

EFFECTS OF FOOD IMPORTS INCLUDING
FOOD AID ON KENYA'S AGRICULTURAL PRODUCTION

A Thesis
Presented to
The Faculty of Graduate Studies
of
The University of Guelph

by
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In partial fulfilment of requirements
for the degree of
Master of Science
October, 1993

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ABSTRACT

EFFECTS OF FOOD IMPORTS INCLUDING FOOD AID ON KENYA'S AGRICULTURAL PRODUCTION

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The effects of commercial wheat imports and aid on domestic wheat production, in Kenya were investigated. The Kenyan Government agricultural policy is to be self sufficient in food production and produce surplus for export. The country is currently not self sufficient in production of some major food commodities one of which is wheat. The direct impact of wheat imports and aid on achieving this goal were investigated.

Domestic supply, consumer income, consumer demand and commercial wheat imports functions were specified and estimated for the period 1970 to 1989 using ordinary least squares (ols). The estimated equations were combined to form a multi-equation model for the Kenyan wheat sector. The multi-equation model was then used to establish the effects of wheat imports and aid on domestic wheat production and to predict possible options for reducing wheat imports.

Domestic wheat production was found to substitute for commercial wheat imports by more than unity. It was also established that wheat aid does not substitute for commercial wheat imports.

Domestic wheat production was found to be very responsive to producer price changes. The best option established by the study, for reducing commercial wheat imports was through increased domestic supply.

ACKNOWLEDGEMENTS

I am grateful to my supervisor Dr. Wayne H. Howard for assisting me through out my research. In fact he is the one who suggested the research topic to me while I was attending one of his classes. He was a good source of encouragement and inspiration in my efforts to complete my research in time. I also would like to thank him for his deep interest in Kenya's agriculture and Kenyans (he has supervised several other Kenyans). I wish to thank the other members of my supervisory committee, Dr. Alfon Weersink and Dr. Wayne C. Pfeiffer. Dr. Weersink was very resourceful at the development of the proposal and through out the entire thesis writing. I would like also to thank Dr. Truman Phillips for chairing my thesis defence on a short notice.

I wish to thank the many friendly faculty and staff of the Departments of Agricultural Economics and Business and Department Economics who taught or helped me at one time or another. I owe special thanks to fellow students at the department especially Daniel Sellen and Emmanuel Yiridoe. Mr. Daniel Sellen was of great help in data and reference material. Emmanuel Yiridoe was of special help in my computer work.

Funds for my studies were provided by the Kenya Agricultural Research Institute, KARI-CIDA Training Fund. I express my sincere gratitude to them and to my employer, KARI for granting me study leave.

I owe special thanks to my entire family and friends who encouraged me to carry on and to be patient.

Friends like Mr and Mrs Joel Mutisya were a good source of encouragement. I am more than grateful to my parents, Mr. and Mrs. Peter Musembi Makau who would appreciate to see their names in print. To my parents I say thanks once more for the many years of support and encouragement in my studies. To the many Canadians whom I met at and outside the University of Guelph I say thanks a lot.

TABLE OF CONTENTS

	Page
ABSTRACT	
ACKNOWLEDGEMENTS	i
TABLE OF CONTENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	vii

Chapter 1 INTRODUCTION

1.1 Background	1
1.2 Economic Problem	4
1.3 Research Problem	5
1.4 Objectives of the Study	6
1.5 Outline of the Study	6

Chapter 2 THEORY AND LITERATURE REVIEW

2.0 Introduction	8
2.1.1 Demand.....	8
2.1.3 Elasticity	14
2.2.0 Research Review.....	19
2.3.0 Summary.....	23

Chapter 3 METHODOLOGY

3.0 Introduction.....	24
3.1.0 Structural Econometric models.....	24
3.1.1 Mann's Model.....	25
3.1.2 The Structural Model for the Study	30
3.1.3 Summary	32

Chapter 4 DATA ESTIMATION AND INTERPRETATION

4.1 Introduction	33
4.2 Sources of Data	33
4.3 Data Description	34
4.4 Model Estimation	36
4.5 Empirical Results and Interpretation.....	38
4.6 Summary	48

Chapter 5 SUMMARY AND CONCLUSIONS

5.1 Introduction	49
5.2 Summary of Research Problem and Methodology.....	49
5.2.1 Research Problem	49
5.2.2 Objective	51
5.2.3 Methodolgy.....	51
5.3 Conclusions.....	52

5.4	Limitations of the Study.....	55
5.5	Suggestions for Further Research.....	56

REFERENCES	57
-------------------------	-----------

Appendix 1 Wheat Data	59
-----------------------------	----

Appendix 2 Other Data that Affect Wheat Production.....	60
---	----

Appendix 3 Maize Data.....	61
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LIST OF TABLES

	Page
Table 4.1 Domestic Wheat supply.....	39
Table 4.2 Domestic Wheat Supply.....	39
Table 4.3 Domestic Wheat Supply	40
Table 4.4 Domestic Wheat Supply	40
Table 4.5 Consumer Income	44
Table 4.6 Consumer Demand for Wheat	44
Table 4.7 Commercial Imports of Wheat	45

LIST OF FIGURES

	Page
Figure 1. Elasticity.....	16
Figure 2. Elasticity	17

EFFECTS OF FOOD IMPORTS INCLUDING FOOD AID ON KENYA'S AGRICULTURAL PRODUCTION

CHAPTER ONE

INTRODUCTION

1.1 Background

Kenya is basically an agricultural country with 85% of its Gross Domestic Product coming from agriculture (Development plan 1989-93). Over 80% of the Kenyan population is employed in agriculture and agricultural related activities. The agricultural sector provides not only employment to the majority of the population but also food for those working in the agricultural sector and those in other sectors of the economy. Furthermore the agriculture sector is second only to the tourism and wildlife industry in earning foreign exchange for the country.

The overall goal of the agricultural policy of Kenya is to achieve self sufficiency in food production and produce surplus for export (Development plan 1989-93). However, currently the country is not self sufficient in food production and with its population growing rapidly, at 3.7% per year, it is likely that the country will continue to import foodstuffs to meet the growing local demand.

Currently the country imports wheat, rice, meat, some pulses, milk and some vegetables among other foodstuffs (FAO Trade Yearbook, 1989). In addition to these commercial imports, the country also receives some food aid from various donors to meet the excess demand, as a form of development assistance and sometimes for emergency relief when production shortfalls occur, mainly due to drought (FAO Food Aid Bulletin).

Food imports, whether commercial or aid, have various effects and implications on the recipient country. They may,

- (i) distort the balance of payments and exchange rates, if the food is given free of charge;
- (ii) distort labour markets, especially where the country is dependent on agriculture for employment;
- (iii) shift demand towards imported non-traditional food stuffs because people's taste may change as they get used to imported foods;
- (iv) cause rural to urban migration as imported food increases the availability and lowers the relative prices of foods in the cities;
- (v) and even reduce the urgency of food security problems as imports increase the availability of food (Isemun and Singer, 1977; Bhagwati, 1983).

One aspect of food imports and aid that has received a lot of attention is the effect they have on local agricultural production. This is the focus of this study with emphasis on Kenya.

Food imports and aid may have disincentive effects on local agricultural production in two ways. If they are sold in the open market they may have a depressive effect on prices and thus lead to reduced local production (Shultz,1960). However, if the prices are controlled then this depressive effect may not occur. Alternatively, if food aid is used as pay for labourers in nonagricultural work projects, such projects may attract agricultural labour away from agriculture thus reducing agricultural production (Maxwell and Singer, 1979).

If food aid substitutes for commercial food imports it will release the foreign exchange required, which may then be used to import implements and inputs which may be used to enhance local agricultural production (Johnson,1973; Stevens, 1977a). The use of food aid in food for work projects like road and irrigation construction that reduce the obstacles to agricultural production may be very beneficial in increasing agricultural production (Sen,1960).

The role of food aid in releasing the land used in food production for producing export cash crops may be a worthwhile undertaking in a developing country like Kenya that greatly needs foreign exchange for its economic development. In improving nutritional status of the poorly fed people, food aid

may be a source of human-capital formation, which in turn would be more productive in their agricultural production activities (UN,1961; Belli,1971).

1.2 Economic Problem

As the major goal of the Kenyan Government agricultural policy is to produce enough food for local consumption and surplus for export and at the same time produce other products for both export and local industrial use, there is considerable concern on the impact of food imports and aid on achieving this goal. Food imports and aid may have a depressive effect on the price of agricultural products and thus lead to reduced local food production which is contrary to the objectives of the Government. In the long run this reduced local food production may require the Government to rely on food imports. On the other hand, if food aid substitutes for commercial food imports it will release the foreign exchange required. Currently Kenya faces a great problem of limited foreign exchange (Development plan 1989-93). The funds may then be used to import implements and inputs which may be used to enhance local agricultural production and to import other investment goods. If food aid can be used to release the land required in food production for use in producing export cash crops, this may be beneficial to the country.

Thus the economic problem is what are the long-term consequences of receiving food imports/aid; e.g., food security issues, dependency on food

imports/aids, maximising income through specialization in cash crops and implication of food imports/aid on foreign exchange among other issues i.e whether food imports/aid will rise food security problem, lead to dependency on food imports/aids or rise problems of foreign exchange among other issues contrary to the Government agricultural policy.

1.3 Research Problem

The main research problem to which this study is addressed is to identify the effects of food imports and aid on domestic production with the aim of identifying possible solutions to the economic problem. The study will therefore determine the relationship between food imports/aid and local food production. At the same time the relationship between commercial food imports and aid will be established.

Thus the study will determine whether food imports\aid lead to reduced domestic food production and if so to what extent. The study will also establish whether food aid substitute for commercial food imports and if so to what extent. These relationships will be determined using econometric methods.

There are seven major commodities that are "central to achieving the development goals established for agriculture in Kenya": coffee, tea, maize, wheat, milk, meat, rice and horticultural crops (Development Plan 1989-93). Among those seven commodities the country is not self sufficient in wheat

production for domestic consumption and there are always some commercial imports and aid to meet excess demand. The study will therefore focus on wheat.

1.4 Objectives of the Study

The overall objective of this study is to determine the impact of food imports/aid on local agricultural production in Kenya, specifically on wheat.

The specific objectives are:-

- (i) To determine whether food imports and aid reduce local food production.
- (ii) To determine whether food aid substitutes for commercial food imports.

1.5 Outline of the Study

Chapter two contains the theory and literature review of previous studies on the effects of food imports/aid on local agricultural production that have been carried in various countries. Chapter three contains the methodology used in the study. Chapter four deals with data used as well discussing the results. A summary of the analysis as compared to the objectives, conclusions,

recommendations and limitations as well as future areas of research is provided in chapter five.

CHAPTER TWO

THEORY AND LITERATURE REVIEW

2.0 Introduction

This chapter begins by reviewing the economic theory behind demand, supply and elasticities of both supply and demand. Section 2.2 reviews research that has been done on the impacts of food imports/aid on local agricultural production in various parts of the world.

2.1.1 Demand

The neo-classical theory of demand is based on the allocation of a consumer's income such that the maximum level of utility is attained (Huang,1985). A utility function measures the level of satisfaction that an individual experiences as a result of consuming a particular bundle of goods and services (Johnson,1984).

Given a fixed income to be allocated to the various commodity bundles of his choice, the consumer is assumed to:

$$\begin{aligned} \text{Max. } U &= U(q_i) \\ \text{s. t. : } \sum p_i q_i &\leq Y \end{aligned} \quad (2.1)$$

where q =quantity of commodities consumed per unit time.

p =prices

Y =total income;

The demand function for quantities, q , obtained as solution to the maximization problem are called Marshallian or uncompensated demand functions.

$$q_i = f_i(p, Y) \quad \text{for } i=1, 2, \dots, n \quad (2.2)$$

When the optimal values of quantities are substituted back to the objective function of (2.1), it yields an indirect utility function.

$$V = V(p, Y) \quad (2.3)$$

where V is the indirect utility function.

Demand functions may also be derived in terms of prices and utility level. In this situation the consumer is assumed to minimise the cost of reaching a predetermined utility level, U^0 given prices. This can be written as,

$$\begin{aligned} \text{Min. } \sum_i p_i q_i &= Y \\ \text{s. t. } U(q_i) &= U^0, \quad \text{for } i=1, 2, \dots, n \end{aligned} \quad (2.5)$$

Through the Lagrangian method, a system of demand equations, can be derived.

$$q_i^* = g_i(P_i, U^a) \quad \text{for } i=1, 2, \dots, n \quad (2.6)$$

These are called compensated or Hicksian demand functions. If the optimal q^* in (2.6) is substituted back to the objective function of (2.5), an expenditure function is obtained,

$$C = C(P_i, U^a), \quad \text{for } i=1, 2, \dots, n \quad (2.7)$$

where C is the consumer's expenditure function.

To obtain an estimable formulation for complete demand system additional restrictions must be imposed on the consumer behaviour problem as classically formulated. The usual approach for obtaining the additional restrictions necessary to make the complete demand system estimable is more *ad hoc* than systematic.

Certain price variables in the demand functions are omitted. Resulting demand functions may then, for instance, include own price, price of one or two commodities thought to be substitutes, and income (with all other prices assumed to be represented by the CPI). Examples of demand systems estimated on this basis are those of Shultz (1938), Wold and Jureen (1953). These studies, although forerunners of much applied work, incorporate *ad hoc* restrictions on the demand system in an attempt to ensure consistency with theory.

Thus demand of a commodity is generally thought to be a function of the price of the commodity, price of the commodity's substitutes and the income of the consumer.

2.1.2 Supply

The neoclassical theory of supply is based on the firm's maximisation of profit from production of goods given technological and input price constraints. Thus given technology and price of inputs the firm aims to achieve the highest profit possible:

$$\begin{aligned} \text{Max. } \Pi &= P_y Y - \sum_i P_i Z_i \\ \text{s. t. } f(z) &= Y \quad \text{for } i=1, 2, \dots, n \quad (2.8) \end{aligned}$$

where

Π = profit

Y = output

P_y = price of output

P_i = price of input i for $i= 1, 2, \dots, n$.

Z_i = input used

$f(z)$ =production function

The input demand functions determined from solving the maximization problem are a function of prices.

$$z_i = (p_y, p_x) \quad \text{for } i = 1, 2, \dots, n \quad (2.8)$$

where

P_y is the vector of output prices (P_1, P_2, \dots, P_n).

P_x is the vector of input prices (P_1, P_2, \dots, P_n).

The output level, y , obtained under (2.8) as a function of input and output price is the

$$y = (P_x, P_y) \quad (2.9)$$

supply function. When the optimal values of Z_i and Y_i are substituted back to the objective function of (2.8), the indirect profit function is obtained:

$$V = V(P_x, P_y) \quad \text{for } i = 1, 2, \dots, n \quad (3.0)$$

where V is the indirect profit function.

The cost minimization function can be obtained if the firm had already decided to obtain a certain level of output, y , its problem would be to minimise the cost of reaching the predetermined output level at given prices of input and technology. This can be formulated as

$$\text{Min} \sum P_i z_i = C$$

$$\text{s.t. } f(z_i) = y^* \quad \text{for } i=1, 2, \dots, n \quad (3.1)$$

Through the Lagrangian method, a system of input demand equations can be obtained.

$$z_i^* = g(P_i, y^*) \quad \text{for } i=1, 2, \dots, n \quad (3.2)$$

which are called the conditional input demand functions. If the optimal Z^* in (3.2) is substituted back to the objective function of (3.1) it gives

$$\begin{aligned} \sum P_i z_i &= P_i g(P_i, y^*) \\ &= C(P_i, y^*) \quad \text{for } i=1, 2, \dots, n \quad (3.3) \end{aligned}$$

where C is the cost function of the firm.

Agricultural supply is influenced by many other factors like weather, technological and structural changes in addition to the expected price of output and price of inputs. Factors such the application of fertilizer, planting of hybrid seed varieties, availability of requisite inputs and provision of credit and extension services may lead to structural and technological changes. The effect of these factors on agricultural supply response are too difficult to measure with a reasonable degree of accuracy. The multiplicity of these factors and the difficulty of their measurement appear to make time trend the best proxy for them (Mwananembo, 1985).

Additional agricultural supply may also come from previous years storage. Producers store their produce if there is inadequate demand and sometimes when they expect better prices in the subsequent periods.

2.1.3 Elasticity

An elasticity measures the responsiveness of a dependent variable to changes in an independent variable. The dependent variable is influenced by many variables and therefore an elasticity can be calculated for each separate factor, *ceteris paribus*. There are many types of elasticities; price, income, cross-price, compensated and substitution elasticities.

The signs of the various elasticities are important. The own price elasticity E_{xp} , of demand for X is negative, if X is an input but positive if X is an output (Call and Holahan, 1983). Absolute values are frequently used for convenience. The income elasticity E_{xi} , is positive for normal goods and negative for inferior goods. Food is a normal good at the lower levels of income but it is an inferior good at the higher levels of income (Call and Holahan, 1983). The cross-price elasticity is E_{xpy} , is positive when Y is a gross substitute for X and negative when Y is a gross complement for X (Call and Holahan, 1983).

The price elasticity of supply (PES) is important in agricultural production because it tells us the response of farmers to price changes. Thus,

for example, if a 2% fall in price causes a 1% fall in output, the PES is 0.5 . The higher the price elasticity of supply therefore, the greater is the effect of price on output.

The price elasticity of demand (PED) is also important in agricultural production. The higher the PED, the higher the change in demand caused by a small change in price. If the PED is low a small change in price does not affect the quantity of food demanded.

It is the interaction of the two price elasticities that is important on the impacts of food imports/aid on domestic food production. The availability of food imports/aid in an open market, where the price is determined by the equilibrium between supply and demand, increases the quantity of food available for domestic consumption assuming local demand remains the same at a given period. The change in both price and domestic supply will depend on the PES and DES (Fisher,1963)(see Figures 1 and 2).

DD' is the demand curve and SS' the domestic supply curve in figure 1. Before the importation of food imports/aid, the equilibrium quantity is OQ₁ and the price is OP₁. The effect of importation of a certain amount, say I, of food which is then released on the market is to shift SS' to the right by an amount equal to I. Total quantity is then OQ₂, and price OP₂, with domestic production falling to OS₂. If there was no cutdown in domestic production due the fall in price the total quantity available would be OQ₃ and the price would be OP₃.

The demand curve D_2D' in figure 2 is more price elastic than the original demand curve D_1D' . Assuming the same supply curve SS' , before the

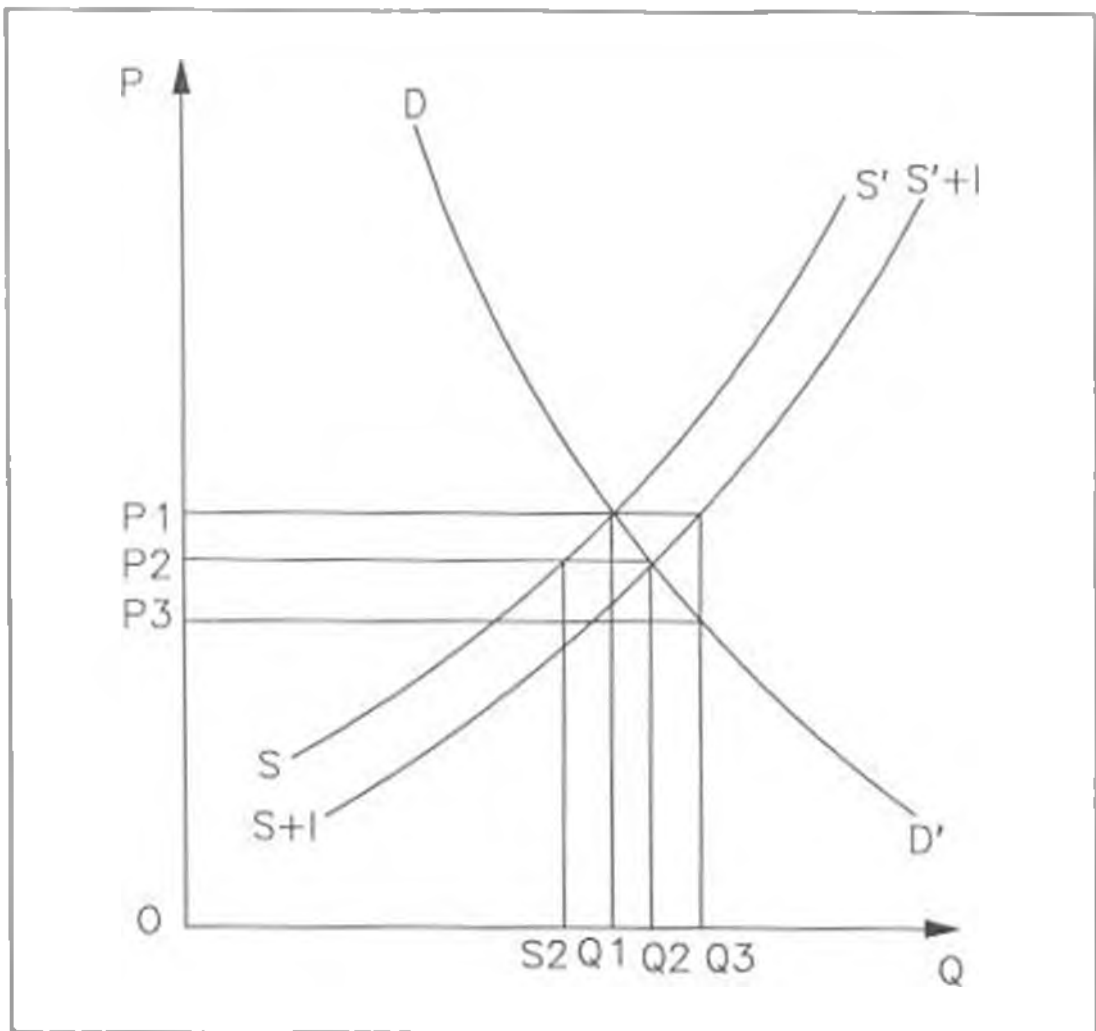


Figure 1: Elasticity

importation of food imports/aid, the quantity of supply available for the consumers facing the demand curve D_2D' is OQ_4 and the price is OP_4 . The effect of an importation of a certain amount, say I , is to shift the supply curve

to the right by an amount equal to 1. Total quantity available for the consumers facing the demand curve D, D' is then OQ_3 , and price OP_3 , with domestic production falling to OS_4 . For the consumers facing the demand curve

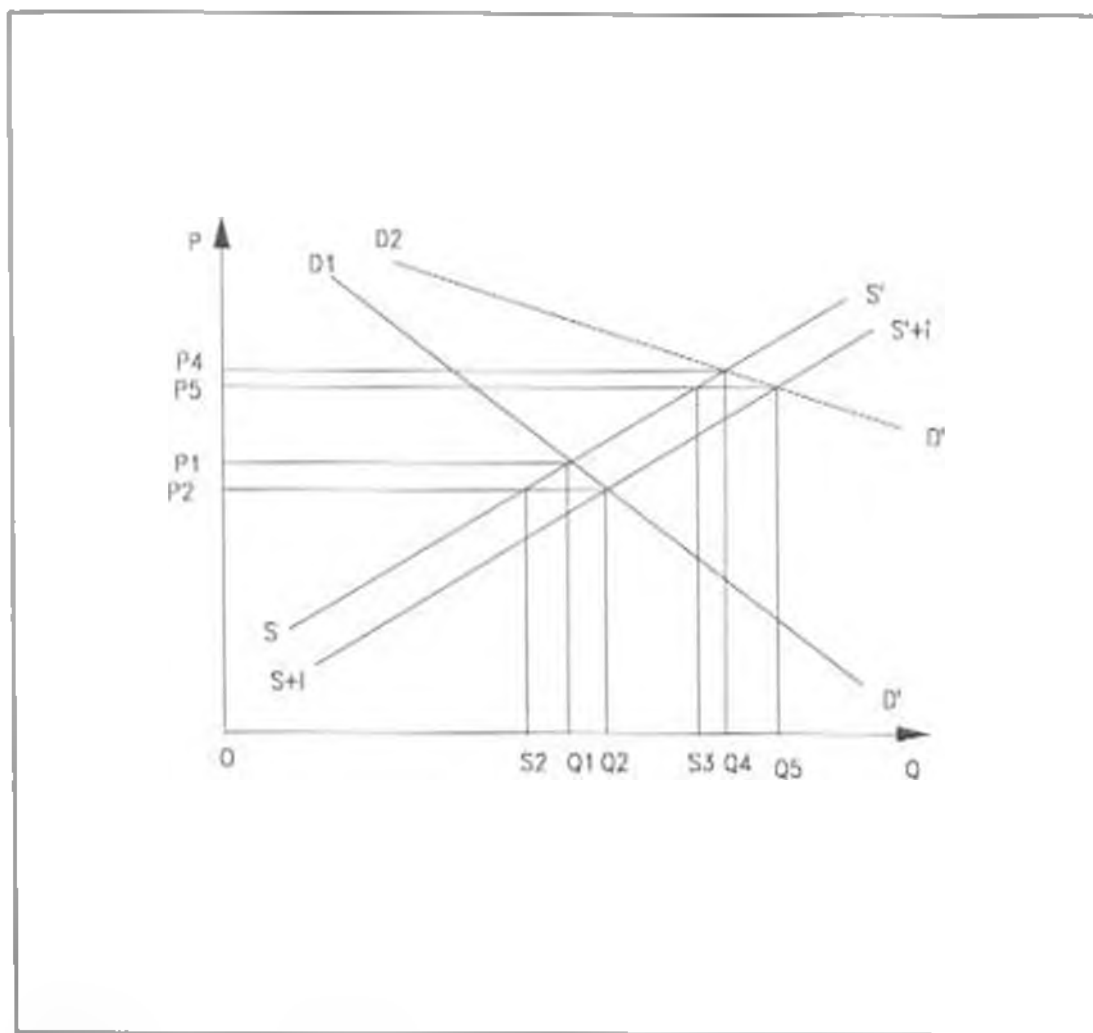


Figure 2. Elasticity

D, D' , before the importation of food imports/aid, the quantity is OQ_1 and the price is OP_1 . After the importation of the quantity I , the total quantity is then OQ_2 , and price OP_2 , with domestic production falling to OS_2 . The change in

domestic supply with the less elastic demand curve, S_2Q_1 , is greater than S_1Q_4 . The price change from OP_1 to OP_2 is less than the price change from OP_1 to OP_3 . Thus the change in both the price and domestic production will depend on both elasticities of supply and demand.

The price elasticity of supply in agricultural production is believed by many people to be positive but rather small, perhaps of the order of 0.2 (Hesman and Singer, 1979). The World Bank, however challenges these findings of a low PES. The Bank claims that if measured over a long period, the PES is highly significant, tending to be at least three times higher. The PES may also be low because of shortages of inputs, or because of poor infrastructure. Hence the effect of food imports/aid on domestic production of food depends on the PES; a low PES implies that a small increase in food imports/aid causes little change in domestic food production and a high PES implies a small increase in food imports/aid causes a large decrease in domestic food production.

The impacts of food imports/aid on domestic food prices and output cannot therefore be directly predicted. It requires empirical work to be carried out to determine the effects of food imports/aid on domestic food production in a given country like Kenya.

2.2 Research review

Most empirical work on the effect of food imports including food aid on local food production is on the effect they have on prices and thus production (Maxwell and Singer 1979). Schultz (1960) studied the impacts and implications of foreign surplus disposal of food on undeveloped countries and concluded that if these food imports are sold in the open market the prices are likely to fall and the farmers would respond by producing less food than they otherwise would. S.R.Sen (1960) argued that the Schultz formulation ignored the income creating and growth effect of food aid which may lead to an increase in food demand offsetting at least in part, the effect on prices of increased supply. The price disincentive effect may also not occur if the food aid just replaces the commercial imports to meet the usual market requirements or in a situation whereby food imports are distributed selectively to the poor or are used to increase demand.

Fisher (1963) developed a theoretical model to analyze the impacts of food surplus disposal on agricultural production on recipient countries and concluded that the impact depended on the elasticities of both supply and demand and suggested the need for an econometric analysis of the price effects on both supply and demand of agricultural commodities in less developed countries (this model was presented in the previous section and discussed as figure 1).

Many empirical studies on the effect of food imports including aid on local food production have been carried out: In 1979 Maxwell and Singer reviewed twenty-one empirical studies, demonstrating a variety of approaches, with the later ones tending more to the use of multi-equation econometric models. As many as 12 of the studies deal with the Indian experience of U.S PL480¹ (Maxwell and Singer 1979).

Studies on the estimation of how far food aid substitutes for commercial food imports have been carried out using various methodologies ranging from opinion surveys to econometrics models (Maxwell and Singer 1979). These studies report that with the exception of India somewhere between a half and three-quarters of food aid has substituted for commercial imports which countries would have made anyway. **Rath and Patvardhan (1967)** estimated that food aid substituted for commercial food imports by one-fifth in India. **Mann (1967)** carried out a study to quantify the impact of cereal imports under U.S Public Law 480 on the prices and domestic supply of cereals in India. In his study he used an econometric model encompassing six simultaneous equations. His study reported that the importation of cereals under U.S Public Law 480 led to lower prices for cereals and a decline in domestic supply but the decrease in domestic supply was less than the

¹ PL480 stands for public law number 480 set by the U.S Government to govern the disposal U.S surplus agricultural production in developing countries

quantity imported. His method did not incorporate the income effect of food aid which may lead to an increase in demand as suggested by Sen(1960).

In his study he set a theoretical framework of analysis in terms of:

- (i) Supply equation of cereals
- (ii) Demand equation of cereals
- (iii) An income generation equation
- (iv) Total cereal imports equation
- (v) Withdrawal from stocks equation
- (vi) A market clearing identity

Rogers et al (1972) developed a multi-equation econometric model to study the impacts of U.S PL480 in India under market differentiated distribution. Their model incorporated the income effect on demand resulting from the distribution of food aid commodities to consumers at concessional prices and found the production effect to be one-tenth of the previous estimates. This model is a modification of Mann's model. In this model an equation for distribution under the concessional market is incorporated in Mann's model.

Dudley and Sandilands (1973) studied the effects of surplus imports of wheat on domestic wheat production in Colombia and reported that the decline in domestic production as surplus imports increased depended on the pricing policy of the domestic marketing agency responsible for distributing imports. Their study reported a substantial decline in producer price and domestic production in Colombia. In their study they developed a theoretical model of

wheat marketing. Using this model they determined the social optimum of meeting domestic demand and profit maximising policy for the recipient government. Using the model they also, showed the possibility of a discrepancy between the socially optimal price and the price which maximises government revenues.

Pinstrup-Andersen et al (1970) studied the impact of food aid on commercial imports of US PL480 in 12 countries, India, Pakistan, Brazil, Korea, Turkey, China, Israel, Morocco, Chile, Colombia, Greece and Congo. They found that US food aid reduced commercial imports by the recipient countries. This reduction in commercial food imports was less than the actual amount of food aid received. In their study they used one food commodity, wheat. Using the 1964-1966 level of food aid, they found that, on average, each ton of wheat exported under U.S aid program replaced 0.41 tons of commercial imports. The commercial import replaced by the last ton of wheat aid was estimated to be 0.27 tons.

The method they used was a mail survey whereby 441 persons representing the twelve countries were conducted and asked to estimate the reduction in wheat imported by each participant's country when the quantity of wheat under PL480 was reduced by some hypothetical amounts i.e 25, 50, 75 and 100 per cent.

2.3 Summary

This chapter started by briefly reviewing the theory behind consumer demand, output supply and elasticity measures. Review of literature was also done in the chapter. Several studies quantified the relationship between food aid and commercial food imports and found that food aid substituted for commercial food imports to a great extent. The relationship between food aid and domestic supply and price is found to be inverse in several studies. The next chapter discusses the method used in the study.

CHAPTER THREE

METHOD

3.0 Introduction

This chapter discusses the method that was used in the study. A structural econometric model (Mann's model) is discussed.

3.1.0 Structural Econometric Models

Most previous work on the study of the impacts of food imports/aid on local food production has tended to use structural multi-equation econometric models (Maxwell and Singer ,1979). The most documented multi-equation econometric model is the one developed by Mann (1967) and extended by Rogers et al (1972). The model was initially used to study the impacts of cereal imports under U.S PL 480 on the prices and domestic supply of cereals in India.

In structural econometric analysis a variable, Y, is defined as a function of other specific variables and there are priori restrictions on which variables enter specific equations in analysis of a multivariate system. In a system whereby the variable, Y , is considered to be a function of two variables X and Z , (Y=f(X,Z)), the equation may be specified as:

$$Y = a + bX + cZ + E$$

where a , b and c are estimable coefficients, and E_t is a random factor representing all the observable and non observable variables that influence the value of Y but have not been included in the estimation of the Y equation.

The variables that enter specific equations are determined from economic theory and the researcher's work is mainly to estimate the coefficients and thus to test the economic theory; i.e., to establish whether a relationship exists between the variables. The variables that explain the value of Y are termed the exogenous variables and the variable, Y , that is explained by the variation in the exogenous variables is called the endogenous variable.

Most a priori theory used in econometric specification is static and thus structural econometric analysis is often informative about the influence of one variable on another but has little or nothing to say about particular lag lengths (Bessler, 1984).

3.1.1 Mann's (1967) Model

The structural multi-equation econometric model originally developed by Mann (1967) may be generalised for any developing country like Kenya that receives both commercial and food aid imports.

The model Mann developed was to provide answers to three questions:

- (i) The impact of a unit increase in total imports of cereals during a given time period on domestic production and the price of cereals during the same time period,
- (ii) The impact of such a change during each of the successive time periods,
- (iii) What the total impact of a unit increase in total imports of cereals, particularly on domestic production, over a period of time is.

In the case of wheat imports in any developing country such as Kenya, a theoretical framework of analysis of the Mann's model can be set in terms of:

- (i) Supply equation of cereals
- (ii) An income generation equation
- (iii) Demand equation of cereals
- (iv) Commercial cereal imports equation
- (v) A market clearing identity

The quantity of wheat consumed during a given year comes from three sources (1) Domestic production, (2) Commercial imports, (3) Imports other than commercial (i.e. food aid). The quantity from domestic production in a given year in Kenya comes mainly from production during the year. Kenyan wheat farmers respond to producer price changes. Maitha's (1974) findings indicate that wheat farmers adjust their wheat acreage as producer price changes.

Elasticity coefficients were 0.65 for the long run. Thus, domestic wheat supply in year t becomes a function of prices in the year ²t-1 and the other factors like technology and weather influencing production, generally represented by the time trend. The theoretical supply function is thus specified as,

$$Q_t^s = f(p_{t-1}, t) \dots \dots \dots (1)$$

where

Q_t^s =the quantity of cereal available from domestic production for consumption in period t,

p_{t-1} =a deflated index of whole prices of cereals in period before production(deflated by the consumer price index), and

t=Time trend.

The economy of many developing countries is dominated by agriculture. Hence, agriculture output constitutes a very large portion of the national income. The sector that is second in importance is the government and hence the income generation equation is specified as,

$$Y_t = f_2(Q_t^s, G_t) \dots \dots \dots (2)$$

where

G_t =deflated per capita government expenditure in period t,

¹ Alternative supply functions whereby current and the two lag period producer prices were alternatively used in place of the one lag period price gave insignificant statistical results at the ten per cent level of significance, which is the lowest level of significance generally accepted by economists.

deflated by the consumer price index,

Y_t = deflated consumer income, deflated by the consumer price index,

and Q_t^d , is as previously defined.

The demand function for a commodity can be formulated from microeconomic theory. The quantity demanded by the consumers is a function of the price of the commodity, the price of related goods and consumer income.

$$Q_t^d = f_3(p_t, p_t', Y_t) \dots \dots \dots (3)$$

where,

Q_t^d = per capita quantity of cereals demanded in period t,

p_t = the index of deflated wholesale prices of cereals in period t, (deflated by the consumer price index),

p_t' = the deflated wholesale price index for food other than cereals, (deflated by the consumer price index), and

Y_t is as previously defined.

The commercial imports are considered to be a function of domestic production and wheat aids to meet the excess demand not met by production and aids. Thus the imports equation is specified as;

$$I_t = f_4(Q_t^d, I_t^a) \dots \dots \dots (4)$$

where,

I_t^* = per capita quantity of commercial imports of cereals in period t ,

I_t^a = per capita cereals aid, and

Q_t^* is as previously defined.

A market clearing identity is required to close the system by forcing excess demand to be zero and is specified as;

$$Q_t^d = Q_t^* + I_t^* + I_t^a \quad (5)$$

The model consists of five equations and four endogenous variables. Since the purpose of the model is to evaluate the economic impact of imports on domestic supply of cereals in any developing country, certain variables are treated as given outside the system. The predetermined variables include P_{t-1} , P_t^* , G_t , P_t , I_t^* . Given the values of these predetermined variables it is the object of the model to determine the impact of the explanatory variables on the values of the endogenous variables, Q_t^d , Q_t^* , Y_t and I_t^* .

Equations 2 through 4 are overidentified. Under conditions of over identification, the two stage least squares method of regression provides consistent estimates of the coefficients of the structural form (Johnston, 1960). In equation 1 there is only one endogenous variable and therefore the ordinary least squares method of regression is used to provide coefficients of the structural form.

3.1.2 The Structural Model for the Study

The appropriate structural model for this study is the one that answers the questions of the study i.e the impact of wheat imports/aid on domestic wheat production at the current period, on successive time periods and over a period of time. However, since the price of wheat in Kenya is regulated by the government, wheat imports\aid have no direct effect on the price of wheat and therefore it is difficult to measure the impact of price in the succeeding years and the total impact of a unit increase in imports/aid of wheat on domestic production over a period of time.

Since all the food imports in Kenya are sold in the same market as the locally produced food, the impact of food imports/aid on domestic food production, in Kenya, was examined using the Mann's multi-equation econometric model. In this model the assumptions are that the imported food is similar to the locally produced food and consumers don't distinguish between the two products. The following five equations were estimated:

$$(i) \quad Q_t^* = f_1(p_{t-1}, L)$$

$$(ii) \quad Y_t = f_2(Q_t^*, G_t)$$

$$(iii) \quad Q_t^* = f_3(p_t, p_t^*, Y_t)$$

$$(iv) \quad I_t^* = f_4(Q_t^*, J_t^*)$$

$$(v) \quad Q_t^d = Q_t^* + I_t^* + I_t^*$$

Since the price of wheat in Kenya is regulated by the government, it was difficult to analyze the impact of wheat imports on domestic wheat production using the above five equation model. It was found necessary to estimate three more ad hoc equations of supply of wheat for the purpose of this study, whereby wheat aid ($I_{1,t}^*$), wheat imports ($I_{1,t}^*$) and total imports (TI) of wheat were alternatively included as explanatory variables in the supply equation, as follows:

$$(vi) \quad Q_t^s = f_t(p_{t-1}, t, I_{1,t-2}^*)$$

$$(vii) \quad Q_t^s = f_t(p_{t-1}, t, I_{1,t}^*)$$

$$(viii) \quad Q_t^s = f_t(p_{t-1}, t, TI_{t-2})$$

Where,

$I_{1,t-2}^*$ = wheat aid lagged two periods before production,

$I_{1,t}^*$ = commercial imports lagged two periods before production,

TI_{t-2} = Total imports (defined as the sum of commercial imports and aid) lagged two periods before production, and the other variables are as previously defined).

Wheat imports/aid in the current period may have no effect on domestic production in the current period because by there may be delay in the distribution of the imports after they arrive at the port and by the time they reach the consumers the current years production may have already taken place. It is therefore expected that it is the lagged wheat imports/aid that have effect on the current wheat production. For the three supply equations, vi, vii

and viii the two¹ lag period values of aid (I_t^*), commercial imports (I_t^*) and TI were used. The two lag period had significant statistical results at the ten per cent level of significance, which is generally the lowest level of statistical significance accepted by economists. Although the price of wheat is regulated by the government, commercial imports and aid may lead to decreased domestic wheat supply through other effects other than through the price disincentive effect. For instance some consumers may prefer imported wheat products to domestic wheat products or wheat received from aid may be used as pay labourers in food for work projects that attract labour away from wheat production and thus lead to decreased wheat production.

3.1.3 Summary

This chapter started by briefly discussing structural econometric models and their definitions. A structural model, Mann's model, was discussed in the second part of the chapter. A justification for using the Mann's model for this study was provided in the third section of the chapter. In the last part of the chapter an eight equation model for the study was specified. The next chapter discusses the data, the model estimation, results and their interpretation.

¹ The two lag period was chosen against the one lag period because the one lag period didn't give significant statistical impact on current domestic wheat production.

CHAPTER FOUR

DATA, ESTIMATION AND INTERPRETATION

4.1 Introduction

This chapter deals with the following subjects: (1) description of data and its sources; (2) estimation of the model (3) presentation of the estimated results from the model; and (4) interpretation of the results.

4.2 Sources of Data

Determined by the objectives and methodology of the study, the data came mainly from the Statistical Abstract of the Republic of Kenya and partly from the Food Aid in Figures publication of the Food and Agriculture Organisation (FAO) of the United Nations. It may be useful to introduce the background information of the Statistical Abstract and the Food Aid in Figures publication of FAO before using the data.

The Statistical Abstract is prepared by the Central Bureau of Statistics of the Ministry of Planning and National Development of the Republic of Kenya. The Bureau prepares Statistics based partly on surveys undertaken by the Bureau and partly from Statistics compiled by other Government Departments and other organisations. The Bureau is also responsible for the

preparation of a quarterly Statistical Digest in which emphasis is placed on current statistics for which monthly and quarterly time series are available. In addition reports are published on various regular and ad hoc statistical surveys undertaken by the Bureau.

FAO continuously monitors food aid flows and development and publishes relevant up-to-date information in its monthly Food Outlook and special report on the Food Supply Situation and Crop prospects in Sub-saharan Africa. Food Aid in Figures complements the information presented in these publications by providing further details on food aid flows by donors, recipients and commodities.

The information included in the publication is reported as supplied by donor countries, complemented by data provided by the FAO consultative sub-committee on Surplus Disposal, the World Food Programme, the international Wheat council, OECD and other international organisations.

1.3 Data Description

Data recorded in the Statistical Abstract and the Food Aid in Figures is recorded as obtained from the field. Such data may not be directly useful for research purposes. For purposes of this study therefore, some adjustments and manipulations were carried out on the data obtained from these two

publications and are explained at the relevant data sections. The data is presented in the appendix.

A set of annual time series data for wheat and other factors affecting its production and consumption was prepared for the years 1970 to 1989. The wheat data includes production, producer price, average yield per hectare, consumption, imports and aid. In addition, data was collected on consumer income, government expenditure, population and producer price of maize. Definitions of each variable and their adjustments for the purpose of this study are as follows.

Production in each year is presented as output per capita. The producer price of wheat is presented as an index number using 1985 prices as the base year. In order to capture the effect of the price of other goods on the price of wheat, the producer price index is deflated by the consumer price index.

Average yield per hectare was prepared as total output divided by the total acreage harvested and recorded as average yield per capita.

Consumption was estimated as the sum of domestic production, imports and aid and reported as consumption per capita.

Imports and aid were taken as recorded in the Statistical Abstract and the Food Aid in Figures publications respectively and recorded on per capita basis.

Consumer income and government expenditure were prepared as index numbers deflated by the consumer price index for each year at 1985 fixed prices.

Producer price of maize was prepared as an index number of the producer price for each year deflated by the consumer price index at 1985 fixed prices.

4.4 Model Estimation

The procedure for estimating the supply, consumer income, consumer demand and commercial imports functions of wheat is discussed along with the estimation results.

Aggregate annual time series data for the period 1970 to 1989 were used to estimate the supply, consumer income, consumer demand and commercial imports functions. Dummy variables were included for the "bad" year, 1984, for wheat supply and aid respectively, for drought is reported to have caused production to decline by a factor of 35% from the normal trend and aid was increased by a factor of about 35% to cover the decline in production in order to meet the domestic demand for wheat (Republic of Kenya, Economic Review, 1986). Ordinary least squares (OLS) was employed for the supply function, because the supply equation contains only one endogenous variable and two stage least squares (2SLS) was employed for the consumer income, consumer

demand and commercial imports functions. The Time Series Processor (TSP) computer package was employed for the estimation.

The estimated equations selected for the final model were selected based upon estimates that were statistically sound (t-statistics, R^2 etc). However, the overall priority remained with choosing equations that contained the theoretical a priori relationships between the dependent and independent variables as outlined in chapter 3. Once a "good" equation was estimated all variables that were not significant at 10% level or lower level were dropped and the equation was estimated again until the "best" equation was obtained. This procedure worked for the supply, imports and consumer income equations. On the consumer demand function some variables that were not significant (e.g price of maize as the related food commodity and consumer income) were retained when the explanatory power of the equation could not be improved any further. The final functional forms selected for the supply, consumer income, consumer demand and imports equations are presented in tables 4.1-4.7.

The Durbin-Watson statistic (D-W) was employed to test for first order autocorrelation due to the use of time series data. In the presence of autocorrelation OLS estimators do not have minimum variance (Rao and Griliches; Cochrane and Orcutt). The D-W test was used to test the hypothesis of zero autocorrelation against hypothesis of first order autocorrelation. Wherever first order serial correlation was present the autoregressive method

of regression (AR1) was used in place of OLS or Two-Stage Least Squares regression.

4.5 Empirical Results and Interpretations

The domestic supply, consumer income, consumer demand and commercial imports of wheat functions were estimated using explanatory variables as suggested in chapter three, using annual data for the period 1970 to 1989. This period was chosen because it had the most reliable data on production, imports and aid for Kenya. In order to estimate the influence of wheat imports and aid on domestic supply (production), three further equations of domestic supply were estimated whereby wheat aid, commercial imports and total imports (defined as the sum of commercial imports and aid for each year), respectively, lagged two periods were included as explanatory variables in the supply equation. The two lag period was chosen against the one lag period because it presented the best results for the supply equations of wheat. The current imports and aid are not expected to have any effect on current domestic wheat production because by the time they arrive wheat production has already taken place.

The regression results including the autoregressive coefficient (ρ), where applicable, are presented in Tables 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7. and described and interpreted.

TABLE 4.1: DOMESTIC WHEAT SUPPLY
DEPENDENT VARIABLE: DOMESTIC WHEAT SUPPLY

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY ¹
CONSTANT	1.700	0.249	
P_{t-1}	940.667	3.129	0.820
Time	-0.196	-2.382	
Rho	0.655	4.256	
R^2	77.68		
ADJ R^2	73.10		
DW	2.42		
F-STATS	1.18	17.31	

1. Elasticities were calculated at the average values of the explanatory and dependant variables.

Where P_t = Deflated producer price index of wheat
 Time = Time trend
 Rho = Autoregressive coefficient

TABLE 4.2: DOMESTIC WHEAT SUPPLY
DEPENDENT VARIABLE: DOMESTIC WHEAT SUPPLY

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	-0.526	-0.547	
P_{t-1}	633.547	2.134	0.552
Time	-0.349	-3.565	
I_{t-1}^*	-0.653	-2.351	-0.167
R^2	80.16		
ADJ R^2	75.98		
D-W	1.19		
F-STATS	2.17	19.19	

Where P_t = Deflated producer price index of wheat
 Time = Time trend
 I_t^* = Percapita wheat aid

TABLE 4.3: DOMESTIC WHEAT SUPPLY
DEPENDENT VARIABLE: DOMESTIC WHEAT SUPPLY

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	3.294	0.446	
P_{t-1}	512.908	3.086	0.447
Time	-0.285	-1.911	
T_{t-2}	-0.068	-1.827	-0.026
Rho	0.675	4.382	
R^2	76.49		
ADJ R^2	69.96		
D-W	1.19		
F-STATS	2.17		
	11.71		

where P_t = Deflated producer price index of wheat
 Time = Time trend
 I_t = Per capita commercial wheat imports

TABLE 4.4: DOMESTIC WHEAT SUPPLY
DEPENDENT VARIABLE: DOMESTIC WHEAT SUPPLY

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	-0.816	0.114	
P_{t-1}	503.839	3.028	0.439
Time	0.338	-2.429	
TI_{t-2}	-0.269	-1.241	-0.085
R^2	77.99		
ADJ R^2	71.88		
D-W	2.30		
F-STATS	2.17		
	12.75		

where P_t = Deflated producer price index of wheat
 Time = Time trend
 TI = Total imports (defined as the sum of commercial imports and aid)

The independent variables explained over 77% of the variation in the dependent variable in the first supply equation. The estimated coefficient for the price of wheat was significant at the one per cent level of significance and had a positive sign, as expected, implying that farmers respond positively to price rise. The estimated coefficient for the time trend had a negative sign and was significant at the five per cent level of significance. The negative sign on the coefficient for the time trend may be due the huge drop in acreage under wheat production following the subdivision of the former large scales wheat farms and resettlement of people after independence in 1963 and replacement of wheat crop by maize and dairy farming as explained by Mulamula, Jaetzold and Schmidt (1985). The calculated elasticity was 0.820 for the price of wheat and had positive sign, as is expected, implying that farmers react positively to price rise. The calculated price elasticity of supply, 0.820, was less than the one estimated by Maitha (1974) of 0.650.

In the second supply equation the independent variables explained over 80% of the variation in the dependent variable. The estimated coefficient for the price of wheat had a positive sign as expected and was significant at the one per cent level of significance which compares closely with the coefficient in the first supply equation which was also significant at the one per cent level of significance while the coefficient for the time trend variable had a negative sign and was significant at the five per cent level of significance as it was in the first supply equation. The estimated coefficient on the lagged wheat aid variable had a negative sign and was significant at the five per cent level of significance. The negative sign on the coefficient for the lagged wheat aid implies

that wheat aid lead to reduced domestic wheat production. This reduction is expected as some wheat aid is used for pay for work projects which may attract some labour away from wheat production leading to reduced wheat production as suggested by Kilungo (1992). The calculated elasticities were 0.552 for the price (less than it was in the first supply equation) and 0.167 for the lagged wheat aid, implying that wheat supply is inelastic to both price and aid. However, wheat production is more responsive to price than it is to aid.

The independent variables explain over 76% of the variation in the dependent variable in the third supply equation. This explained variation is lower than in the second supply equation, indicating that that aid explains more of the variation in domestic supply than commercial imports. The estimated coefficients for price and time trend had positive and negative signs respectively and were significant at one per cent and ten per cent level of significance respectively. The sign on the coefficient for lagged wheat imports was negative and significant at the ten per cent level of significance. Compared to the coefficient for lagged wheat aid in the second supply equation, the coefficient for lagged commercial wheat imports is lower than the one for wheat aid, implying that wheat aid has a greater negative effect on domestic wheat supply than commercial imports. The calculated elasticities were 0.447 for the price of wheat ((lower than in the first (0.820) and second (0.552) supply equations)) and -0.026 for the lagged commercial imports. The supply elasticity with respect to commercial imports is lower than the one with respect to wheat aid, indicating as suggested above, that wheat supply is more negatively responsive to wheat aid than to commercial wheat imports.

In the fourth wheat supply equation the independent variables explained over 77% of the variation in the dependent variable (lower than in the second supply equation but greater than in the third supply equation). The sign on the estimated coefficient for the price of wheat was positive, as expected and the coefficient was significant at the one per cent level of significance. The estimated coefficient for the time trend had a negative sign and it was significant at the five per cent level of significance while the one for total imports had a negative sign as expected and it was insignificant at the ten per cent level of significance. The calculated elasticities were 0.439 for the price of wheat (lower than in first, second and third equations) and -0.085 for the total imports of wheat, lower than the one for lagged wheat aid but greater than the one for commercial imports).

TABLE 4.5: CONSUMER INCOME
DEPENDENT VARIABLE: CONSUMER INCOME

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	0.003398	0.881	
Q_t^1	0.0000914	3.812	0.116
G_t	0.837	23.462	0.858
Rho	0.496	2.738	
R^2	93.11		
ADJ R^2	92.42		
D W	2.04		
F-STATS	1.18		
	254.00		

Where Q_t^1 - Percapita domestic production
 G_t - Percapita government expenditure

TABLE 4.6: CONSUMER DEMAND FOR WHEAT
DEPENDENT VARIABLE: CONSUMER DEMAND

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	33,743	4.749	
P_t^1	360.030	1.230	0.178
P_t	1477,120	-2.341	-0.760
Y_t	482.650	1.578	0.232
R^2	37.56		
ADJ R^2	24.10		
D W	1.47		
F STATS	2,17		
	4.5		

where P_t^1 - Deflated producer price index of maize
 P_t - Deflated producer price index of wheat
 Y_t - Deflated Consumer income

TABLE 4.7: COMMERCIAL IMPORTS OF WHEAT
DEPENDENT VARIABLE: COMMERCIAL IMPORTS

VARIABLE	COEFFICIENT	T-STATS	ELASTICITY
CONSTANT	8.113	4.339	
Q_1^*	0.412	-3.472	-1.093
I_1^*	0.320	1.986	0.218
Rho	-0.124	-0.397	
R^2	63.81		
ADJ R^2	58.10		
DW	2.14		
F STATS	1.18		
	11.17		

where Q_1^* = Per capita domestic production
 I_1^* = Per capita wheat aid

The two independent variables, government expenditure and agricultural supply, explained over 93% of the variation in the dependent variable in the consumer income function. In fact this equation had the highest explained variation in the dependent variable among the eight equations of the model of the study. The estimated coefficients for both government expenditure and agricultural supply had positive signs, indicating that consumer income is positively correlated with government expenditure and agricultural supply, as is expected. Both coefficients were highly significant at the one per cent level of significance. The calculated elasticities were 0.858 for the government expenditure and 0.116 for the agricultural supply. The elasticity with respect to government expenditure was far much higher than the one with respect to agricultural supply, implying that consumer income is far much more responsive to government expenditure than to agricultural supply.

The independent variables explained over 37.56% of the variation in the dependent variable in the consumer demand equation. The low explained variation implied missing explanatory variables in the equation. However, as previously explained the equation could not be improved any further. The equation had a negative sign on the coefficient for the price of wheat and positive signs on the coefficients for other foods and consumer income, as expected. The coefficient for the price of wheat was significant at the ten per cent level of significance while the ones for the other foods and consumer income were insignificant at the ten per cent level of significance. The negative sign on the coefficient for price of wheat agrees with economic theory which states that the demand of a commodity decreases as its own price rises. The positive sign on the coefficient for the price of other foods also agrees with economic theory which states that the demand of a commodity increases as the price of its substitutes rises. The positive sign on the coefficient for the consumer income agrees with economic theory, that the demand of a commodity increases as the consumer income rises. The calculated elasticities were -0.76 for the price of wheat, 0.178 for the other foods and 0.232 for consumer income. Thus, apart from the elasticity with respect to the price of wheat, the elasticities with respect to the other two variables were very inelastic. The wheat demand elasticity with respect to the price of wheat (-0.76) is very close to unity, implying that the price elasticity of demand for wheat is very close to unity.

The independent variables explained more than 63% of the variation in the dependent variable in the commercial imports equation.

The estimated coefficient for domestic supply had a negative sign and the one for aid had a positive sign. The coefficient for domestic wheat supply was significant at the one per cent level of significance while the one for aid was significant at the ten per cent level of significance. The negative sign on the coefficient for domestic supply indicates that as domestic production rises, commercial imports decline. This is so because commercial importation is for the purpose of meeting the excess demand which domestic production does not meet. The positive sign on the coefficient for wheat aid was not expected (it is expected that a rise in aid would lead to a decline in commercial imports). The possible explanation for the unexpected positive sign is that wheat received as aid is partly used to feed famine stricken people and partly as pay for work projects in Kenya and therefore it may have no much direct effect on commercial imports. The calculated elasticities were -1.093 for domestic wheat supply and 0.218 for aid. Thus, commercial wheat imports is more than unity elastic (1.093) with respect to domestic wheat supply, implying that commercial wheat imports can be highly reduced by increased domestic wheat production. The unexpected low positive relationship between commercial wheat imports and aid may possibly be due to the fact the wheat aid used in feeding the famine stricken poor people of Kenya may be a source saving on the money that would otherwise been used to purchase food and thus lead to increased real income. This income may be used to purchase more wheat and thus creating need for commercial wheat imports for domestic supply is always less than demand.

4.6 Summary

In the first section of this chapter, data sources and its description were discussed. The main source of the data was the Statistical Abstract of the Republic of Kenya and the FAO Food Aid in Figures publication. In the second part of the chapter, the equation of wheat supply, consumer income, consumer demand and commercial imports of wheat were estimated. Various forms of each equation were estimated. The final equation used in the analysis were selected in terms of statistical significance and theoretical a priori expectations between the dependent and independent variables. The consumer demand equation could not be improved any further indicating that there were missing variables in the independent variables and the equation was taken as it was. Elasticities for each dependent variable were calculated with respect to each of its independent variables.

In the third section of the chapter the results of the model estimation and their interpretation were presented. Apart from the coefficients of wheat aid in the commercial imports equation, all the other coefficients in the other equations had signs as expected. A possible explanation for the unexpected sign was provided and discussed further in the last part of the chapter.

The next chapter presents a summary of the study. This includes conclusions from the model estimation, limitations of the study and suggestions for further study.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.1 Introduction

This chapter provides a summary of the study and discusses the implications of the study. A brief summary of the research problem and methodology is presented in section 5.2, the major conclusions of the study follow in section 5.3. The chapter closes with a discussion of the limitations of the study and suggestions for further research in section 5.4 and 5.5 respectively.

5.2 Summary of Research Problem and Methodology

5.2.1 Research Problem

The importance of the agricultural sector in Kenya's economy cannot be over emphasised. The agricultural sector provides over 85% of the country's Gross Domestic Product. It provides employment for over 80% of the Kenyan population. Food for both those working in the agricultural sector and the other sectors of the economy comes from the agricultural sector. The sector is only second to the tourism and wildlife industry in earning foreign exchange for the country.

Although the overall goal of agricultural policy of the Kenyan Government is to achieve self sufficiency in food production and produce surplus for export, the country is currently not self sufficient in food production. In order to meet the excess demand the country imports some food stuffs. Among the foodstuffs that the country is not self sufficient in is wheat. Wheat is also one of the seven major commodities that are "central to achieving the development goals established for agriculture in Kenya." The others are coffee, tea, maize, milk, rice, meat and horticultural crops. Apart from the commercial imports of wheat the country also receives some wheat in the form of aid from various donors to meet the excess demand and sometimes for emergency relief when production shortfalls occur, mainly due to drought.

Food imports/aid may have various effects on local food production among other effects and implications on the recipient country. They may have disincentive effects on local agricultural production in two ways. If they are sold in the open market they may have a depressive effect on prices and thus lead to reduced local production. However, if the prices are controlled then the depressive effect may not occur. In some cases food aid is used as pay for labourers in non agricultural work projects, such projects may attract agricultural labour away from agriculture thus reducing agricultural production. Food aid may substitute for commercial food imports. This substitution of food aid for commercial imports may release the foreign exchange required for the commercial food imports, which may then be used to import implements and inputs which may then be used to enhance local agricultural production. Food aid may release the land used in food production for use in producing export cash crops.

The study dealt on the consequences of receiving food imports and aid on the agricultural production of Kenya. Emphasis was placed on determining whether food imports/aid lead to reduced local food production and whether food aid substitutes for commercial food imports.

5.2.2 Objectives

The objectives of the study were to: 1) To determine whether food imports and aid cause reduced local food production, 2) To determine whether food aid substitute for commercial food imports.

5.2.3 Methodology

In order to achieve the objectives of the study, domestic supply, consumer demand, consumer income and commercial imports of wheat functions were specified and estimated for the period 1970 to 1989. Domestic wheat supply was modeled as a function of producer price and time trend as a proxy for all the other factors that influence wheat production. Three other supply equations of wheat were estimated whereby wheat aid, wheat imports and total imports of wheat, respectively, were included as explanatory variables in addition to price and time trend. Consumer income was modeled as a function of agricultural supply and government expenditure. Consumer demand of wheat was modeled as a function of price of other foods, price of wheat and consumer income. The

commercial imports equation was modeled as a function of domestic supply and wheat aid. All the equations were estimated on per capita basis and all the prices and consumer income were deflated by the consumer price index (CPI). The econometric relationships between the variables for the supply equation were estimated using ordinary least squares (OLS). The other three equations were estimated using two stage least squares (2SLS). Statistical inferences were based on the test statistics. The equations were chosen based on consistency with theoretical expectations and statistical criteria based on t statistics and F statistics as well as R^2 and the adjusted R^2 .

5.3 Conclusions

The conclusions of the study can mainly be drawn from the elasticities obtained from the estimated supply, consumer income, consumer demand and commercial imports functions of wheat. It was calculated that a 1% increase in wheat aid lagged two periods results in a 0.167% reduction in current domestic wheat supply, an increase of 1% in commercial wheat imports lagged two periods results in 0.026% decrease in current domestic wheat supply and a 1% increase in total wheat imports lagged two periods leads to a 0.085% reduction in current domestic production. A 1% increase in producer price of wheat leads to an increase of 0.820% in domestic supply while a 1% increase in domestic supply leads to a decline of 1.093% in commercial wheat imports and a 1% increase in wheat aid leads to 0.218% increase in commercial wheat imports.

From the analysis of this study it was therefore concluded that wheat imports and aid lead to reduced domestic production two years later. The time lag is possibly explained by the delay in the distribution of the imported wheat after it arrives at the port to the consumers. Another conclusion is that wheat aid does not substitute for commercial imports.

The negative effect of wheat aid on domestic wheat production is possibly through the use of some of the wheat aid as pay for labour in food for work projects which may attract some labour away from wheat production leading to reduced wheat production. The study does not establish whether this labour attraction, away from wheat production is the cause of the negative impact of wheat aid on domestic production. If this labour effect is the cause of the decline in domestic wheat supply, and the fact that the effect is very low (0.167%) and it occurs two years later, it follows that a selective distribution of wheat aid to the famine stricken people and/or use of wheat aid as pay for labourers in food for work projects that do not interfere with wheat production will have no effect on domestic wheat production. Alternatively if all the wheat received as aid is sold in the same market as the domestically produced wheat, it follows that wheat aid will not lead to decreased domestic production as the price is government regulated.

It is not clear, from the study, as to why commercial imports leads to some decline in domestic production. The possible reason for this declined domestic production due to commercial imports is that some consumers may prefer imported wheat products to domestic wheat products. Although this effect of commercial imports is very low (1% increase leads to 0.026% decline), the long term effect is not known, it might increase in

future. If the long term impact is increased decline in domestic production due to commercial imports, it follows that the government will be forced to rely more and more on imports which is contrary to its policy of increased domestic supply and save on foreign exchange. If the reason for the decline in domestic supply as a result of commercial imports, is due to some consumers preference of imported wheat, then it follows that a change in the market structure such that consumers don't distinguish between the two products, this negative effect of imported wheat on domestic production can be largely reduced if not avoided.

The positive response of wheat supply to producer price is explained through adjustment in the acreage under wheat. Wheat farmers respond to producer price increase by increasing the acreage under wheat (Maitha,1974). The positive response of domestic wheat supply to producer price may be worthwhile point for the government of Kenya to consider as domestic demand is always higher than domestic supply. However, there is a high degree of substitution between maize and wheat and therefore a producer price policy in favour of wheat cultivation could in turn adversely influence maize production which would run counter to the food needs of the greater majority of the Kenyan population (Merlink, 1985).

The more than unit elastic (1.093) negative response of the commercial imports to domestic wheat supply greatly implies that any measures taken towards increasing domestic production would largely lead to decreased commercial imports. Whether increased domestic production is to be achieved through increased producer prices or increased yields per hectare or increased wheat production or through bringing marginal

lands into wheat production or any other measure would greatly reduce the need for commercial wheat imports and therefore save on the foreign exchange spend on importing wheat.

The positive relationship between commercial imports and aid implied that no foreign exchange is saved through wheat aid and as such, in order to save on foreign exchange spend on wheat imports, the best approach, for the government, established by the study, is through increased domestic supply. However, the study has not established the best option for increasing domestic wheat supply.

5.4 Limitations of the Study

The major limitation of this study was lack of adequate data. The data available was for a short period, from 1970 to 1989. It would have been better if data were available for the period before 1970, say for another fifteen or more years. The short of period of data for the study may account for the low R^2 in some of the equations.

A second data problem was the unavailability of a price index for other foods. This unavailability of a price index of other foods led to the use of the price index of maize as a representative of other foods because maize is the main food for the majority of the Kenyan population. Although maize is main food for the majority of Kenyans, it may not be the main other food for all the wheat consumers.

A third limitation of this study was the presence of government intervention in wheat price regulation. Due to this price regulation limitation, the impact of wheat

imports and aid on domestic wheat production in subsequent years could not be captured. However, the model used in this study and results obtained were good subject to the mentioned limitations

5.5 Suggestions for Further Research

It may be of interest to establish why commercial wheat imports have some negative effect on domestic wheat production despite the presence of government price regulation. The study established a substantial decline in commercial wheat imports as domestic supply rises, it may therefore be of much interest to determine the "best" option for increasing domestic wheat supply and more so without reducing maize production.

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Appendix 1.

WHEAT DATA

YEAR	CONSUMPTION PER CAP	PER CAP PRODUCTION	PROD PRICE	DEFLAT PROD PRICE	PER CAP IMPORTS	PER CAP AID
19 -	KG/YEAR	KG	INDEX	INDEX	KG	KG
70\71	20.6	19.72395	0.154	0.0089	0.2671	0.1692
71\72	19.16	17.62639	0.171	0.0095	1.4053	0.1371
72\73	19.16	13.62055	0.174	0.0092	5.4515	0.0911
73\74	16.17	9.983974	0.195	0.0094	6.1779	0.008
74\75	13.38	12.35476	0.273	0.0112	1.0147	0.0077
75\76	17.44	10.86821	0.358	0.0123	6.1194	0.4627
76\77	17.61	13.48736	0.41	0.0128	3.6101	0.5126
77\78	14.77	11.84798	0.454	0.0122	2.3013	0.6206
78\79	17.74	11.1642	0.454	0.0104	6.1238	0.4576
79\80	18.6	13.1201	0.491	0.0105	1.3807	4.0927
80\81	19.79	12.27355	0.56	0.0105	2.9071	4.6131
81\82	19.61	12.76448	0.57	0.0095	2.8398	4.4175
82\83	29.22	13.00998	0.645	0.009	7.7232	8.4922
83\84	22.54	12.9089	0.758	0.0094	4.3658	5.2584
84\85	24.09	9.35	0.918	0.0104	7.6718	6.17
85\86	22.31	9.517954	1	0.01	7.0729	5.7157
86\87	20.03	10.63327	1.085	0.0104	5.4481	3.0509
87\88	23.69	9.02354	1.085	0.0099	9.4968	5.1656
88\89	17.06	9.21273	1.16	0.0098	3.1658	4.6817
AVG	19.41	11.99613	0.622	0.0103	4.4754	2.8765
STD	3.68	2.780794	0.38	0.0011	2.4921	2.5904
MAX	29.22	13.00998	1.017	0.0128	9.4968	8.4922
MIN	13.38	7.840772	0.154	0.0089	0.2671	0.0077

Source: Statistical Abstract and Food Aid in Figures Publications of FAO

DATA OF FACTORS INFLUENCING WHEAT PRODUCTION

Year	Producer Price of Maize Ksh/Kg	Government Expenditure Million Ksh	Consumer Income Million Ksh	Population Million	Consumer Price Index
1969\70	0.31	1679	6593	10.88	58.1
1970\71	0.28	1848	7292	11.23	59.3
1971\72	0.33	2426	8153	11.67	62.5
1972\73	0.39	3076.6	9003	12.07	64.4
1973\74	0.39	3428.2	10848	12.48	75
1974\75	0.46	3936.5	12554	12.91	84
1975\76	0.7	5179.3	16240	13.4	100
1976\77	0.77	6163.6	17908	13.85	111.4
1977\78	0.69	7240	20680	14.34	128
1978\79	0.77	9909	24991	14.86	149.6
1979\80	0.89	11935	29160	15.32	161.6
1980\81	0.95	13615	32178	16.67	100
1981\82	1	16731	37203	17.34	111.8
1982\83	1.07	19410	42554	18.04	134.7
1983\84	1.54	19961	47270	18.77	150.2
1984\85	1.75	22014	52777	19.54	88.5
1985\86	1.87	25981	61970	20.33	100
1986\87	1.98	28606	68996	21.16	103.9
1987\88	2.1	36654	80757	22.94	109.3
1988\89	2.14	39968		23.88	118.4

Sources: Statistical Abstract

MAIZE DATA

Year	Area '000Mt	Total Production '000Mt	Average Yield Kg/ha	Producer Price Ksh/Kg
1963\64	701.3	229.5	327.25	0.33
1964\65	454	187.7	413.44	0.36
1965\66	346	295.7	851.02	0.56
1966\67	447.7	403.2	900.6	0.40
1967\68	629.3	611.2	616.42	0.35
1968\69	939.4	619.2	659.14	0.31
1969\70	943.4	727.2	770.83	0.31
1970\71	974.7	835.2	856.89	0.28
1971\72	1043	943.2	904.31	0.33
1972\73	1111.6	1051.2	945.66	0.39
1973\74	1181.3	1159.2	1006.9	0.39
1974\75	1161.8	1267.2	1090.7	0.46
1975\76	1190.9	1375.2	1154.8	0.70
1976\77	1218.8	1697.1	1313.6	0.77
1977\78	1246.7	1671.4	1340.7	0.89
1978\79	1282.1	1620	1265.6	0.77
1979\80	1322.7	1606.5	1214.6	0.89
1980\81	1364.9	1688.3	1363.8	0.95
1981\82	1120	2560	2285.7	1.00
1982\83	1208	2450.1	2028.2	1.07
1983\84	1236	2214.8	1791.0	1.54
1984\85	1200	1300	1250	1.75
1985\86	1130	2440.3	2159.6	1.87
1986\87	1124	2609.4	2321.5	1.98
1987\88	1200	2732.1	2276.8	2.10
1988\89	1230	2850	2317.1	2.14
SUM	28435	39845	35434	1.57
AVEG.	1053.1	1475.7	1312.4	0.32
STD	268.79	831.59	604.79	0.09
VAR	7225.1	691550	365773	0.48
MAX	1364.9	2850	2321.5	2.23
MIN	346	187.7	327.25	0.28