogenous variables) to close the model. The closure rules, that is, which variables should be endogenous and which variables should be exogenous, depend on the problems at hand (Chowdhury and Kirkpatrick 1994). The main areas of concern are the rest of the world sector and macroeconomic relationship (Wong 1990).

As explained in Wong (1990), in macro closure, the aim is to specify how aggregate

expenditure is to be determined. On the supply side of the economy, equality of factor incomes to the total value of output is guaranteed through competition and profit maximisation. It is usually on the demand side that the problem arises. Standard neoclassical general equilibrium theory is followed in Walrasian-type macro closure. The rule ensures a full employment level of income by letting aggregate income equal aggregate expenditure. All the markets in the model clear in equilibrium and Walras' Law is satisfied. The strength of this closure is that it is based strictly on the microeconomic foundations of utility and profit maximisation. However, it may be criticised on its inability to accommodate non-market clearing situations such as persistent unemployment of labour (Wong 1990).

The non-Walrasian macro closure rule follows the Keynesian approach to macroeconomics. Aggregate income is not always equal to aggregate expenditure because of insufficient demand. An aggregate consumption function is used to denote private expenditure which with Walrasian macro closure is based on individual preferences. Hence, desired expenditure is not necessarily expected to equal income and as a result a non-market clearing equilibrium is modelled. Such a specification has the advantage of adding realism to the model however its major weakness (at least as perceived by neoclassical economists) is that it is not based on microeconomic foundations but is rather ad hoc in nature (as recommended by structuralists). This ad hoc nature may introduce difficulties when it comes to interpreting the results (Robinson 1989, Wong 1990).

Solutions to different CGE models differ with the closure rule invoked. The closure rule chosen has been shown to have important ramifications for the model, both theoretically as well as in terms of the robustness of results generated (Rattso 1982). Therefore, not only must care be taken, but modellers need to be aware of implicit constraints put into the model by adopting a specific closure rule. The choice of closure rule should be guided by the features of the economy being modelled. Such features include whether the exchange rate is fixed; invoking the small country assumption that would imply fixed world prices; assuming that exports might be determined by world income and hence might be exogenous for the economy; noticing whether the interest rate is administratively determined; or whether there exists surplus labour which would imply

that the wage rate is not affected by labour demand and can therefore be regarded as fixed.

Putting the above issues into consideration in formulating the closure rules are an important part of CGE modelling. For instance, introduction of the rest of the world sector in a closed economy model and making the assumption about fixed exchange rates, combined with a constant returns to scale assumption may imply that world prices determine the domestic prices. The form that import and export functions take should allow for the balance of payments equilibrium condition to hold. Nevertheless, a closure rule here may simply take exchange rate and domestic prices as given and, if this is the case, fixed world prices make the open economy model a fixed-price rather than a flex-price model. This would lead to another closure rule component since market clearing is brought about by quantity adjustments. In so far as prices are sluggish or administratively fixed in the economy under consideration, quantity adjustment would be an important and appropriate closure rule, otherwise it would be misplaced if the economy did not have these features as its characteristics.

4.7.4 Computation of equilibria

A solution algorithm that solves the system of equations in the CGE model needs to be defined once the model is calibrated and the appropriate closure rule determined. This is the computation procedure that yields values that are consistent with general equilibrium. Five categories of general equilibrium solution algorithms are explained in Wong (1990). The five are: fixed-points algorithms, Newton-type algorithms, tatonement processes, optimisation techniques and linearisation techniques. There is no single best algorithm for all CGE models and it depends on which procedure best suits the problem under investigation. There are many computer programs such as GEMPACK (documented in Harrison and Pearson 1994) and GAMS which have made it possible for researchers to be able to construct large CGE models and be able to easily get solutions from them.

4.8 Concluding Remarks

In this chapter, the rationale and justification for use of a CGE model was given. The chapter also attempted to highlight some of the issues ranging from differences in

theoretical paradigms to issues for consideration in setting up and implementing CGE models. This leads to Chapter 5, which reviews some applications of CGE models in developing countries, relevant to this study.