7. Data, Model Implementation and Calibration

7.1 Introduction

In this chapter data used in implementation of KEGEM and the calibration procedure used for unknown parameters are presented and described. The model is used in Chapter 8 in the analysis of terms of trade shocks and to determine the effects of policies undertaken during the period of the first oil crisis and during the unprecedented export boom. The model is also used in Chapter 9 in the analysis of the effects of alternative economic policies to the ones used by the government of the day on the outcome of the terms of trade shocks. During the period under analysis, the financial markets in Kenya were not liberalised and were controlled by the government, therefore, KEGEM, which is a real CGE model without a financial sub-model, is appropriate for the analysis.

This chapter is organised as follows. Section 7.2 describes the input-output tables and SAM for Kenya used in determining the initial solution for KEGEM. This is followed by a brief description of how the model was implemented in Section 7.3. The calibration of the unknown parameters used in KEGEM is described in Section 7.4. In this section, the values for the calibrated parameters are presented. The chapter concludes with Section 7.5.

7.2 Data Base

Data for CGE models usually consist of input-output tables data or social accounting matrix (SAM) data and parameters. A general rule in CGE modelling exercises is that a bench-mark solution is required before the model can be used for policy analysis. The data provided are expected to provide an initial solution to the CGE model. That is, it is necessary to provide data from which initial or pre-simulation values of all levels variables and values of all parameters (including elasticities) can be inferred.

Consequently, data used in KEGEM in simulations must consist of a complete set of values for all the real variables in the base year and also a complete set of values for the parameters. Therefore, the first step before implementing the model is to choose the appropriate base year on which the simulations are to be undertaken. In line with the

objectives of this study, 1976 was taken as the base year for the start of the empirical analysis. There are two reasons for this choice. First, 1976 is a year with available SAM and input-output tables for Kenya, the key sources of data required. Second, the year 1976 was ideal as it marked an interface between the end of the first-oil crisis and the beginning of the coffee boom. These are the two key external shocks analysed in this study.

The 1976 input-output tables and 1976 SAM for Kenya are described in this section. These are the sources of data used as the base solution for the model and in calibrating the model to determine the various variables and parameters whose values were not known. In practice, the input-output tables are created from the more familiar double-entry national accounts. Input-output tables have been produced for Kenya for the years 1967, 1971 and 1976. The 1976 input-output tables for Kenya, as for tables for 1967 and 1971, can be regarded as composed of four quadrants (Figure 7.1). The upper left quadrant shows the inter-industry transactions or flows of intermediate products from delivering sectors to receiving sectors that use such products as inputs. No Make matrix assigning commodity outputs to producing industries is included in Kenya's input-output system. This is because there is no distinction made between commodities and industry outputs. The 1976 tables distinguished 37 sectors, including five representing government activities and two dummy industries.

The lower-left or value added quadrant shows transactions in primary factors. Six value added categories are distinguished: labour, interest, depreciation, indirect taxes (excluding import duties), and other operating surplus including land rents. The operating surplus is categorised as profits. The column sum over the first two quadrants is equal to gross output. Addition of imports to this sum gives the total supply of resources. The upper-right quadrant shows deliveries to final demand for export, private consumption plus changes in stocks, general government consumption and gross fixed capital formation (public and private). The row sum over the two upper quadrants gives total use of resources.

Figure 7.1: Structure of the Total Dimension Version of Kenya's Input-Output Tables

INTER-INDUSTRY TRANSACTIONS	DELIVERIES TO FINAL DEMAND
VALUE-ADDED	

The fourth, lower right-quadrant is empty. There is no final demand for primary factors. Likewise, there are no indirect taxes on final demands over and above those already included in gross output. The indirect tax is thus viewed as an activity-based tax.

Imports are valued at c.i.f. prices plus import duty. Import duty on inputs is thus included in the value of gross output. Likewise, duties are included in the value of imported goods flowing directly into final demand. The sum of the cells in the final demand wing, or the total use of resources, is therefore equal to gross domestic product plus imports including all indirect taxes (sales, excise and duty).

Kenya's input-output tables have been published in two alternative versions distinguished by the dimension of the rows of delivering sectors. In the "total dimension" version (Figure 7.1) deliveries are totals of domestic and foreign origin treated as competitive products. There are no non-competing imports. In this version, the flows of goods and services to intermediate and final uses include both domestic products and imports, the latter including duties (Kenya, Republic of 1979b). The flows are recorded at basic values. That is, they are net of distribution charges which are treated as a payment for services rendered by the distributing sector. Hence the row totals (total uses) are seen to balance against the corresponding column totals (total supplies). This version further includes the uses of primary inputs and when adding indirect taxes (excluding import

duties) less subsidies both gross value added and gross output are at market prices. The addition of total imports—classified according to the characteristic products of each industry—provides figures for total supply of each type of industry product recorded at producer prices.

In the "domestic and import" dimensions version (Figure 7.2) two more wings are sandwiched between the uses-of-output wings and the value added wing. In this version, the flows of goods and services to intermediate and final uses are split according to origin. That is, domestic and imported products are treated separately, both recorded at basic values.

Figure 7.2: Structure of Domestic and Import Dimensions Version of Kenya's Input-Output Tables

DOMESTIC INTERMEDIATES	FINAL DEMAND (DOMESTIC)
IMPORTED INTERMEDIATES	FINAL DEMAND (IMPORTED)
VALUE-ADDED	

For imports, the c.i.f. value plus the duty is taken as producer prices. The primary input (value added) components are the same as in the total dimensions version. This "domestic and import" dimensions version shows the flow of imports to their various

uses in rows corresponding to industries with which the imports compete. Deduction of these imports from the flows in the total dimension leaves only flows of domestic products. This separation of imports from domestic products assumes that they are imperfect substitutes used in fixed proportions.

The SAM is different in content to the input-output tables. It is a presentation of income and financial flows in the economy. It is a presentation in matrix format of the transactions or flows of the Kenyan economy. It is an alternative presentation of the national accounts and combines several of the national accounts in a single table. It presents national accounts information on production, distribution of income, consumption and accumulation in an alternative format. Therefore, in content, it is related to the United Nations revised system of national accounts. By combining several national accounts in a single table, the SAM provides a very concise view of the structure of the economy and a consistent data framework such as is required for economic modelling. The SAM's input-output sub-matrix is derived from the input-output tables.

The conventional method of presenting macroeconomic data by means of double-entry national accounts is generally associated with monitoring economic progress by means of national income aggregates, such as national income and the value and composition of GDP (Kenya, Republic of 1980). Such aggregates, however, are of limited use in portraying the distribution of income within an economy. Studies of income distribution are usually separate analyses based on household socioeconomic survey results, often bearing little relation to any data collected on the national accounts. This fragmented approach to data collection and presentation does nothing to facilitate an understanding of inter-relationships between production, distribution of income and consumption within the economy, knowledge concerned with policy measures to improve the living standards of poorer people as well as other development objectives.

In contrast with this, the SAM approach to social accounts attempts to integrate the distributional dimension within its picture of the economy. The generation of income by production is disaggregated into various types of income such as wages and salaries earned by different skill groups of labour, self-employed income and profits. Households are disaggregated as much as possible in order to show both the degree of dependence

on these different categories of income and the distribution of income between household groups classified by socioeconomic characteristics. The divergence of consumption patterns between different households can then be portrayed.

Most CGE models either use one of the two as their database: SAM or input-output tables of the particular country. KEGEM departs from this procedure and uses information from both sources for these reasons. First, KEGEM identifies five types of labour categories. The Kenyan input-output tables present aggregated wages and salaries. There was need to disaggregate this wages and salaries component using the disaggregated factor payments to the five labour categories presented in the SAM.

Second, KEGEM incorporates ten household groups which meant that the aggregated private consumption data in the input-output tables had to be disaggregated using the ten household consumption entries identified in the SAM. The desire in KEGEM to portray the distribution of income within the economy meant that the data from the input-output tables were not sufficient and the SAM information had to be used to disaggregate wages to the five labour categories in the ten household groups. Third, the KEGEM production structure differentiates intermediate inputs by source, whether imported or domestically produced. For this reason, aggregate intermediate inputs data in the SAM were not sufficient and the use of the differentiated (by source) intermediate inputs data provided in the input-output tables were necessary.

The original SAM has 28 production activities and input-output tables have 37 production activities. Since KEGEM identifies three sectors, data from the SAM and the input-output tables were aggregated to give three sectors. Table 7.1 shows the sectoral classification in the Kenyan input-output tables and SAM that were aggregated to form the three sectors used to implement KEGEM.

Table 7.1: Sector Aggregation of the SAM and Input-Output Tables to KEGEM

Sector classification in KEGEM	Classification in input-output Tables	Classification in SAM
Agriculture	Agriculture	Agriculture
	Fishing and forestry	Forestry and fishing
Manufacturing	Prospecting, mining and quarrying	Mining and quarrying
	Food preparations	Food and beverages
	Bakery products, chocolates and sweets	Textile, wearing apparel and leather
	Beverages and tobacco	Wood and wood products
	Textiles raw materials, rope and twine	Paper, paper products, printing and publishing
	Finished textiles	Petroleum refineries
	Garments, knitwear, and made-up textiles	Other chemical industries
	Footwear, leather and fur products	Non-metallic mineral products
	Wood products include. furniture	Metal products, machinery
	Paper and paperboards, printing and publishing	Miscellaneous manufacture
	Petroleum products	Electricity
	Rubber products	Water
	Paint, detergent and soap	Building and construction
	Other chemicals	
	Miscellaneous non-metallic mineral products	
	Metal products, machinery and miscellaneous	
	Building and repair of transport equipment	
	Electricity supply	
	Water supply	
	Building and construction	
Services	Traditional economy	Traditional economy
	Wholesale and retail trade	Wholesale and retail trade
	Transport and services allied to transport	Hotels and restaurants
	Communication	Transport and services allied to transport
	Restaurant and hotel services	Communications
	Ownership of dwellings	Finance, real estate, insurance and business services
	Financial services	Ownership of dwellings
	Miscellaneous services (excl. government services)	Other services including domestic services
	Govt. services (public admin. and defence)	Producers of govt. services (public administration and defence)
	Govt. services (education)	Govt. services (education)
	Govt. services (health)	Govt. services (health)
	Govt. services (agric)	Govt. services (agric.)
	Other govt. services	Other govt. services
	Ownership of business premises	
	Unspecified (incl. hunting)	

Having defined sectoral aggregations, the data from the input-output tables and the SAM used to determine the initial solution of KEGEM are presented in Tables 7.2, 7.3 and 7.4. The data present the key structural characteristics extracted from the SAM and input-output tables flow accounts as defined and used in KEGEM. The data show Kenyan economic structure, distribution of labour income, consumption of gross output especially by household type and openness to international trade.

Table 7.2 which shows the total supply of resources was derived from the input-output tables. This captures the upper-left and the lower-left or value added quadrants of the input-output tables. The intermediate inputs demand for production are given distinctively by their origin. Thus, the first three rows show domestic intermediate input demands. These are followed by another three rows that show imported intermediate input demands. In the value added component, the disaggregation of capital and labour is shown. As mentioned previously, input-output tables show only aggregate wages and salaries. In order for these data to be used in KEGEM, there was a need to distribute it according to five labour categories. This was done by computing distribution proportions from the SAM where the labour is classified according to categories used in KEGEM. While capital used in production is a component, the disaggregation shown in Table 7.2 was necessary for more detailed income distribution aspects of KEGEM and reflects a desire to have a more elaborate framework for fiscal policy analysis.

Table 7.3, also derived from the input-output tables, shows total use of resources. It captures the upper-right quadrant of the input-output tables. It shows the amount of total production going to intermediate demand and the amount going to final demand. As would be expected, the totals across the rows of Table 7.3 equal the totals of corresponding columns in Table 7.2. KEGEM pays particular attention to disaggregation of households in Kenya into different categories. It was therefore necessary to further disaggregate private consumption in Table 7.3 to the ten households categories in the model. This disaggregation of private consumption is shown in Table 7.4 and was carried out using information derived from the SAM where the same ten types of households are identified.

Table 7.2: Total Supply of Resources (Kshs million)

	Agric.	Manuf.	Services	Total
Domestic-Agriculture	397.20	2173.60	46.80	2617.60
Domestic-Manufacturing	390.90	6486.10	3332.28	10209.28
Domestic-Services	252.34	2256.82	4058.38	6567.54
Total Domestic Intermediate	1040.44	10916.52	7437.46	19394.42
Imported-Agriculture	28.50	148.78	2.26	179.54
Imported-Manufacturing	240.36	5067.28	354.22	5661.86
Imported-Services	17.08	76.58	479.24	572.90
Total Imported-Intermediate	285.94	5292.64	835.72	6414.30
Intermediate-Agriculture	425.70	2322.38	49.06	2797.14
Intermediate-Manufacturing	631.26	11553.38	3686.50	15871.14
Intermediate-Services	269.42	2333.40	4537.62	7140.44
Total Composite Intermediate	1326.38	16209.16	8273.18	25808.72
Unskilled labour	1000.00	730.00	1606.00	3336.00
Skilled labour	46.00	810.00	984.00	1840.00
Semi-professional labour	62.00	424.00	1864.00	2350.00
Professional labour	44.00	406.00	2514.00	2964.00
Self-employed labour	5096.00	200.00	2236.00	7532.00
Total labour	6248.00	2570.00	9204.00	18022.00
Depreciation	552.00	634.00	562.00	1748.00
Profits	2479.62	1044.54	1176.82	4700.98
Interest	176.32	359.22	928.38	1463.92
Subsidies	-7.22	-0.20	-7.98	-15.40
Indirect taxes	55.38	1835.76	304.84	2195.98
Total capital	3256.10	3873.32	2964.06	10093.48
Total value added	9504.10	6443.32	12168.06	28115.48
Gross output	10830.48	22652.48	20441.24	53924.20
Import c.i.f.	219.48	7389.06	1158.80	8767.34
Import duty	8.46	1301.00	5.72	1315.18
Total import	227.94	8690.06	1164.52	10082.52
Total supply of resources	11058.42	31342.54	21605.76	64006.72

Source: 1976 Kenyan input-output tables and the SAM.

Table 7.3: Total Use of Resources (Kshs millions)

	Total intermediate	Export demand	Private consumption	Government consumption	Investment demand	Total use of resources
Agriculture	2797.14	2833.56	5322.70	0.00	105.02	11058.42
Manufacturing	15871.14	2856.44	7572.30	0.00	5042.66	31342.54
Services	7140.44	3353.14	5375.44	5075.82	660.92	21605.76
Total	25808.72	9043.14	18270.44	5075.82	5808.60	64006.72

Source: 1976 Kenyan input-output tables

Table 7.4: Distribution of Private Consumption Among Households[a] (Kshs Millions)

	Uhh1	Uhh2	Uhh3	Rhh1	Rhh2	Rhh3	Rhh4	Rhh5	Rhh6	Rhh7	Total
Agriculture	276.21	271.96	78.77	184.19	168.18	352.33	233.64	2894.71	179.89	682.83	5322.70
Manufacturing	787.60	1634.09	546.87	149.06	178.72	232.12	242.50	2124.02	138.68	1538.65	7572.30
Services	846.34	1192.25	804.24	113.49	80.14	152.81	109.02	1085.74	73.68	917.72	5375.44
Total	1910.16	3098.30	1429.87	446.73	427.04	737.26	585.17	6104.47	392.25	3139.19	18270.44

Source: 1976 Kenyan input-output tables and the SAM.

[a]Uhh1 = Low income urban households; Uhh2 = Middle income urban households; Uhh3 = High income urban households; Rhh1 = Rural households holding less than 0.5 ha. and with little additional income; Rhh2 = Rural households holding 0.5 ha. with substantial additional income; Rhh3 = Rural households holding greater than 0.5 ha. but less than 1.0 ha. with little additional income; Rhh4 = Rural households (holding more than 0.5 ha. but less than 1.0 ha. with substantial additional income; Rhh5 = Rural households holding greater than 1.0 ha. but less than 8.0 ha.; Rhh6 = Rural households holding greater than 8.0 ha. (small farms only); Rhh7 = Other rural households.

7.3 Model Implementation

KEGEM was implemented using the General Equilibrium Modelling Package (GEMPACK), a suite of general-purpose economic modelling software suitable for general equilibrium models documented in Harrison and Pearson (1994). A model is implemented in GEMPACK when the equations describing it are written in an algebraic form and data describing one solution of the model assembled as a starting point for simulations (Harrison and Pearson 1994). In order to build the theoretical KEGEM within GEMPACK, it was necessary to prepare a file containing the equations of the model and to construct data files whose purpose was essentially to give one solution for the 'levels' equations in the model. The file containing the equations of the model in GEMPACK is called the TABLO Input file. The preparation of the TABLO Input file required writing down equations in a suitable form and working out the data requirements of the model. Appendix A contains the TABLO Input file used to implement KEGEM in GEMPACK version 5.1. The equations in KEGEM were used mainly in their levels[1] form. The data requirements are those described in the preceding section. Appendix B contains the text file used with the program MODHAR to create the Header Array file containing data that were used in providing the initial solution for KEGEM. But since thes data were not complete, the calibration of the unknown parameters is described below.

7.4 Model calibration

The data assembled from the input-output tables and the SAM were not sufficient to implement KEGEM. Information on the efficiency, distribution, and substitution parameters in the production and Armington CES functions needed to be determined before any simulations could be carried out. In the same vein, the efficiency, distribution and transformation parameters in the output CET function used to determine the

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[1] Previous versions of GEMPACK required the structural non-linear equations of a given model to be linearised as a first step to implementation. However, GEMPACK Vers. 5.1 and 5.2 possess the capability of handling TABLO Input files that are written in either levels (non-linear) or linear form. The two can even be mixed to produce a Mixed-TABLO Input file. KEGEM was implemented through a primarily Levels-TABLO Input file with few linearised equations.

allocation of output to the domestic and export markets also needed to be defined before any simulations could be carried out. Moreover, in the LES consumer demand functions, the marginal budget shares and fixed levels of subsistence expenditure also needed to be determined.

Ideally, the elasticity parameters enumerated above need to be estimated through an econometric procedure. While this is possible, the gains from such an exercise would need to be weighed against the time spent collecting data and undertaking the estimations. There are also potential problems associated with econometric estimations of the non-linear CES, CET and LES functions used in the model. These problems are identified by Huang (1989) as lack of enough degrees of freedom and the inability to find all the price data for estimating and specification errors. Huang (1989) tried to ignore these difficulties and attempted to estimate elasticity parameters in the CES production functions used in a US economy CGE model. Huang found that the empirical result of the CES function was not satisfactory and hence the estimates could not be relied upon. As in most other CGE models, elasticities of substitution derived from the literature were favoured for the US model. Since econometric estimates of elasticity parameters used in KEGEM could not be found in the literature in the case of Kenya, the common practice of most CGE models of assuming values for the elasticities was adopted. The production and trade elasticities chosen are shown in Table 7.5. The income elasticities and the values for the Frisch parameter[2] that were needed to calibrate the LES function are shown in Table 7.6.

The efficiency and distribution parameters in the various CES and CET functions were then derived from the input-output tables and SAM data and the assumed elasticity parameters by a process of calibration. The same procedure was applied to determine the benchmark values for the marginal budget shares and the subsistence parameters in the LES consumption functions.

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[2] The values for Frisch parameter were borrowed from Fargeix and Sadoulet (1994). The characteristics of the Ecuadorian economy were considered not to be very much different to the Kenyan economy. Furthermore, information contained in Lluch et. al. (1977) where values for different households with given levels of income are estimated for some developing countries indicate that the magnitudes of these parameters for Kenyan households may not be very different from the values chosen.

Table 7.5: Sectoral Parameters

	Agriculture	Manufacturing	Service
Elasticity in intermediate input CES	0.80	0.60	0.40
Elasticity in value added CES	0.50	0.70	0.60
Elasticity in composite labour CES	0.50	0.30	0.40
Elasticity in import CES	0.80	0.60	0.40
Elasticity in export CET	1.30	0.80	0.30

Source: Average of equivalent values used in Fargeix and Sadoulet (1994) for Ecuador, Dervis et al. (1982) for a semi-industrialised Turkish economy, Dorosh (1996) for Madagascar and Dorosh et al. (1996) for Niger.

Table 7.6: Household Consumption Parameters (Income Elasticities)

	Uhh1	Uhh2	Uhh3	Rhh1	Rhh2	Rhh3	Rhh4	Rhh5	Rhh6	Rhh7
Agriculture	0.90	0.70	0.50	0.90	0.80	0.70	0.60	0.50	0.50	0.70
Manufacturing	1.10	1.30	1.40	1.10	1.20	1.30	1.40	1.50	1.60	1.30
Service	0.70	0.80	1.10	0.70	0.80	0.90	1.00	1.10	1.20	0.80
Frisch parameter	-4.00	-3.00	-2.00	-4.50	-4.00	-3.50	-3.00	-2.50	-2.00	-3.50

Source: Fargeix and Sadoulet (1994); Lluch et. al. (1977)

The calibration procedure can be explained as follows. While KEGEM is solved for values of endogenous variables given values of parameters and exogenous variables, calibration involved a reversal of this process. Given base year values for endogenous variables, exogenous variables and chosen elasticity parameters, KEGEM was solved for the production, trade and consumption parameters.

As explained in Huang (1989), the calibration procedure for a model like KEGEM relies on some important assumptions. It was assumed that producers minimize costs and receive zero profits. These assumptions have certain implications that allow the choice of values for the production function parameters. Similarly, the assumption that a

household maximises its utility subject to a budget constraint implies that it is permissible to choose the values of the utility function parameters.

In this section, the calibration formulas for the efficient, distribution, and subsitution parameters in the CES and CET functions are presented. The calibration formulas for the marginal budget shares and the fixed levels of subsistence parameters in the LES on household consumptions are also explained.

Since the input-output tables and SAM transactions are given as values, a set of prices and corresponding measuring units to compute quantities were chosen. Therefore, the initial value of all prices, exchange rate, and wage rate was set to one. Hence, the values given in the input-output tables and in the SAM for production, imports, exports, and consumption could be read as quantities of commodities, and the values given to labour and capital payments could be read as quantities or units of labour and capital.

7.4.1 Calibration of the composite intermediate CES function

The derivation of the calibration formulae for the various CES and CET functions in KEGEM follows the same procedure. Therefore, in this section, the derivation for these parameters in the case of the composite intermediate CES function is shown. Since the procedure is the same, the remaining calibration formulae for the other cases are given without the derivations.

The production function for the composite intermediate as defined in the production technology of KEGEM is chosen to be CES in domestic and imported intermediate inputs. Based on the values of these intermediate inputs and the assumed elasticity of substitution between the two, the parameters of the CES function, that is the efficiency, distribution and substitution parameters, can be computed by solving the system of production constraints and first-order conditions for cost minimisation.

Recall that the CES production function for the composite intermediate input defined in the production side of KEGEM is:

$$N_{ji} = A_{ji}^{N} \left(\alpha_{IM_{ji}} IM_{ji}^{-\rho_{n_i}} + \alpha_{ID_{ji}} ID_{ji}^{-\rho_{n_i}} \right)^{-1/\rho_{n_i}}$$

where the substitution parameter is given by $\rho_{n_i} = \dfrac{1-\sigma_{n_i}}{\sigma_{n_i}}$. Given the value for the

elasticity of substitution σ_{n_i} assumed already, what is needed is to derive the calibration

formulas for the efficiency parameter, A_{ji}^{N}, and for the distribution parameters, $\alpha_{IM_{ji}}$ and

$\alpha_{ID_{ji}}$. From the cost minimisation assumption, the following Lagrangian can be formed:

$$\Lambda_{N_{ji}} = P_{im_{ji}} IM_{ji} + P_{id_{ji}} ID_{ji} - \lambda_{n_{ji}} \left(A_{ji}^{N} \left(\alpha_{IM_{ji}} IM_{ji}^{-\rho_{n_i}} + \alpha_{ID_{ji}} ID_{ji}^{-\rho_{n_i}} \right)^{-1/\rho_{n_i}} - N_{ji} \right)$$

Taking the derivatives with respect to the two intermediate inputs, which act as inputs to the production function in this case, the following equation can be derived:

$$\frac{P_{im_{ji}}}{P_{id_{ji}}} = \frac{\alpha_{IM_{ji}} IM_{ji}^{-\rho_{n_i}-1}}{\alpha_{ID_{ji}} ID_{ji}^{-\rho_{n_i}-1}}$$

By the unit conventions for initial prices and with some rearrangement, one can solve for the two distribution parameters as follows:

$$\alpha_{IM_{ji}} = \frac{IM_{ji}^{1+\rho_{n_i}}}{IM_{ji}^{1+\rho_{n_i}} + ID_{ji}^{1+\rho_{n_i}}} = \frac{IM_{ji}^{1/\sigma_{n_i}}}{IM_{ji}^{1/\sigma_{n_i}} + ID_{ji}^{1/\sigma_{n_i}}}$$

and

$$\alpha_{ID_{ji}} = \frac{ID_{ji}^{1+\rho_{n_i}}}{IM_{ji}^{1+\rho_{n_i}} + ID_{ji}^{1+\rho_{n_i}}} = \frac{ID_{ji}^{1/\sigma_{n_i}}}{IM_{ji}^{1/\sigma_{n_i}} + ID_{ji}^{1/\sigma_{n_i}}}$$

Once the substitution parameter and distribution parameter values are known, the efficiency parameter from the CES can be easily computed using the following formula:

$$A_{ji}^{N} = \frac{N_{ji}}{\left(\alpha_{IM_{ji}} IM_{ji}^{-\rho_{n_i}} + \alpha_{ID_{ji}} ID_{ji}^{-\rho_{n_i}} \right)^{-1/\rho_{n_i}}}$$

which can be expressed using the elasticity of substitution parameter:

$$A_{ji}^{N} = \frac{N_{ji}}{\left(\alpha_{IM_i} IM_i^{-(1-\sigma_{n_i}/\sigma_{n_i})} + \alpha_{ID_{ji}} ID_i^{-(1-\sigma_{n_i}/\sigma_{n_i})} \right)^{-(\sigma_{n_i}/1-\sigma_{n_i})}}$$

Table 7.7 shows the calibrated values for the three sectors that are used in implementing KEGEM. The distribution parameters represented by the Greek alpha indicate the intensity of a given input in a particular sector's production process. For example, the composite intermediate agricultural commodity used in agricultural production uses the domestic intermediate agricultural input with an intensity of 0.9642 compared with 0.0358 for imported intermediate agricultural input.

Table 7.7: Calculated Distribution and Efficiency Parameters in the Composite Intermediate Input

	1. Agriculture	2. Manufacturing	3. Services
$\alpha_{IM_{1i}}$	0.0358	0.0113	0.0005
$\alpha_{IM_{2i}}$	0.3525	0.3986	0.0037
$\alpha_{IM_{3i}}$	0.0334	0.0035	0.0048
$\alpha_{ID_{1i}}$	0.9642	0.9887	0.9995
$\alpha_{ID_{2i}}$	0.6475	0.6014	0.9963
$\alpha_{ID_{3i}}$	0.9666	0.9965	0.9952
A_{1i}^{N}	1.2222	1.1600	1.0814
A_{2i}^{N}	1.9300	1.9751	1.1805
A_{3i}^{N}	1.2113	1.0812	1.2006

Of the three sectors, the services sector uses the domestic intermediate inputs more intensively while the manufacturing sector uses the imported intermediate inputs on a more intensive scale. With regard to efficiency parameters, results in Table 7.7 show that in the cases of both the agricultural and manufacturing sector production, there is higher efficiency in the usage of domestic and imported intermediate manufactured inputs of the level of 1.93 and 1.9751 respectively. The least efficiently used of the

intermediate inputs are those in the services sector, in particular its utilisation of the domestic and imported intermediate agricultural inputs whose efficiency is 1.0814.

7.4.2 Calibration for the composite value added parameters

Following the same procedure as above, the calibration formulae for the efficiency and distribution parameters in the composite value added CES function were derived. The distribution parameters for capital and labour in the composite value added CES are given respectively by the following expressions:

$$\alpha_{K_i} = \frac{K_i^{1/\sigma_{va_i}}}{K_i^{1/\sigma_{va_i}} + L_i^{1/\sigma_{va_i}}} \text{ and } \alpha_{L_i} = \frac{L_i^{1/\sigma_{va_i}}}{K_i^{1/\sigma_{va_i}} + L_i^{1/\sigma_{va_i}}}$$

Given the values for the distribution parameters, the efficiency parameter can then be calibrated using the following formulae:

$$A_i^{VA} = \frac{VA_i}{\left(\alpha_{K_i} K_i^{-(1-\sigma_{va_i}/\sigma_{va_i})} + \alpha_{L_i} L_i^{-(1-\sigma_{va_i}/\sigma_{va_i})}\right)^{-(\sigma_{va_i}/1-\sigma_{va_i})}}$$

The calibrated values are given in Table 7.8.

Table 7.8: Calculated Distribution and Efficiency Parameters in the Composite Primary Input

	Agriculture	Manufacturing	Services
α_{K_i} = Capital	0.2136	0.6424	0.1314
α_{L_i} = Labour	0.7864	0.3576	0.8686
A_i^{VA}	1.8197	1.9426	1.6268

The distribution parameters show that the services and agricultural sectors are the most labour intensive. Services sector production has a labour intensity of 0.8686 while agriculture's is 0.7864. The manufacturing sector, as would be expected, is more capital intensive with an intensity level of 0.6424. As for efficiency, the manufacturing sector leads the other two sectors with an efficiency level of 1.9426.

7.4.3 Calibration for the composite labour CES parameters

The distribution parameters in the composite labour CES function are given by the following general formulae, derived the same way as before:

$$\alpha_{li} = \frac{L_{li}^{1/\sigma_{l_i}}}{\sum_l L_{li}^{1/\sigma_{l_i}}}$$

The efficiency parameter in the creation of composite labour was derived as:

$$A_i^L = \frac{L_i}{\left(\sum \alpha_{li} L_{li}^{-(1-\sigma_{l_i}/\sigma_{l_i})}\right)^{-(\sigma_{l_i}/1-\sigma_{l_i})}}$$

The calibrated values are given in Table 7.9. The agricultural sector uses the self-employed labour more intensely with a level of 0.9626. The intensity in the sector for skilled, semi-professional and professional labour is negligible. In the manufacturing sector, there is an intensive utilisation of the skilled labour force followed by unskilled labour. However, there is a very low intensity of self-employed labour usage in this sector. The services sector which employs the civil servants has a high intensity of professional workers usage. The semi-professional labour use is also significant. Self-employed labour intensity in the services sector is also very significant. With respect to efficiency, this is higher in the services sector followed by the manufacturing sector. The agricultural sector's efficiency in labour utilisation appears to be low compared with the other sectors. Probably the fact that most workers in this sector are self-employed explains the lower efficiency compared with the other sectors where targets are likely to be set for workers.

Table 7.9:   Calculated Distribution and Efficiency Parameters in the Effective Labour Input

	Agriculture	Manufacturing	Services
α_{1i} = Unskilled	0.0371	0.3600	0.1235
α_{2i} = Skilled	0.0001	0.5176	0.0363
α_{3i} = Semi-professional	0.0001	0.0598	0.1792
α_{4i} = Professional	0.0001	0.0518	0.3786
α_{5i} = Self-employed	0.9626	0.0049	0.2824
A_i^L	1.4471	3.9243	4.5512

7.4.4 Calibration for the Armington CES function parameters

The same calibration process was followed for the trade equations. Thus, the distribution parameters in the import demand function were determined through the following formulae for domestic and import goods respectively:

$$\alpha_{D_i} = \frac{D_i^{1/\sigma_{q_i}}}{D_i^{1/\sigma_{q_i}} + M_i^{1/\sigma_{q_i}}} \text{ and } \alpha_{M_i} = \frac{M_i^{1/\sigma_{q_i}}}{D_i^{1/\sigma_{q_i}} + M_i^{1/\sigma_{q_i}}}$$

The efficiency parameter was determined through the formulae:

$$A_i^Q = \frac{Q_i}{\left(\alpha_{D_i} D_i^{-(1-\sigma_{q_i}/\sigma_{q_i})} + \alpha_{M_i} M_i^{-(1-\sigma_{q_i}/\sigma_{q_i})}\right)^{-(\sigma_{q_i}/1-\sigma_{q_i})}}$$

The calibrated values are given in Table 7.10. The manufacturing sector has a higher intensity in the usage of imports in the formation of the composite domestic commodity. The agricultural sector surprisingly has a lower intensity of imports usage than would otherwise be expected. The services sector, as might be expected from the non-tradeability of some of its components, uses mainly the domestically produced commodity in the formation of the composite domestic service commodity. The efficiency in the formation of the composite domestic commodity is highest in the manufacturing sector and lowest in the agricultural sector.

Table 7.10: Calculated Distribution and Efficiency Parameters in the Armington CES Function

	Agriculture	Manufacturing	Services
α_{D_i} = Domestic	0.9884	0.7977	0.9988
α_{M_i} = Imported	0.0116	0.2023	0.0012
A_i^Q	0.9021	1.7908	1.1844

7.4.5 Calibration for the output CET function parameters

The parameters in the export CET function were calibrated using the same principle as those of the CES functions. Thus, the distribution parameters for the domestically used commodity and that exported were calibrated using the following formulae respectively:

$$\gamma_{D_i} = \frac{D_i^{1/\psi_{x_i}}}{D_i^{1/\psi_{x_i}} + E_i^{1/\psi_{x_i}}} \quad \text{and} \quad \gamma_{E_i} = \frac{E_i^{1/\psi_{x_i}}}{D_i^{1/\psi_{x_i}} + E_i^{1/\psi_{x_i}}}$$

In the same way, the efficiency parameter in the export CET function was calibrated by the formulae:

$$B_i^X = \frac{X_i}{\left(\gamma_{D_i} D_i^{(1+\psi_{x_i})/\psi_{x_i}} + \gamma_{E_i} E_i^{(1+\psi_{x_i})/\psi_{x_i}}\right)^{\psi_{x_i}/(1+\psi_{x_i})}}$$

The calibrated values are given in Table 7.11. The distribution parameter for agricultural exports is quite high compared to the other two sectors. This reflects the importance of the agricultural sector in contributing export earnings to the Kenyan economy. The other two sectors have low values for exports implying that most of their production is domestically absorbed. As for the efficiency in the transformation of the outputs to domestic and export commodities, the agricultural sector is most efficient at a level of 1.6067.

Table 7.11: Calculated Distribution and Efficiency Parameters in the Output CET Function

	Agriculture	Manufacturing	Services
γ_{D_i} = Domestic	0.6896	0.9183	0.9956
γ_{E_i} = Export	0.3104	0.0817	0.0044
B_i^X	1.6067	1.1879	1.1974

7.4.6 Calibration of the Linear Expenditure System (LES) parameters

The households' consumption system in KEGEM is specified as the Linear Expenditure System. For each of the ten household categories, the consumption C_{jh} of commodity j by household h is a function of total income Y_h of the group and prices of the commodities P_{q_j}:

$$C_{jh} = \theta_{jh} + \frac{\beta_{jh}\left(Y_h - HTAX_h - SV_h - \sum_j P_{q_j}\theta_{jh}\right)}{P_{q_j}}$$

The fixed level of subsistence parameter, θ_{jh} and the marginal budget share parameter, β_{jh}, were derived from the observed value of consumption, the income elasticity for commodity j by household h, η_{jh}, and the flexibility of money (Frisch parameter) for each household, ω_h, using the following formulas:

$$\beta_{jh} = \frac{\eta_{jh}P_{q_j}C_{jh}}{Y_h}$$

and

$$\theta_{jh} = C_{jh}\left(\frac{1 + \eta_{jh}}{\omega_h}\right)$$

The calibrated subsistence levels and the marginal budget shares are given in the Tables 7.12 and 7.13. The most telling of these calibration values are the marginal budget shares. It is clear from Table 7.13 that the urban households have lower budget shares

for agricultural commodities compared with all rural households. Among the urban households, the urban low income group has a higher budget share allocated to agriculture than the urban middle and high income groups.

As would be expected, the urban middle income group has manufacturing commodity getting the highest share and in the urban high income group, the services commodity is the most important. In general, the rural households have their highest budget allocations to the agricultural commodity followed by the manufactured goods. Services are not considered to be of priority among the rural households needs.

Table 7.12: Calculated Hoseholds[a] Subsistence Expenditures (Kshs '000)

	Uhh1	Uhh2	Uhh3	Rhh1	Rhh2	Rhh3	Rhh4	Rhh5	Rhh6	Rhh7	Total
Agric.	214066	208506	59073.8	147349	134544	281861	186913	2315770	134915	546262	4229260
Manuf.	571012	925982	164060	112620	125105	145902	129335	849608	27735.8	967149	4018510
Service	698232	874320	361909	95836	64110.4	113519	72682.7	608013	29472.8	707952	3626050
Total	1483310	2008810	585043	355805	323759	541282	388931	3773390	192123	2221360	11873800

[a]Uhh1 = Low income urban households; Uhh2 = Middle income urban households; Uhh3 = High income urban households; Rhh1 = Rural households holding less than 0.5 ha. and with little additional income; Rhh2 = Rural households holding 0.5 ha. with substantial additional income; Rhh3 = Rural households holding greater than 0.5 ha. but less than 1.0 ha. with little additional income; Rhh4 = Rural households (holding less than 0.5 ha. but less than 1.0 ha. with substantial additional income; Rhh5 = Rural households holding greater than 1.0 ha. but less than 8.0 ha.; Rhh6 = Rural households holding greater than 8.0 ha. (small farms only); Rhh7 = Other rural households.

Table 7.13: Calculated Marginal Budget Shares for Different Households[a]

	Uhh1	Uhh2	Uhh3	Rhh1	Rhh2	Rhh3	Rhh4	Rhh5	Rhh6	Rhh7
Agric.	0.1446	0.0878	0.0551	0.4123	0.3938	0.4779	0.3993	0.4742	0.4586	0.2175
Manuf.	0.4123	0.5274	0.3824	0.3337	0.4185	0.3148	0.4144	0.3479	0.3536	0.4902
Service	0.4431	0.3848	0.5625	0.2540	0.1877	0.2073	0.1863	0.1779	0.1878	0.2923
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

[a]Uhh1 = Low income urban households; Uhh2 = Middle income urban households; Uhh3 = High income urban households; Rhh1 = Rural households holding less than 0.5 ha. and with little additional income; Rhh2 = Rural households holding 0.5 ha. with substantial additional income; Rhh3 = Rural households holding greater than 0.5 ha. but less than 1.0 ha. with little additional income; Rhh4 = Rural households (holding less than 0.5 ha. but less than 1.0 ha. with substantial additional income; Rhh5 = Rural households holding greater than 1.0 ha. but less than 8.0 ha.; Rhh6 = Rural households holding greater than 8.0 ha. (small farms only); Rhh7 = Other rural households.

7.5 Concluding Remarks

This chapter has described the data needed to implement KEGEM. The calibration procedure used for the unknown parameters has also been described. Once KEGEM was implemented, it was ready to carry out simulations. Solving models within GEMPACK is always done in the context of a simulation (Harrison and Pearson 1994). From the initial solution supplied as the starting point with the 1976 data described in the foregoing sections together with the calibrated values of various parameters, the simulations calculate new solutions to the equations of the model. As is the case with other CGE models, the simulations undertaken with KEGEM are the answers to the questions of the type "what was the effect of" and "what if". The simulations and a discussion of their results are presented in the remaining chapters of this study.

8. Terms of Trade Shocks and Economic Policy: Simulation Results

8.1 Introduction

Results from simulations of external shocks and a combination of the external shocks with policy variables are presented in this chapter. The simulations are carried out using the Kenyan economy general equilibrium model developed in Chapter 6. The simulations initially explain the effects of external shocks that were beyond the control of the Kenyan government. Then, changes in domestic policy variables when external shocks occurred are analysed in conjunction with the external shocks.

The chapter is organised as follows. Section 8.2 introduces the aspects of Kenya's terms of trade shocks being considered in this study. The section analyses the negative and positive terms of trade shocks that affected the Kenyan economy. The analyses of terms of trade shocks is followed in Section 8.3 by a look into how particular government policies affected the outcome of these external shocks. Section 8.4 presents concluding remarks.

8.2 Aspects of Kenya's Terms of Trade Shocks

To introduce the analysis of adjustment policies, the effects of the most striking aspects of Kenya's terms of trade shocks are described using the model. This is done by first simulating the negative terms of trade shocks resulting from increases in import prices following the oil price shock in 1973-74 period. The export boom is then simulated through an increase in the world agricultural export price to show the contribution of a positive terms of trade shock. The two changes in terms of trade are then combined to form the reference simulation for analysis of economic policies. The three simulations addressing the aspects of the terms of trade are defined as follows:

- NTOT = Terms of trade shock through a 12 per cent increase in world price of manufactured imports.

- PTOT = Terms of trade shock through a 25 per cent increase in world price of agricultural exports.

- JTOT = Joint terms of trade simulation combining the 12 per cent increase in world manufacturing import prices with the 25 per cent increase in world agricultural export prices.

The simulations are described in more detail in the respective sub-sections discussing results. The results from these simulations generated by solving the system of equations using GEMPACK are presented in Tables 8.1 and 8.2. All the results from GEMPACK reported in this study show the per cent deviation from the base (or initial solution) for each of the variables except for the balance of trade which is reported as a per cent of base year GDP.

8.2.1 Effects of the negative terms of trade shock from the first oil-crisis

Kenya experienced a negative terms of trade shock when the price of imports rose substantially during the first oil-crisis period and in the following years, mainly reflecting higher manufacturing costs in developed countries. The price rise was also attributed to tight monetary policies pursued in developed economies. To explain the effects of this negative terms of trade, the Kenyan economy is 'shocked' in the model with a 12 per cent increase in world price of manufactured imports where this has been computed from import price information contained in Kenya's *Economic Survey* (Kenya, Republic of 1979c).

The simulation results in column NTOT of Table 8.1 illustrate how the Kenyan economy might have been affected by this external shock if it was the only event affecting the economy. The results of the import price shock have a negative effect on key variables in the Kenyan economy. Real GDP contracts by 3.9 per cent.

The price rise caused agricultural imports to decline by 1.2 per cent while manufacturing import demand contracted 6.8 per cent. These reductions, coupled with falls in the level of imported intermediate inputs lead to a fall in GDP and output. Manufacturing sector output contracted by 1.9 per cent, showing the negative impact of higher import prices

as this sector relies to a significant extent on imported capital goods for use as intermediate inputs. The slowdown in the manufacturing sector inevitably leads to a slowdown in the rest of the economy. This explains the one per cent fall in agricultural production and the 1.4 per cent contraction in the services sector. Investment in each of the three sectors was also reduced in the short run. Investment contractions reflect lower savings resulting from higher production costs and hence less production. Contractions in output and investment caused exports to decline. Agricultural exports fell marginally by 0.8 per cent with manufacturing exports falling by 3.4 per cent. The fall in exports outweigh the fall in imports as a deterioration in the trade balance equivalent to 1.9 per cent of the base period GDP results from higher import prices.

Employment as measured by labour demand also fell with the highest reduction being 4.6 per cent in the manufacturing sector. When classification of different labour categories is considered, it is skilled, unskilled, semi-professional and professional labour that bear most of the burden of the contraction with reductions of more than two per cent. Unskilled, skilled and semi-professional labour reductions can be attributed to contractions in the manufacturing sector where most of these workers are employed. The explanation for the contraction in the self-employed and family labour category employment demand is the reduction in agricultural production as most of these people are employed in agriculture.

Since domestic prices and domestic currency import prices directly affect the level of the consumer price index (CPI), consumers face slightly higher prices when import prices rise. Therefore, the inflationary effect of higher import prices is evident from the rise in CPI of 1.3 per cent. This marginal rise is not consistent with the Kenyan government's argument that Kenyan inflation has mainly been imported. The results appear to give credence to econometric results showing that Kenyan inflation in the 1970s was due to the monetary policy adopted at that time (Mwega and Killick 1990).

Table 8.1: Effects of Terms of Trade Shocks (Percentage Changes From Initial Solution)

	NTOT	PTOT	JTOT
Real GDP	-3.86	6.98	3.23
Output			
Agriculture	-0.95	5.87	4.98
Manufacturing	-1.88	3.87	2.33
Services	-1.41	3.00	1.71
Exports			
Agriculture	-0.78	21.77	20.90
Manufacturing	-3.44	-0.04	-3.17
Services	-1.52	2.11	0.69
Imports			
Agriculture	-1.16	6.29	5.24
Manufacturing	-6.85	7.93	1.01
Services	-1.22	4.61	3.56
Investment			
Agriculture	-0.63	2.57	2.13
Manufacturing	-2.19	9.37	7.71
Services	-4.30	19.44	15.86
Employment			
Agriculture	-1.44	9.20	7.78
Manufacturing	-4.62	10.12	6.00
Services	-1.86	4.00	2.27
Employment by Category			
Unskilled	-2.34	6.90	4.74
Skilled	-3.07	6.82	4.05
Semi-professional	-2.35	5.24	3.09
Professional	-2.23	4.91	2.87
Self-employed	-1.65	7.68	6.10
Aggregate prices			
Nominal wage	0.38	1.53	1.95
Real wage	-0.89	-3.48	-4.40
Consumer price index	1.28	5.20	6.63
Producer price index	0.63	6.48	7.24
Consumer prices			
Agriculture	-0.73	9.54	8.95
Manufacturing	5.35	4.10	9.67
Services	0.42	3.14	3.68
Producer prices			
Agriculture	-0.14	12.87	12.78
Manufacturing	2.08	5.65	8.02
Services	0.36	3.03	3.50
Balance of trade (per cent of base year GDP)	-1.88	2.82	0.66

While in the 1970s and early 1980s monetary policy played very little role in the management of the Kenyan economy, these results seem to suggest that the government concentrating its efforts against inflation on imported inflation may not have been appropriate. The 30 per cent indexation[1] of money wage to the CPI leads to a marginal 0.4 per cent increase in the nominal wage. Overall, the real wage declined by 0.9 per cent as a result of high import prices.

It is also important to understand the distributional effects of the external shocks. Assessment of income distribution effects shows how each category of the population has been affected. The ten household classifications in the model make this possible. The results for the income distribution effects of the terms of trade shocks are presented in Table 8.2. In order to put the income distribution changes for households in perspective, two points must be recognised. First, the structure of the model captures two main sources of household income. The income from labour and net income transfers from other institutions. However, since the net household transfers are considered to be exogenous, the income distribution changes for households are principally brought about by changes in labour demand and wages. With regards to wages, the macroeconomic closure introduces a substantial partial rigidity through only 30 per cent indexation to the CPI. Hence, changes in nominal incomes are bound to come from the level of employment demand for the different categories of labour supplied by a particular household group.

Second, it is worth recognising that KEGEM is a real model whose design does not take account of the monetary side of the economy, such as the money supply, domestic credit, interest rates, and foreign currency reserves. Thus, it was not possible to effect inflation control measures that might have been used by the government. Therefore, it is possible that nominal income rather than real income better represents the gains or losses of workers, and therefore households, before any inflation control measures. Hence, the discussion on income distribution will be based on nominal income as changes in real

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[1] The 30 per cent wage indexation adopted in this model was determined from the annual four per cent wage rise that the government allowed in the public service. Given that average inflation at the time was less than 20 per cent, 30 per cent wage indexation is a reasonable approximation of the tripartite wage guidelines agreement between trade unions, employers and the government.

income may be overestimated where particular shocks are inflationary since monetary policy measures are not in place in the simulations. Moreover, real income may be underestimated in a simulation where the shock is deflationary.

Table 8.2: Terms of Trade Shocks Effects on Income Distribution (Percentage Changes From the Initial Solution)

	NTOT	PTOT	JTOT
Labour incomes			
Unskilled labour	-1.97	8.54	6.78
Skilled labour	-2.70	8.46	6.08
Office workers and semi-professionals	-1.98	6.85	5.10
Professional workers	-1.86	6.52	4.87
Self-employed and family labour	-1.28	9.33	8.16
Household incomes			
Urban households (low income)	-1.99	7.67	5.90
Urban households (middle income)	-2.13	7.72	5.82
Urban households (high income)	-2.38	10.22	8.09
Rural households (<0.5ha)	-1.09	7.46	6.46
Rural households (<0.5ha + income)	-1.16	6.48	5.43
Rural households (>0.5ha but <1ha)	-1.02	7.32	6.39
Rural h'holds (>0.5ha but <1ha + income)	-1.07	6.11	5.14
Rural households (>1ha but <8ha)	-1.14	7.34	6.30
Rural households (>8ha)	-0.91	6.16	5.33
Rural households (other)	-1.44	6.06	4.78
Sectoral profits and government revenue			
Agriculture	-2.72	47.95	44.82
Manufacturing	-29.47	36.44	8.00
Services	-6.08	2.64	-3.45
Government revenue	-1.19	12.05	11.25

The simulation results for the negative terms of trade shock are shown in column NTOT of Table 8.2. The results indicate that all the institutions from households to government were worse off in nominal terms as income fell due to higher import prices. In the case of the households, it is urban and rural households classified as 'other' that are mostly affected. This is because urban households derive most of their income from the manufacturing sector hence a contraction in this sector lowers income directly. As

noted, urban households contribute mainly to unskilled and skilled labour and since labour income of these two groups declined by two and 2.7 per cent respectively in nominal terms, this caused declines in nominal income for urban low income households and urban middle income households by two and 2.1 per cent respectively. High income urban households' nominal income declined by 2.4 per cent reflecting the larger fall in income of skilled workers.

Most rural households fall into the labour category of self-employed and family workers. Even after being 'spread' over the first six rural household groups the 1.3 per cent fall in nominal income of the self-employed and family labour group meant declines in nominal incomes between 0.9 and 1.2 per cent for all rural households. The nominal income of the extremely poor group owning less than half a hectare of land falls by 1.1 per cent. This means that any shock that creates a negative impact on the agricultural sector causes more poverty. The rural household group with more than eight hectares of land experience the lowest reduction in nominal income of 0.9 per cent. However, rural households classified as 'other' experienced a larger fall in nominal income of 1.4 per cent.

The high import prices faced by the manufacturing sector and the reliance of this sector on imported intermediate inputs resulted in 29.5 per cent reduction in sector's profits in the short-run. In contrast, the agricultural sector experiences a relatively mild reduction in profitability of 2.7 per cent. The fall in agricultural sector's profitability is attributable to the higher prices of manufactured inputs sourced domestically. The fall in profitability in all the sectors caused lower tax revenues resulting in 1.2 per cent reduction in government revenue since government revenues are tied particularly closely to manufacturing and the service sectors.

8.2.2 Effects of the positive terms of trade shock from the coffee boom

The simulation of the negative impact of a higher manufactured import price shows the situation facing the Kenyan economy following the oil price shock and assumes no change in other exogenous variables. However, this scenario changed following the increases in world prices of coffee and tea. These crops contribute significantly to gross domestic product and the boom in prices occurred when the negative terms of trade from

higher manufactured imports and oil prices were causing distress in the economy. Consequently, it is important to know how increases in world prices of these commodities affected the Kenyan economy. This positive terms of trade shock is simulated by increasing world prices of agricultural exports by 25 per cent where, again, this reflects export price information contained in Kenya's *Economic Survey* (Kenya, Republic of 1979c). This simulation illustrates the effect of a positive shift in the terms of trade in the short-run, *ceteris paribus*.

The results of change in the world price of agricultural exports shown in column PTOT of Table 8.1 show the effect that the boom had on the economy. In the Kenyan case, unlike other developing countries, the increase in world price of agricultural exports is transmitted directly to producers as higher domestic currency export prices in the absence of export taxes. Since output in the agricultural export sector is price-responsive, higher prices lead to increased output. Thus, the increases in agricultural export prices in this simulation cause an increase in output. This results in increased export earnings which increase the money available for consumption of goods and services and investment, thus raising aggregate demand. This effect of increased aggregate demand on output is responsible for the increase in the real GDP which expanded by seven per cent with agricultural production rising by 5.9 per cent. An important observation that needs to be noted is that a higher price for agricultural exports is quite effective in contributing to real GDP and this is due to output in the agricultural sector being price-responsive. The expansionary impact of higher agricultural production contributes to higher production in the other two sectors. Manufacturing sector's output increased by 3.9 per cent and the services sector output by three per cent. However, increased profitability of agricultural production encourages increased use of resources in agriculture. The shift of resources to agriculture means that this brings about a much smaller increase in total production in non-agricultural sectors mainly for domestic supply, thereby discouraging non-agricultural exports. This justifies committing additional resources to agriculture as agricultural exports become relatively more profitable than non-agricultural exports. This explains why an increase in agricultural export prices leads to a 0.04 per cent fall in manufactured exports and only 2.1 per cent increase in exports of services.

Increased export earnings also add to total savings in the economy causing increases in investment resulting in increased demand for investment goods and services. Since the sectoral investment shares favour the services sector[2], a 19.4 per cent increase in its investment occurs as a result of the boom. The manufacturing sector also enjoys a 9.4 per cent rise in investment. Not surprisingly, the agricultural sector's investment improved by a mere 2.6 per cent due to its lower share of total savings. This low agricultural investment is in spite of the fact that the export boom is taking place in the agricultural sector. This does raise the question whether something could have been done to encourage re-investment of export earnings in the agricultural sector. For instance an active government policy[3] that supported allocation of more savings to agriculture might have helped ensure that a significant proportion of the boom was reinvested back into the agricultural sector.

The higher flow of export earnings also makes an increase in import demand possible. The increased importing capacity can be attributed to increased export volumes or, put in another way, changes in imports are partly induced by changes associated with generally higher output.

In response to increased investment demand, output grows further and this leads to an increase in demand for labour. Thus, the importance of the agricultural sector in providing employment for Kenyans becomes evident when the effects of the boom on labour demand are considered. An increase in agricultural export prices makes it more lucrative to commit more resources to produce agricultural commodities. That is, this kind of windfall calls for increased use of production inputs, including labour. With relatively rigid wages, more labour is employed. Labour demand as a result of the boom in the agricultural sector increases by up to 9.2 per cent. Employment of self-employed and family labour, mainly involved in agricultural production, contributed to the increase

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[2] The exogenous sectoral investment shares determining the proportion of savings going to a particular sector were as follows for 1976: agriculture (8.68 per cent), manufacturing (30.61 per cent) and services (60.71 per cent).

[3] In actual fact, the Kenyan government did attempt to ensure that agriculture received a substantial level of savings for investment purposes through a policy requiring commercial banks to lend at least 17 per cent of their deposits to the sector. However, the banks did not implement this recommendation in their lending policies.

when it grew by 7.7 per cent. Employment demand for unskilled and skilled labour increased by 6.9 per cent and 6.8 per cent respectively. The increase in manufacturing sector labour demand of 10.1 per cent is higher than the 9.2 per cent increase in demand for labour in agriculture. This unexpected discrepancy in increases in labour demand is attributable to higher export earnings being spent on goods and services that boost manufacturing production.

Higher export earnings spent in the country cause prices of domestic goods to rise. Therefore, agricultural export prices, in addition to stimulating an increase in output of the agricultural export sector, also cause increases in the CPI and nominal wage as a result of the indexation of the latter to the former. The simulation results showed a 5.2 per cent increase in the consumer price index and 1.5 per cent rise in the nominal wage from the boom in the export sector, *ceteris paribus*. This translates to a 3.5 per cent fall in the real wage. Also, the producer price index increased by 6.5 per cent which is mainly attributable to the 12.9 per cent increase in the agricultural sector's producer prices resulting from the favourable export prices.

The negative impact of high world import prices on nominal incomes for all the institutional groups observed in the negative terms of trade simulation is reversed in this simulation for higher export prices as can be seen in column PTOT of Table 8.2. Increased use of factors such as labour implies increased factor receipts by respective households, increasing income. The gains from higher export earnings accrue to both rural and urban households. Higher world prices cause higher nominal labour incomes and the skilled and unskilled labour groups benefit almost as much as self-employed and family labour group even though the boom occurs in the agricultural sector. This leads to substantial increases in nominal incomes of all urban households in magnitudes higher than for the rural households. Urban households obtain considerable benefits from the export boom compared to what might have been expected. This can possibly be explained by the increased investment resulting from higher export earnings directly benefiting them since urban households supply most skilled and professional labour in the urban areas where most investment occurred. This implies that unless there was a policy to divert export earnings to investments in rural areas, urban households benefited more even though it was rural workers who were involved in the booming agricultural sector.

With an increase in the terms of trade, agricultural and manufacturing profits rose significantly along with government revenue. Agricultural profits increased 47.9 per cent mainly due to high producer prices resulting from favourable agricultural export prices. The boost that the manufacturing sector gets from a well performing agricultural sector led to a 36.4 per cent increase in manufacturing sector's profits. Surprisingly, the profits of the services sector rose by only 2.6 per cent, a poor performance when compared with the two other sectors. Overall, government revenue increased by 12.1 per cent.

8.2.3 Combined effects of the terms of trade shocks

In this simulation, since the economy was still facing the effects of oil price increases, the two world price effects are combined without changing domestic conditions. That is, a 12 per cent increase in world manufacturing import prices was combined with a 25 per cent increase in world agricultural export prices. This combined simulation forms the reference experiment against which various economic policies evaluated here and in Chapter 9 are discussed.

The results of the joint terms of trade shock reported in column JTOT in Table 8.1 show that the boom in the agricultural sector saved the situation which otherwise would have been very unfavourable for Kenya. The contraction that would have been expected to occur due to prevailing high world manufactured import prices was reversed by more than proportionate expansion in the economy resulting from the export price boom. That is, the expansionary effect of higher agricultural production was larger than the contractionary effect of lower manufacturing production in the sole negative terms of trade simulation. Hence, with no policy intervention by government, real GDP would have increased by 3.2 per cent. At the same time, contraction in imports resulting from higher import prices is curtailed. There is a one per cent increase in manufactured imports and 5.2 per cent and 3.6 per cent increases in imports of agricultural goods and services, respectively. The improvement in import demand and substantial increase in export supply explain the healthy performance of the economy in response to the joint terms of trade simulation. However, the increase in total exports was not as large as in the sole positive terms of trade simulation when there is no import price shock. This is

because the export price had to compensate for the losses in exports resulting from the import price shock included in this combined simulation.

This expansion led to a substantial growth in employment in all three sectors. Most labour demand growth was in the agricultural sector (7.8 per cent) followed by a six per cent increase in manufacturing labour demand. Self-employment and family labour demand increased by 6.1 per cent with demand for skilled labour rising by 4.1 per cent, semi-professional and professional labour rising by 3.1 and 2.9 per cents respectively and that of unskilled labour rising by 4.7 per cent.

The positive impacts on nominal household incomes from higher world export prices outweigh the negative impacts resulting from high world import prices as in the JTOT column in Table 8.2. Contrary to expectations, results from this column show that rural households involved in agricultural production did not experience significantly larger increases in nominal incomes than their urban household counterparts. In fact, in some cases, urban households had better nominal income growth than some rural households. As with employment demand, whereas the export boom took place in the agricultural sector, the manufacturing sector benefited substantially in terms of employment. Export earnings, while going directly to rural producers, was mostly spent on goods resulting in higher employment for the manufacturing sector. This means that increases in urban household nominal incomes were as good as or much better than rural households.

Profits for agriculture and manufacturing did increase. Since government derives most of its tax revenue from the manufacturing and services sectors, its revenue rose by 11.3 per cent compared to 12.1 per cent in the sole export price simulation (PTOT). The slightly lower increase could be due to lower direct profits from the services sector and also lower direct taxes from households.

The three results from the terms of trade shocks lead to some important observations about income distribution. First, the external shock that led to contraction of the manufacturing sector affected all income groups. Second, the external shock that created a positive impact on the agricultural sector led to substantial improvements in the income of all groups. In the specific simulation carried out here, it was observed that while an inflow of foreign exchange earnings benefited all household groups, it was rich

urban households that do very well. This is largely because the accompanying investment spending took place in urban areas. These two observations lead to the third one, that the agricultural sector provides a means for income generation for all households in the economy, and hence policies for dealing with poverty should take its development into account. This is supported by the relatively large positive effects of the export price boom compared to the negative effects of the import price shock. This suggests that negative external shocks can be counteracted by putting in place policies that are 'friendly' to the agricultural sector as an effective way to support household incomes. The expansionary impact of higher export prices, with higher production, is thus larger than the contractionary effect of higher import prices.

8.3 Domestic Policy Simulations

The discussion so far indicates that the Kenyan economy benefited from the positive contribution of the boom in export prices. This suggests that non-intervention by the government was probably an acceptable policy position. However, given the uncertainty about how long the boom would last, and also the difficulties resulting from the oil-crisis in the Kenyan economy prior to the boom, it is understandable that the government did not abandon previous economic policy decisions. Therefore, policy experiments to show how various domestic policies affected the economy, especially the agricultural sector, given the external shocks discussed previously, are of interest. The importance of the direction of the government's policy response under these circumstances is highlighted by Akinboade (1996). Akinboade (1996) poses the question about what policy makers should do when confronted with a massive influx of foreign exchange and suggests three ways in which the government can respond to the situation. First, the increased receipts could be saved by the government. If it is anticipated that the windfall is likely to be ephemeral, then it might be sound policy to save what is earned against the time when world prices come down. This policy has the advantage of having low political risk and is also very easy to implement. A second policy option is for the increased receipts to be spent on provision of more social services. This is appealing especially if the pre-boom state of social infrastructure has been poor. In a country where a large proportion of the population is illiterate and where basic health facilities are lacking or poor in many areas, the influx of foreign currency may provide an avenue to implement populist policies

through the provision of these and other social services. A third option would be to spend the increased receipts on debt servicing or repayment. While this may increase the creditworthiness of the country, it is likely to be resisted internally and may have complications for the relevance of the boom to redressing income distribution and poverty alleviation.

Dick et al. (1983) also identified dealing with increased export receipts as a policy issue. They noted that in the face of sudden increases in export prices, the government could pursue a range of adjustment strategies. At one end of the range, Dick et al. (1983) suggested a policy aimed entirely at domestic expenditure stability. That is, the foreign account would simply be allowed to accumulate while domestic fiscal and monetary policies would be designed to keep domestic absorption constant. It would be expected (in the absence of strong linkages between exporting sectors enjoying the world price increases and other domestic sectors) under such policy that adjustment pressures would be largely confined to the commodity producing sector. At the other extreme, the policy option would be one of stabilisation of the foreign account by endogenous adjustment of domestic expenditure. This involves a shift of resources from the traded to the more domestically oriented sectors. The price adjustment mechanism underlying this resource shift is in fact a revaluation of the real exchange rate sufficient to bring about the required increase in the relative price of non-traded and traded goods. In such a situation, adjustment pressures would be spread more evenly over sectors in the domestic economy.

The points raised by Akinboade (1996) and Dick et al. (1983) make the policies implemented by the Kenyan government in response to the terms of trade shocks important. The discussion presented in this section seeks to investigate how active government policy affected the economy in this period. The policy simulations include variables that the government changed at this time. These are import duties, indirect taxes (excluding import duties) and total government expenditure on goods and services. A simulation of how the economy would have been affected in the absence of external shocks is carried out for each of the domestic policy variables analysed. However, the key results are for the simulations that combine the joint terms of trade shock with the respective domestic policy variable shock. In other words, this discussion compares

results from a combination of different policy variables with the joint terms of trade shock to the sole joint terms of trade shock. The joint terms of trade simulation acts as the reference allowing the effects of particular policy decisions on the contribution of the boom to the economy to be understood. A more elaborate explanation of the domestic policy variables, the level of the shocks and a discussion of the simulation results follow.

8.3.1 Fiscal adjustment through an increase in import tariffs

In 1975, the Kenyan government introduced fiscal measures to broaden the tax base by imposing higher rates of duty on non-essential and luxury consumer goods. It also encouraged industry to adopt labour intensive technology by raising duties on imported capital goods. These fiscal measures were introduced to try and rectify internal and external imbalances created by the first oil-crisis which still persisted. The question to be answered concerns the effect of increasing the rate of import duties.

The pre-shock tariff rates for the three sectors as computed from the information contained in the 1976 input-output tables were as follows: 3.71 per cent for agriculture sector; 14.97 per cent for the manufacturing sector; and 0.49 per cent for the services sector. These rates are increased by 50 per cent across the board in this simulation to 5.56 per cent for agriculture, 22.46 per cent for manufacturing and 0.74 per cent for the services sector. This raises an extra Kshs 657 million for the government in revenue income. However, this extra income, equivalent to a 9.92 per cent increase in government revenue is assumed to be part of government savings and there is no attempt in this simulation to raise government spending over its pre-simulation level. This is because the purpose of the simulation is to analyse the effects the fiscal measure had on the outcome of the terms of trade shock. Since there is no separate variable in the model capturing government (public) investment, this increase in government savings represents an improvement in fiscal balance. The simulations undertaken in this experiment were as follows:

- JTOT = The reference joint terms of trade simulation combining the 12 per cent increase in world manufacturing import prices with the 25 per cent increase in the world agricultural export prices.

- STARR = 50 per cent increase in existing import tariff rates.

- TARR = 50 per cent increase in existing import tariff rates combined with the joint terms of trade.

Results for the individual effect of the 50 per cent increase in across the board import duties on the economy are presented under column STARR in Tables 8.3 and 8.4 and those when it is combined with the external shocks are reported in column TARR of Tables 8.3 and 8.4. As intimated above, the discussion focuses on the results in column TARR. The results of the individual policy variable simulation are primarily to present a clearer picture of what is going on. The simulation results in TARR indicate that the change in import tariffs somehow altered the impact of the terms of trade shock on the economy. Real GDP that grew by 3.2 per cent in the reference simulation ends up growing by 2.2 per cent as a result of the tariff increases.

The increases in sectoral production resulting from the boom was suppressed marginally in the agricultural sector by increases in import tariffs. However, remember that the fiscal measure to increase tariffs was decided upon before the government realised the existence of the export boom. This means that if there was no positive terms of trade shock, the economy might have contracted further from its level precipitated by the high import prices emanating from the oil shock.

Table 8.3: **Effects of Higher Tariffs on the Outcome of External Shocks (Percentage Changes from Initial Solution)**

	JTOT	STARR	TARR
Real GDP	3.23	-0.98	2.17
Output			
Agriculture	4.98	-0.17	4.79
Manufacturing	2.33	0.86	3.25
Services	1.71	0.25	1.95
Exports			
Agriculture	20.90	-0.79	19.97
Manufacturing	-3.17	-1.32	-4.50
Services	0.69	-0.08	0.58
Imports			
Agriculture	5.24	-0.85	4.37
Manufacturing	1.01	-0.74	0.35
Services	3.56	0.74	4.33
Investment			
Agriculture	2.13	1.15	3.18
Manufacturing	7.71	4.11	11.68
Services	15.86	8.31	24.49
Employment			
Agriculture	7.78	-0.26	7.47
Manufacturing	6.00	2.18	8.43
Services	2.27	0.33	2.59
Employment by Category			
Unskilled	4.74	0.56	5.33
Skilled	4.05	1.13	5.28
Semi-professional	3.09	0.65	3.77
Professional	2.87	0.58	3.46
Self-employed	6.10	-0.02	6.05
Aggregate prices			
Nominal wage	1.95	0.57	2.55
Real wage	-4.40	-1.32	-5.70
Consumer price index	6.63	1.92	8.75
Producer price index	7.24	1.41	8.79
Consumer prices			
Agriculture	8.95	1.16	10.22
Manufacturing	9.67	4.15	14.27
Services	3.68	1.24	5.04
Producer prices			
Agriculture	12.78	0.49	13.24
Manufacturing	8.02	3.09	11.51
Services	3.50	1.12	4.72
Balance of trade (per cent of base year GDP)	0.66	-2.03	-1.67

To continue with the effects of the tariff changes on sectoral output, manufacturing output actually increased by 3.3 per cent, one percentage point higher than the 2.3 per cent in the joint terms of trade simulation. This means that, higher tariffs favour the import competing manufacturing sector. The services sector's output also improved marginally as it expanded by two per cent compared with 1.7 per cent attained in the reference simulation.

Import demand in the economy contracted as a result of the tariff changes. In particular, agricultural and manufacturing imports contracted from their level in the joint terms of trade simulation. This contraction suggests a reduction in the amount of imported capital goods used as intermediate inputs in domestic production. An outcome positively sought by the government in its 1975 budget.

The increase in tariffs meant more protection to the domestic economy from outside competition. Thus, whereas an increase in import tariffs meant reduced imports of final and intermediate goods and services, it also meant a stronger market for import substitutes. Hence, the additional import substitution production suggested by the increase in manufacturing and services sectors' production.

With an increase in import tariffs (column TARR, Table 8.3), exports increased by 20 per cent and 0.6 per cent in the case of the agricultural and services sectors compared to their increase under the joint terms of trade experiment of 20.9 per cent and 0.7 per cent with tariffs unchanged. This means that the tariffs hurt the exporting agricultural sector. One reason for this would be the effect of the reduced use of imported capital goods, which are expected to lead to a higher level of exports.

The increase in import tariffs led to slight declines in the amount of agricultural employment achieved in the reference simulation. That is, instead of the employment increase being fully realised in this sector, an increase in import tariffs reduced the number of jobs that would have been added to the economy by the export boom. The explanation for the fall in agricultural employment is that as an export producing sector, it is contracted by the tariffs through higher costs of domestic and imported inputs.

The tariff increase outcome is different for the manufacturing and services sectors. There is a slight increase in employment in these sectors. The higher level of employment is a result of the higher levels of investment expenditures in these two sectors resulting from import substitution activities. Increase in investment was possible as a result of a higher level of savings, especially from the government since its expenditure remained unchanged. The possibility of investment increases to support the growth in the import competing manufacturing sector, which gains from higher tariffs, explains why there is a higher demand for labour services in the sector. Another explanation for the increase in employment demand in the manufacturing sector is to do with the government's expected outcome while raising tariffs in the first place. That was to encourage industry to adopt labour intensive technology through higher duties on imported capital goods. This could be due to the effect of producers in these two sectors demanding more labour input as imported capital inputs became more expensive. Since employment changes from the reference experiment are small, and given wage changes were also small, nominal labour incomes, and nominal incomes of households for that matter, did not change significantly (Table 8.4).

The labour incomes for unskilled, skilled, office workers and semi-professional, and professional workers rose by at least an extra 1.1 per cent over the joint terms of trade simulation in nominal terms. This can be explained by the higher level of employment in the manufacturing and services sector which seem to benefit substantially from the import substitution activities resulting from higher tariffs.

Households enjoyed a marginal increase in nominal income compared to the reference run. The three urban households benefit most. As explained previously, the urban households reap most of the benefits whenever unskilled, skilled, office workers and semi-professional and professional labour income increases more than self-employed and family labour income. Raising import tariffs resulted in less than a percentage point increase over the reference simulation in nominal income of rural households. This might be explained by the depressing effects tariffs have on an exporting sector such as agriculture where the rural households derive most of their income.

In terms of sectoral profitability, the increase in tariffs leads to better profits in the import competing manufacturing sector. However, the export producing agricultural sector

experienced a reduction in its profitability. Higher tariffs meant more tax income hence government revenue increased substantially over the level attained in the reference joint terms of trade simulation.

Table 8.4: Impact of Higher Tariffs on the Income Distribution Effects of External Shocks (Percentage Changes From Initial Solution)

	JTOT	STARR	TARR
Labour incomes			
Unskilled labour	6.78	1.13	8.01
Skilled labour	6.08	1.71	7.97
Office workers and semi-professionals	5.10	1.23	6.42
Professional workers	4.87	1.15	6.10
Self-employed and family labour	8.16	0.55	8.75
Household incomes			
Urban households (low income)	5.90	1.19	7.20
Urban households (middle income)	5.82	1.30	7.24
Urban households (high income)	8.09	1.38	9.58
Rural households (<0.5ha)	6.46	0.50	6.99
Rural households (<0.5ha + income)	5.43	0.60	6.08
Rural households (>0.5ha but <1ha)	6.39	0.45	6.87
Rural h'holds (>0.5ha but <1ha + income)	5.14	0.55	5.73
Rural households (>1ha but <8ha)	6.30	0.54	6.88
Rural households (>8ha)	5.33	0.42	5.78
Rural households (other)	4.78	0.84	5.69
Sectoral profits and government revenue			
Agriculture	44.82	-0.93	43.41
Manufacturing	8.00	1.19	10.48
Services	-3.45	-2.37	-6.13
Government revenue	11.25	12.74	25.71

8.3.2 Fiscal adjustment through an increase in indirect taxes

The other policy variable investigated in the fiscal analysis is indirect taxes excluding import duties. The Kenyan government also relies on these taxes as a source of revenue. Like the import tariffs discussed above, indirect taxes were a major policy instrument for government during the oil-crisis. These taxes increased by 31 per cent. This increase raises the effective pre-shock indirect tax rates calculated from the 1976 Kenyan input-output tables from 0.51 to 0.67 per cent for agriculture sector, 8.1 to 10.61 per cent for

the manufacturing sector and 1.49 to 1.95 per cent for the services sector. The resultant government revenue income from this increase is equivalent to Kshs 681 million. This revenue increase which is equal to a 10.27 per cent rise in the government's base period revenue is allowed to be part of government savings as once again expenditure of the government is not changed in the simulation. The simulations under this experiment are as follows:

- JTOT = The reference joint terms of trade shocks simulation combining the 12 per cent increase in world manufacturing import prices with the 25 per cent increase in the world agricultural export prices.

- SITAX = 31 per cent increase in indirect taxes above the existing rates.

- ITAX = 31 per cent increase in indirect taxes above the existing rates combined with the joint terms of trade shocks.

The effects of this 31 per cent increase across the board in indirect taxes are shown in column SITAX in Tables 8.5 and 8.6. As in the other policy experiments, the simulation is then combined with the joint terms of trade changes and results are reported in column ITAX in Tables 8.5 and 8.6. The increase in indirect taxes did substantially affect the impact of the export boom on the overall economy with regard to real GDP. Unlike in the case with tariff increases, the effects on output are more significant. This is especially so in the manufacturing and services sectors. Increases in indirect taxes led to a 4.1 per cent expansion in agricultural output (Table 8.5) which is lower than the five per cent under the reference simulation. The manufacturing sector is most affected. Output increased marginally by 0.2 per cent compared with a 2.3 per cent expansion from the reference joint terms of trade simulation. This can be explained by the added costs of production to the sector coming from higher indirect taxes.

Table 8.5: **Impacts of an Increase in Indirect Taxes on Effects of the Terms of Trade Shocks (Percentage Changes From Initial Solution)**

	JTOT	SITAX	ITAX
Real GDP	3.23	-1.31	1.99
Output			
Agriculture	4.98	-0.84	4.14
Manufacturing	2.33	-2.23	0.16
Services	1.71	-1.44	0.26
Exports			
Agriculture	20.90	-0.47	20.36
Manufacturing	-3.17	-3.64	-6.67
Services	0.69	-1.58	-0.90
Imports			
Agriculture	5.24	-1.27	3.92
Manufacturing	1.01	-0.80	0.37
Services	3.56	-1.20	2.36
Investment			
Agriculture	2.13	0.17	2.30
Manufacturing	7.71	0.60	8.37
Services	15.86	1.19	17.29
Employment			
Agriculture	7.78	-1.27	6.44
Manufacturing	6.00	-5.46	0.40
Services	2.27	-1.90	0.34
Employment by Category			
Unskilled	4.74	-2.49	2.18
Skilled	4.05	-3.45	0.52
Semi-professional	3.09	-2.53	0.51
Professional	2.87	-2.38	0.44
Self-employed	6.10	-1.57	4.47
Aggregate prices			
Nominal wage	1.95	0.12	2.08
Real wage	-4.40	-0.27	-4.69
Consumer price index	6.63	0.39	7.10
Producer price index	7.24	0.58	7.93
Consumer Prices			
Agriculture	8.95	-1.09	7.80
Manufacturing	9.67	1.93	11.84
Services	3.68	0.49	4.25
Producer prices			
Agriculture	12.78	-0.29	12.50
Manufacturing	8.02	1.84	10.16
Services	3.50	0.46	4.03
Balance of trade (per cent of base year GDP)	0.66	-0.30	0.33

Reduced expansion of production contributes to reduced vigour in export supply. Agricultural exports did not change much from the increase of 20.9 per cent in the reference joint terms of trade simulation, expanding by 20.4 per cent. However, in the cases of the manufacturing and service sectors, exports actually registered much poorer performance and declined by 6.7 per cent and a marginal 0.9 per cent respectively. As for imports, the effect of the increase in indirect taxes is that import demand contracted. Manufactured imports increased by a marginal 0.4 per cent compared with a one per cent increase in the reference simulation. Both agriculture and services experienced lower increases in imports which are lower than those in the reference joint terms of trade simulation.

Contrary to what might be expected, indirect taxes did not have a contractionary effect on investment. Investment increases in the reference simulation were marginally boosted as a result of the increase in indirect taxes. This can be explained by the improvement in government revenue which leads to higher savings given fixed government spending. This is because the government is a significant contributor to domestic savings and hence the Kshs 681 million raised from indirect taxes increases domestic savings and hence investment.

The suppressed effects of the export boom on output and trade arising from higher indirect taxes led to even smaller growth in employment (Table 8.5). The increase in indirect taxes means that the export boom leads to only a 6.4 per cent expansion in agricultural employment demand. The manufacturing sector employment increased marginally by 0.4 per cent. The services sector also registered a very small growth in labour demand of 0.3 per cent. When the sectoral employment demands are classified under different labour categories, the unskilled, skilled, semi-professional and professional categories are affected most. The skilled, semi-professionals and professional workers experience smaller increases in demand for their services compared to the reference simulation. The self-employed labour demand still increased by a respectable 4.5 per cent. Unlike in the case with tariffs increases (Table 8.3), the nominal wage remained relatively stable as a result of indirect taxes increase, rising by 2.1 per cent as compared with two per cent in the reference simulation. This can be linked to the surprising stability of the CPI which rose by only 7.1 per cent in comparison

with the 6.6 per cent rise in the reference simulation despite higher indirect taxes. This points to subdued inflationary effects of indirect taxes on the macroeconomy contrary to expectations. This result suggests that tariffs are more important than indirect taxes in influencing the cost of production on the macroeconomy.

As expected, higher indirect taxes led to smaller increases in nominal labour incomes (Table 8.6). Due to lower employment demand, all labour groups registered much smaller expansions in income in nominal terms. Unskilled labour income increased by 4.3 per cent in nominal terms which is smaller than the 6.8 per cent increase registered under the reference joint terms of trade simulation. Income for self-employed and family labour increased by a reasonable 6.6 per cent. The other three labour categories are also worse-off as nominal incomes attained in the reference simulations fell by at least two percentage points.

The distributional effects of lower labour demand is that all households were worse off in terms of nominal income. Low income urban household income registered an increase of 3.4 per cent compared to the 5.9 per cent increase in the reference run. As for rural households, the increase in indirect taxes appears to have impacted more strongly on the income of those household groups that have extra income. Thus, for the rural households with only half and between half and one hectares but no extra income, nominal incomes increased by 5.2 per cent which was not a large decline from the 6.5 and 6.4 per cent attained in the reference simulation. Other rural household income increased by magnitudes that were much smaller from their levels in the reference simulation indicating the negative effect on income of higher indirect taxes.

Table 8.6:   Effects of Indirect Tax Increases on External Shocks' Impacts on Income Distribution (Percentage Changes From Initial Solution).

	JTOT	SITAX	ITAX
Labour incomes			
Unskilled labour	6.78	-2.38	4.30
Skilled labour	6.08	-3.34	2.61
Office workers and semi-professionals	5.10	-2.42	2.60
Professional workers	4.87	-2.27	2.52
Self-employed and family labour	8.16	-1.46	6.64
Household incomes			
Urban households (low income)	5.90	-2.43	3.38
Urban households (middle income)	5.82	-2.60	3.12
Urban households (high income)	8.09	-2.87	5.12
Rural households (<0.5ha)	6.46	-1.26	5.15
Rural households (<0.5ha + income)	5.43	-1.37	4.01
Rural households (>0.5ha but <1ha)	6.39	-1.17	5.16
Rural h'holds (>0.5ha but <1ha + income)	5.14	-1.26	3.83
Rural households (>1ha but <8ha)	6.30	-1.33	4.91
Rural households (>8ha)	5.33	-1.05	4.23
Rural households (other)	4.78	-1.74	2.97
Sectoral profits and government revenue			
Agriculture	44.82	-2.32	42.05
Manufacturing	8.00	-36.55	-30.78
Services	-3.45	-7.14	-10.88
Government revenue	11.25	7.51	19.73

8.3.3 Fiscal adjustment through increased government spending

In the previous two fiscal policy changes, the level of government spending is held constant at its base solution level of Kshs 5.08 billion. However, there was increased government spending during the boom period. In fact, on average, total government spending on goods and services increased by 20 per cent between 1976 and 1977 as computed from the 1979 Kenya's *Economic Survey* report (Kenya, Republic of 1979c). This is equivalent to an increase of Kshs 1.02 billion. The impact on the economy of this increase in government spending is simulated in this experiment. To avoid creating a budget deficit in the economy[4], the government spending is financed by the two tax

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[4] I am grateful to Kym Anderson for making the suggestion in a conference presentation of part of this study of ensuring that a fiscal deficit is not created. This particular issue had been previously overlooked.

increases discussed so far, the Kshs 658 million raised from the 50 per cent increase in import tariffs and the Kshs 680 million from the 31 per cent increase in indirect taxes. The results of the 20 per cent increase in government spending combined with the two tax increases are shown under column SIGOV in Tables 8.7 and 8.8. This shock was combined with the joint terms of trade changes and the results shown in column IGOV. The simulations were as follows:

- JTOT = The reference joint terms of trade simulation combining the 12 per cent increase in world manufacturing import prices with the 25 per cent increase in the world agricultural export prices.

- SIGOV = 20 per cent increase in government spending, 50 per cent increase in tariff rates and 31 per cent increase in rates of indirect taxes.

- IGOV = 20 per cent increase in government spending, 50 per cent increase in tariffs and 31 per cent increase in indirect taxes combined with the joint terms of trade.

The increase in government expenditure clearly complements the positive effects of the export boom as shown in column IGOV in Tables 8.7 and 8.8. As a result of higher demand for goods and services resulting from increased government spending, there is a 6.3 per cent expansion in real GDP. Agricultural sector's output expands by 5.7 per cent which is higher than the five per cent in the reference simulation (JTOT column). The increase in production results in increased demand for imports with increases being greater than the respective increases following the joint terms of trade change.

Table 8.7: Effects of Increased Government Spending on the Impacts of External Shocks (Percentage Changes From Initial Solution)

	JTOT	SIGOV	IGOV
Real GDP	3.23	3.40	6.29
Output			
Agriculture	4.98	0.81	5.65
Manufacturing	2.33	1.53	3.92
Services	1.71	8.59	10.17
Exports			
Agriculture	20.90	-2.44	18.09
Manufacturing	-3.17	-4.88	-7.96
Services	0.69	6.57	4.04
Imports			
Agriculture	5.24	3.29	8.54
Manufacturing	1.01	4.31	5.37
Services	3.56	12.18	15.87
Investment			
Agriculture	2.13	1.37	3.45
Manufacturing	7.71	4.90	12.69
Services	15.86	9.96	26.75
Employment			
Agriculture	7.78	1.24	8.86
Manufacturing	6.00	3.91	10.26
Services	2.27	11.62	13.82
Employment by Category			
Unskilled	4.74	6.82	11.55
Skilled	4.05	7.96	12.13
Semi-professional	3.09	9.95	13.04
Professional	2.87	10.41	13.26
Self-employed	6.10	4.39	10.37
Aggregate prices			
Nominal wage	1.95	1.91	3.89
Real wage	-4.40	-4.33	-8.52
Consumer price index	6.63	6.53	13.57
Producer price index	7.24	6.20	13.74
Consumer prices			
Agriculture	8.95	4.62	13.76
Manufacturing	9.67	10.65	21.25
Services	3.68	5.58	9.53
Producer prices			
Agriculture	12.78	2.60	15.17
Manufacturing	8.02	9.45	18.43
Services	3.50	6.72	10.49
Balance of trade (per cent of base year GDP)	0.66	-3.91	-3.91

Imports of services increased dramatically by 15.9 per cent. This increase was important given that in the reference simulation such imports increased by only 3.6 per cent. The explanation for this huge increase is that when government expenditure goes up, imports are increased due to the expansionary impact that the economy experiences in general. Hence, any policy that allows government to spend more means that there is likely to be an increase in demand for imports. Since higher government spending directly influences other sectors, it is not surprising that agricultural and manufactured imports also rose. For instance, increased provision by government of research and extension services to the agricultural sector as a result of higher expenditure may indirectly lead to increased agricultural imports. This may explain partly why agricultural imports increased by 8.5 per cent as compared with the 5.2 per cent increase in the reference simulation.

As for the exports, there was a notable decline for those from the agricultural and manufacturing sectors. This decline can be attributed to high inflation resulting from these policy measures as can be seen from increases in the CPI. The expansionary policy simulated here leads to an increase in the CPI of 13.6 per cent compared to 6.6 per cent in the reference simulation. This means higher costs of production, in particular for the intermediate inputs sourced domestically, and this may explain the fall in agricultural and manufactured exports. The other explanation may be that the expansionary effects of increased government spending leads to more of these goods being diverted to domestic market for consumption.

In terms of investment, more government expenditure implies less public savings. However, this is likely to be the case where there is no extra finance for new spending hence investment would be expected to fall as a result of higher government spending. The positive impact of more government spending leads to higher levels of investment since in this simulation the increase in spending is financed through the two tax measures.

The increase in government expenditure is accompanied by increases in employment by magnitudes that are above the reference joint terms of trade simulation. Employment in all labour categories is better than in the reference run (column IGOV, Table 8.7). This means that all households are better off as nominal incomes increase more than in the case of the sole terms of trade simulation (Table 8.8).

Each of the ten household groups enjoy substantially higher nominal incomes due to higher labour incomes arising from the higher labour demand for all the labour categories. Government spending directly benefits urban households hence the highest increases in nominal income are registered in urban households. Improved demand for agricultural products as a result of this contributes to growth in rural nominal incomes. From these results of household incomes, an important observation can be made regarding government expenditure on goods and services. Government spending in a small agricultural economy like Kenya seems to be an important determinant of total activity in the economy.

Table 8.8: Effects of Increased Government Spending on Impacts of External Shocks on Income Distribution (Percentage Changes)

	JTOT	SIGOV	IGOV
Labour incomes			
Unskilled labour	6.78	8.86	15.89
Skilled labour	6.08	10.03	16.49
Office workers and semi-professionals	5.10	12.06	17.44
Professional workers	4.87	12.52	17.66
Self-employed and family labour	8.16	6.39	14.66
Household incomes			
Urban households (low income)	5.90	9.20	15.37
Urban households (middle income)	5.82	11.12	17.24
Urban households (high income)	8.09	13.97	22.37
Rural households (<0.5ha)	6.46	5.46	12.02
Rural households (<0.5ha + income)	5.43	5.75	11.31
Rural households (>0.5ha but <1ha)	6.39	5.13	11.60
Rural h'holds (>0.5ha but <1ha + income)	5.14	5.30	10.56
Rural households (>1ha but <8ha)	6.30	5.69	12.10
Rural households (>8ha)	5.33	4.55	9.96
Rural households (other)	4.78	7.70	12.67
Sectoral profits and government revenue			
Agriculture	44.82	0.68	44.16
Manufacturing	8.00	-12.17	-2.45
Services	-3.45	12.08	7.96
Government revenue	11.25	29.69	44.17

8.4 Concluding Remarks

The discussion in this chapter has centred around the effects of two important terms of trade shocks facing Kenya in the mid-1970s. It is evident that the Kenyan economy is very vulnerable to external shocks. Each of these shocks when analysed individually was shown to have important results for stakeholders in the economy. Consequently, as these shocks invariably created internal and external imbalances, the policies pursued by government were important.

Some of the policies that the Kenya government pursued during the time of the two external shocks have also been analysed in this chapter. What seems to be an important outcome of these results is that higher import tariffs and indirect taxes may have reduced the positive impacts of the export boom that were being experienced by the economy at the time, albeit marginally. However, as noted in the discussion, these policies had been introduced as the government tried to grapple with the adverse effects that the oil-price shock seemed to have created in the economy. Hence, the policies may not be seen as an indication of government's mismanagement given that the government may not have been aware of the impending windfall from the boom. However, the expansionary fiscal policy pursued by the government through higher spending casts doubt on whether the government really did not know of the existence of the boom.

This raises the question about whether government should have adopted a different policy package in its economic management during the period of the two external shocks. This question is analysed further in Chapter 9 where alternative policies to the ones that the government pursued at the time are looked into.