THE APPRAISAL OF THE IMPACT OF ALTERNATIVE TRADE POLICIES ON THE KENYAN ECONOMY FROM A GENERAL EQUILIBRIUM MODEL

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The appraisal of the impact of alternative trade policies on the Kenyan economy from a general equilibrium model

M.Phil dissertation

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I ...Joost Verlinden.... hereby certify that this thesis which is approximately ...35.000... words in length has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

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I was admitted as a research student under Ordinance N° 12 on ...17. May .1982... and as a candidate for the degree of .M.Phil...Economics....Mode.A......... on ..July.1983.; the higher study for which this is a record was carried out in the University of St. Andrews between .October.1982... and .May.1984....

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I hereby certify that the candidate has fulfilled the condition of the Resolution and Regulations appropriate to the degree of ..M.Phil......... of the University of St. Andrews and that he is qualified to submit this thesis in application for that degree.

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Abstract

The aim of the dissertation is giving an empirical appraisal of trade policy changes in a developing country, using a general equilibrium model.

In a first half, an overview is given of the evolution in the theory of incorporating trade policy in planning models starting from simple calculations of effective rates of protection. It is shown that the general equilibrium price endogenous models form a natural outcome of the evolution of the theory. This part forms the theoretical background of the model developed in the next part.

The second half develops and applies a general equilibrium simulation model for the economy of Kenya. In explaining the model an attempt has been made to keep the transparence of the Kenya model as high as possible. The main characteristics of the model are its general equilibrium nature and its high level of disaggregation in the production sector. In the final chapter some simulations with trade policy are carried out with the stress on the different reactions over an eight year time period of import-substituting and export-promoting policies. The main finding is that the quantitative results confirm the trade theory as developed by the classical trade theorists but the dynamic effects are relatively slow and low.

The dissertation ends with appendices on the complete model in equation form, the main results of the regressions and some considerations about the statistical data set.

CONTENTS

List of Tables

List of graphs

Introduction

Four different topics of economics enter in this study. Mathematical economics is necessary to build a theoretical general equilibrium model. Development economics enters as the study of the special behaviour of different markets in the Kenyan economy. International economics is involved in the theory on trade policy in the development process. And finally, econometrics is present in estimating numerous equations.

Some people might argue that this project was too ambitious to carry out by myself in an M. Phil thesis. And this was perhaps so. Everyone will easily find weaknesses in my treatment of the four topics. But I must say that I am still happy that I started it and enjoyed much to do the work. It is hoped that it makes a small contribution to the analysis of the Kenyan economy.

Numerous people helped me at various stages of the research. And it is only natural to thank them in this introduction.

Professor P. Robson was a very helpful and encouraging supervisor. He understood major difficulties and was alert when considering crucial hypotheses. He was the major link between the University and myself and I appreciated this link very much. Dr. Mo Malek read the manuscript and made valuable comments, especially on econometric issues.

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Lorna was ready to give me any advice outside economics. And this was necessary at various moments.

Finally, colleagues at the Planning Office in Brussels made it possible to finish my work.

Theoretical Part

Trade Policy in planning models

It is easily observed that planning models are extensively used in developing countries. Planning authorities take the responsibility to simulate and analyse policy changes. Industrial policy is one of the important study objects in planning development. The reason for this is the high correlation observed between a rise in the proportion of output of industrial products in total output and a successful economic development.

External trade policy has traditionaly served as a popular form of industrial policy. The reasons for this popularity among policy makers is more politically based than economically. Indeed, while import tariffs and domestic taxes have similar effects, tariffs on imports are not necessarily perceived as taxes on consumers so that they can be easily implemented. Moreover, the practical problem of collecting tariffs at the border of a country is smaller than the disbursements of subsidies or the collection inside the country.

Predicting the effects of changes in trade policy with the use of planning models has for a number of years been a task of planning authorities. An overview of existing models treating this problem is given in the next three chapters. It will be clear at the end that a general equilibrium model is one step in the evolution of building models for development policy.

Chapter 1 : Partial equilibrium models

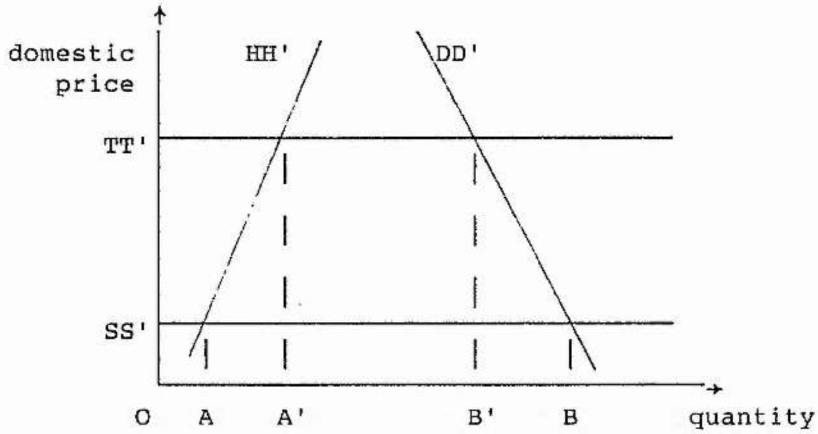
1.1. Nominal rate of protection

The trust in nominal rates of protection is based on a number of simplifying assumptions.

A small open economy (as Kenya is), not able to influence world prices, will be considered. This country will be assumed to produce, consume and import one and the same single product. The domestic product is a perfect substitute for the imported good. With no trade barriers, consumers will buy the good at the world price. The imported good will be bought residually so that all goods supplied by domestic producers will be bought. If more goods are demanded than supplied, the difference will be imported.

With the implementation of a tariff in the home country, the price of the imported good will rise. In a price- taker economy, this has the effect of a higher domestic price. With the usual supply and demand curves, consumers will demand less and supply more with a higher domestic price. This results is an increase of domestic production and a decrease of the quantity of imported goods. With the well known graphs of Corden(1), the following is observed :

Graph 1.1. Protection in a partial equilibrium model



SS' is the perfectly elastic supply curve of imports, HH' is the supply curve of domestic import competing production and DD' is the domestic demand curve.

1. Before protection : OA : quantity produced in the home country, OB is the quantity consumed, AB the quantity imported and OSS' is the world price
2. After protection : OTT is the domestic price, OA' the quantity produced in the home country, OB'the quantity consumed and A'B' the quantity imported.

The protection imposed can be called a specific tax (i.e. the absolute amount TT' - SS') or an ad valorem rate, which is calculated as SSTT'/OTT' and can be called the nominal rate of protection. The crucial assumption of this partial equilibrium model is that of one single good. This had the consequence of no distinction between input and value added so that the output in this partial equilibrium model is always equal to the value added of the good.

When this assumption is altered, the analysis will proceed by considering the effects of price changes through a change in trade policy on the production of other goods. This will be done by general equilibrium models.

1.2. Effective rate of protection

When the fact that the output of a product consists of an input and a value added is taken into consideration, it becomes clear that the measured rate of protection should only have an effect on the value added part of the output and not on the output as a whole.

The effective rate of protection on product j (ERP_j) not only depends on the nominal rate of protection on product j (NRP_j) but also on the nominal rates of protection on all inputs and the shares of these inputs in the output of product j. So that,

$$ERP_j = NRP_j + \frac{NRP_j . \Sigma_i a_{ij} - \Sigma_i a_{ij} . NRP_j}{1 - \Sigma_i a_{ij}}$$

a_{ij} : share of i in the cost of j at free trade prices(2).

As $(1 - \Sigma a_{ij})$ is always positive, the ERP can be smaller or larger than the NRP_j depending on $(NRP_j . \Sigma a_{ij} - \Sigma a_{ij} . NRP_i)$.

If $NRP_j . \Sigma a_{ij} > \Sigma a_{ij} . NRP_j$, $ERP_j > NRP_j$

If $NRP_j . \Sigma a_{ij} < \Sigma a_{ij} . NRP_j$, $ERP_j < NRP_j$

An implication of the adoption of this method of measurement will reveal in which way this method is much more realistic compared to the method of the nominal rate of protection.

In an imaginary developing country, new chemical industries are implanted. To protect these, the government imposes a tariff on the import of chemical products. As a result, the domestic production in the chemical industries will increase while imports will decrease, just as is predicted by graph 1.1. However, the effective rate of protection of agricultural products will no longer be zero but negative as a result of the fact that chemicals are used as an intermediate input to produce agricultural products. The result is that the import of agricultural products will increase and the domestic production of agricultural products will decrease. This is not only true for the agricultural sector but for every sector using domestic chemical products as an input.

It is clear that a reasoning with nominal rates of protection would have been very misleading.

References

(1) for a discussion at length : CORDEN, W.M., 'The theory of protection', Oxford U.P., Oxford, 1971

(2) CORDEN, ibid. p. 36-40

Chapter 2 : General Equilibrium Models

2.1. Introduction

a. Geometrical representation

A general equilibrium is defined as a situation of equality between demand and supply in every sector of an economy at a certain period of time. The most simple case of a general equilibrium consists in the simultaneous equilibrium in two sectors of an economy and is called in trade theory the orthodox two sector analysis. This analysis is able to elucidate the most important differences between partial and general equilibrium models.

The two sectors, X and Y, produce one homogeneous good. Each good is partly produced at home and partly imported. With free trade, domestic prices and world prices are equal :

$$DP_x = WP_x . EXR$$

$$DP_y = WP_y . EXR$$

so that $(DP_x / DP_y) = (WP_x / WP_y)$ (2.1)

with DP_x, DP_y : domestic prices of X and Y

WP_x, WP_y : world prices of X and Y

EXR : the exchange rate (domestic price per world price)

An implementation of a tariff on good X leads to the following situation :

$$DP_x = (WP_x + tx. WP_x). EXR$$

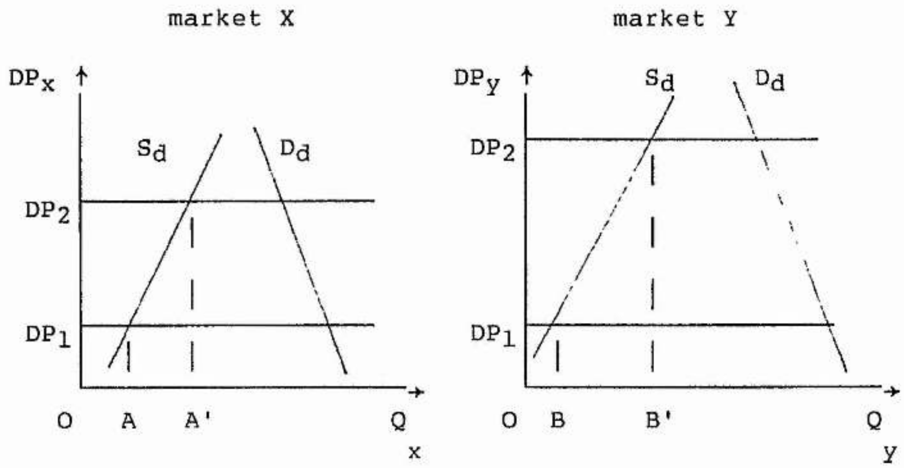
$$DP_y = WP_y . EXR$$

In a partial equilibrium model domestic production of X will increase if the demand curve is downward sloping and the supply curve upward. But in a general equilibrium model domestic production of X will increase relative to the domestic production of Y. The tariff on X will increase (DP_x / DP_y) so that domestic production of X will increase while domestic production of Y will decrease in order to maintain an equilibrium position.

The difference between a partial and a general equilibrium model can be clarified by the example of a nominal protection rate on the import of X of tx % and a nominal protection rate on the import of Y of ty % with ty < tx. The relationship between the change in the protective structure of this economy and the output will be considered.

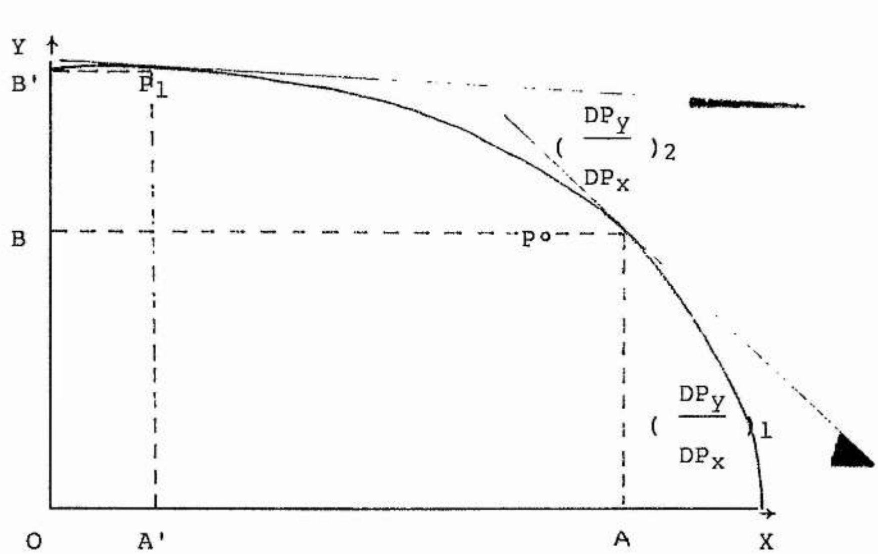
In a partial equilibrium model (Graph 2.1), the domestic production of both X and Y will increase : from OA to OA' for X and from OB to OB' for good Y.

Graph 2.1. Partial equilibrium analysis for two sectors



In a general equilibrium model (graph 2.2), on the other hand, the domestic production of X will decrease while this of Y will increase.

Graph 2.2. General equibrium analysis for two sectors



Free trade situation : $(DP_x)_1 = (WP_x).\ EXR_1$

$$(DP_y)_2 = (WP_y).\ EXR_2$$

$$\text{and } (DP_x / DP_y) = (WP_x / WP_y) \qquad (2.2)$$

Protection situation : $(DP_x)_2 = (WP_x).\ (1 + tx).\ EXR_1$

$$(DP_y)_2 = (WP_y).\ (1 + ty).\ EXR_2$$

$$\text{and } (DP_x / DP_y) > (WP_x / WP_y) \qquad (2.3)$$

Resource movements no longer depend on absolute nominal protection rates but on relative nominal protection rates. This analysis can easily be extended to effective exchange rates. tx and ty will then be ERP's.

To conclude, it is observed that the determination of the resource allocation effects of a protective structure depends on the comparaison between

$$\frac{WP_x.\ (1 + tx)}{WP_y.\ (1 + ty)} \quad \text{measured with } EXR_2$$

and

$$\frac{WP_x}{WP_y} \quad \text{measured with } EXR_1$$

WP_x, WP_y : world prices of X and Y

EXR_1, EXR_2 : observed and hypothetical exchange rate

tx, ty : effective rates of protection of X and Y. These depend on :

- the nominal rates of protection
- total intermediate inputs (both traded and non-traded
- the share of the cost of different intermediate inputs in the total cost of total intermediate inputs

b. Considerations about aggregation

The analysis of calculating nominal rates of protection in a one sector model was followed by an orthodox two sector model. The problem arises if further disaggregation matters.
To answer this question, let us imagine the following example. We

are interested in the prediction of an aggregative level of investment. The aggregate investment function is (1) :

$$Y = \alpha . X + \varepsilon \tag{2.4}$$

If the economy consists of two sectors, we have $Y = Y_1 + Y_2$ and $X = X_1 + X_2$ with two investment functions :

$$Y_1 = \alpha_1 . X_1 + \varepsilon_1$$

$$Y_2 = \alpha_2 . X_2 + \varepsilon_2$$

It is clear that equation (2.4) will produce correct predictions if $\alpha_1 = \alpha_2$. Another sufficient condition for correct predictions is : $X_2 = k.\ X_1$, where k is a positive constant. This can be seen as follows:

$$Y_1 + Y_2 = \alpha_1 . X_1 + \alpha_2 . X_2 + (\varepsilon_1 + \varepsilon_2)$$

$$Y = \alpha_1 . X_1 + \alpha_2 . k . X_1 + (\varepsilon_1 + \varepsilon_2)$$

$$Y = (\alpha_1 + \alpha_2 . k) . X_1 + (\varepsilon_1 + \varepsilon_2)$$

$$Y = (\alpha_1 + \alpha_2 . k) . [(X_1 + X_2)/(1 + k)] + (\varepsilon_1 + \varepsilon_2)$$

$$Y = [(\alpha_1 + \alpha_2 . k)/(1 + k)] . X + (\varepsilon_1 + \varepsilon_2)$$

So that $\alpha = (\alpha_1 + \alpha_2 . k)/(1 + k)$ will be constant if k is a constant. It is an empirical question to see if $\alpha_1 = \alpha_2$ or $X_2 = k.\ X_1$.

An idea of the accuracy of the two predictions can be obtained by looking at the variance of the estimator. Imagine that the real value of Y is called $Y° = Y°_1 + Y°_2$ for a specific value of X, $X° = X°_1 + X°_2$.

The variance with the aggregate prediction is :

$$Var(Y° - Ya) = (\omega_{11} + \omega_{22} + 2\omega_{12})\ [1 + X°(X'X)_{wx}X°']$$

The variance with the disaggregated prediction is :

$$Var(Y° - Yd) = \omega_{11}[1 + X°_1(X_1'X_1)_{wx}X°_1'] + \omega_{22}[1 + X°_2(X_2'X_2)_{wx}X°_2'] + 2\omega_{12}[1 + X°_1(X_1'X_1)_{wx}X°_1X°_2(X_2'X_2)_{wx}X°_2']$$

ω is the symbol of standard deviation

These variances are equal if and only if $X_2 = k.\ X_1$ and $X°_2 = k.\ X°_1$. This is, once again, an empirical question.

Disaggregation of the economy not only leads to an increase in the usefulness of a model but also diminishes the probability of errors when disaggregated data are used.

2.2. Criticisms of the effective rate of protection measures

a. Theoretical basis :

Effective rate or protection (ERP) measures have the same aim as measures of nominal protection, i.e. to examine the effects of protection on resource allocation. This task can be formulated more specifically in two parts. First, there is a qualitative task : the ERP must be able to predict the directional effects of protection on a particular activity relative to other activities. The second task is quantitative in nature; it consists of a prediction of the effects of protection on resource allocation in quantifiable changes.

The main merit of ERP consists in the fact that it provides a good overview of the protection structure for developed and developing countries. Trade theorists critise the usefulness of ERP-measures for the quantitative task. They argue that substitution elasticities and changes in factor prices are too important to be left out by the analysis. Moreover, no unanimity exists on the way of incorporating non-traded inputs, and the calculation of the hypothetical exchange rates seems unfeasible.

These criticisms stimulated ERP advocates to look for new measures that incorporate improvements to overcome its shortcomings. Still, it is generally accepted that these new measures can only satisfy the first of the two tasks raised above. Bruno (2) and Bhagwati and Srinivasan (3) show in a theoretical way that a ranking of industries (the qualitative task), obtained from ERP-calculations, is only able to give correct relative resource allocation shifts in limited cases. For these reasons, Corden, one of the pioneers of ERP-theory, concludes (4)

> "... so perhaps we should attempt instead to build complete general equilibrium programming exercises to give us total rather than partial answers ..."

Some of the criticisms formulated by trade theorists in the early 70's that have been formulated above, will be now looked at in more detail.

1. the treatment of non-tradable inputs

In calculating effective rates of protection, allowance is made for inputs in producing the good. A nominal rate of protection is applied to every good necessary in the production of the product. However, the whole input is not tradable so that the nominal rate of protection should only be applied to the tradable part of all inputs. Different authors give some methods to deal with this problem.

Balassa regards non-traded inputs as traded inputs with constant prices. Later, he also made allowance for tariffs on non-traded imputs. Corden divides the total non-traded inputs in a non-traded and a traded input content. He lumps the former with the primary factor content with value added while the latter is regarded as a direct traded input. In the Scott-method, the non-traded and primary factor content of non-traded inputs are considered as if they were traded inputs, as in the Balassa-method. Unlike Balassa, prices are influenced by the change in prices of tradable goods.

Ray examined in which way these different measures can be used to predict correctly changes in output, resource allocation and value added (5). He found that results vary substantially according to the method adopted. The comparable 'correct' result is obtained in a theoretical general equilibrium model with two tradable and two non-tradable goods. The two non-tradable goods are called 'pure' intermediate goods in the sense that they have a zero final demand. He assumed further fixed intermediate input-coefficients and variable primary coefficients.

The following scheme shows the way in which different measures give predictions for changes in the output of tradable goods, in resource allocation and in value added

Effect on change in measure	Output of traded goods	Resource allocation	Value added
CORDEN	+	+	+
BALASSA	-	-	0
SCOTT	-	-	0

+ : measure will predict correct results
- : measure will never or only in limited cases predict the results obtained in the theoretical general equilibrium model
0 : results not reported by the author

If allowance is made for non-tradable goods as final consumption, no ERP-measure will predict correctly the output, resource or value added movements.

2. substitution elasticities

(i) Separable production functions :

Separable production functions with three inputs have the following form :

$X = f((K,L), I)$

X : production
K,L : capital, labour
I : traded input

This means that substitution elasticities between every pair of primary factors (K,L) and intermediate inputs are constant. In this case ERP-theory is able to predict changes in prices and quantities in a limited number of cases :

a. Correct prediction of ΔP and ΔQ of gross output is not possible
b. correct prediction of ΔP and ΔQ of net value added depends on the amount of the tariff change :

   1. if the tariff change is small, ERP-theory is able to predict ΔP and ΔQ for net value added
   2. if the tariff change is considerable, the results depend on the substitution elasticities between nominal protective rates on final products and inputs :

      -substitution elasticities = 0 (input coefficients remain constant) : ERP-theory can predict ΔP and ΔQ.
      -substitution elasticities greater than 0 but less than 1 : empirical research shows that in most cases ERP-theory can predict ΔP and ΔQ (6)
      -substitution elasticities = 1 : ERP-theory can predict ΔP and ΔQ.

(ii) Non separable production functions
Non separable production functions with three inputs have the following form :

$$X = f(K,L,I)$$

i.e. the substitution elasticities between I and (K,L) are no longer constant (e.g. the substitution elasticity between I and K is greater than 0 and between I and L).

Trade economists have tried to obtain empirical estimates of the possibility of non-separable production functions rather than discussing in a theoretical framework. It is observed that substitution elasticities, taken as a unit, and individual intermediate inputs cluster around one.

3. Factor price considerations

In contrast to the conclusions obtained so far, the consideration of factor price changes and exchange rates argue for a general equilibrium approach.

It is accepted that incentives to an activity provided by the system of protection will depend not only on product prices but also on its effects on factor prices. An increase in import tariffs, for example, will rise the domestic prices through import prices but will also influence real wage rates. A change in factor prices will influence in turn resource allocation.

In order to fulfil the two tasks outlined above, ERP has to take factor price considerations into account. Since this is not possible, ERP is not able to predict quantifiable changes of prices and quantities. The first task, qualitative in nature, can be performed if the influence of the system of protection on product prices outweigh its incidence on factor prices. Balassa (7) gives an intuitive reason that this is the case in developing countries. In these countries, large variations in effective rates of protection are observed. Very large differences in factor intensities between industries would be required for the factor price effects of protection to reverse the product price effects indicated by effective rates of protection.

4. Hypothetical exchange rate

An attempt to measure the effects of protection in a comparative static model consists in a comparison between two situations : one is the actual situation and the other is a theoretical situation in which there is a change in trade policy. The theoretical situation is characterised, among other things, by a hypothetical exchange rate. An attempt is made to estimate this hypothetical exchange rate in the more recent ERP-studies. In practice, however, we encounter difficulties in estimation for two reasons :

- Balassa mentioned the limited information we have on demand and supply responses to changes in tariffs, export subsidies and exchange rates. (8)
- Dornbusch shows that the partial equilibrium estimation of the exchange rate is based on the restrictive assumptions as to cross-price elasticities between traded goods, which are taken to be zero, and the marginal propensity to spend on non-traded goods, which is taken to be unity. (9)

b. Empirical basis :

The summarised conclusions of three studies (10) that compare changes in resource flows predicted by ERP and general equilibrium computations under different conditions will be presented now. It has to be stressed that ERP-calculations are undertaken with the theoretical criticisms in mind so that the actual calculation is more complicated as the one defined in chapter 1.

Taylor and Black analyse the effects of small tariff changes (10 - 20 % reduction) under different model specifications. When capital is immobile (i.e. a short run assumption), they study the sensitivity of the substitution elasticity between primary factors and intermediate inputs. If this elasticity is equal to zero, ERP predictions are very close to 'actual' (i.e. general equilibrium prediction) changes. If this elasticity is equal to one, however, ERP-calculations underestimate most changes ; the absolute differences between the two being high.

Anastasopoulos and Sims find that an ERP ranking of industries is correct but that important differences in quantitative predictions occur in the case of capital immobility and a fixed substitution elasticity between primary factors and intermediate inputs. This finding is consistent with the findings of Taylor and Black. The model, however, differs in an important way in its consideration.

de Melo analyses the sensitivity of the immobile capital assumption. His findings are the following :

- the ranking of industries by ERP-calculations is not completely equal to the 'actual', but close to it.
- ERP-projections are better in the short run (capital immobile) than in the long run (capital mobile).

c. Conclusion :

Having outlined the shortcomings of ERP-measures, it has become clear that ERP cannot be used for all purposes. If the object of the study is the ranking of industries within an economy by their static comparative advantage, ERP can be used in limited cases.

While a general equilibrium model can provide this information together with more specific results, only a few attempts have been made to use this kind of model. The reason for this is straightforward : general equilibrium models have much more requirements :

- linkages in the economy must be known in order to build the model
- data required by the model are not always available
- the sollution of a general equilibrium model is an exercise in programming itself.

2.3. General equilibrium price exogenous models

a. Input - Output models

1. Static input-output models :

A static input-output model is the most simple way to describe a multisectoral analysis of the economy but it is at the same time the core of every planning model. Central to the input-output model are the material balance equations. These define the equilibrium between demand and supply in each sector.

The essential assumptions are :

- (i) each sector produces one good. This is the output of the sector
- (ii) inputs are required in fixed proportions to output in each sector

Given these assumptions, the material balance equation can be written as :

$$P_i . X_i = \Sigma_j P_i . X_{ij} + P_i . D_i \qquad (2.5)$$

P_i : price of output per sector
X_i : production per sector
D_i : final demands for output produced by sector i
X_{ij} : flow of intermediate goods from sector i to j

$$a_{ij} = X_{ij} / X_j$$

a_{ij} : intermediate requirements from sector i per unit of output in sector j

Dividing equation (2.5) by prices and using assumption (ii) :

$$X_i = \Sigma_j a_{ij} . X_j + D_i$$

or in matrix notation :

$$X = A.X + D$$
$$X = (I - A)^{-1} . D \qquad (2.6)$$

where $(I - A)^{-1}$ is the well-known Leontief inverse. The requirements of production in each sector can be obtained if the Leontief inverse and the final demands matrix are known. The use of the model can be extended when it is assumed that capital and labour are tied to outputs in proportional relationships, that is

$$L_i = l_i . X_i$$

$$K_i = k_i . X_i$$

then is $L_i = l_i . (I - A)^{-1} . D$

$K_i = k_i . (I - A)^{-1} . D$

L and K are the vectors of labour and capital use.
In matrix notation :

$$L = L . (I - A)^{-1} . D \qquad (2.7)$$
$$K = K . (I - A)^{-1} . D$$

The proportionality assumption allows to recast equation (2.6) in incremental form :

$$\Delta L = L \ (I - A)^{-1} . D$$

If it is assumed that the final demand remains constant in each sector except in sector j ($\forall i \neq j : \Delta D_i = 0$) and given the property that $(I - A)^{-1} = I + A + A^2 + \ldots + A^n$:

$$\Delta L = L . (I - A)^{-1} . \Delta D$$
$$\Delta L = L . (I + A + A^2 + \ldots) . \Delta D$$
$$\Delta L = (L + LA + LA^2 + \ldots) . \Delta D$$

where ΔL is the total employment effect
$L . \Delta D$ the direct employment effect
$(L + LA + LA^2 + \ldots) . \Delta D$ the indirect effect

Integration of the foreign trade sector in static input -output analysis is done in two ways : first imports and domestic goods can be regarded as the same so that there is perfect substitution between them. And second, they can be regarded as completely different from domestic production, so that there is no substitution possible.

1. Perfect substitution between domestic production and imports : Imports are part of the supply of the economy while exports are seen as a supplement to the demand. The material balance equation in matrix form becomes :

$$X + M = A . X + D + E$$

M : import vector
E : export vector
D : final domestic demand vector

or $$X = (I - A)^{-1} . (D + E - M)$$

A problem arises when imports (M) exceed final demand (D + E) so that (D + E - M) becomes negative. Every element in the $(I - A)^{-1}$ matrix is zero or positive so that some elements in the X vector can become negative. To solve this problem, Chenery and

Clark (11) assume that $\mu_i = M_i / X_i$ is fixed by sector. This has the effect that every element in the X vector is non-negative.

While this sollution is elegant, there is no reason to assume $_m$ to be fixed by sector. When M is considered as an input in the production of X, the assumption is not very unreasonable but when M is seen as final demand, there is no more reason to accept this assumption. The hypothesis of perfect substitution implies that the substitution elasticicities between domestic demand and import demand are infinite and that the corresponding price ratio's are constant. It is clear from empirical studies that this hypothesis only holds for a few well defined commodities.

2. In the case of no substitution between domestic production and imports, imports are regarded as non- competitive and treated as primary inputs. They do not enter the material balance equation and they can never be an aggregation of non-competitive imports with intermediate or final demand.

   This situation, like the 'perfect substitution' case is highly unrealistic. Imports are neither perfect substitutes, nor completely different from domestic production. An intermediate case seems desirable.

2. Dynamic input-output models

In reality, investment in period t is undertaken to make consumption in period t + 1 possible. So, investment demand should be derived from demand rather than be incorporated in total final demand as is done in the static input-output model. The basic difference between static and dynamic input-output models is that in a dynamic model investment is an endogenous variable, dependent on domestic production.

Two assumptions are made at the outset :
(i) the incremental capital-output ratio's by sector are fixed
(ii) sectoral capital stocks have a fixed compositional structure, so that

$$\Delta K_j = k_j . \Delta X_j \qquad (2.8)$$

$$\Delta K_j = (K_j)_{t+1} - (K_j)_t$$

$$\Delta X_j = (X_j)_{t+1} - (X_j)_t$$

ΔK_j : investment by sector of destination

ΔX_j : change in output in sector j

The demand for investment by sector of origin is :

$$z_i = \Sigma_j s_{ij} . \Delta K_j \qquad (2.9)$$

where s_{ij} is the transition component of investment by sector of destination into investment by sector or source.
Combining (2.8) and (2.9) we have :

$$z_i = \Sigma\ s_{ij}.\ k_j.\ \Delta X_j \qquad (2.10)$$

A matrix H is defined as the capital coefficients matrix where

$$h_{ij} = s_{ij}.\ k_j$$

so that : $Z = H.\ \Delta X$

$$Z = H.\ (X_{t+1} - X_t)$$

Domestic production must equal final demand which is composed of investment demand, intermediate demand and net final demand, so :

$$X_t = A.\ X_t + H.\ (X_{t+1} - X_t) + D_t$$

This can be re-written as :

$$X_{t+1} = [H^{-1}.\ (I - A + H)].\ X_t - H^{-1}.\ D_t$$

Foreign trade is introduced in a similar way as it was done in the perfect substitution case of the static model :

$$X_t + M_t = A.\ X_t + H.\ \Delta X_t + D_t + E_t$$

or $$X_{t+1} = [H^{-1}.\ (I - A + H)].\ X_t + H^{-1}.\ (M_t - E_t - D_t)$$

Given this equation, the construction is possible of an X_t vector given X° (a starting vector X), the vector of final demand, export demand and import supply. Once X_t, D_t, M_t and E_t are given, X_{t+1} can be obtained, and so on. However, after a few time-periods it is likely that elements in the X_t vector are negative. The reasons for this are the unrealistic assumptions made. As is clear from (2.10) the investment in sector i will be equal to the difference of production and intermediate demand and final demand. All that is not demanded will be invested.

As explained by Dervis, de Melo and Robinson (12), this assumption contains two assumptions that are contradictory. On the one hand to assume that there is never unused production in each sector (the assumption of full-capacity) is a long run assumption. On the other hand one assumes to depart from arbitrary initial conditions which are, by definition, partly influenced by temporary conditions (13).

Evaluation

Two problems emerge when one wants to apply an input- output model. First, I.O.- models assume a number of economic variables to be constant over time while in reality they are interrelated with the endogenous variables. The result is that forecasts of sectoral production can be wrong and tend to diverge even more when long run exercises are made. The variables that should be included are -among others- : goods and factor prices, the exchange rate and the labour supply at a sectoral level.

Second, the model has a very limited use even under the stringent assumptions made. It is clear that the best that can be expected is a correct vector of sectoral outputs in the future. When the proportionality assumptions are also made, prediction of factor requirements on a sectoral level is also possible.

b. Linear Programming models

The equations in I.O.-models are technical relations between production requirements and final demand (and investment demand in the dynamic I.O.-models). Linear Programming models on the other hand try to optimise a welfare function under constraints and give the requirements to adjust the production vector. The presence of constraints enables the model builder to make the model better suited for particular problems.

Every L.P.-model has the same structure : maximize (or minimize) an objective function subject to constraints and non-negativity conditions.

The objective functions can have any form but that most likely in planning models involves a maximization of consumption, possibly combined with capital accumulation.

Concerning the constraints, three types can be distinguished :

1. Constraints that represent real limitations on economic growth. These include :
   - Material balance equations : stating that the supply of each good must exceed the demand of the good, decomposed in intermediate, investment and consumption demand :

$$X_i \geq \Sigma_j a_{ij} . X_j + \Sigma_j s_{ij} . I_j + \Sigma_j q_{ij} . C_j$$

   - Factor uses constraints : stating that the sectoral production is constrainted by the availability of capital and labour in each sector :

$$k_{ii} . X_i \leq \bar{K}_l$$

$$l_{sj} . X_j \leq \bar{L}_s$$

2. Constraints on the growth of different components that are important but not defined in a strict way. These include

constraints on the absorptive capacity of investment, upper bounds on savings, lower levels on employment, etc.

3.Constraints for purely technical reasons, to avoid for example over-specialization in trade.

The non-negativity conditions state that production in each sector must exist.

We do not consider the dynamic L.P.-model. It is only an extension of the static L.P.-model by including t as a subscript in the variables and incorporating a capital updating equation :

$$(K_i)_{t+1} = (K_i)_t \cdot (1 - d_i) + (I_i)_t$$

d_i : proportion of the capital stock that depreciates in one time period.

It is assumed in the following that dynamic relations are absent. The conclusions on the usefulness of the dynamic L.P.-model for our problem (measuring the effects of a change in protection) do not change when allowance is made for dynamic relations.

The incorporation of foreign trade is done by assuming that imports consist partly of competitive and partly of non-competitive imports, a more realistic case than the perfect or no substitution cases considered earlier. Exports are endogenous to meet the balance of payments requirements. The no-substitution case for non- competitive imports is materialized by linking non-competitive imports and investment, consumption and gross output with fixed coefficients :

$$M\mu = \Sigma\, a^*_j \cdot X_j + \Sigma\, s^*_j \cdot I_j + \Sigma\, q^*_j \cdot C_j \qquad (2.11)$$

$$a^*_j = \frac{M^*}{X_j} \qquad s^*_j = \frac{M^*}{I_j} \qquad q^*_j = \frac{M^*}{C_j}$$

The material balance equations become :

$$M_i + X_i \geq \Sigma\, a_{ij} \cdot X_j + \Sigma\, s_iJ \cdot I_j + \Sigma\, q_{ij} \cdot C_j + E_i \qquad (2.12)$$

The balance of payments becomes :

$$\Sigma\, \pi_i \cdot M_i + \pi^o \cdot M^o \leq \Sigma\, \pi_i \cdot E_i + F \qquad (2.13)$$

π_i : world prices for imports and exports

$\bar{\pi}^o$: world prices for non-competitive imports

F : net-capital inflow (measured in world prices)

The L.P.-model presented in this way is the 'primal' problem and can be solved by making use of the simplex method. This is a simple method because only corner points on the frontier of the feasible set (i.e. all possible production combinations under the constraints) can be the result of the exercise.

The 'dual' problem can be considered as the mirror of the 'primal' problem. 'Shadow prices' are obtained from the solution of the dual problem. This is the reason why linear programming models can be seen as general equilibrium models. A dual variable corresponding to the material balance equation is the goods price P ; the dual variable corresponding to the balance of payments constraints is the shadow price of foreign exchange (SE). Imports and exports enter only in these constraints so that it is enough to consider these relations to obtain tradeable price equations.

From (2.11) and (2.13) and the L.P.-theory :

$$- P_i + SE_i . \pi_i \geq 0$$

$$P_i - SE_i . \pi_i \geq 0$$

Taking these two equations together :

$$P_i = SE_i . \pi_i$$

The relative domestic shadow prices for tradables are completely determined by relative world prices. The difference with the results obtained in a partial equilibrium model are again the same : not absolute but relative prices are determined.

How can these shadow prices be interpreted ? Can they be regarded as market prices or do they reflect 'only' scarcity ? The problem is to calculate the effects of a reduction of trade protection on different economic variables. Unfortunately, the L.P.-model outlined as before, is not able to do this. The reason is that the dual problem and the shadow prices only exist as a by-product of the solution of the primal problem. Two possibilities exist to overcome the problem of the omission of tariffs.

First, endogenous price variables can be introduced into the primal system. These have to be multiplied with the endogenous quantity variables. This would destroy the linearity of the system and so the problem cannot be called a linear optimisation problem any more. The easy way to solve the model by the simplex method also disappears.

A second approach is followed by Evans (14). His idea is to alter the model so as to incorporate tariffs in the shadow price system. The relative domestic shadow prices would reflect the existing tariff-structure :

$$P_i = SE_i . \pi_i . (1 + tm_i)$$

tm_i : ad valorem tariff rate

Evans' analysis is presented here to show why a L.P.- model is not chosen for the Kenya model. We generalize his model to a multi-commodity L.P.-model to make the comparison with our previous model easier. Consumption is maximized, subject to four sets of constraints :

(i) Material balance constraints :

$$M_i + X_i \geq \Sigma q_{ij} . C_j + E_i + \Sigma a_{ij} . X_j + r_i . TR$$

TR : tariff revenue
r_i : the relative weight of good i per unit of expenditure out of tariff revenue

(ii) Labour and capital supply constraints :

$$\Sigma l_j . X_j \leq \bar{L}$$

$$\Sigma k_j . X_j \leq K$$

(iii) Tariff revenue constraint :

$$tm_i . M_i \leq TR$$

tm_i : import tariff

(iv) Balance of payments constraint :

$$\Sigma \pi_i . M_i \leq \Sigma \pi_i . E_i$$

When the problem is worked out the following price- equation is obtained :

$$- P_i + \lambda_i . tm_i + \pi_i . SE = 0$$

λ : shadow price of the bundle of goods purchased by the government with the tariff revenue

This equation is re-written in the following form :

$$P_i = \pi_i . SE. [1 + (tm_i . \lambda_i) / (\pi_i . SE)]$$

The relative domestic shadow prices do not only depend on world prices but also on import tariffs. This is a highly desirable situation and very useful to study the change in import tariffs. However, the question remains how realistic the implicit assumption is concerning the government's action with reference to the earning of the tariff revenue. Evans assumes that the tariff revenue only consists of import duties. This can be partly overcome by introducing export subsidies in the tariff revenue constraint. The tariff revenue constraint (iii) would then become

$$tm_i . M_i - s_i . E_i \leq TR$$

An extension of the model to include non-price restrictions by the modeling of the behaviour of economic agents is not possible. This is a serious shortcoming of the model given the importance of non-price restrictions in developing countries.

c. Evaluation

The linear models we discussed so far have been used as tools for development planning. Both the L.P. and the I.O.-models are well suited to be used in a centralised economy where the government is the only actor to take decisions and where firms follow the behaviour spelled out for them.

Even the so-called centrally planned developing countries are to a more or less extent mixed economies. The government admits and takes individual utility maximization into account.

A second problem with I.O. and L.P.-models is that they do not allow for feed-back reactions through relative domestic prices. In more advanced L.P.-models, the authors are aware of this problem and try to include ad-hoc feed-back relations in the primal problem (cfr. the example given for the Evans model). It is clear, that inclusion of feed-back reactions in a model is very important just because we cannot foresee if and in what degree they are important. Including some and excluding the others is the same as pushing the model to particular solutions.

A third problem is due to the linearity of the model. It is repeatedly stressed that a non-linear world cannot be modeled in a linear planning model. Trying to do so means taking (sometimes arbitrary) compromises.

The last problem is the basic criticism on the models built by Staelin(15) and Black and Taylor(16). These models have removed the first and second problem by incorporating feed-back reactions and allow for decentralised optimization. Both models tried to specify the non-linear world into a log-linear model. This is much more realistic than other models but the question remains if one can model a non-linear world into a log-linear model.

2.4. General equilibrium price endogenous models

a. Different ways of modeling

Input output and linear programming models are extensively used in many developing and centrally planned economies. These models, however, show a serious shortcoming for countries with more than one decision making entity. In other words, I.O. and L.P.-models cannot give complete satisfaction in developing countries with a (partly) decentralised decision-making system. It is more realistic to see the economy as decomposed of dependent utility maximizers (an infinite number of producers and consumers) and a government trying to maximize social welfare. The utility maximizers are dependent on the economy for they all depend on a common price-system.

This price-system has to be central in a general equilibrium model because consumers, producers and government have an influence on this system. In a non-centrally planned developing country, the government will influence the behaviour of the other economic actors.

It should be clear then that a general equilibrium model should incorporate these price-incentive variables. This idea gave rise to the development of a number of price- endogenous general equilibrium models in the late 70's. These models differed in the way the behaviour of the various economic actors is modeled, in the way the models are 'closed' and in the solution techniques. We now look at these differences in turn.

1. The modeling of the behaviour of economic agents

   Two ways are dominant. Both find their origin twenty or more years ago.

   Johansen(17) and others built neoclassical models in which preferences of consumers and producers are so defined that they can be generated by aggregative demand and supply functions. The differences between these two give a number of excess-supply functions dependent on prices. The solution of this system lays in finding a vector of prices that equilibrates demand and supply so that excess-supply is zero.

   Manne(18) and others, on the other hand, specified the behaviour of consumers and producers by mathematical programs with a function to maximize (utitlity or profit) subject to inequality constraints. The solution method is obviously much more complicated and more expensive from the computational viewpoint.

2. Different macro-closures

   The issue gives rise to many different opinions. It has its roots in the theory on the interaction between micro and macro economics. The question is : is it necessary to have a macro economic understructure of the main microeconomic model. Rattso(19) has shown that this question is most important by comparing different closure rules and their results in one model.

   In practice, two ways have been followed. On the one hand, there is the conviction that an interaction of macro and micro variables is necessary. Taylor(20) is perhaps the best known advocate of this route. On the other hand a so called 'neutral' closure is presented, meaning that no macro block (mainly money variables) is interacting. The aggregate price level is not determined within the model but is exogenously given.

3. Solution algorithms

Solution methods depend partly on the model specification and partly on the numerical methods available. Most recent developed models are non linear in the coefficients (i.e. equations remain non linear in their log-form) so that usual solution techniques cannot be used. Three ways are in current use in solving general equilibrium models. They all use iteration techniques so that accuracy is not always guaranteed. They differ in efficiency (C.P.U.-time), in their use of derivatives and in accuracy (convergence).

The first type is developed by Scarf(21) and is based on fixed point theorems (Whalley -among others- uses this method) It always converges but is much less efficient than other methods. This means that modelers wanting to use this algorithm usually restrict themselves to the number of equations that have to be solved.

A second way is a modified Gauss-Seidel iteration method. Prices are calculated depending on the excess-supply functions. Convergence is not guaranteed but efficiency is much higher and they do not need derivatives.

The 'Jacobian' algorithms are a third possibility but are in fact a special case of the Gauss-Seidel iteration method. It also works with a $t_a$tonnement process but needs derivatives for next iterations. It is clear that accuracy and efficiency increase by this.

b. Avantages and disadvantages :

The model that will be presented is a Johansen-type model with a neutral macro-economic closure and will be solved with a modified Gauss-Seidel iteration procedure. It is a general equilibrium model as all sectors will simultaneously be in equilibrium. Essential is that market clearing happens in two different ways. For most sectors in the manufacturing and service sector the market clearing works in a neo-classical, Walrasian way with domestic prices equilibrating demand and supply. For all other sectors the market will clear either by adjusting demand and supply in the sector. This is done with the idea in mind that far from all sectors in Kenya work in a 'perfect competitive' environment.

Still two major other alternative waysof economy-wide modelling of LDC's is possible. One of these possibilities consists of considering the economy as a dual economy (see e.g. Blitzer (22)), the rural economy being mainly traditional and relatively poor and the urban economy being modern, rich and industrial. Both sectors have different structural characteristics while linkages between the rural and the urban sector exist. Focus is on income distribution and employment implications of various policies. This model is well suited to study long-term structural changes in the overall economy but less suited to find out consequences of specific industrial policies. At the other hand, models that try to capture short-run problems have been built (see e.g. Behrman (23)). In the short run, the modelling exercise will be concentrated on the incorporation of capacity constraints and will try to endogenize fiscal and monetary variables.

General equilibrium modelers are aware of the problems still present in applied research. Two of them are recently expressed.

Srinivisan(24) sees the lack of data as a serious problem so that modeling involves simplifying assumptions and compromises. Dervis(25) finds the most serious problems in the specification of models and their computational solution. He expects that it will be necessary to develop easy replicable models with robust computational packages before general equilibrium models can be used. If these are not present, the modeler will find it hard to spend enough time in data-collection, empirical estimation and testing his model.

Considerable help in solving these difficulties is given in the book 'General equilibrium models for development policy' by Dervis, de Melo and Robinson.

However, a number of problems remain. More in particularly, to describe the behaviour of the external sector, a system of export demand and import supply functions is used to 'close' the model. Rattso and Whalley and Yeung (26) have studied this subject and warned for the possible misinterpretation. Another problem is the (unrealistic) assumption of perfect competition in every sector (and hence an easy sollution algorithm). Finally, Kehoe (27) has argued that the CGE models of the type developped by Dervis et al. do not have a unique solution, so that again the kind of sullution algorithm is questioned. These problems point to the fact that it is necessary to continue research on the behaviour of economic agents in developing countries itself before proceeding to modeling.

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Chapter 3 : Effects of import substituting and export promoting policies in developing coutries.

Concentration in this chapter will be essentially on the indication economic theory gives to analyze the probable effects of policies affecting foreign trade in developing countries.

Any model, whether partial or general equilibrium, should try to reflect a real world situation. But because every model is an abstraction of reality, no one can expect a model to be completely realistic. What are then the most important mechanisms in a trade model ?

3.1. Theory on the effect of a change in trade policy

Import substitution and export promotion have been rival policies for a long time. An import substitution policy consists of an increase in tariffs and/or quota's on imports while an export promoting policy tries to increase exports by giving incentives to exporting industries, e.g. export subsidies or a devaluation. The short and long run effects of these policies differ. In turn will be looked at the effects with an import substituting and export promoting policy.

a.Import substituting policy

1. Short run effects :

   The immediate effect of an increase in import duties is an increase of import prices resultin: in a decrease in imports, the amount of the decrease depending on the import price elasticities. On the other hand of the current account, the effects on exports are not so well understood. Total exports can be divided into two groups : exports depending on domestic factors on the one side and exports depending on supply and demand at the other hand.

   Exports depending primarily on domestic factors : this is clearly the case for agricultural products where exports are to a large extent influenced by domestic production and consumption. Factors external to the country such as world demand and world prices are volatile and also take a longer time to influence production. When the assumption is made that domestic production is independent of policy changes (an assumption that can be held in the short run), consumption becomes the most important factor for determining exports. With an IS policy, imports will be substituted for domestic consumption so that these exports will increase.

For exports depending on supply as well as demand factors, the case is more complicated. The relation can go in either one or the other direction, depending on the terms of trade. Pomfret (1) has shown that an IS policy can lead to an increase in exports depending on the point of the average cost curve where the country is operating.

The domestic activity of the country is expected to increase due to the substitution of imports into domestic production. With a constant labour productivity by sector, employment opportunities will also increase.

A domestic demand pull inflation is expected, due to a decrease of imports and consumption. It is, however, not certain if the obtained domestic inflation will be higher than the imported inflation. Inflation depends not only on the domestic price evolution but also on the share and the level of imported inflation.

Concerning income distribution, it is clear that the government will increase their revenue through higher import duties and more direct taxes due to a higher economic activity. A tax on imports means a taxation of household consumption. The share of the income of households will thus decrease. The income of capitalists can be expected to increase as well because of the increase of profits in the domestic market. Investment will increase for the same reason. With a higher economic activity in the country and an increase in national income, private consumption will also increase.

Bruton (2) sees three more reasons in which way an economy is affected by an import substituting policy. First, import substitution leads to a change in relative prices through import tariffs changes. Various sectors will respond differently to these changes so that the structure of the economy will move away from its natural resource endowment. Second, the creation of new activities following the substitution from imports to domestic production will have internal and external effects. Internal in the sense of producing effects within the sector and external as to the impact on other sectors. Finally import substitution leads to more investment because of the fact that the protected industries become more profitable. There is, however, not a clear link between capital formation and economic growth in the sense that import substituting policies may lead to other growth-defeating developments.

2. long run effects :

The longer-run or dynamic effects of import substituting policies are not always well understood. The process is the outcome of two polar tendencies where the strength of the tendencies is unknown.

The first effects are positive. The infant industry argument of Hamilton-List stresses the beneficial effects of protecting industries from the more developed rest of the world. This will enable them to benefit from economies-of-scale, resulting from the fact that protection will bring these industries on a downward sloping part of its average cost curve, provided the markets being important enough. Another dynamic argument in favour of import substitution is put forward by Hirschman (3). Once an industry is protected with a tariff wall from the rest of the world, he argues, it will increase its production. Its domestic intermediate demand will increase as well so that the production of these industries will also increase and so on. Import substitution will result in a self sustaining process due to the direct and indirect intra-industry linkages.

The second dynamic effect is negative and is much stressed in recent country studies (4). The most protected industries will become competitors to more efficient less protected industries. Efficient industries will be put out of business without any gain in efficiency, comparative advantage towards the rest of the world or employment. The key variable in this process is the slow down of efficiency caused by dampening of an increase of labour productivity. Recently, Bardhan and Kletzer (5) questioned the validity of this process in a theoretical model. They arrived at the conclusion that nothing can be said a priori about the direction of the evolution of labour productivity following protection. The immediate effect of an import substituting policy on labour productivity may well be negative but average productivity gains may result eventually. These results depend on the technical characteristics of the economy and on the importance of protection.

b.2. export promoting policy

In the first instance, the level of households and capitalists income will remain constant while the government revenue will decrease due to higher export subsidy rates and more exports. This leads to lower government demand and through lower total income to a decrease in consumption. On the other hand, economic activity will be stimulated by higher exports. These effects will work in opposite direction so that the final direction of the economic activity and of employment in the short run is not known a priori.

The effects on imports, will for a large part depend on the economic activity. It is clear, however, that the possible negative effects of an export promotion policy will be more than off-set by the increase in exports, so that the current account will definitely become more positive.

The problem of inflation is the same as for the import substituting policy : it depends on the share and the level of the domestic and the foreign inflation component. A devaluation leads to an increased inflation. Not much can be said on the effects over time. In the very short run, for example, the well known 'J-effect' can appear.

Dynamic effects of an export promoting policy can be found in an ever increasing efficiency of the domestic economy due to the competition of domestic exporters with foreign producers and the linkages of domestic exporters with other domestic producers. This will lead to an increase in the comparative advantage of domestic producers over foreign producers. Investment will increase and economic growth will not any longer be based on exports alone. As for import substituting policies, intra-industry linkages will lead to a self sustaining process.

3.2. Possible inter-relations between different trade polcies

Numerous articles studied the relation between exports and economic growth in LDC's. The positive correlation found is the basis of the trade engine model which goes back to Lewis. He stressed that the demand of primary products of industrialised countries is the source of growth in LDC's. In other words, a cause and effect relation is formulated between exports and GNP : an increase of exports leads to a growth of GNP. It is clear then that industrial policy should be used to increase exports.

This analysis can be misleading. Instead of studying the relation between exports and GNP and deducing trade policy from this relationship, one ought to study the immediate effects of trade policy on exports and growth. This analysis is impossible to carry out with past data for a policy is always the result of a mixture of different actions. The only way to study this subject is to use a simulation model able to identify the total effects of a specific policy. We will argue that a particular trade policy does not always lead to the pre-determined outcome. In particular, an EP policy might lead to import substitution while an IS policy might lead to an increase in exports. In other words, IS and EP are inter-related. The crucial condition being the size of the market and thus the demand consequences of a policy.

The country can be represented as a profit maximizing firm. The condition on what will be produced in the firm depends on the market condition. When import tariffs are increased to carry out an IS policy and the firm is producing on the downward sloping part of the average cost curve, some part of production will become more competitive. A greater quantity can now be produced efficiently. If this production volume is larger than the domestic demand it can be exported so that exports will increase.

In the case of an increase in export subsidies in order to stimulate exports, the firm can be thought of as producing on the upward sloping part of the IS curve. As a consequence, an increase in the domestic price leads to less competitive production. If this production level is not sufficient to cover domestic demand, imports will have to increase.

This analysis (5) is built on the assumption that the firm must produce for both the domestic and foreign market to achieve economies of scale. Some empirical support is found for Israel. The crucial importance for an industry specific approach is also stressed. Nothing a priori can be said about the outcome of a trade policy for a country as a whole. It all depends on specific industrial characteristics.

The above model is a static and partial equilibrium model. In a small theoretical model, Bardhan and Kletzer (7) show that the dynamic effects of protection depend on, among other things, the technological characteristics of the protected industry. In capital intensive sectors, production leads to a fall in labour productivity while the opposite is true for labour intensive sectors. When learning by doing is introduced in the model, they found that the increase in output followed by higher import tariffs results in an increase in the growth rate of productivity. The conclusion of their study depends to a large extent on the importance of the effect of learning by doing and the characteristics in each industry.

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(5) BARDHAN, P., K. KLETZER, 'Dynamic effects of protection on productivity', Journal of International Economics', 1984, p. 45-57

(6) see POMFRET, ibid.

(7) see BARDHAN, KLETZER, ibid.

Empirical part

Kenyan Trade Policy in a General Equilibrium Model

Chapter 4 : A General Equilibrium Model of protection for the economy of Kenya.

4.1. Introduction :

a. Sectoral disaggregation

The attempt has been made to disaggregate the Kenyan economy as far as possible. Because considerable information comes from the Input-Output tables (1), the disaggregation in these tables is taken as a starting-point. Further disaggregation is certainly useful in the agricultural sector, but is difficult to achieve with the published data. An attempt, however, is made in chapter 5.

A number of important data are obtained from different 'Census of Industrial Production' (2). It has been necessary to match the disaggregation followed in these publications with the Input-Output tables. The result is a disaggregation in 31 sectors : 14 in the manufacturing sector, 3 sectors in the primary sector, 12 sectors in the tertiary sector (6 private services and 6 government services), the traditional economy, ownership of dwellings and building and construction (3).

The 31 sectors are divided in two categories on the basis of tradability : sectors 1 to 18 are tradable while 19 to 31 are non-tradable. A tradable sector is defined as a sector that actually imports or exports a considerable amount. In this way, all services sectors are non-tradable.

b. Market-clearing mechanisms :

Market-clearing mechanisms are perhaps the least-studied subject of the Kenyan economy. Only one 10-year old study, made for government use, gives an analysis of the market- structure in Kenya (4). The few studies examining the problem limit themselves to the industrial sector.

Different factors determine the extent of non-competitive behaviour into the industrial sector in Kenya. These factors can be divided in natural and artificial barriers of entry. Among the natural barriers we have the smallness of the economy and few possibilities for economies-of- scale.

Artificial barriers are more important for our purpose because they are under the influence of government policy. These barriers are well developed in Kenya as a result of the followed industrialization policies.
A first factor is trade-policy. Over the years, Kenya followed an import substitution policy by attracting foreign investment and had to pay the price of high protection walls.
A second form is the incomplete or non-existent knowledge of technical advancements (5). In reality the domestic market is far from transparent.
A third factor influencing the non-competitive behaviour of the market is the ownership of companies. The distinction can be made between private-owned and state-owned companies. In some cases, the Kenya-government is the only owner of companies in a particular sector (6), which means that they are pure monopolies.

House(7) gives a list of industries classified by use of a concentration-index for 1963, 1967 and 1972. Starting with this sectoral classification, anattempt has been made to determine the non-competitive sectors taking the evolution of the mentioned determinants of market-disruption into account (see e.g. the evolution of tariff-protection from 1962 in graph 4.1).

Graph 4.1 The evolution of the index of the ratio of government income from import duties to total imports
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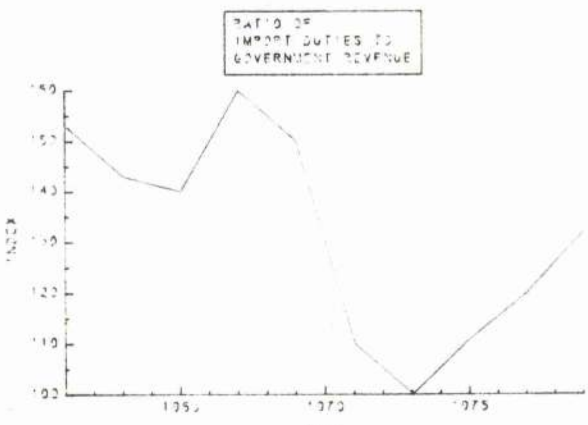


Source : calculations from Statistical Abstracts

Price-formation exists in different forms. Perfect competition is the easiest way to model price-formation. Modeling price-behaviour in monopolistic and oligopolistic markets is far more difficult. The fact that a certain sector does not follow a perfect competitive market model does not predict which model can be used. In other words, it is not enough to know a certain sector IS NOT behaving in a competitive way. It is necessary to know what behaviour IS followed.

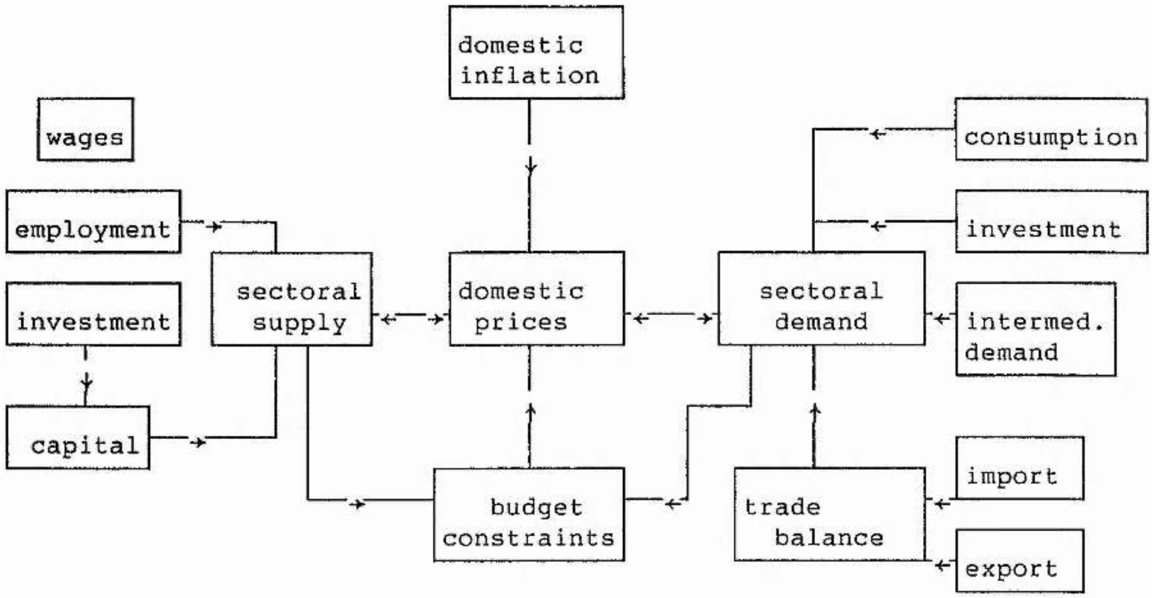
It has been decided to include 11 manufacturing sectors into the competitive category and 3 sectors in the demand-clearing category.
Concerning the non-industrial sectors, the non-government services are 'competitive' while all the other sectors have different market-clearing mechanisms.
An overview of all sectors is given in table 4.1.

Table 4.1. Market-clearing mechanisms

MARKET CLEARING MECHANISM			
Domestic price adjust.		Quantity adjustment	
		Import / Export	
8	M. of textiles	1	Agriculture
9	of clothes	2	Fishing and forestry
10	of footwear, etc	3	Prospecting and mining
11	of wood and furn.	4	M. of food prepartations
12	of paper, printing	5	M. of bakery products
13	of rubber prod.	6	M. of beverages and tobacco
14	of petroleum		Consumption
15	of plastics, etc	7	Ownership of dwellings
16	of mineral prod.	19	Traditional economy
17	of transport eq.		Demand determined
18	of metal prod.	20	Water and electricity
26	Building and Constr.	21	Public adm. and defence
27	Wholesale and Retail	22	Education
28	Hotels and Restaur.	23	Health
29	Transport and allied	24	Agricultural services
30	Financial services	25	Government services NEC
31	Services NEC		

Graph 4.2. gives an overview of the model-specification for the competitive sectors. Far from all relations are depicted. It is only meant as a general overview.

Graph 4.2. General equilibrium in the price-clearing sectors



In algebraic terms, we have

XD = XD (DP,...)
XS = XS (DP,...)
EXSUP = XS (DP,...) - XD (DP,...) = 0

XD, XS : demand and supply vectors with dimension (1 x k) with k the number of sectors
EXSUP : the excess-supply vector, dimension (1 x k)
DP : the domestic price vector, dim (1 x k)

In the following sections the determination of demand and supply is explained. Supply depends on a production function with capital and labour as inputs. Demand depends on the sum of intermediate demand, consumption demand, investment demand and the difference between imports and exports. The relative-price determination is the subject of the last section.

4.2 Production block

a. The labour market: determination of wages and employment

1. Determination of sectoral wages :

At the outset, an attempt has been made to set up a labour-market model able to determine wages.

In a competitive labour market, wages are equal in all sectors for there is complete mobility among sectors. There is no agreement as to whether the labour market in Kenya is competitive or segmented (8).
The labour market is divided in two main segments : the urban and the rural labour market segment. This distinction is since long acknowledged for Kenya and many other developing countries. Wage determination will be different in these two groups.

a. The rural labour market :

The rural labour market is sub-divided by province. This is to follow the less than complete mobility among rural workers between provinces. The actual existing wage- differentials by province remain the same over the whole period. The wage growth-rate for the three sectors (1, 2 and 3) in the rural sector is equal to the growth- rate of the domestic prices in the agricultural sector, exogenously set by the government. This can be seen as a complete wage-indexing with agricultural prices. In this way, 6 different wage-levels are obtained. An average wage for every sector in the rural segment will be calculated with the wage-employment levels as weight-coefficients.

b. The urban labour market :

There is less agreement on the determination of urban wages. The following determinants seem to be candidates

-Labour market pressure :

If the urban labour market is competitive, wages will be the labour market-clearing mechanism. Labour demand and supply both depend on a number of factors.
Labour demand is a derived demand and will depend on the output level on a sectoral basis.
The supply of labour depends on the demographic evolution and on rural-to-urban migration (9). The demographic evolution is well-studied by the ILO and growth rates of Kenyan population by different age-groups are readily available.
Literature on the rural-to-urban, interregional and international migration in Kenya is overwhelming. It is necessary to estimate a migration function with the proportion

of people who moved from the rural sector to the urban sector to total population per skill-level as the dependent variable (10). A Lot of variables could be the independent variables. House and Rempel(11) list the conclusions of the existing literature on the subject. No overall consistency exists for all variables. The following variables are studied by most researchers.

Income in destination area serves as an appropriate measure of what migrants expect to earn. Income in source area is only significant in some studies. Employment opportunities in the destination area has a positive significant effect. Employment opportunities in the source area, however, have a less significant effect. Knowles and Ankar(12), for example, come to opposite conclusions to House and Rempel.
Most of the studies support the Harris- Todaro hypothesis (13) that the expected income differences have an important significance.
Researchers are unanimous on the positive effect of skill-level on migration.
Distance between the urban and the rural place is another significant variable. Only Huntington (14) disagrees.

In the case of a competitive urban labour-market, the following system exists :

$$LD_l = LD_l(XD)$$

$$(LS_l)_t = (LS_l)_{t-1}\ (1 + GL) + \sum_{l=1}^{6} MIG_l$$

$$MIG_l = MIG_l(Wu,\ We_l,\ D)$$

LD_l, LS_l: labour demand and supply per skill level output-level

GL : growth-rate of population in a certain age-group

MIG_l : the proportion of people who moved from the rural to the urban segment in skill level l to total population

We, We_l, D: independent variables as wages in the urban sector, expected wage-level per skill, distance from rural to urban regions

The following question needs to be answered : Does the urban labour market in Kenya actually behave as a competitive market ?

When data from 1962 to 1969 are analyzed, Bigsten (15) and

House and Rempel (16) come to the conclusion that market pressures have no influence on wage-formation and so the labour market does not behave in a competitive way.
For data from 1972 to 1977, Gunning(17) and Collier and Lal (18) come to different conclusions, due to the fact that Gunning adjusts the data for elderly people, students and self-employed, while Collier and Lal do not undertake this adjustment. Gunning's data show a decline in Nairobi real wages with an increase in labour-supply. When no adjustments are made (as Collier and Lal did), a decline in Nairobi real wages goes together with a decrease in labour supply.

-Unionization :

A test of the impact of unionization on wage-employment of unskilled labour (probably the wage most sensitive to unionization) has to reject the hypothesis that unionization has any differential impact on wage evolution. (19).

-Wage-leaders :

Candidates for wage-leaders are the government and certain leading companies. While the government is named on different occasions as a wage-leader, no formal test is done on this subject.

-Labour-productivity :

In trying to explain the inter-industry structure of wages, House and Rempel (20) found that the average productivity per worker is "the most consistently significant explanatory variable ... which never fails to be significant at the one percent level".

Three factors are taken into account in modeling wage-determination :

(i) The explained empirical results,
(ii) Data constraints, e.g. wages per skill only exist for a short period and are not very reliable,
(iii) The government policy, spelled out in Sessional Paper N° 4, 1982 on Development prospects and policies, aimed to make industry more competitive.

This has led us to determine wages as follows :

(i) The Kenyan labour-market is segmented into a rural and an urban segment,
(ii) The wages in the rural segment (in the model, sectors 1, 2 and 3) will grow with the same growth-rate as the agricultural prices. The actual divergence among sectors remains constant,
(iii) The wages in the urban segment are not labour- market clearing but are segmented on a sectoral level, there is

no competition. Wages are determined by the labour-productivity in the previous period. In practice, wage- formation is assumed to happen at a sectoral level on a yearly basis with the existing labour-productivity as the independent variable.

As a consequence :

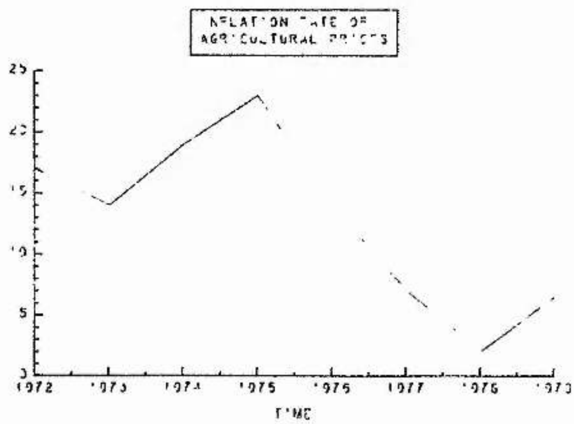
$$(WR_i)_t = (WR_i)_{t-1} \cdot (1 + GPD_i) \quad i=1,3 \qquad (4.1)$$

$$(WU_i)_t = \alpha_i + \beta_i \cdot (XS_i/L_i)_{t-1} \quad i=4,31 \qquad (4.2)$$

WR_i , WU_i: wage rate in rural and urban labour segment
GPD_i : exogenous growth rate of domestic prices in the agricultural sector
XS_i : value added
L_i : wage-employment

Results of the estimation of α and b are given in Appendix 2. It has to be decided which growth rate for agricultural prices has to be taken. As in the past, the government will set this growth rate. Graph 3 gives the inflation rates for domestic agricultural prices.

Graph 4.3 : Evolution of the inflation rate of domestic agricultural prices



Source : Calculated from Statistical Abstracts

The evolution of these prices is influenced mainly by two factors : the money supply and goods supply factors (21).
The financial help of the IMF to Kenya has been provided since the late seventies on condition that a more restrictive monetary policy is adopted. This explains -partly- the lower inflation rates in 1978-1980. From 1980 on, however, continued devaluation raised the inflation rates. Another factor in the evolution of the inflation rate is the supply condition. This is especially the case for agricultural prices and more particularly for maize.

The further evolution of the increase in domestic prices depends on these two factors : monetary policy and supply conditions.
Concerning monetary policy, the Sessional Paper N°4 of 1982 (22) states the conditions of a new international loan : new devaluations are announced; strengthening of price controls and a new orientation of trade policy. In this way industry must become more competitive. Concerning the surplus conditions described above, these disappeared in the early eighties.
This has led us to conclude to take as the exogenous price increase for agricultural goods the non-weighted average of growth rates of the last 9 years, i.e. 12.29%

2. Determination of wage employment

Wage-employment is equal to labour-demand. This is consistent with the idea of a labour-abundant developing country. Labour demand is a derived demand, dependent on value added. This dependence is not the same for all sectors. Three different categories exist:

$$(L_i)_t = (L_i)_{t-1}.(1 + GXS_i)_{t-1} \qquad i=1,18 \qquad (4.3)$$

$$(L_i)_t = \alpha_i.(XS_i)_{t-1}.(1 + GXS_i)_{t-1} \qquad i=20,25 \qquad (4.4)$$

$$(L_i)_t = \alpha_i.(XS_i)_t \qquad i=26,31 \qquad (4.5)$$

L_i : wage employment
GXS_i : growth rate of value added in period (t-1)
XS_i : value added in current prices

The distinction between these three sectors results from different regressions.

b. The capital-market :determination of investment and capital

Capital is the second input in the production function. The capital stock is assumed to be fixed in a certain period so that no substitution possibilities between sectors exist. The capital updating has the usual form of :

$$(K_i)_t = (1 - d_i).(K_i)_{t-1} + (Y_i) \quad i=4-18 \qquad (4.6)$$

K_i : fixed capital stock
d_i : depreciation rate
Y_i : investment by sector of destination in (t-1)

Once the investment and the capital-stock for the previous period are determined, it is possible to calculate the capital stock in period t.

1. Investment determination (23)

Investment by sector of destination is endogenously modeled. In order to do this two variables have to be calculated, in casu, the total volume of investment and the sectoral shares.

The volume of total investment is determined by savings behaviour. This approach is classical but it has to be stressed that other approaches are equally possible. One advantage in this approach is certainly that income distribution aspects are brought into the system. As will be explained more fully in the next section on demand determination, three economic agents are considered : the households, the capitalists and the government. Each group has an income and a fixed savings rate. The determination of the income levels is subject of section 4.3. The fixed savings rates are calculated from the Social Accounting Matrix (SAM) of Kenya, constructed for 1976 (24).

The total volume of investment is calculated by applying the savings rates on the income groups of each category :

$$TINV = Sh.Rh + Sc.Rc + Sg.Rg \qquad (4.7)$$

TINV : total volume of investment
Sh, Sc, Sg : savings rates of households, capitalists and government
Rh, Rc, Rg : income of households, capitalist and government

The total volume of investment is allocated to the different sectors by endogenously determined sectoral investment shares:

$$Y_i = \rho_i . TINV \qquad i=1,31 \qquad (4.8)$$

These shares depend on the relative profitability of the sector and the sectoral shares in the previous period.

The profitability of each sector is calculated as the ratio in that sector of the profit to the output in current prices. Profits are equal to the difference between value added and the wage cost and indirect taxes :

$$PI_i = \frac{XSC_i - W_i.L_i - td_i . OUT_i}{OUT_i}$$

PI_i : profitability index
td_i : indirect tax rate
$W_i.L_i$: wage costs
XSC_i : value added in current prices

The sectoral investment share then is equal to :

$$\rho_i = \frac{(XS_i - W_i.L_i - td_i . OUT_i)/ OUT_i}{\Sigma_i[(XS_i - W_i.L_i - td_i - OUT_i)/OUT_i]} . \frac{(\rho_i)_{t-1}}{\Sigma(\rho_i)_{t-1}} \qquad (4.9)$$

2. Determination of the fixed capital stock

In order to be able to calculate the fixed capital stock in period t it is necessary to determine the capital stock in period t-1. This task is a nightmare for every researcher. Two approaches have been used in Kenya-research.

Powell(25) undertook the enormous task of calculating the fixed capital stock in the monetary economy. This is done on the basis of investment series extending to 1931. This study presents data for 1971 on a (necessarily) very aggregated level.

The alternative approach is followed by Pack(26) who considers a number of assumptions, the most important being a fixed ratio of capital to gross value added.

Yet another approach is followed here. Imagine for this a production function with two inputs, labour and capital :

$$XS = XS(K, L)$$

If the parameters of a certain specification (e.g. a CES function) are estimated without the knowledge of the capital stock (as will be explained inthe next section), XS, L and the parameters are known. In this case, it is possible to calculate the fixed capital stock. The results are given in appendix 2.

In agreement with most other studies, a depreciation rate of 10 % is assumed.

c. Value added and Output determination

1. Determination of value added

Different approaches to the construction of production functions exist. Value added in constant prices will depend on different factors according to the differences in the sectors. An attempt has been made to divide all sectors into three categories. A first category consists of the sectors Agriculture and Fishing and Forestry. A Constant Elasticity of Substitution (CES) production function of labour and land is estimated. The second category consists of all manufacturing sectors. Value added is a CES production function with capital and labour as inputs. The third category consists of the private services sectors and the sector Mining and Quarrying. In this category, value added depends on the investment undertaken in this sector. Net Incremental Capital Output Ratios (ICOR's) are estimated for these sectors.

To start with, a CES production function of the following form is estimated for all manufacturing sectors (sectors 4-18) :

$$XS_i = [d_i K^{-\rho_i} + (1 - d_i) L_i^{-\rho_i}]^{\mu_i/\rho_i} \qquad i=5,9,11,15,18 \qquad (4.10)$$

XS_i : value added in constant prices
K_i, L_i: capital and labour input (27)
ρ_i : substitution parameter
d_i : distribution parameter
μ_i : degree of homogenity

Constant returns-to-scale are assumed so that $\mu = 1$. A direct

estimation of this function is econometrically a difficult task since the function remains non-linear in the parameters after linearization by taking logarithms of both sides. But, due to the lack of data on the capital stock, this taskhas not been not tried.
Arrow et al.(28) give a method to estimate the substitution-elasticity and the distibution parameter without the knowledge of the capital stock with cross-section data, while Ferguson(29) does the same for time-series. Their argument is based on the assumption of competitive equilibrium. In this case, the marginal product of labour is equal to the wage-rate. This is no problem since this assumption is consistent with what is said earlier on market clearing mechanisms.

Following Arrow et al., the following function is estimated :

$$\ln (XS_i/L_i) = \alpha_i + \beta_i.\ln(W_i/P_i) + \varepsilon_i$$

W_i : nominal wage rate
P_i : price deflator
ε_i : disturbance term

This regression gave good results for 5 out of 14 sectors in the manufacturing sector. For the other 9 sectors, the Durbin-Watson statistic has a too low level showing a high positive first-order correlation. This leads to an estimation of a new CES function with time as an explanatory variable :

$$XS_i = 10^{\lambda t} [d_i K_i^{-\rho_i} + (1 - d_i) L_i^{-\rho_i}]^{-1/\rho_i} \qquad i = 4,6,8,10,12,13,14,16,17 \qquad (4.11)$$

Following Ferguson, this is estimated in the following way :

$$\ln (XS_i/L_i) = \alpha_i + \beta_i \ln (W_i/P_i) + \lambda_i.t + \varepsilon$$

The results for the 9 sectors show an acceptable DW- statistic and a statistically significant coefficient. The estimated results are :

$$\alpha_i = [-1/(1 + \rho_i)] . \ln (1 - \lambda_i)$$

$$\beta_i = 1/(1 + \rho_i) \text{ (i.e. the substitution elasticity)}$$

$$\mu_i = [\rho_i/(1 + \rho_i)]\lambda_i$$

For private services, Mining and quarrying and Ownership of dwellings, ICOR's are calculated. The World Bank(30) points out the reasons for the popularity of calculating ICOR's : limited data requirements; simple interpretation and easy comparability in policy oriented research. The calculation method proposed by Chenery and Eckstein(31) and followed by the World Bank(32), Bigsten(33) and Gunning(34) is also adopted here :

$$(ICOR_g)_i = (ICOR_n)_i + Y_i/GL_i$$

$ICOR_g$, $ICOR_n$: gross and net incremental capital output ratios

Y_i : investment by sector of destination (see appendix 2 for their calculation)

GL_i : growth rate of value added

The following equation is estimated :

$$(XS_i)_t = (XS_i)_{t-1} + ICOR_n.(Y_i)_{t-1} \quad i=2,7,26-31 \qquad (4.12)$$

This equation with a one-year lag of investment gave good results (see appendix 2) for net ICOR's for all sectors, apart from the sector Mining and Quarrying. This is explained by the fact that investment in this sector takes longer to have its effect. In order to take account of this, an equation with investment over two years is estimated :

$$(XS_i)_t = (XS_i)_{t-1} + (ICOR_n) .[(Y_i)_{t-1} + (Y_i)_{t-2}] \qquad (4.13)$$

i=3

Good results for this sector are obtained this way.

For the agricultural sector and the sector Fishing and forestry a CES function with and without time as an explanatory variable and labour and land as inputs are estimated. The results are not acceptable because they are very poor, due, perhaps, to the very high level of aggregation of this sector. A further disaggregation by province or product is not possible since very few data on primary and intermediary inputs are published. The ICOR approach was also tried and gave good results for the Fishing and forestry sector. For the agricultural sector a theoretical poor solution is acceptable. Value added in constant prices will grow with a growth rate equal to the average growth rate in the past 9 years.

A final word has to be said on the traditional economy. The treatment of this sector is very simple. It is a non-tradable sector, it does not pay any indirect taxes, pays very few wages and salaries and also very little direct taxes.
A great part of what the sector produces is traded by the informal sector and is not laid down in the National Accounts. An equilibrium between demand and supply does not make sense. Ouput determination is only important because some sectors use the output of the traditional sector as intermediate input. Modeling output-determination is, however, very difficult since very little is known about intermediate inputs of the traditional sector. The treatment followed is similar to the one followed for the agricultural sector, i.e. a fixed growth rate dependent on the growth rate of real output during the last 9 years.

For these last two sectors, we have the simple autoregressive model :

$$(XS_i)_t = (1 + GL_i) . (XS_i)_{t-1} \qquad i=1,19 \qquad (4.14)$$

GL_i : exogenous growth rate in sector i

2. Output determination :

Output in constant prices is equal to the sum of value added and intermediate inputs in constant prices:

$$OUT_i = XS_i + \Sigma_j a_{ij} . OUT_j$$

Or in matrix notation :

$$OUT = XS + A . OUT$$

Or with output as the unknown :

$$OUT = [I-A]^{-1} . XS$$

A is the complete input-output table and remains constant over the simulation period. This also means that $[I-A]^{-1}$ is constant and that output is in linear relation with value added. In other words, intermediate inputs are in fixed proportions to value added.

Output in current prices is equal to the sum of value added and intermediate inputs in current prices. Because of the lack of a sectoral output deflator, the gross domestic product deflator is also used for calculating intermediate inputs in current prices.

$$OUTCST_i = \alpha_i \,.\, XS_i \qquad i=1,31 \qquad (4.15)$$

$$OUT_i = XS_i \,.\, GDPD_i + \Sigma_j a_{ij} . OUTCST_j \,.\, GDPD_j \quad i=1,31 \qquad (4.16)$$

$OUTCST_i$: output in constant prices
OUT_i : output in current prices
$GDPD_i$: sectoral gross domestic product deflator

4.3. Demand block

Aggregate sectoral demand is defined as the sum of the domestic components of consumption, intermediate demand and investment demand plus the difference between imports and exports. In algebraic terms :

$$AD_i = C_i + V_i + I_i + (X_i - M_i) \qquad (4.17)$$

AD_i : aggregate sectoral demand
C_i : consumption demand
V_i : intermediate demand
I_i : investment demand
$(X_i - M_i)$: the difference between exports and imports

The different sectoral total demand components C, V and I will be calculated first.

a. Consumption determination :

The problem of determining sectoral consumption is usually seen in the consumption literature as a two-level problem. The first level consists of determining total consumption with the consumption theory providing the explanatory variables. The disaggregation of the obtained total consumption to a sectoral level is a problem of the demand systems theory.

To capture income-distribution among socio-economic groups and different patterns of consumer behaviour among them, it is worth distinguishing three socio-economic groups : households, capitalists and the government.

If it is assumed that the aggregate consumption function is a simple Keynesian function, the following three- level problem emerges :

1. $Cc = Cc\ (Rc)$
   $Ch = Ch\ (Rh)$
   $Cg = Cg\ (Rg)$

2. $C = Cc + Ch + Cg$

3. $C_i = C_i\ (C,\ PD_i/PD_j)$

Cc, Ch, Cg : total consumption of capitalists, households and government
Rc, Rh, Rg : revenue of capitalists, households and government

The problem of allocating total consumption among sectors is usually solved by assuming that the demand theory is valid. A utility function is then maximised under a budget-constraint :

$$\text{Max } U(C_1, C_2, \ldots, C_n)$$

$$\text{sub } C = Rc + Rh + Rg$$

Well-known specifications of this utility function are of the Klein-Rubin form (which is after transformation the Linear Expenditure System) or more general forms with less constraints on the parameters (for e.g. the Rotterdam system, the translog system, the S-branch utility function, etc.).(35).

Due to a number of data problems (36), a two-level system had to be estimated for the tradable sectors. Aggregate consumption was determined by a Keynesian consumption function and this total consumption was allocated to the different sectors following a Linear Expenditure System by maximising the Klein-Rubin utility function under the budget constraint :

$$\text{Max } U = \Sigma_i \beta_i .\ \ln\ (C_i - \alpha_i)$$

$$\text{sub } C = Rh + Rc + Rg$$

After transformations (37), one arrives at the following system of equations :

$$CQ_i = \alpha_i + (\beta_i/DP_i).\ (C - \Sigma_j \alpha_j . DP_j) \qquad i=1,18$$

$$\Sigma_i \beta_i = 1$$

CQ_i : quantity consumed

Due to the small data sample and to a great number of explanatory variables, linear dependence of one or more series with others was a serious problem and made the LES impossible to estimate. Moreover, with domestic prices being at the left side of the equations, the solution of the complete model becomes very complicated.

For these reasons it was necessary to accept a less perfect theoretical solution. A simple Keynesian function is actually estimated and used in the simulation analysis for all tradable sectors :

$$C_i = \alpha_i + \beta_i \, . \, (Rh + Rc + Rg) \qquad (4.18)$$

Private consumption of government and non-government services (i=20,31) is a derived function of the private consumption of all sectors :

$$C_i = cc_i . \, (\Sigma_i C_i) \qquad i=20,31 \qquad (4.19)$$

Government consumption is exogenous and will be determined in chapter 4.

Revenue per socio-economic group

The revenue of households is defined as the difference between the total wage sum and the direct taxes paid to the government. The non-inclusion of other households income (in casu transfer payments) is not a serious shortcoming since only 7.7% of total disposable income came from transfer payments in 1976 (38).
Direct tax rates differ certainly among sectors and among income-levels. Due to the lack of data and difficulties in modeling to capture these effects it has been impossible to take these differences into account. A uniform tax rate is applied to all sectors and income- levels :

$$Rh = \Sigma_i W_i . L_i - tl.(\Sigma_i W_i . L_i) \qquad (4.20)$$

tl : direct tax rate on labour income

The income of capitalists is equal to the difference between total output and total production costs multiplied by a direct company tax rate. The production costs consist of intermediate costs, wage costs and indirect taxes paid to the government :

$$Rc = (1-tc).(\Sigma_i[OUT_i - (\Sigma_j a_{ji}.OUT_i + td_i.OUT_i + W_i.L_i)]) \qquad (4.21)$$

tc : direct tax rate on non-labour income
td_i : indirect tax rate (exclusive of import duties)

Government income is defined as the difference between their revenue and their expenditure. Revenue consists of direct taxes paid by households and capitalists, indirect taxes, import duties paid by importers and foreign capital while their endogenously modeled expenditure consists of export subsidies :

$$Rg = tl.\Sigma_i W_i.L_i + tc[\Sigma_i OUT_i - (\Sigma_j\Sigma_i\ a_{ji}.OUT_i + \Sigma_i td_i.OUT_i + \Sigma_i W_i.L_i)] + \Sigma_i tm_i.M_i - \Sigma_i te_i.E_i + F \tag{4.22}$$

tm_i : sectoral import tariff rate
te_i : sectoral export subsidy rate
M_i, E_i : sectoral import and export
F : capital inflow

b. Investment determination

Two main ways of handling investment by sector of origin in Kenya are possible.

First, the assumption can be made that each sector invests as much as it receives from investment. In other words, investment by sector of origin is equal to investment by sector of destination :

$$I_i = Y_i$$

I_i : investment by sector of destination

Y_i : investment by sector of origin

In this way, sectoral investment demand is endogenously modeled in the same way as is explained in the previous section.

Second, it can be assumed that sectoral shares used to disaggregate total investment remain constant over time. This second way can be applied to Kenya since the sectoral domestic shares for 1976 can be found in the SAM (column 53, rows 23-50) (39).

An ideal method does not exist ; both approaches have advantages and disadvantages. The second method has been chosen for there does not seem to be an a priori reason to accept that investment by sector of destination equals investment by sector of origin.

The following equation is the used :

$$I_{di} = s_i . TINV \qquad i=1,31 \qquad (4.23)$$

s_i : sectoral domestic share for investment by sector of origin

c. Determination of intermediate demand :

Fixed input-output coefficients are a necessary assumption in most economic models. This Kenya model is no exception so that the following equation is used :

$$V_i = \Sigma_j a_{ji} . OUT_i \qquad i=1,31 \qquad (4.24)$$

V_i : sectoral intermediate demand
OUT_j : sectoral output
a_{ji} : input-output coefficients : intermediate demands from sector j per unit of output of sector i.

d. Import and export determination

Tradeable sectors are divided in two categories.

The first category consists of the sectors Agriculture and Mining and Quarrying and those directly dependent of them. Trade in these sectors is directly dependent on the difference between domestic demand and supply. Domestic production is highly influenced by climate condition, something which is clearly impossible to model. Imports and exports are therefore used as the market-clearing mechanism.

The second category consists of all manufacturing sectors to the exclusion of those in the first category. For those sectors, import and export functions are estimated.

1. Import functons

It has been repeated on different occasions in the previous chapter that imports are neither perfect substitutes nor completely different from foreign goods. An intermediate solution is preferable.
A method, with some characteristics of the Armington- method (40), is adopted for the model. The share of sectoral total demand that is imported depends on relative prices :

$$M_i/Q_i = f_i \ (PDM_i \ / \ PM_i \ ) \qquad i=8,18$$

PDM_i: domestic price for imported products
PM_i : import price
M_i : imports in constant prices
Q_i : aggregate domestic demand in constant prices

Aggregate domestic demand is the sum of domestic production and the difference between imports and exports :

$$Q_i = OUT_i + (M_i - E_i) \quad i=8,18 \tag{4.25}$$

The domestic price for imported products depends on the world price and the domestic price for the same goods :

$$PDM_i = [(M_i)_{t-1} / ((OUT_i)_{t-1} + (M_i)_{t-1} - (E_i)_{t-1})] \,.\, (PM_i)_t + [(1 - (M_i)_{t-1}) / ((OUT_i)_{t-1} + (M_i)_{t-1} - (E_i)_{t-1})] \,.\, (PD_i)_t$$

To estimate the trade-substitution elasticities the following form is used :

$$\ln (M_i/Q_i) = \alpha_i + \beta_i . \ln (PD_i/PM_i) \quad i=8,18 \tag{4.26}$$

In this way, demand and supply factors in import determination are taken into account. An increase in domestic demand will increase imports and an increase in the domestic price with a constant import price will lead to a decrease of imports.

Imports are specified in the simulation model as :

$$M_i = aa_i / (1-aa_i) . (OUT_i - E_i) \quad i=8,18 \tag{4.27}$$

where

$$aa_i = 1 - \alpha_i . (PDM_i / PM_i)^{\beta_i}$$

The import price is dependent on the world price, the exchange-rate and the import tariff in the following way :

$$PM_i = PW_i . (1 + tm_i) . ER \quad i=8,18 \tag{4.28}$$

PW_i : world price in \$
tm_i : import tariff rate
ER : exchange rate (Kenyan pounds per \$)

2. Export functions

Sectoral export functions are specified in a similar way as the import functions. Demand and supply conditions enter in the equations in the form of world demand and relative prices respectively :

$$E_i = f_i(WED_i, (DEP_i \,/\, WEP_i)) \qquad i=8,18 \qquad (4.29)$$

WED_i : world export demand in constant prices
E_i : exports in constant prices
DEP_i : domestic export prices
WEP_i : world export prices

The following specification is used in the regression :

$$(E_i) = \alpha_i + (DEP_i/WEP_i)^{\beta_i} \,.\, \omega_i \,.\, WED_i \qquad i=8,18 \qquad (4.30)$$

The same specification is used in the simulation model.

The coefficient β is fixed across sectors because the data sample was too small to obtain reliable results. A coefficient of (-4) is assumed. This is consitent with comparable studies. World export demand and world export prices grow at a fixed exogenous growth rate. Domestic export prices depend on world export prices, the exchange rate and the export subsidy (on the assumption that export taxes are non existant) :

$$DEP_i = WEP_i \,/\, (1 + te_i) \,/\, ER \qquad i=8,18 \qquad (4.31)$$

te_i : export subsidy

4.4. Equilibrium

a. Monetary mechanisms

The importance of not disregarding monetary mechanisms has been stressed in the previous chapter. So far, money does not enter into our demand or production functions as in the theoretical model by Malliaris(41). This is certainly a less serious shortcoming for a developing countrythan it is for an industrialised country because the average savings rate for LDC's is certainly lower than for industrial countries. Moreover, financial markets are less accesible and less efficient in developing countries.

Given the state of the theory and the controvery on the subject, it is preferable to disregard any influences or inter-dependencies of micro and macro variables.

b. Balance of payments :

Most applied general equilibrium models incorporate a balance of payments equilibrium by fixing the capital account. The current account will be set exogenously in this kind of model.

In studying the effects of trade policy on the economy, it is considered useful to be able to look at the consequences on the current account in changing trade policy. The balance of payments will be equilibrated by the capital account where an unlimited supply of foreign exchange is assumed.

c. Material balance equations and overall equilibrium

The excess supply functions are equal to the difference between sectoral supply and demand. A simultaneous equilibrium of all these sectors is necessary in order to obtain a solution for the general equilibrium model.

$$ES_i = (OUT_i + M_i) - (C_i + G_i + V_i + Y_i + X_i) = 0 \quad \begin{matrix} i=8,18 \\ i=26,31 \end{matrix} \qquad (4.34)$$

The excess supply functions have two properties.
First, they are homogenous of degree zero in the prices. This means that if the vector PD forms a solution for the model, (${}_1$. PD) forms a solution as well, provided that ${}_1 > 0$. Second, it is not sufficient that all excess supply functions are independently equal to zero. It is necessary that the economy (the total of all sectors) must be in equilibrium as well. Starting from Walras Law,

which is the second property of the excess supply functions :

$$\Sigma\ (OUT_i + M_i) = \Sigma\ (C_i + G_i + X_i + Y_i + V_i)$$

$$Rh + Rc + Rg = \Sigma\ (C_i + G_i + X_i + Y_i + V_i) \qquad (4.35)$$

This means in practise that if 17 of the 18 excess supply equations are equal to zero and (4.35) also holds, the last excess supply function must be in equilibrium too. The closing of the model iscompleted by incorportating the inflation formation process which has been explained in the previous point.

The result is a model of 18 equations which are non-linear in the parameters. The method to solve the model was proposed by Powell (42) and does not require any a priori derivatives.

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Chapter 5: Simulations with trade policy changes in Kenya

5.1. Simulations with the Kenya model

a. Hypotheses and simulations

The results of three simulations are discussed in this section. The hypotheses concerning exogenous influences on the model are first presented. Results of the model start in 1981 and terminate in 1988 so that eight years are considered.

Hypotheses concern the exogenous growth rates of world prices for tradable goods in the market-clearing sectors, the domestic prices for the non market-clearing sectors and the evolution of world trade.

An average growth rate is calculated for the world prices in the market-clearing sectors. It is particularly difficult to project the evolution of the price for petroleum and petroleum products. Instead of taking a simple average growth rate over the last nine years (1972-1980) -as is done for the other sectors- only the last five observed years (1979-1983) are taken into account. In this way is a yearly increase of 40 % assumed (see table 5.1). These rates remain fixed over the whole period.

The most recent data on the probable evolution of world trade is taken from EEC - projections. A fixed growth rate of 4 % is assumed, with an inflation rate of 10 % which means that the exogenous nominal growth rate is equal to 14 %.

Table 5.1. Hypotheses concerning the price increases of imported and domestic goods (in %)

World prices		Domestic prices	
8	14.55	1	7.49
9	12.11	2	5.17
10	12.40	3	6.98
11	12.40	4	6.95
12	12.10	5	10.30
13	24.30	6	6.02
14	40.00		
15	14.20		
16	18.24		
17	9.30		
18	7.10		

As explained earlier, domestic prices of the sectors Agriculture and those depending on them, are exogenously set by the Kenyan Government. It is assumed that the government continues that policy. The simple average growth rate of the past nine years is assumed. (see table 5.1).

The hypotheses used in the three simulations differ from those in the base run in the following way :

Simulation 1 : 'Import Substitution' policy (IS) :
import tariffs increase by 50 %

Simulation 2 : 'Export Promotion' policy (EP) :
export tariffs increase by 50 % and
the exchange rate devalues by 10 %

Increasing the export subsidies has the same effect as a devaluation of the exchange rate but leaves the prices of foreign goods in domestic currency in principle unaffected. In combining this policy with an exchange rate devaluation we come close to the recommendations of the World Bank and the IMF.

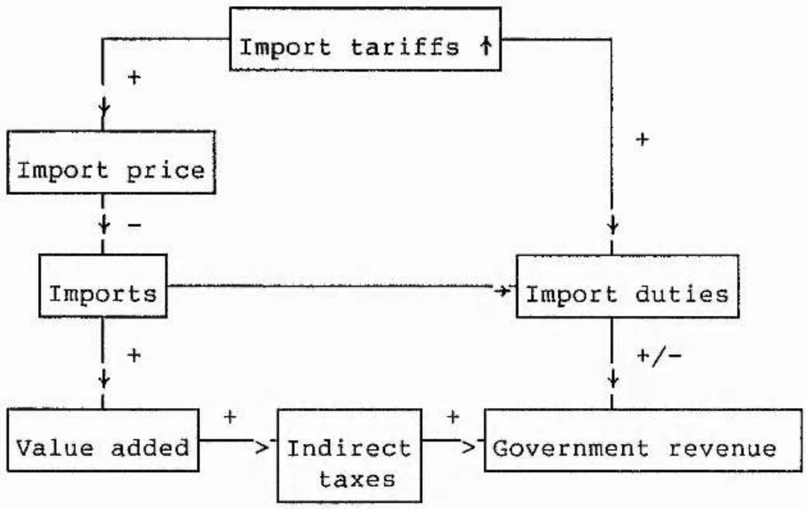
Simulation 3 : 'Adjusted Trade Liberalization' (ATL)
import tariffs disappear,
export subsidies disappear and
indirect taxes increase by 30 %

The classical trade theory arguments are based on a number of unrealistic assumptions about factor and product markets in different countries. This is the reason why a free trade situation is impossible to accept for developing countries. In this simulation, it is assumed that the government introduces free trade but wants to compensate the loss in import tariffs by a non-discriminatory increase in indirect taxes of 30 %.

b. Trade policy in the Kenya model : fiscal implications of a change in trade policy

The basic relation in the study of the National Accounts is the equality of the three main aggregates : total value added, total demand and total income. As a consequence, an increase in income will by definition have its counterpart on the production and demand side.

Changes, however, may occur within the revenue and expense side. The income distribution or the financial state of the economic groups may change as a result. In this way, the budget of a state as a whole is always in equilibrium, while the accounts of households, capitalists and government may either have a surplus or a deficit.
What are now the most important short-term effects of change in trade policy on the government account ? In the case of an increase in import tariffs, the results can be summarised as follows :



The quantitative results of an increase in import tariffs are summarised in table 5.2. An increase in import tariffs by 50 % leads in the first year to an increase in import prices and so to a decrease in imports by 3.9 %. The combined effect of a decrease in imports and a rise in import tariffs leads to an increase of the import duties by 32.8 % (so that the effect of a decrease of imports by 3.9 % only would result in a decrease of import duties by 50 - 32.8 = 17.2 %). As is pointed out in Wynn and Holden (1), a change in a tax rate (e.g. import tariffs) may result a change in the tax base so that the tax yield might differ. This is clear in this situation : an increase by 50 % of import tariffs does not lead to an increase of imports duties by the same rate but by only 32.8 % because of the fall in imports. The indirect effect in the short run is given by a small increase in value added and indirect taxes. The major effect of the increase in import tariffs of 32.8 % is an increase in government revenue of 9.6 %. In the longer run (5 years after implementation), it can be observed from the table that the decrease in imports becomes smaller and smaller (to -10 %) while the increase in value added becomes stronger (to 28 %). The effects of these factors is an increase in indirect taxes (+2.4 %) and import duties (+35.4 %) so that government revenue continues to grow (+12.6 %).

Table 5.2 Fiscal effects of an increase in import tariffs by 50 % on manufactured goods (absolute difference from base run in % points).

Year	Imports	Value added	Import duties	Indirect taxes
1	-3.9	1.6	32.8	0.0
3	-2.8	2.3	34.0	1.4
5	-1.0	2.8	35.4	2.4

Year	Households revenue	Capital. revenue	Government revenue	Government expenditure
1	0.0	0.0	9.6	11.4
3	4.0	1.1	9.9	11.5
5	4.6	1.6	11.1	12.6

In the case of an increase in export subsidies, the model provides the following important relations :

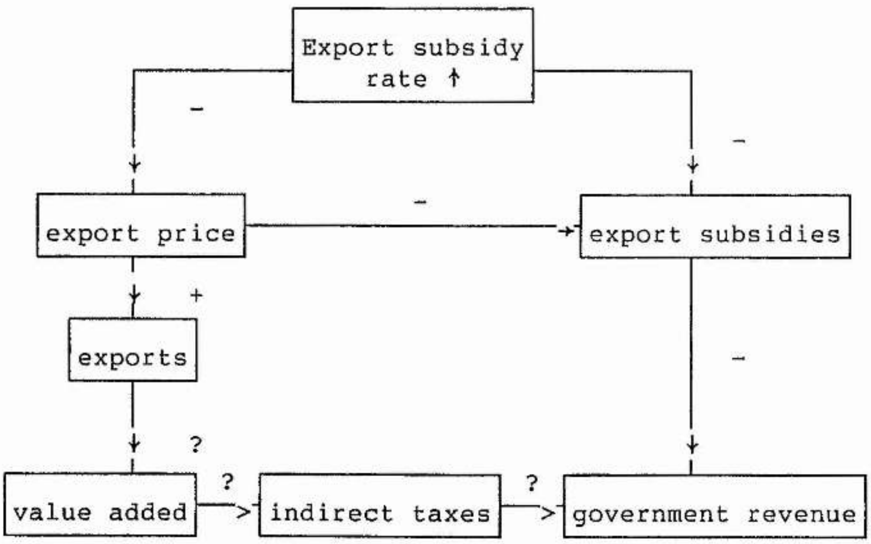


Table 5.3 summarises the quantitative results of a 50 % increase

in export subsidies. In the short run, total export subsidies increase by 77.4 %. This is due to the increase in the subsidy rate of 50 % and the increase in export by 4.8 % (so that the effect of an increase in exports alone would result in an increase in export subsidies of 77.4 - 50 = 27.4 %). The impact on value added is slightly negative but the revenue from indirect taxes rises by 0.4 %. This rise, however, cannot compensate the loss of government revenue from export subsidies, so that in the first year government revenue decreases by 2.6 %.

Table 5.3 Fiscal effects of an increase in export subsidies of 50% on manufactured goods (absolute difference from base run in % points).

Year	Exports	Value added	Export subsidies	Indirect taxes
1	4.8	-0.3	77.4	0.4
3	4.7	-0.7	82.2	0.0
5	4.4	-0.8	89.4	-0.3

Year	Households revenue	Capital. revenue	Government revenue	Government expenditure
1	0.0	0.0	-2.6	-3.2
3	-1.4	-0.4	-3.5	-4.2
5	-1.6	-0.5	-3.7	-4.3

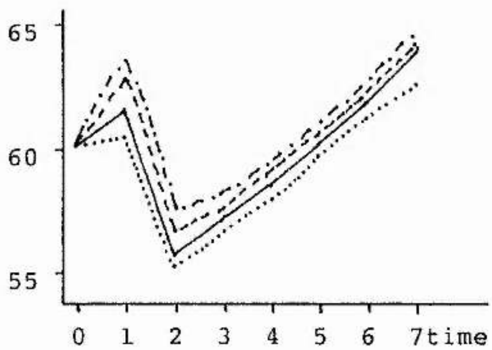
In the longer run, indirect taxes decrease due to a lower economic activity. This is the foremost reason for an ever lower government revenue.

While the fiscal impact of a change in trade policy is significant, it can be observed from the table that the impact on the government budget is not so strong. This is primarily due to the strong dependence of government expenditure on government revenue. The effect of a change in trade policy in the short run on government revenue is always re-inforced in the longer run. This is due to the important role played by government services. An increase in government revenue has an immediate impact on government demand. The consequences of this higher demand are clear : immediate spill-over effects to other sectors due to intermediate demand, more government employment, a higher wage bill and higher private consumption. These effects accumulate each year and play an important role in the determination of total value added.

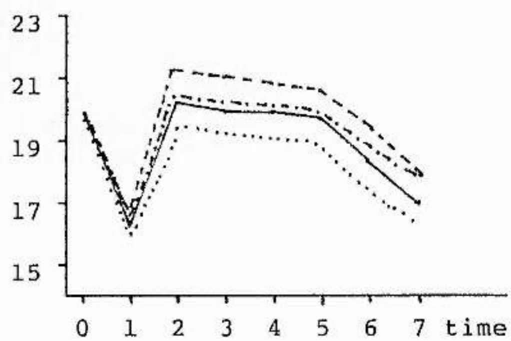
c. Income distribution :

A change in trade policy in one or the other direction is undertaken in the light of their anticipated static and dynamic beneficial effects. In the Kenya model the dynamic forces find their source mostly in income re-distribution and investment.

As can be seen from graphs 5.1, 5.2 and 5.3 the evolution of the distribution of income among socio-economic groups is parallel for the four different policies. Household revenue is higher at the end of the period while capitalists' revenue is lower. Government revenue is most affected due to the incidence of import tariffs, export subsidies and indirect taxes.

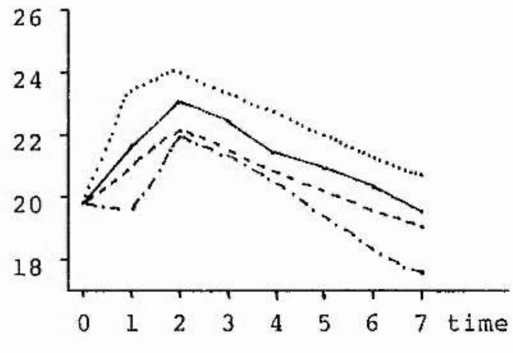


Graph 5.1 Household revenue



Graph 5.2 Capitalists revenue

——— : Base run
.... : Import Substitution
---- : Export Promotion
-.-. : Trade Liberalization



Graph 5.3 Government revenue

Table 5.4. gives the re-distribution of income among groups. The table can be read as follows. In the first year of an IS policy, government income increased by 1.60 % of total income. The two

other sectors loose income : the households loose 1.26 % and capitalists 0.34 %.

The opposite evolution is observed for an EP policy : a loss of 0.80 % for the government and a gain of 0.63 % for households and 0.17 % for capitalists. In the longer run the picture is not very different. The government continues to gain income from households and capitalists with an IS policy and looses with an EP policy.

Table 5.4 Absolute differences in importance in total revenue from base run

Year		Household revenue	Capitalists revenue	Government revenue
IS	1	-1.26	-0.34	1.60
	5	-0.45	-0.69	1.13
	8	-0.88	-0.60	1.48
EP	1	0.63	0.17	-0.80
	5	0.24	0.49	-0.73
	8	0.25	0.32	-0.57
ATL	1	2.16	-0.17	-2.00
	5	0.80	0.24	-1.05
	8	1.72	0.53	-2.25

The magnitude of changes is slightly different. While the income re-distribution is great in the first year, it becomes less after 5 years. Another observation is that a trade liberalization policy leads to a big decrease in government income even when the indirect taxes are increased by 30 %. This increase does notseem to be enough to compensate for the loss of import duties (see table 5.5).

Table 5.5. Government revenue with an adjusted trade liberalization policy.

Year	Loss in import duties	Gain in indirect taxes
1	144.2	59.4
3	128.2	64.7
5	156.9	67.1
7	239.1	63.7

These results areconsistent with a recent study (2) on India, Kenya and Turkey. The authors found an increase in the share of households and capitalists income in total income following a liberal policy (a 10 % decrease in import tariffs). While the three countries differ considerably, results are not different concerning income re-distribution.

Our study is not able to determine income re-distribution within the households revenue. Kim and Turrubiate (3) have shown that for Mexico 'expansion of export is a greater equalizer of income than any other strategy', certainly in the short run. In other words, an import substituting policy may not only lead to a decrease in households income but also to an increase in incomes inequality. This, of course, is an important social factor to consider.

d. Structure of the economy

The Kenyan economy can be divided into four major sectors :
- the agricultural sector with 32 % of GDP in 1980,
- the manufacturing sector, 13 % of GDP,
- the government services sector, 16 % of GDP and
- the private services sector, 29 % of GDP.
(The other sectors -10 % of GDP- will be disregarded now)

The great sensitivity of government income to a change in trade policy and the relation between government income and governent expenditure observed earlier, explain why the importance of government services sector in GDP change most.

Table 5.6. Absolute differences in importance of the economy in GDP and employment from the base run in 1988

		IS	EP	ATL
GDP	Agric.+ Mining	-1.42	0.64	2.92
	Manufacturing	0.01	0.28	-0.92
	Government Ser.	1.34	-0.69	-2.15
	Priv. Services	0.32	-0.34	-0.46
Employment	Agric.+ Mining	-1.43	0.71	3.10
	Manufacturing	-0.29	0.45	-0.32
	Government Ser.	2.24	-1.17	-3.79
	Private Servic.	-0.51	0.01	1.01

Table 5.6 presents the differences in importance of the four sectors with the base run in the last simulation year.

One can see that these differences are similar for GDP and employment, except for the sector Private services. Employment in the Government services sector is very sensitive to changes in GDP in this sector. The effect of a change in GDP on employment in the Government services sectors is always superior to the change in GDP itself. This is also true to a lesser extent for the sector Agriculture and Mining.

The direction of the changes is as the expected. Liberalizing policies increase the importance of agriculture and mining while an import substituting policy favours the services sectors. Important to observe are the minor changes in the manufacturing sector for GDP and employment with every policy. It would be interesting to see if this change in the manufacturing sector as a whole does not cover more important changes within the manufacturing sector. Indeed one of the preoccupations of trade policy makers is fear of important structural changes within the economy and more especially within the manufacturing sector. Table 5.7. shows this picture for the 14 manufacturing sectors.

Table 5.7 Difference (in %) from base run in the structure of the manufacturing sector in total GDP in 1988

	IS	EP	ATL
4. Food preparations	-0.56	-2.65	7.54
5. Bakery products	-1.50	-1.50	13.53
6. Beverages and tobacco	-1.12	-2.32	12.01
8. Textiles	0.91	-0.30	-23.17
9. Clothes	-0.38	-2.29	9.92
10. Footwear, leather	1.50	1.33	-24.42
11. Wood and furniture	1.22	-0.52	0.00
12. Paper and printing	0.52	-0.70	-0.35
13. Rubber	1.77	-3.25	-7.68
14. Petroleum products	-1.57	4.09	12.58
15. Chemical procucts	-0.39	1.30	-7.52
16. Non metallic mineral	0.61	7.06	2.25
17. Transport equipment	-0.55	-0.37	8.46
18. Metal products, etc.	-0.61	1.12	-7.34

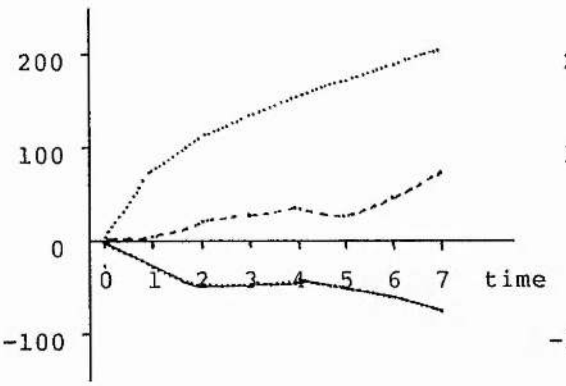
The greatest change in trade policy (an ATL policy) has the most important consequences within the manufacturing sector. As is expected, those industries closest to the primary sector (food preparations, bakery, beverages and tobacco and petroleum products) benefit most from a removal of trade barriers. Those sectors would decrease their importance with an increase of import tariffs. Those sectors that depend heavily on local manufacturing (textiles, footwear and leather) would suffer most from free trade because they can expect strong competition from outside, more efficient producers. It is important to note that while a free trade situation has important effects within the manufacturing industry, this is not the case for less radical policies. An IS policy for example shows hardly any changes at all. The fact that not one sector can increase its importance in a significant way might indicate that no support in the manufacturing sector is really needed or that the increase by 50 % is not great enough. If the former is true, one has to conclude that the benefits from an IS policy only come from an income re-distribution from households and capitalists to the government. One can ask if another policy specifically aimed at a re-distribution would not be better.

e. Trade balance

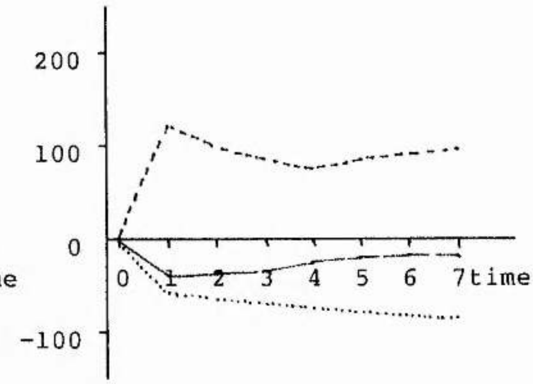
The immediate reason for a change in trade policy can be the situation of the current account. The impact, therefore, on the current account and on the balance of payments needs a closer look.

Graphs 5.4 and 5.5 show the incidence on exports and imports with the three different policies. An export promoting policy leads to an increase in exports and a fall in imports. Import substitution leads to a decrease of both imports and exports while a trade liberalization policy has the effect of increasing both. The magnitude of the changes can also be observed. With a trade liberalization policy, imports will increase more than exports so that the current account hardly can become better. An export promoting policy, on the other hand, favours the current account as clearly the difference between exports and imports increases.

Graph 5.4 Total exports



Graph 5.5 Total imports



—— : Import Substitution.... : Export Promotion ---- : Trade Liber

Considerable changes in the structure of exports occur. With a trade liberalization policy 75 % of all exported goods are primary and 25 % manufacturing in the last simulation year. Primary exports are only 66 % and 62 % of total exports for an import substituting and export promoting policy respectively. This clearly indicates that Kenya has comparative advantage in producing primary products. Every turn away from a free trade situation distorts of this comparative advantage. The importance of this distortion can be measured by comparing the 75 % in free trade situation with 68.0 % obtained in the base run. In other words, Kenya exports 7 % points (32 % - 25 %) too much of its exports of manufacturing goods than it would do if it abolished its import tariffs and export subsidies.

Table 5.8 shows the evolution of the current account for manufactured goods. As was observed earlier for total exports, an import substituting policy does not alter the current account in a significant way. This is different for the other two policies. An export promoting policy leads to a much better current account. Most of this result is achieved after four years and certainly after six years. The opposite is true for a trade liberalization policy. The deficit, already existant in the base run, is strongly re-inforced. These results lead to a very important point on the assumption of an unlimited supply of foreign exchange.

Table 5.8. Accumulated difference between exports and imports of manufactured goods.

Year	Base Run	IS	EP	ATL
1 and 2	-325	-291	-62	-569
3 and 4	-198	-176	130	-436
5 and 6	-354	-327	38	-625
7 and 8	-850	-816	-411	-1147
Accumulated	-1727	-1610	-305	-2777

A number of LDC's suffer from a shortage of foreign exchange. A policy aimed at an increase of exports can be followed with the idea in mind that the revenue of exports can be used to finance development programs. A situation of a strong deficit in the current account is very undesirable for these countries. While Kenya is not a country where this need is much felt, it certainly cannot escape looking carefully at the consequences on foreign exchange of a change in trade policy.

The last line of table 5.8 gives the accumulated deficit for the four policies. The foreign exchange needed to finance the deficit is 1400 Million Kenyan pounds lower with an export promoting policy and 1000 Million Kenyan pounds higher for a trade liberalization policy. It is clear that if the foreign exchange availability is a constraint on the evolution of the economy, an EP policy will make it possible not to depend too much on them. Another implication of the assumption of unlimited supply of foreign exchange not taken into account by the model is the ever increasing dependency of foreign exchange. Import rationing in order to allocate the foreign exchange in the most efficient way, a common practise among LDC's, is out of the question with this assumption. A final consequence is the increase of foreign exchange. This has the effect of of the stock of moneybeing uncontrolable so that a fight against inflation becomes more difficult.

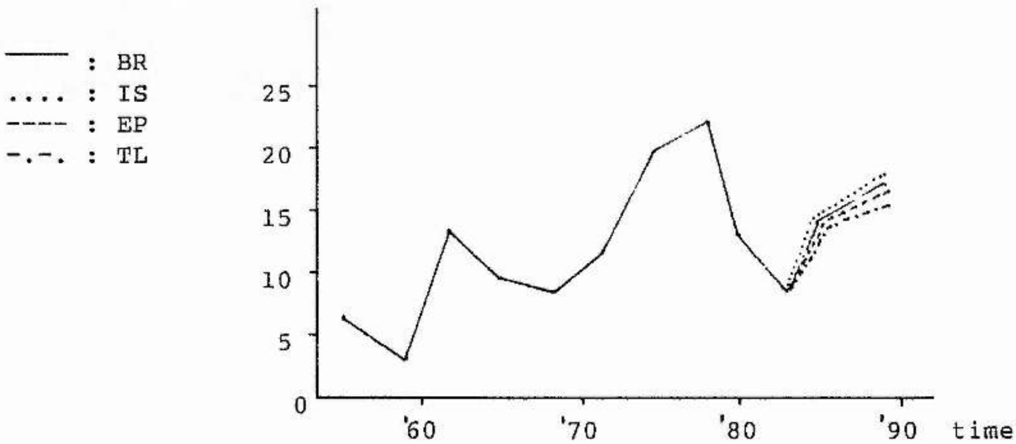
f. Macro-economic results

It must be clear from the start that the model described is not a prevision model but "only" a simulation model in the sense that it will never predict results but can only be used to compare results between the base run and simulations. Moreover, the model is not a macro-economic model but a model that tries to capture structural changes in the importance of different sectors and income groups. It is, therefore, only for the sake of interest that one can look at the macro-economic results from the Kenya model.

Implications of government policies on the global economy should be studied with great care. Traditionally these implications have been analyzed looking at various macro- economic aggregates as GDP, exports, investment, consumption, etc. In theoretical studies and recently also in some empirical models (4), one tries to find the welfare implications of alternative policies. Because of insufficient detail in the modelling, we are obliged to continue in the traditional way. The model is indeed not able to find real income and consumption by small segments of consumers in the economy. And this is essential to calculate welfare implications in a way that is of interest to us.

Graph 5.6 gives the growth rates of nominal gross domestic product for a longer time period.

Graph 5.6



It is clear that growth rates differ according to different policies. The differences, however, are not very important. Table 5.8 indicates that growth rates are superior with an import substituting policy and inferior with an export promoting or trade liberalizing policy.

It is interesting to see that the differences in growth rates are smaller in the third and fourth year of simulation than in the first and second year. The shocks of a policy change being absorbed seems to be thereason. After the fourth year, however, differences increase again, except for an export promoting policy where the difference becomes minimal.

Three sub-periods seem to emerge. The first period being the first two years where the change of the policy is strongly felt. The second sub-period shows a movement towards equilibrium (third and fourth year) while the last sub-period (after the fourth year) indicates an evolution away from equilibrium.

Table 5.9. Absolute differences in average growth rates from base run in GDP

Year	IS	EP	ATL
1 and 2	1.03	-0.45	-1.28
3 and 4	0.34	-0.27	-0.54
5 and 6	0.34	-0.18	-0.87
7 and 8	0.46	-0.07	-1.30

This last observation is consistent with Bruton's findings (5) for import substituting policies. These policies do not only lead to a distortion of the economy in the short run but alsoshow that the distortions do not correct themselves in the longer run.

Buffie (6) has studied the macro-economic effects of trade liberalization, limiting himself to the short run effects. His findings are similar to the ones obtained here : 'Liberalization may have a significant contractionary impact on the level of economic activity'. He also points out that this is the observation of the actual evolution in a number of less developed countries and the reason why some liberalization programs have collapsed.

This general picture is confirmed for the three most important demand components, consumption, investment and exports. The case of export promotion is very interesting. In the first place, the distinction between the three sub-periods does not make sense. The third period does not exist since a continuing movement towards equilibrium is observed. Second, the dynamic effects of an export promoting policy emerge in the seventh and eighth year of the simulation. In other words, the effects of efficiency that would arise after a certain time are observed from the results of the model but they remain low.

Table 5.10 Absolute differences in average growth rates from base run in demand components

	Years	IS	EP	ATL
Consumption	1 and 2	1.86	-1.14	-2.54
	3 and 4	0.45	-0.54	-0.35
	5 and 6	0.43	-0.19	-1.23
	7 and 8	0.58	0.10	-1.97
Investment	1 and 2	2.92	-1.70	-4.15
	3 and 4	0.35	-0.43	-0.18
	5 and 6	0.53	-0.22	-1.38
	7 and 8	0.85	0.08	-2.48
Exports	1 and 2	-3.27	11.39	1.84
	3 and 4	0.49	-0.26	0.72
	5 and 6	-0.22	-0.86	0.20
	7 and 8	-1.16	0.36	2.53

Another interesting point is the evolution of exports with an import substitution policy. As was described in chapter 3, it is not impossible that an import substitution policy leads to an increase in exports. This is clearly what happens in the second sub-period. The increase in exports is not great enough, however, to hold on for the future so they decrease again from the fifth period onwards.

Table 5.11. Absolute differences in average growth rates of employment from base run

		IS	EP	ATL
Employment	1 and 2	2.34	-1.31	-2.73
	3 and 4	0.45	-0.40	-0.66
	5 and 6	0.51	-0.23	-1.59
	7 and 8	0.71	-1.63	-2.24
1981-88	Production	0.7	-0.5	-1.6
	Labour procutiv.	-1.1	0.4	2.6
	Employment	1.1	-0.5	-2.2

The picture of employment is the same as that found before. This is no surprise since employment and production are strongly linked. One can wonder if the employment situation is the outcome of production alone or if labour productivity is an added factor. From table 5.11, it is observed that the greatest labour productivity takes place with a trade liberalization policy, so that it is no wonder that employment decreases most with this policy.

In a recent article, Nishimizu and Robinson (7) study the possible links between trade policies and productivity growth. A first link might be the argument that opening up the market through liberalizing trade policies will lead to productivity growth and increasing growth rates. No empirical support can be found in their study for this argument, an argument which is better know as Verdoorn's Law. A second argument is that international competition will lead to higher domestic efficiency and higher productivity growth rates through a "challenge - response" mechanism. The authors warn of the possibility of overstatement of this argument. Import substitution to protect the infant industry is only meant for high cost industries which cannot compete with imports until they become internationally competitive. On the other hand, export promoting policies may distort incentives and so lead to inefficiency. A final argument is that liberalizing policies lead to higher productivity growth rates because certain imports for intermediate inputs and capital goods cannot be produced domestically. Making them available, possibly at a lower cost, will reduce costs and increase productivity. The general conclusion of their empirical research is that import substituting policies seem to be negatively correlated with productivity changes while the opposite is true for export promoting policies.

It can be seen that the results of table 5.11 support the conclusions of Nishimizu and Robinson : labour productivity increases most with liberalizing policies and least with an import substituting policy.

5.2. Existing ERP calculations and a trade liberalization simulation

a. A priori considerations

Four studies calculating effective rates of protection for the Kenyan economy have been carried out in the past. However, they differ to a large extent in their methodology.

Reimer's study(8) takes most of its data from the input-output tables of 1967 so that it also relates its calculations to that year. Regarding non-traded goods, he made calculations with the Balassa and the Scott-method. Phelps and Wasow (9) used unpublished sales returns for firms employing more than 50 people in their study and is in that way different from the Reimer study. Data are for 1968 and the Balassa-method is followed. MacRae(10) carried out his study in 1971 on a firm level so that all data are submitted by firms. The way he tackles non-traded goods is close tothat of the Corden-method. Finally, Low(11) calculates ERP's and DRC's on a very disaggregated way (industry or product level) with mostly unpublished data andhas in his way made the study incomparable with the other studies.

Prior to regarding the results, it is useful to compare theoretically the ERP's of the above studies with those the Kenya general equilibrium model would obtain. Results will differ for two reasons, first, the ERP- calculations are not up-to-date and second, results are obtained by a different method.

Even if the methods of calculation were the same, the outcome would be different because of the different time horizon. This is due to the fact that the variables used in ERP-calculations change over the years. More particularly a change in trade policy in Kenya is observed (12). This results in a change in the average nominal rate of protection as well as in the structure of the nominal rates of protection. Equally, the average terms of trade and the structure of these terms of trade changes over the years. The most obvious change occurs in the structure of value added and in the change of the input-output coefficients. All these effects must result in important differences among ERP's obtained for different time periods.

Ithas been explained in chapter 2 how a general equilibrium model tries to obtain not only a ranking of industries according to their comparative advantage but also an assesment of quantitative effects of certain policies. The differences in the way static and dynamic qualitative effects of trade policy changes are generated in the partial and general equilibrium models for Kenya will be highlighted now.

Partial and general equilibrium models differ in the way and in the number of static and dynamic effects they consider. The differences between the static effects generated in the partial and general equilibrium model are due to the feedback effects of prices considered in a general equilibrium model.

The result of improving the Kenyan terms of trade (increase of import tariffs or decrease of export subsidies) is a substitution of foreign goods for domestic produced goods. This is clearly the effect partial equilibrium models try to capture.

However, the increase of the import price or decrease in the domestic export price will not only have a direct substitution effect but also an indirect feedback effect. In the case of an increase of the import price the domestic price will increase and so also will the domestic export price in foreign currency. This leads to a fall in exports. The net result of the increase in import tariffs on domestic production is lower than initially thought due to the off-set by exports.

A decrease of export subsidies leads to a fall in exports but also to a fall in the domestic price. Foreign goods become relatively more expensive so that the volume of imports falls. In this case the off-set is due to imports. It also must be stressed that the final terms of trade are in both cases lower than was calculated in a partial equilibrium model. Partial equilibrium models try to take a 'picture' of the existing economic reality at a specific period of time. The importance of the time period in comparing results has already been stressed.

Dynamic effects are, however, omnipresent in the economy and an attempt has been made to capture them by endogenizing structural changes in the economy. Dynamic effects are formed by the links between different periods in the simulation model. More particularly in the Kenya model, investment is calculated in period t on the basis of total investment and sectoral investment shares to serve in period t+1.

A general equilibrium model has numerous interactions. We will look at three among them where a change of trade policy has an effect on sectoral investment.

A change in trade protection has an impact on government revenue through changes in the revenue from import duties and export subsidies. Total revenue will increase or decrease so that total investment will also change.

A second effect is an income distribution effect. Because of the change in total and government revenue, the shares of the revenues of the three socio-economic groups will also change. With the savings rate fixed but different for each of these groups, total investment will probably also change due to this effect.

While these first two effects may have a change in total investment as a result, the third effect has an influence on the sectoral investment shares. As we have seen from the static effects, trade policy has an impact on domestic prices. Due to this effect, demand and supply are influenced. As a consequence, sectoral value added and wage-bills will change. These factors influence profit rates and in this way sectoral investment shares.

These three effects influence sectoral investment and also value added through changes in capital or net incremental capital output ratios.

b. Partial and general equilibrium results

The market will be free of any market distortion caused by trade policy if import tariffs and export subsidies are completely abolished. It is, however, very unlikely that such a dramatic change of trade policy will occur in Kenya. Our main interest in a free trade simulation lies in the fact that a ranking of comparative advantage can be obtained if the results of the simulation are compared with those obtained in the base run. What has to be compared in particular is the change in importance in value added of the manufacturing sectors. These results are given in table 5.12.

The percentage change in importance compared to the base run is given in the last column. For example, the sector 'Manufacturing of bakery products, chocolates and sweets' will increase its importance with 6.02 % if import tariffs and export subsidies are completely abolished.

Table 5.12. Ranking of comparative advantage

5	Bakery products, chocolates and sweets	6.02
14	Petroleum and petroleum products	5.35
6	Beverages and tobacco	4.16
4	Food preparations	2.93
9	Clothes	2.29
17	Transport equipment	1.29
18	Metal products, machinery and misc.	1.12
15	Plastic, paint and other chemical prod.	0.65
12	Paper products and printing	-1.22
13	Rubber products	-2.36
11	Wood, cork and furniture	-2.60
8	Textiles	-3.66
10	Footwear, leather and fur products	-4.82
16	Non-metallic mineral products	-6.24

These results are compared with ERP-rankings in table 5.13. Having argued above in which important ways calculation differs, it is not very surprising to observe very different results between ERP and GEM (General Equilibrium Model) calculations and among ERP-calculation.

Table 5.13. ERP and GEM-rankings compared (for numbers of sectors, see appendix 1)

Partial Equilibrium calculations (ERP)			GEM
Phelps-Wasow 1967	Reimer 1968	MacRae 1971	
10	12	5	5
16	9	12	6
6	4	9	4
9	18	11	9
11	8	6	18
15	6	4	15
4	16	16	12
12	11	10	11
8	15	8	8
18	10	18	10
5	5	15	16

Rankings are obtained from the existing studies. Assumptions on the weights of industries in sectors and on the representative nature of industries or firms for sectors must be made (this is clearly the case for MacRae who calculated ERP's on a firm level). The Reimer ranking is obtained as an average between the Balassa and the Scott-method. Results from these methods, however, did not differ significantly.

Not much can be said about these rankings. If the total manufacturing sector is divided into three groups,an attempt can be made at further explanation. The groups (13) are obtained in the following way :

1. Food-based industries : food preparations, bakery products, chocolates and sweets, beverages, tobacco

2. Labour-intensive industries : textiles, clothes, footwear, leather and fur products and wood, cork and furniture

3. Capital-intensive industries : rubber products, petroleum products, chemical industries, transport equipment, metal products and machinery

The sectors 12 (Paper and printing) and 16 (non-metallic mineral products) are excluded for it is not clear in which group they should be treated. If an index of 'suffering' is given to each industry according to their ranking (positive for 'suffering' and negative for 'gaining'), the following result is obtained :

Table 5.14. Index of 'suffering' in ERP and GEM-studies

	Phelps-W 1967	Reimer 1968	MacRae 1971	GEM
Food Based	-3	-2	6	13
Labour Intensive	5	-1	0	-13
Capital Intensive	-4	1	-8.5	2

If the MacRae result for capital intensive goods is left out (MacRae did not consider the sector of transport equipment which suffered from the protection system), a clear evolution is obtained. While the food based industries and the capital intensive industries first benefited from the existing protection system in the sixties, they do not any more. Food based industries would certainly benefit most from a trade liberalization policy. The opposite is observed for the labour intensive industries : they suffered from the system during the sixties and benefit from it now. Another observation is that the polarization has become more pronounced in recent years. The government action for capital intensive industries is not pronounced in either one way or the other.

The strength of the model is based on industry-specific characteristics of the Kenyan economy. Different sectors will react differently on certain policies. This has become clear when considering the effects of a trade liberalization policy. Bruton (14) and many others have repeatedly said that trade policy should differ according to industries, firms and even plants. For this reason, an industry-specific trade policy is simulated. Two considerations determine in which way import tariffs and export subsidies should change :

1. Bruton has emphasised that a trade policy should try to encourage those activities in which the country has a comparative advantage. Translated for Kenya this means that the agricultural based manufacturing industries (sectors 4, 5 and 6) should be encouraged to enlarge their markets.

2. In chapter 3 it is argued that IS and EP policies are inter-related so it is not contradictory to increase import tariffs and export subsidies at the same time. This is what is done for sectors 4, 5 and 6, while the other manufacturing sectors have decreased their import tariffs and export subsidies.

The main results of this simulation are given in table 5. 14.

It can be observed thatthe three 'protected' sectors increased their the importance in value added This is especially so in the longer run. The increase of these sectors, however, is not important enough to lead to an overall increase of the manufacturing sector. The importance decreases for the manufacturing and agricultural sector while the government sector increases in importance. This picture is similar to the one observed with an import substituting policy. This is equally true for income distribution : households and capitalists transfer income towards the government.An important observation is that the overall growth rates of GDP and employment are superior with the industry specific trade policy after 3 years of implementation but not any longer after 7 years. Differences remain, however, very small.

Table 5.15 Absolute differences in growth rates from base run following an industry specific policy

1. Importance of sector in GDP		4	5	6
year 3		0.46	0.77	1.02
year 7		4.31	5.77	6.69
2. Importance in revenue		Hous	Capit	Gover
year 3		-0.36	-1.48	1.83
year 7		-0.66	-1.22	1.88
3. Importance main sectors	Agric	Manuf	Gov.S	Priv S
year 3	-0.78	-0.34	1.36	-0.01
year 7	-0.83	-0.78	1.43	0.33
4. GDP and employment		GDP	Employ	
year 3		0.40	0.80	
year 7		-0.06	-0.08	

5.3. Sensitivity analysis : the agricultural sector :

The sector of agriculture is by far the most important in the model : one third of total GDP in 1976. In order to study the possible effects of dividing the agricultural sector in more than one sub-sector, a sensitivity analysis has been carried out.

Two options are open. The agricultural sector can be divided into sub-sectors by crop or it can be divided into what can be called small and large farms. The second option is chosen because a division in sectors by crop makes the model highly complicated and would require a change in all the technical coefficients for the input-output table and for the regressions. A division into small and large farmsmakes it possible to keep a lot of technical coefficients while changing the most important ones.

Data are very di:ficult to find so it is necessary to make them up with a priori ideas about this part of the market. Small agricultural farms have a number of characteristics from the traditional economy that large farms do not have. Looking at the characteristics gives a view of the most important factors of the division; the terms 'small' and 'large' farms are only helpful in doing this.

Table 5.16. Assumptions on small and large agricultural farms

	one sector	small farms	large farms
1. Wage	217.3	145	362
Employment	186.641	124.4	62.241
W.L	40,557	18,038	22,519
2. Value added	688,130	364,700	323,421
Output	784,468	382,944	401,524
Labour Productivity	3.69	2.93	5.20
Output/Value added	1.14	1.05	1.24
3. Investment	24,977	3,647	21,330
4. Consumption	367,810	248,520	119,290

- Small farms have proportionally less labour costs than large farms.
- A lot of employment in small farms is unrecorded so the actual labour productivity will most likely be lower than in large farms.
- The sector of small agricultural farms is for the most part self-sufficient : input in the seAEH,GGGG
- The investment in

proportionally lower than the sector of large farms agriculture.
- Exports of and imports in the small farms are low, consumption is the most important demand component.

The purpose of this study is to analyze the sensitivity of the model to changes as described. In order to do so, a new model that incorporates the new assumptions has been built. The results of this model for the base run are described and compared in the following tables.

Table 5.17. Results for the agricultural sector from both models

	Model with 1 agricul. sector	Model with 2 agricul.sectors
GDP	2052	2035
Employment	556	551
Output	2331	2223
Exports	762	756
Imports	0	0
Consumption	1165	1108

It is clear that the results from the two models are very similar. The hypothesis that results are different cannot be accepted at a 95 % confidence interval. The same picture is observed for the results of the economy as a whole.

Table 5.18. Macro-economic results from both models.

	Model with 1 agricul. sector	Model with 2 agricul.sectors
GDP	5494	5291
Employment	2777	2629
Exports	1268	1249
Imports	1179	1085
Consumption	3429	3275

Table 5.17 presents the results for the agricultural sector obtained for the two models for the last simulation year.

Table 5.19. Structural results from both models in 1988

	Model 1	Model 2	(2 - 1)
Revenue: -Households	65.67	65.41	-0.26
-Capitalists	15.47	15.76	0.30
-Government	18.87	18.83	-0.04
GDP: -Agric.+ Mining	39.73	40.64	0.91
-Manufacturing	11.72	11.44	-0.28
-Govern. Services	13.23	12.96	-0.27
-Priv. Services	22.91	22.14	-0.77
-Others	12.41	12.82	0.41

The model with only 1 agricultural sector underestimates capitalists' revenue and overestimates households' and government revenue. But all these differences remain veryslight and one has to conclude that a disaggregation of the agricultural sector, in the way it is done, will not significantly alter the results obtained from the main model. This is a reassuring conclusion since one of the weaknesses of the modelling exercise is certainly the simple treatment of the important agricultural sector.

5.4. Shortcomings of the model

It is felt that the model is particularly weak in six different areas. Some of them are concerned with modelling, others with theory or data.

Right from the start, the data constrainthas been omnipresent. Estimating parameters in functions with several dependent variables with a sample of only nine is simply impossible. It is helpful that the quality and the number of data increases with time. In 1986 , it will be possible to carry out regressions with 13 or 14 data, with new Input-Output tables and an up-to-date Social Accounting Matrix.

A problem partly related to the data, is the unsatisfactory way the Agricultural sector is modelled. This sector is responsible for one third of total GDP andyet is still considered as one. A simple sensitivity study on the agricultural sector, however,has led to the conclusion that the results obtained from a model with two different parts of the agricultural sector do not differ significantly from the main model. Additional disaggregation will not alter the results in a significant way.

It is felt that more research on the Kenyan labour-market is needed. In explaining the wage by sector, it is probably labour productivity which is the most significant independent variable, and it is used in the model. It would be, however, very rewarding to build yearly wage matrices with sector and occupation on the axes. In explaining wages by occupation, not only demand but also supply factors will become important. With some important assumptions in mind, one should be able to calculate labour supply for particular occupations from education statistics.

Simulations have always been carried out with the assumption in mind that foreign exchange is always available. While this hypothesis is perhaps tenable in the short run, it is more difficult to keep in the longer run and certainly in simulations that have a deterioration in the current account as a consequence. It is necessary, therefore , to incorporate a foreign exchange constraint in the model. The consequences of not doing so are described in point 5.2.e.

The importance of the way the model is macro-economically closed is accepted among theorists but the links between an essentially micro-economic model and macro-economic aggregates remains vague. In including the monetary- financial market with an endogenous determined interest rate, the modelling of investment would also be preferable. The contribution of Bourguignon et al.(15) showed that increasing the importance of the macro-economic part in the model would also lead to less short-run rigidities inherent to every medium-term model.

While the model captures all important short run effects that are described in theory, this is not the case for all longer run impacts. This leads to the question of modelling the dynamic effects of trade policies in an economy-wide model. It is felt that more research is needed on the actual effects of the opening or closing of frontiers ; in particular, the size of the market and the possibilities of continuing to substitute imports have not been taken into account.

The Kenya model is necessarily a simplified representation of the Kenyan economy, just as is every economic model. It is thus never perfect. In building the model and using it for simulations, particular weaknesses have becomeobvious and it is our hope that these will not be present in future Kenya models.

5.5. Conclusions

The main aim of this study has been to build a multi-sectoral economy wide model within a price consistent framework for a developing economy. Particular attention has been given to the relation between trade barriers and detailed economic performances. Simulating changes in these trade barriers enabled us to analyze the possible effects in trade policy. The major results can be summarized as follows.

The total economy can be divided according to economic activity in a primary, manufacturing and services sector. A change in trade policy, through changes in relative prices, leads to differences in importance of the three sub-sectors. Liberalizing trade leads to a heavier reliance on the primary sector and a diminishing importance for the services sector. A policy that protects more the domestic production leads to an opposite conclusion : decreasing importance of agriculture and mining and an increasing importance of the services sector. A policy that promotes export through higher export subsidies leads to a rise in the importance of both the agricultural and manufacturing sector while the importance of the services sector is decrease.

While the manufacturing sector as a whole does not have its importance changed significantly whatever the policy, this is not any longer so within the manufacturing sector. A trade liberalization increases the importance of the food-based industries while the labour-intensive industries decrease in importance. These changes are relatively important compared to changes following import substituting or export promoting policies. This is perhaps so because industries are already heavily protected so that one more increase does not any more affect the structure within the manufacturing sector.

The economy can also be divided into socio-economic groups. In this way three groups are obtained : households, capitalists and the government. Given the heavy reliance of households on agriculture and the links between government revenue and expenditure, the impact of a change in trade policy is parallel to that which is obtained for the structure of the economy. An abolition of import tariffs and use of export subsidies leads to an income re-distribution from the government to households and capitalists. An import substituting policy, on the other hand, leads to an increase in importance of government revenue, coming from households and capitalists.

While the Kenya model is designed to reveal the outcome of structural changes following trade policies, one can also look at the macroeconomic impacts of various policies. The nominal growth rates of GDP and different demand components following the simulations indicate that a trade liberalization policy leads to lower growth rates than the base run. The opposite is true for an import substituting policy. Export promotion has lower growth rates than the base run in the short run while differences disappear in the longer run.

A last conclusion concerns the contribution of calculations of effective rates of protection. While no calculations of resource pull effects for Kenya on the partial and general equilibrium models are compared for the same period, one can draw some conclusions from what is described above. From studies comparing partial and general equilibrium results, one finds that the ranking or qualitative prediction of partial equilibrium models usually is the same as that obtained for general equilibrium models. From what has been observed in this chapter, we can say that ERP-rankings are 'in line' with GEM-rankings. Ithas also been observed that individual positions of particular sectors are difficult to compare, which is not the case when the total manufacturing sector is divided in three sub-sectors. From this, it must be concluded that the aggregation considerations formulated by econometricians have a strong basis of truth in them.

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(13) Note that the names labour and capital intensive do not need necessarily reflect the reality, they are only chosen to group industries together with similar characteristics.

(14) BRUTON, ibid.

(15) BOURGUIGNON, F., G. MICHEL, D. MIQUEU, 'Short-run rigidities and long-run adjustments in a computable general equilibrium model of income distribution and development', Journal of Development Economics', 1983, p. 21-43

Appendix 1 : Statistical data and sector definition :

1. Adjustments to the Input - Output table :

The Central Bureau of Statistics of Kenya published the Input - Output tables for 1976 in October 1979 with 37 sectors. Two adjustments are made before the total dimension table is used.

First, the I.O.-table is reduced from 37 sectors to 33 sectors by making one sector out of two in four cases :

1. Manufacturing of textile raw-materials, rope twine and textiles is taken together in sector 8 : Manufacturing of textiles.
2. Manufacturing of plastic, paint, detergent soap and Manufacturing of other chemicals is taken together in sector 15 : Manufacturing of plastic, paint and other chemicals.
3. Electricity supply and Water supply is taken together in sector 20 : Water and electricity.
4. Transport services allied to transport and Communications is taken together in sector 29 : Transport and allied services.

Second, a further reduction to 31 sectors is carried out by spreading the last two sectors in the I.O.-table (i.e. Ownership of business premises and Unspecified (incl. hunting)) over all other sectors. This spreading out is conform to the existant magnitudes of the input- output coefficients of the (31 × 31) table.

2. Sectoral disaggregation

1. Agriculture
2. Fishing and forestry
3. Prospecting, mining and quarrying
4. Manufacturing of food preparations
5. Manufacturing of bakery products, chocolates and sweets
6. Manufacturing of beverages and tobacco
7. Ownership of dwellings
8. Manufacturing of textiles
9. Manufacturing of clothes
10. Manufacturing of footwear, leather and fur products
11. Manufacturing of wood and cork products and furniture
12. Manufacturing of paper and paperproducts, printing and publishing
13. Manufacturing of rubber products
14. Manufacturing of petroleum and petroleum products
15. Manufacturing of plastic, paint and other chemical products
16. Manufacturing of non-metallic mineral products
17. Manufacturing of transport equipment
18. Manufacturing of metal products, machinery and miscellaneous
19. Traditional economy
20. Water and electricity
21. Public administration and defence
22. Education
23. Health
24. Agricultural services
25. Government services Not Elsewhere Classified
26. Building and construction
27. Wholesale and retail trade
28. Hotels and restaurant services
29. Transport and allied services
30. Financial services
31. Services Not Elsewhere Classified

3. Sector definition and concordance table

SECTOR	ISIC CLASSIFICATION (1)	SITC CLASSIFICATION (2)
1	11-(1120+1130)	00, 04-(048), 05, 07, 22, 2
2	12, 13	03, 291
3	2	27, 28, 32, 34
4	311-(3117+3119), 312	01, 02, 08, 09, 4
5	3117, 3119	06, 048
6	313, 314	1
7		
8	3211, 3215, 3210	26, 65
9	3212, 3213, 3219, 3220	84
10	323, 324	21, 61, 83, 85
11	33	24, 63, 82
12	34	25, 64
13	355	62
14	353	33
15	351, 352, 356	5, 292
16	36	66
17	384, 9513	73
18	37, 38-(384), 39	67, 68, 69, 71, 72, 81, 86, 89, 9
19		
20	41, 42	
21	911, 9120, 9130	
22	9140	
23	9150	
24	1120, 1130, 1300, 9332	
25	9160, 9170	
26	5	
27	60, 61, 62	
28	63	
29	71,72	
30	8-(833)	
31	833, 93-(931+933), 94, 95-(9513), 96	

(1) UNITED NATIONS, Statistical Papers, Series M, Rev. 2
(2) UNITED NATIONS, Statistical Papers, Series M, Rev. 1

Appendix 2 : Regression results of the production and demand block

1. Statistical data :

1972 was an important year for the industrial production statistics in Kenya (1). In this year public authorities decided to change the coverage of the industry and to use a different classification.

Coverage was extended to all industrial establishments. Prior changes occured in 1970 (coverage for all industrial establishments with 50 or more persons plus a 25 % sample for establishments between 20 and 49 persons) and 1964 (coverage for all establishments with 50 persons or more).

The classificaition system remained the ISIC-system but a switch from 3-digit to 4-digit was decided.

Comparability between statistics before and after 1972 is not possible since industries consist of firms with less than 50 people while others consist mainly of firms with more than 50 people. The accuracy of the definition of each sector is also increased with the 4-digit sectoral classification.

For this reason, most of the estimations are done for the period 1972 till the most recent available statistics, i.e. 1980. This gives a sample of only 9 data. It has been tried not to decrease the degrees of freedom too much. This is done by keeping the number of explanatory variables as low as possible. As a consequence it is not always tried to bring the Durbin-Watson statistics to an acceptable level by incorporating new explanatory variables. On the other hand, first order autoregressive estimation was undertaken to overcome a positive or negative first order serial correlation.

2. Wage functions

The results of the regression of equation (4.2) are given in table A.1.

$$(WU_i)_t = \alpha_i + \beta_i.(XS_i/L_i)_{t+1} \qquad i=4,31 \qquad (4.2)$$

Data of wages and value added are in current prices.

Table A.1. Results for wage equations

	α_i	β_i	R^2	DW
4	296.64 (3.01)	0.0661 (2.59)	0.45	1.63
5	247.34 (21.3)	0.0859 (8.24)	0.91	2.30
6	377.63 (3.22)	0.1410 (5.00)	0.77	1.88
8	-55.89 (-0.3)	0.3190 (2.34)	0.39	2.40
9	52.000 (0.34)	0.6680 (1.80)	0.24	1.33
10	23.190 (3.14)	0.2400 (3.26)	0.58	1.00
11	85.130 (2.54)	0.2640 (5.92)	0.83	2.30
12	345.54 (6.22)	0.1940 (7.58)	0.89	2.29
13	441.39 (5.64)	0.0729 (3.69)	0.64	1.45
14	-386.8 (-0.4)	0.1180 (2.94)	0.52	1.38
15	-28.80 (-0.1)	0.3810 (2.81)	0.50	1.07
16	490.83 (0.87)	0.0863 (0.33)	-0.20	0.27
17	295.02 (3.59)	0.3370 (3.00)	0.53	1.69
18	-37.22 (-0.2)	0.2880 (4.12)	0.70	2.37

(table A.1. continued)

	α_i	β_i	R^2	DW
20	300.14 (3.45)	0.1170 (3.03)	0.54	1.18
21	-97.92 (-1.7)	0.5300 (11.9)	0.95	1.98
22	106.10 (1.69)	0.5200 (6.20)	0.84	1.74
23	-86.26 (-1.5)	0.9040 (10.8)	0.94	1.06
24	6.6180 (0.05)	0.8020 (5.52)	0.62	2.05
25	-207.6 (-1.7)	1.0880 (7.38)	0.88	1.59
26	148.22 (1.61)	0.2760 (3.33)	0.59	1.78
27	187.43 (2.68)	0.1710 (7.64)	0.89	1.89
28	139.41 (3.09)	0.1990 (6.48)	0.85	1.92
29	96.670 (1.46)	0.3570 (9.15)	0.92	1.41
30	367.22 (1.73)	0.2650 (3.23)	0.57	1.10
31	193.28 (1.44)	0.1230 (0.28)	-0.15	1.28

Regression method : Ordinary Least Squares
Regression period : 1972 - 1980
t-statistics in parentheses
R^2 : determination coefficient corrected for degrees of freedom
DW : Durbin-Watson test for first order autocorrelation
Data : Statistical Abstracts

3. Employment functions

The results of the regression of equations (4.4) and (4.5) are given in table A.2.

$$(L_i)_t = \alpha_i.(XS_i)_{t-1}.(1 + GXS_i) \qquad i=20,25 \qquad (4.4)$$

$$(L_i)_t = \alpha_i.(XS_i)_{t-1} \qquad i=3-26,31 \qquad (4.5)$$

Table A.2. Result for employment equations

	α_i	R^2	DW
3	0.7375 (6.72)	0.85	0.36
20	0.4099 (11.7)	0.94	0.29
21	0.9803 (13.5)	0.96	0.15
22	1.2562 (12.5)	0.95	0.17
23	1.3792 (12.7)	0.95	0.17
24	1.7588 (10.0)	0.93	0.25
25	1.1654 (15.4)	0.97	0.22
26	0.8340 (10.8)	0.94	0.51
27	0.3017 (10.1)	0.93	0.17
28	0.6428 (9.06)	0.91	0.22
29	0.5656 (10.5)	0.93	0.17
30	0.3622 (15.4)	0.97	0.20
31	3.1317 (15.6)	0.97	0.94

Regression method : Ordinary Least Squares
Regression period : 1972 - 1980
t-statistics in parentheses
R^2: determination coefficient corrected for d.f.
DW : Durbin-Watson test for first order autocorrellation
Data : Statistical Abstracts

4. Production functions

a. C.E.S. specification

Results of the regression of equations (4.10) and (4.11) are given in table A.3. The value added data are in 1972 prices. Since value added in constant prices on a disaggregated level and real wages are not published, a problem arises in finding a suitable deflator for both variables. Sector-specific price indices are not published for the period under consideration. The problem has been solved by calculating an implicit sector-specific price deflator, defined as follows :

$$PD_i = (VACrP_i/Q_i).100$$

$VACrP_i$: sectoral value added in current prices

Q_i : sectoral quantity index

The quantity indices are published in the Statistical Abstracts.

$$XS_i = 10^{\lambda t}\,[d_i.K_i^{-\rho_i} + (1-d_i).L_i^{-\rho_i}]^{-1/\rho_i} \qquad (4.11)$$

$$\ln (XS_i/L_i) = \alpha_i + \beta_i.\ln (W_i/P_i) + \lambda_i t$$

Table A.3. Results for the CES production functions

	λ_i	di	ρ_i	β_i	R^2	DW	K('80)
4	0.009	1.000	-9.333	-0.12	0.45	1.79	45478
5	-	1.000	2.390	0.30	0.69	1.65	41440
6	0.032	0.991	0.468	0.68	0.81	2.46	17508
8	-0.058	1.000	1.710	0.37	0.54	1.53	66073
9	-	0.863	0.302	0.77	0.92	1.67	4699
10	0.041	1.000	1.415	0.41	0.67	1.84	2913
11	-	1.000	1.415	0.41	0.22	2.00	12724
12	0.088	0.999	0.908	0.52	0.93	1.86	3609
13	-0.006	1.000	1.577	0.39	0.84	1.70	14341
14	0.018	1.000	3.464	0.22	0.93	2.02	6723
15	-	1.000	1.020	0.50	0.83	2.72	21194
16	-0.003	1.000	2.774	0.27	0.89	2.14	11920
17	0.018	0.996	0.623	1.00	0.96	2.10	10475
18	-	1.000	1.793	0.36	0.25	1.50	45224

Regression method : Ordinary Least Squares
Regression period : 1972 - 1980
t-statistics in parentheses
R^2 : determination coefficient corrected for d.f.
DW : Durbin-Watson test for first order autocorrelation
Data : Statistical Abstracts and see text

b. ICOR specification

Results of the regression of equations (4.12) and (4.13) are given in table A.5.

$$XS_i = (XS_i)_{t-1} + ICOR_n.(Y_i)_{t-1} \qquad i=2,7,26-31 \qquad (4.12)$$

$$XS_i = (XS_i)_{t-1} + ICOR_n.[(Y_i)_{t-1} + (Y_i)_{t-2}] \qquad i=3 \qquad (4.12)$$

To obtain value added and constant prices, current prices are deflated by a price-index, obtained in the same way as explained for the CES specification. The quantity indices are calculated from different statistics in the Statistical Abstracts.

Concerning the investment series, the National Accounts publish only data on fixed capital formation. Instead of making arbitrary assumptions on the sectoral investment composition (2), a different way is followed. Total investment can be calculated in the following way for the period 1971 - 1980 :

$$TINV = Sg.Rg + (Sh + Sc).(Rh + Rc)$$

Data on revenue and savings by socio-economic group are found in the Social Accounting Matrix - 1976 and in the IMF - International Financial Statistics :

$Sg = 21.35$ %
$Sh = 6.14$ %
$Sc = 26.70$ %

The disaggregation of the TINV-series will be done following the fixed capital formation disaggregation. Table A.4. gives the calculated investment-series.

Table A.4. Calculated investment by sector of destination

	3	7	26	27	28	29	30	31
1971	6.32	78.59	24.84	10.99	7.37	62.83	5.15	25.50
1972	4.35	75.73	32.46	19.59	4.23	90.65	5.28	39.73
1973	4.85	86.67	21.39	25.62	5.47	108.16	12.25	25.99
1974	12.47	120.94	22.68	34.65	7.47	146.72	13.88	20.85
1975	4.92	138.27	26.02	45.64	9.85	135.67	9.30	31.34
1976	5.39	132.97	38.20	43.49	9.33	195.89	10.87	42.53
1977	6.35	164.81	79.61	41.14	9.89	272.99	18.92	50.28
1978	13.05	189.97	64.59	35.76	7.75	255.79	20.81	79.96
1979	11.02	254.24	74.11	41.19	9.86	248.51	27.27	84.41

Table A.5. Results for ICOR-production functions

	$ICON_n$	R^2	DW
2	1.1950 (8.00)	0.90	–
3	0.1130 (2.57)	0.48	2.04
7	0.503 (6.65)	0.85	2.58
26	1.039 (5.46)	0.79	2.23
27	2.372 (3.80)	0.64	2.56
28	2.369 (4.09)	0.68	2.49
29	0.244 (6.70)	0.85	2.66
30	0.491 (5.57)	0.80	1.55
31	0.310 (2.16)	0.37	2.44

Regression method : Ordinary Least Squares
Regression period : 1972 - 1980
t-statistics in parentheses
R^2 : determination-coefficient corrected for d.f.
DW : Durbin-Watson test for first order autocorrelation
Data : Statistical Abstracts and see text

5. Consumption functions

a. Consumption data

While data on the production-side of the Kenyan economy exist on a detailed and a rather consistent way, this is is not the case for data on the demand-side.

Consumption data are an eternal problem for Kenya modellers. The National Accounts do not publish any disaggregated data on private or public consumption.

The only available statistics are budget surveys undertaken for a number of years. Urban and rural consumption are considered in separate studies.

Urban consumption data can be obtained from the 'Urban Food Purchasing Survey'(3), undertaken in 1977 with 488 respondents. Consumption is divided in 8 categories : food, housing, clothing, manufacturing, education, transport, services and others. Rural consumption data are published in the 'Integrated Rural Survey'(4) of 1974-75 with 1668 respondents. 7 categories of consumption are considered :home consumption, purchased food, clothing, manufacturing (durables), miscellaneous purchases (commodities), transport and other services.

It is clear that data on private consumption can only partly provide all that is needed for the purpose of the study : disaggregated data on consumption of manufacturing goods are really a necessity and the definition of the above mentioned categories is not the same for both surveys.

For these reasons, consumption data are calculated in a way the National Accounts should have done it. The basic material balance equation of the National Accounts statistics is used as a starting point (5) :

$$\Sigma_j a_{ji}.OUT_i + XS_i + M_i = E_i - \Sigma_j a_{ij}.OUT_j - z_i.OUT_i$$

CG_i : private and government consumption

Consumption can be derived from this equation. Fixed coefficients, obtained from the IO tables, are used in determining the amount of investment goods. The following equation is then obtained :

$$CG_i = \Sigma_j a_{ji}.OUT_i + XS_i + M_i - E_i - \Sigma_j a_{ij}.OUT_j - z_i.OUT_i$$

z_i : fixed investment goods coefficient

Finally, in calculating consumption in this way, it is implied that the price evolution is the same in all sectors. To see this, take the example of the Manufacturing of petroleum and petroleum products. This sector used a lot of unrefined oil as an input, coming from the sector Mining and Quarrying. The input - output coefficient is 0.860. This coefficient is based on the outputs and inputs in current prices for 1976 in these two sectors. Knowing that prices in the sector Mining and Quarrying increased much less than Manufacturing of petroleum (products) since 1976, output in current prices are evolued in a predictable direction.
To take this problem into account, the ratio of sectoral intermediate demand to sectoral consumption is assumed to be constant over the period 1972 - 1980.

These data are presented in table A.6.

Table A.6. Sectoral Consumption data (1972-1980)

YEAR	1	2	3	4	5	6	8	9
1972	142494	4319	129	21624	5335	32816	14842	22235
1973	139616	5701	149	31682	3714	34553	20243	23653
1974	136616	7162	396	41413	7596	45437	26949	32772
1975	178452	7313	506	46991	13090	55054	21427	35275
1976	251652	7014	552	87119	14100	68147	22431	40220
1977	381292	7674	580	143052	18948	151330	38851	43973
1978	336299	9773	540	115554	26788	110537	39633	43239
1979	323352	7663	677	123169	26698	123713	41427	47726
1980	416289	5936	983	134996	32226	146071	44806	38920

10	11	12	13	14	15	16	17	18
5452	5070	5529	2469	2904	16481	3513	9349	17100
5879	5873	5599	3907	3578	17791	3908	8818	20029
7774	8998	5944	6802	10502	36715	4859	13137	25671
9781	7991	5824	4449	10228	35917	5290	12995	24080
11131	9662	5811	5916	10955	37000	6183	15283	32251
12682	12427	5833	9035	10184	44437	6436	23922	46669
16136	16688	6184	15980	12061	55444	8241	46688	51443
15827	17714	6366	16737	16179	64248	8686	43365	33674
21641	15452	6422	22928	22182	88823	12970	48368	43352

b. Consumption functions

Results of the regression of equation (4.18) is given in table A.7..

$$C_i = \alpha_i + \beta_i.(Rh + Rc + Rg) \qquad (4.18)$$

Table A.7. Results for consumption functions

	α_i	β_i	R^2	DW
1		0.16800 (23.50)	0.90	1.70
2	5137.0 (4.05)	0.00136 (1.540)	0.15	1.17
3		0.000335 (14.56)	0.82	1.15
4		0.05670 (14.70)	0.88	1.17
5	-7571.0 (-4.63)	0.01580 (15.80)	0.97	2.68
6		0.05800 (14.90)	0.87	2.21
8		0.01930 (24.80)	0.91	1.58
9	1888.0 (4.00)	0.01160 (4.010)	0.65	1.15
10		0.00783 (33.78)	0.96	2.16
11		0.00726 (24.67)	0.91	1.96
12	5265.0 (41.2)	0.00045 (5.73)	0.80	1.59
13µ	-5584.0 (-2.11)	0.00115 (5.58)	0.81	1.58
14		0.00735 (13.23)	0.79	1.22

(table A.7. continued)

	α_i	β_i	R^2	DW
15		0.02970 (18.63)	0.90	1.15
16		0.00438 (20.68)	0.88	1.43
17μ	-1540.0 (-2.54)	0.02650 (7.100)	0.88	2.05
18		0.02080 (14.32)	0.73	1.24

Regression method : Ordinary Least Squares, except for sectors with a 'μ' where Maximum Likelihood is used t-
Regression period : 1972 - 1980
statistics in parentheses
R^2 : determination coefficient corrected for d.f.
DW : Durbin-Watson test for first order autocorrelation
Data : see text for calculation method.

6. Import functions :

Results of the regressions of equation (4.26) are given in table A.8..

$$\ln (M_i/Q_i) = \alpha_i + \beta_i . \ln (PDM_i/PM_i) \quad i=8,18 \qquad (4.26)$$

Table A.8. Result for the import functions

	α_i	β_i	R^2	DW
8	-7.103 (-7.85)	1.442 (6.74)	0.77	1.35
9	-7.131 (-13.7)	1.214 (10.2)	0.89	1.36
10	2.512 (-1.36)	1.214 (10.2)	0.15	2.39
11	-10.12 (-15.0)	1.666 (9.37)	0.87	1.32
12	-8.767 (-24.2)	1.710 (18.6)	0.96	1.63
13	-7.070 (-4.19)	1.288 (3.30)	0.43	1.05
14	-2.927 (-6.41)	0.471 (4.10)	0.55	2.11
15	-2.591 (-5.01)	0.491 (4.12)	0.55	2.35
16	-4.074 (-4.63)	0.499 (2.51)	0.29	1.43
17	-4.267 (-24.9)	0.854 (19.8)	0.97	1.29
18	-4.373 (-10.1)	0.835 (8.56)	0.85	1.51

Regression method : Ordinary Least Squares except for the sectors with a 'μ' which are estimated with the Maximum Likelihood Method.
Regression period : 1967 - 1980
t statistics in parentheses
R^2 : determination coefficient corrected with d.f.
DW : Durbin Watson test for first order autocorrellation
Data : - Annual Trade Report of Tanzania, Uganda and Kenya
- Annual Trade Report of Kenya
- Statistical Abstract

Domestic price indices are calculated in the same way as explained in the section on production functions. Import price indices are calculated in the following way :

$$PM_i = PM_{ai} \cdot (1 + tm_i) \qquad i=8,18$$

PM_{ai} : import price indices as they appear in the Statistical Abstracts.
tm_i : import duty

The most obvious way to calculate import tariff rates is the following :

$$tm_i = \Sigma_j M_{ij} . tm_{ij}$$

tm_{ij} can be found in different government publications (6).

A number of problems arise with this way of calculating.
First, the number of j's in tm_{ij} is usually high because tariffs are imposed in a very specific way. Sometimes even, the weight coefficient (the duty free import values) are not available on the same disaggregated levels as the import tariff for the period before 1975. Second, beside the import tariffs, different other import taxes have to be paid. For example for 1980, it is calculated that the real tariff is 34 % higher than the published one due to a number of supplementary taxes. Third, if tariff changes occur in the middle of a year, averages have to be calculated with weight coefficients that are not always available.

It is clear that a correct import tariff rate cannot be obtained in this way. For this reason, an ex post tariff rate is derived from the annual trade reports. Paid duties are published for every import category in the SITC-classification. In this way :

$$tm_i = \frac{\text{Duty paid on the import of i}}{\text{Duty free value of import of i}}$$

Imports in constant 1967 prices are obtained by dividing the import values in current prices by the import price indices. Aggregate domestic demand in constant 1967 prices are obtained by dividing imports in current prices by import price indices and output and exports by domestic price indices.

7. Export functions :

Results of the regression of equation (4.30) are given in table A.9..

$$E_i = \alpha_i + (DEP_i / WEP_i)^{\beta_i} \cdot \lambda_i \cdot WED_i \qquad (4.30)$$

World export prices and world export demand depend on fixed exogenous growth rates. The hypotheses concerning these rates are explained in chapter 4.

Table A.9. Results for the export functions

	α_i	β_i	R^2	DW
8	7286.0 (2.49)	0.0468 (0.85)	-0.03	1.69
9	77.610 (0.90)	0.0216 (5.04)	0.76	0.97
10	5292.0 (2.92)	0.2731 (2.58)	0.45	1.06
11	833.80 (2.25)	0.0498 (3.66)	0.58	0.52
12	1773.0 (2.02)	0.0621 (2.44)	0.36	0.93
13	76.960 (0.85)	0.0231 (2.66)	0.40	1.86
14	12770.0 (1.30)	1.3550 (7.59)	0.86	0.79
15	9956.0 (6.23)	0.0217 (1.73)	0.18	2.15
16	3824.0 (2.39)	0.1715 (3.48)	0.55	0.59
17	-507.5 (-2.6)	0.0087 (7.48)	0.86	1.54
18	2123.0 (1.21)	0.0278 (3.03)	0.48	0.65

Regression method : Ordinary Least Squares except for the sectors with a 'μ' which are estimated with Maximum Likelihood.

Regession period : 1972 - 1980

t-statistics in parentheses.

R^2 : determination coefficient corrected for d.f.

DW : Durbin Watson test for first order autocorrellation

Data : - Annual Trade Report of Tanzania, Uganda and Kenya
- Annual Trade Report of Kenya
- Statistical Abstract

Domestic export price indices are obtained in the following way :

$$DEP_i = DEP_{ia} \cdot (1 - te_i) \qquad i=8,18$$

DEP_{ia} : domestic export price indices as they are published in the Statistical Abstracts

te_i : export subsidy

Export subsidies are found in Kenya government publications (7). World export price indices are obtained in the following way :

$$WEP_i = PMW_i \cdot (1 + TC) \qquad i=8,18$$

PMW_i : world import price indices as obtained from the Statistical Abstracts

TC : transport costs indices as obtained from United Nations Statistical Bulletin.

Appendix 3 : List of equations and variables of the model

1. Production block

(1)	$(WR_i)_t = (WR_i)_{t-1}.(1 + GPD_i)$	i=1,3	(4.1)
(2)	$(WU_i)_t = \alpha_i + \beta_i.(XS_i/L_i)_{t-1}$	i=4,31	(4.2)
(3)	$(L_i)_t = (L_i)_{t-1}.(1 + GXS_i)_{t-1}$	i=1,18	(4.3)
(4)	$(L_i)_t = \alpha_i.(XS_i)_{t-1}.(1 + GXS_i)_{t-1}$	i=20,25	(4.4)
(5)	$(L_i)_t = \alpha_i.(XS_i)_t$	i=26,31	(4.5)
(6)	$(K_i)_t = (1 - d_i).(K_i)_{t-1} + (Y_i)$	i=4-18	(4.6)
(7)	$TINV = Sh.Rh + Sc.Rc + Sg.Rg$		(4.7)
(8)	$Y_i = \rho_i.\ TINV$	i=1,31	(4.8)
(9)	$\rho_i = \dfrac{(XS_i - W_i.L_i - td_i.\ OUT_i)/\ OUT_i}{\Sigma_i[(XS_i - W_i.L_i - td_i - OUT_i)/OUT_i]} \cdot \dfrac{(\rho_i)_{t+1}}{\Sigma(\rho_i)_{t-1}}$		(4.9)
(10)	$XS_i = [d_i K^{-\rho_i} + (1 - d_i)L_i^{-\rho_i}]^{\mu_i/\rho_i}$	i=5,9,11,15,18	(4.10)
(11)	$XS = 10^{\lambda t}[d_i K_i^{-\rho_i} + (1 - d_i)L_i^{-\rho_i}]^{-1/\rho_i}$	i=4,6,8,10,12,13,14,16,17	(4.11)
(12)	$(XS_i)_t = (XS_i)_{t-1} + ICOR_n.(Y_i)_{t-1}$	i=2,7,26-31	(4.12)

(13) $(XS_i)_t = (XS_i)_{t-1} + (ICOR_n) .[(Y_i)_{t-1} + (Y_i)_{t-2}]$ i=3 (4.13)

(14) $(XS_i)_t = (1 + GL_i). (XS_i)_{t-1}$ i=1,19 (4.14)

(15) $OUTCST_i = \alpha_i . XS_i$ i=1,31 (4.15)

(16) $OUT_i = XS_i. GDPD_i + \Sigma_j a_{ij}.OUTCST_j. GDPD_j$ i=1,31 (4.16)

2. Demand block

(17) $AD_i = C_i + V_i + I_i + (X_i - M_i)$ (4.17)

(18) $C_i = \alpha_i + \beta_i . (Rh + Rc + Rg)$ (4.18)

(19) $C_i = cc_i. (\Sigma_i C_i)$ i=20,31 (4.19)

(20) $Rh = \Sigma_i W_i.L_i - tl.(\Sigma W_i.L_i)$ (4.20)

(21) $Rc = (1-tc).(\Sigma_i[OUT_i-(\Sigma_j a_{ji}.OUT_i + td_i.OUT_i+ W_i.L_i)])$ (4.21)

(22) $Rg = tl.\Sigma_i W_i.L_i+tc[\Sigma_i OUT_i- (\Sigma_j \Sigma_i a_{ji}.OUT_i+ \Sigma_i td_i.OUT_i + \Sigma_i W_i.L_i)] + \Sigma_i tm_i.M_i - \Sigma_i te_i.E_i + F$ (4.22)

(23) $I_i = s_i. TINV$ i=1,31 (4.23)

(24) $V_i = \Sigma_j a_{ji}. OUT_i$ i=1,31 (4.24)

3. Foreign trade block

(25)	$Q_i = OUT_i + (M_i - E_i)$	i=8,18	(4.25)
(26)	$M_i = aa_i / (1-aa_i) . (OUT_i - E_i)$	i=8,18	(4.27)
(27)	$PM_i = PW_i . (1 + tm_i) . ER$	i=8,18	(4.28)
(28)	$(E_i) = \alpha_i + (DEP_i/WEP_i)^{\beta_i} . \omega_i . WED_i$	i=8,18	(4.30)
(29)	$DEP_i = WEP_i / (1 + te_i) / ER$	i=8,18	(4.31)

4. Equilibrium

(33)	$ES_i = (OUT_i + M_i) - (C_i + G_i + V_i + Y_i + X_i) = 0$	i=8,18 i=26,31	(4.34)
(34)	$\Sigma_i (OUT_i + M_i) =_s (C_i + G_i + X_i + Y_i + V_i)$		
(35)	$Rh + Rc + Rg = \Sigma (C_i + G_i + X_i + Y_i + V_i)$		(4.35)

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(1) The importance of the surveys of industrial production is greater than just giving data on value added or output. Data on wages and wage-employment are equally given in these surveys. See REPUBLIC OF KENYA, 'Report on Surveys of Industrial Production 1973 - 1976', Nairobi, 1980.

(2) Kilby lists a number of problems to the published investment series. See KILBY, P. 'Kenya's manufacturing sector', Draft 1979

(3) REPUBLIC OF KENYA, CBS, 'Urban food purchasing survey , April - June 1977', Nairobi, 1979

(4) REPUBLIC OF KENYA, CBS, 'Integrated rural survey, November 74 - October 1975', Nairobi, 1977

(5) Useful discussions with Dr. P. Collier (I.E.S. Oxford) and R. Vander Hoeven (I.L.O. Geneva) on this point are gratefully aknowledged.

(6) REPUBLIC OF KENYA, 'Import licensing schedules', Nairobi, Nov 1981, REPUBLIC OF KENYA, 'The customs and excise act', Nairobi, 1981, REPUBLIC OF KENYA, 'The finance bill - Ammendments of the customs and excise act', Kenya Gazette Supplement, Nairobi, May 1982

(7) See for a recent survey, LOW, P., 'Export subsidies and trade policy, the experience of Kenya', World Development, 1982, p. 293-304

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