THE IMPLICATIONS OF AGRICULTURAL MARKET LIBERALISATION FOR MARKET EFFICIENCY AND AGRICULTURAL POLICY IN KENYA: THE CASE OF MAIZE //

DANIEL M. G. NGUGI
B.Sc. Range Management (Nairobi)

It has already been used

A THESIS SUBMITTED TO THE FACULTY OF AGRICULTURE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

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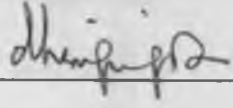
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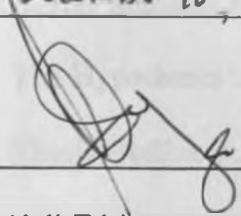
Supervisor: _____

Dr Charles Mataya

Date : _Dec 10, 1997_

Supervisor: _____

Dr Davies Ng'ong'ola

Date : _December 10, 1997_

Supervisor: _____

Mr Abdi Edriss

Date : _Dec 12 - 1997_

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ACKNOWLEDGEMENTS

DEDICATION

To my father George Gatundu, who first taught me the value of education

and hard work and my mother Peninah Wairimu, who first taught me the

value trusting in the Lord and leading a godly life - *ndingihota kumucokeria*

ngatho kuigana, no njugire Ngai witu arotwika wakumurathima, tene na

tena.

ABSTRACT

Liberalisation of food and agricultural markets has been a major component of the Structural Adjustment Programs (SAP) in many African countries. In Kenya, liberalisation of the maize market, a process that was completed about three years ago, was one of the conditionalities for SAP funding. The motive for liberalisation is to promote market efficiency. But there is no sufficient quantitative evidence as to whether this goal has been realised or not. There is need for research not only to assess this program, but also to provide information for future policy formulation.

This study was carried out to examine the implications of market liberalisations for market efficiency and agricultural policy in Kenya and to make reccommendations for the future. The study looked specifically at liberalisation of the maize market in Kenya. Market integration was used as an indicator of market efficiency. The study employed correlation and cointegration analysis to determine market integration. An Error Correction Model was used to test for *causality* among markets and examine the occurence of central markets. However, markets are complex institutions, affected by many factors besides market integration. The study therefore also employed regression analysis to determine structural factors that affect market integration.

The main data used is on retail prices from 13 markets in Kenya. Data spans the period between 1992 and early 1996, thus covering both the pre and post full liberalisation period. Data on determinants of market integration covers a number of factors including distance between markets, transport and communication network, price stabilisation policy and social disturbances.

The main lesson that emerges from this study is that market liberalisation has increased the efficiency of maize markets in Kenya. Nevertheless liberalisation on its own can not guarantee continued and increased market efficiency. There are needs such as social tranquility, reliable transport networks and information systems that need to be addressed if these efficiency gains are to be maintained and furthered.

The main implications of the study include first that the private sector has responded positively to maize market liberalisation and is running the market towards greater market efficiency, contrary to past fears that it would be unable to do so with negative implications particulary for food security. Secondly efforts should always be made to curb social disturbances and improve transport and market information systems to enhance efficiency of food and agricultural markets in Kenya.

LIST OF ACRONYMS

ADF   Augmented Dickey-Fuller Test

AFAA   African Faculties of Agriculture Association

ASS   Agricultural Statistics Section

BLUE   Best Linear Unbiased Estimators

CBS   Central Bureau of Statistics

CPI   Consumer Price Index

CSRP   Cereal Sector Reform Programm

DAAD   German Academic Exchange Service

DF   Dickey-Fuller Test

ECM   Error Correction Mechanism

EEC   European Economic Community

GDP   Gross domestic Product

GOK   Government of Kenya

IMF   International Monetary Fund

KARI   Kenya Agricultural Research Institute

KBC   Kenya Broadcasting Corporation

KSC   Kenya Seed Company

MIB   Marketing Information Branch

MIS   Marketing Information Services

MoALDM   Ministry of Agriculture Livestock Development and Marketing

MoTCOM   Ministry of Transport and Communication

NCPB   National Cereals and Produce Board

OLS   Ordinary Least Squares

SAP   Structural Adjustment program

SPSS   Statistical Package for Social Scientists

USAID   United States Agency for International Development

CHAPTER I

INTRODUCTION

1.1 Background

Many African countries embarked on a series of adjustment policies beginning mid 1980s to restore economic growth after years of economic stagnation that had been brought about by external factors and internal policy distortions. In Kenya as in many of her counterparts, liberalisation of input and produce marketing has been a major component of the structural adjustment program. Several policy distortions, most notably over-expansion of the public sector, excessive public borrowing, heavy consumer and producer subsidies, in the late 1970s and the 1980s led to poor performance of Kenyas' economy during those and later years (Swamy, 1994). The resulting economic scenario was one of high current account deficits, high inflation, and a high debt service ratio, among other things (Swamy, 1994). The situation required external funding to correct such anomalies and retrace the path of economic development.

In the food and agricultural sector, price control was the norm and marketing of major food commodities including maize, rice and wheat was the monopoly of a parastatal, the National Cereals and Produce Board(NCPB). In the maize sub-sector, prices of both maize and maize meal were controlled and movement

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of maize across district borders was restricted. Maize milling was licensed by the NCPB, which was also mandated with allocating milling quotas (Mukumbu, 1992).

Market liberalisation was a condition that was tied to the World Bank's structural adjustment loans. In 1988 grain market liberalisation began and grain movement controls were reduced and towards the end of 1993, all controls to the domestic maize market were removed. International trade in maize is still restricted to-date.

Several authors including most notably Mukumbu (1994), Sasaki (1995), NCPB (1995), Mukumbu and Jayne (1995) have looked at issues relating to market liberalisation in Kenya. Their findings generally point towards change in consumer preference from the more costly sifted maize meal to the cheaper whole grain meal, a drop in consumer prices, and entry of more millers and traders. However the implications of this market liberalisation on the performance of agricultural markets have not been sufficiently quantified. This thesis examines liberalisation of the maize market in Kenya and provides empirical evidence on its implications for market efficiency and agricultural policy.

Kenya's economy grew fast in the first two decades of independence but slowed down in later years. In 1970-1980 average annual growth rate of GDP was

6.4% but in 1980-1992, GDP grew at a slower rate of 4.0% (World Bank, 1994). Growth of the agricultural sector, the single most contributor to GDP, seems to have followed a similar trend to that of the entire economy. In 1980-1992 agriculture grew at a rate of 2.9% per annum down from 4.8% in 1970-1980 (Swamy, 1994).

The problems that led to the aforesaid Kenya's economic decline are many and diverse. The two oil shocks of 1973 and 1979 contributed to the decline, but macroeconomic policy distortions in the late 1970s and the 1980s are the greatest cause. Swamy (1994) observes that by early 1980s the public sector was over-extended. The author further observes that `Kenyanisation' of industries and the desire to industrialize rapidly created massive public sector ownership. Marketing parastatals, most notably NCPB supported high producer prices at all times and facilitated low consumer prices too. The resulting deficits were paid by the banking system and led to over-borrowing from international donor institutions.

Controls on grain movement generated rents for those who granted and obtained licenses according to (Maritim, 1982; Swamy, 1994). Swamy argues that other factors that worked to the detriment of the economy are a perverse import licensing system and regulation on the business activities including over-protection of some industries that were not only a great opportunity for rent seeking but also strangled investment and growth.

The implications of these distortions were many and diverse. For one, the over-extended public sector became highly inefficient. Swamy (1994) argues that the government had changed in the early 1980s from being a net provider of investment to a net user of private savings to finance its investment and consumption expenditure. The author observes that the current budget dwindled to zero and that the current account deficit as a percentage of GDP increased from 4% in the 1970s to 14% in 1980. Swamy further points out that:

> 'Inflation which had averaged 3% in the first 10 years of independence (in 1963), accelerated to 13% in 1981 and 22% in 1982... Borrowing on relatively hard commercial terms expanded sharply, thereby increasing the debt service ratio from less than 4% in 1977 to 13.2% in 1980'.

It is under this kind of economic scenario that the Kenya government sought for structural adjustment funds. Liberalisation of input and produce marketing was one of the components of the structural adjustment program.

The process of market liberalisation, inclusive of price decontrol, has been on in Kenya since the early 1980s. But it was not until 1988 when grain movement controls were reduced that private traders were able to enter the maize market. Movement controls of the level that existed before removal in 1988 were reimposed in 1992 before final and complete removal in December 1993. This tendency to occilate between divergent reform stands reflects the government's shaky stance on liberalisation. In this thesis, the terms pre and post-

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liberalisation are used to refer to the periods prior to and after full domestic maize market liberalisation in December 1993 respectively.

The motive for liberalisation in general is to promote marketing efficiency. A commodity market is said to be efficient when it satisfies a set of conditions including: presence of many buyers and sellers; perfect flow of information; homogeneity of product; and absence of barriers to entry and exit of market participants. But just how far this kind of situation has been realized in the case of Kenya's maize market is a question that requires to be addressed not only to enable assessment of the liberalisation program, but also to provide information that would be useful for policy formulation in the future.

This research provides the said information by performing an analysis on integration of maize markets. In a nutshell, markets could be said integrated if their prices are determined inter-dependently. Thus price changes in one market will be fully transmitted to the other markets and prices will fluctuate together in the long-run. A well integrated market is said to be efficient. A more detailed discussion of the concept of market integration and its use in analysis of market performance is given in the methodology. In this thesis, spatial market integration as opposed to inter-temporal and vertical price integration is referred to as market integration.

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The scenario before price decontrol, removal of grain movement restrictions and the monopoly of NCPB in grain marketing was one of substantial spatial price variations and inefficiency (Meilink,1987; Maritim,1982). By examining market integration before and after liberalisation, this study seeks to assess whether or not the market is more efficient than before or not.

Information on market integration would also be useful to policy makers in identifying *central markets* that could be targeted in formulating intervention strategies to ensure food security particularly in times of national food shortages. A central market is one whose prices can be used to forecast the prices of a number of other markets. The concept of central markets is discussed further in the methodology. This study examines the maize market to find out whether there are any central markets, where they are located and how market liberalisation has affected the occurrence of such markets.

However, markets are complex institutions, and market integration would be affected by factors other than liberalisation which include marketing infrastructure and production. The extent to which roads are passable for instance will determine whether two markets are linked or not and so does the physical distance between them. Dissimilar markets in terms of production are likely to trade more than similar ones. All these and other factors affect market integration and hence market efficiency. This research therefore, also examines structural factors that determine the level of integration among maize markets

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in Kenya.

1.2   Justification

There has been a general consensus that structural adjustments in ailing African economies are necessary. But just how to implement them without sacrificing key policy areas particularly with regard to food security and self-sufficiency has been an issue. Skepticism and suspicion on the workability of Structural Adjustment Programs (SAPs) has been prevalent. It is no wonder that the Kenya government's behaviour towards the SAPs particularly with regard to maize market liberalisation has been one of intermittent commitment. It is necessary therefore to quantify the implications of market liberalisation for guiding further policy formulation particularly with respect to SAPs.

Market segmentation is considered to be a reflection of an imperfect and inefficient market. Market integration has for long been used as a measure for market efficiency. Determining the extent to which markets in Kenya are integrated or segmented would tell us the extent to which they are efficient or inefficient.

Market liberalisation has the motive of increasing market efficiency. Policy makers, donors, economists and market participants would want to know if and to what extent this goal has been realised with respect to agricultural markets

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in Kenya. Policy makers would also be interested in identifying central markets that could be targeted in formulating intervention strategies to ensure food security. Information on the same could be used to justify measures that society may require to take to promote market performance.

Structural factors such as marketing infrastructure have been looked at as determinants of market integration. The question that often arises is whether liberalisation is enough to bring about marketing efficiency or there are other factors that need to be addressed. There is need to examine factors that may determine market integration in Kenya. This would give policy markers guidance in targeting areas of resource allocation to enhance market efficiency.

Maize has been chosen for this study because of several reasons. For one, maize is the staple food for the country and it is produced widely even in areas that are ecologically unsuitable for production. Liberalisation of the maize market has been a controversial issue and this would be understood since it is a staple food commodity. It is therefore important to quantify its effects on the market, not only to assess the policy but also to provide guidance for future policy formulation.

1.3   Objectives of the Study

The general objective of the study is to examine the implications of maize marketing liberalisation on market efficiency and food/agricultural policy in Kenya and to make recommendations for the future.

1.3.1   Specific Objectives

(1) To examine the effects of maize marketing liberalisation on market integration and segmentation.

(2) To determine causality among maize markets and provide information on central markets for maize in Kenya.

(3) To examine structural determinants of the integration of maize markets in Kenya and,

(4) To discuss the implications of maize marketing liberalisation for food/agricultural policy and to make recommendations for policy formulation.

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1.4   The Hypotheses .

The following hypotheses were tested:

(1) Market liberalisation has increased the efficiency of maize marketing in
    Kenya;

(2) *central markets* for maize in Kenya are located in the major consumption
    zones.

1.5   Thesis Outline

This thesis has six chapters. The chapter that follows gives an overview of the
agricultural sector and then delves into a more detailed discussion of the maize
sub-sector. The third chapter includes a review of literature on the Kenyan
maize market regulation and reform, market liberalisation and its policy
implications and structural adjustments as they relate to market integration. The
chapter also covers a review of studies on use of maket integration as a measure
of market efficiency, the concept of causality, determinants of market
integration and the theoretical underpinnings of the various models used in the
study. Chapter four describes the analytical methodology used in this study.
Chapter five provides a presentation of the results and their discussion. The
thesis closes with conclusions, implications and policy recommendations in the
sixth chapter.

CHAPTER II

KENYA'S MAIZE SUB-SECTOR

This section provides a brief overview of the entire agricultural sector - first, its structure and then its contribution to the economy. The greater part of the section is however devoted to a discussion of the maize sub-sector, with emphasis on organization of the maize market.

2.1   The Structure of Kenya's Agriculture

About 80% of Kenya's dry land mass is range land, often referred to as arid and semi arid lands (ASAL). This portion of the country is unsuitable for arable farming mainly because of low and unreliable rainfall. These range lands support about one quarter of the total human population, slightly over half of the livestock population, and the bulk of the country's wildlife.

Within the country there is a great variety of modes of production, varying from large plantation operation to small holder subsistence farming. But generally, the structure of the agricultural sector can be described as being dualistic with small-scale farmers/farms on the one hand and large-scale

farmers/farms on the other[1]. Most of the arable land is under smallholders. Swamy (1994) observes that there were 3500 large farms accounting for 39% of cultivable area in 1979. Large scale farmers keep cattle under ranching, grow wheat, maize, horticultural produce, sisal, tea and coffee. The smallholders keep small numbers of livestock and grow crops mainly maize and beans for subsistence and tea and coffee among other cash and food crops. An interesting thing is that, except in the ASAL, virtually all smallholders grow maize (Odhiambo, 1994) and this underscores the place of this crop in the economy.

2.1.1   The Role of Agriculture in the Economy

Agriculture has been called the backbone of Kenya's economy and over the years, agriculture has been the single most contributor to the country's Gross Domestic Product(GDP). Kenya's agricultural policy has encompassed the broad objective of 'attaining food security and a nutritionally adequate diet for every member of the population' (Government of Kenya 1981, quoted by Meilink 1987). Meilink notes that the specific objectives under this broad objective outlined in the governments 'Sessional Paper Number 4' on national food security were as follows:

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[1] CBS categorises small-holdings as tracts of land less than or equal to 30 acres (Sasaki, 1995). This of course does not apply in most range lands where land is communally owned.

- Maintain a position of broad self sufficiency in the main foodstuffs in order to enable the nation to be fed without using scarce foreign exchange on food imports;

- Achieve a calculated degree of security of food supply for each area of the country;

- Ensure that these foodstuffs are distributed in such a manner that every member of the population has a nutritionally adequate diet.

Stringent control of the food market was considered to be one of ways of ensuring that these objectives were realised.

Although the contribution of agriculture to GDP has been declining over the years from 45% in 1963 to 28% in 1992 (Government of Kenya (GOK). 1993), agriculture is still the single most contributor. Moreover, 75% of the population is dependant on agriculture for employment (Egerton University, 1995) and the bulk of household food needs are met from domestic production. A more productive agricultural sector will no doubt imply higher incomes, food security and contribute to other aspects of economic development.

2.2   Maize Utilisation in Kenya

Maize is a staple food in Kenya. It is consumed in all parts of the country and comprises about 24 percent of total value of food consumed in rural households and about 8 percent in urban households (Ephanto, 1992). Ephanto estimates per capita consumption of maize at 98 kgs and 111 kgs for rural and urban areas, respectively. Odhiambo estimates that 70-75% is consumed in flour form either cooked as *ugali* (a thick porridge) or *uji* (ordinary porridge). Other than in flour form, maize is consumed in mixtures with various pulses including beans and peas.

Maize is also used in making local brews, cooking oils and animal feeds. The country has quite often been self-sufficient in maize and has sometimes sold to the international market although the latter may not be foreseeable in the near future as consumption is increasing with rise in population. This becomes clear as one looks at past trends in maize production.

2.2.1   Maize Production Trends and Productivity[2]

Maize is grown in almost all agro-ecological zones in Kenya with production taking place under smallholder and large scale farming systems. About 75-80% of national maize production comes from smallholder farms while the

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[2] This sub-section draws a lot from Odhiambo (1994).

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remainder is attributed to the large scale sector (Odhiambo, 1994). Odhiambo further observes that smallholder production is largely consumed with only about 30% marketed surplus as compared to large scale production with about 80-90%. However, since smallholders occupy the bulk (about 85%) of total land under maize, they contribute the larger proportion of national marketed output estimated at 60% or more (Sasaki, 1995).

Maize acreage and production have generally been increasing since 1970 reaching a peak around 1.5 million hectares in 1994 (Table 2.1). Nevertheless acreage seems to have been declining since 1989 and production since 1986. Production has been increasing mainly due to increase in acreage and higher yields related to adoption of high yielding varieties. National output has expanded reaching about 2.9 million tons in 1986 then declining for a number of years. However production seems to be recovering since 1994 when it was about 3.1 million metric tons (Table 2.1). Productivity has been low with yields averaging at about 2 tons/hectare. Since 1970 yields have fluctuated between 1.5 and 2.42 tons per hectare, while generally declining from 1986 onwards.

Improved varieties of maize suitable for different agro-ecological zones have been developed at the Kenya Agricultural Research Institute (KARI) stations notably in Kitale, Embu, Katumani and Mtwapa. It is estimated that about 71% of the farmers in Kenya have adopted high yielding hybrid and composite

varieties (Odhiambo, 1994).

A parastatal known as The Kenya Seed Company (KSC) is responsible for production of the maize seeds with KARI being in charge of quality testing and control. Over the last few years, farmers and extension workers have accused the KCS of producing seed of low viability and if unchecked this could erode farmers confidence in the parastatal and affect maize production adversely, as this could force farmers to select their own maize seed from past harvests.

It is surprising to note that whereas hybrid variety adoption rates are relatively high, yields remain rather low. Several factors may have contributed to this scenario and the decline in output and acreage. These factors include low rainfall, poor husbandry practices, rising costs of inputs resulting in their decreased use among farmers, disincentives arising from poor policy formulations and delays in payment by NCPB (Schluter, 1984; Odhiambo, 1994).

2.2.2 Maize Production Patterns and Calendars

Although maize acreage and production have generally been increasing as pointed out earlier, this has been more of the case in the surplus Western zone than in the rest of the country which is largely a deficit zone (Gitu, 1992).

Table 2.1: National maize area, production and yield

Year	Area (000s Hectares)	Production (000s Tons)	Yield (Ton/Ha)[a]
1970	739.0	1107	1.50
1971	708.0	1494	2.11
1972	768.2	1332	1.73
1973	780.0	1296	1.66
1974	763.7	1413	1.85
1975	779.0	1692	2.17
1976	853.0	1746	2.05
1977	1002.0	2079	2.10
1978	875.0	1737	2.00
1979	938.0	1602	1.71
1980	1120.0	1773	1.58
1981	1203.0	2502	2.08
1,982	1236.0	2340	1.89
1983	1200.0	2133	1.78
1984	1130.0	1422	1.26
1985	1240.0	2430	1.96
1986	1200.0	2898	2.42
1987	1200.0	2416	2.01
1988	1230.0	2761	2.24
1989	1420.0	2610	1.84
1990	1380.0	2250	1.63
1991	1310.0	2340	1.79
1992	1407.0	2430	1.73
1993	1343.5	1755	1.31
1994	1500.0	3060	2.04
1995	1438.70	2699	1.88

Note: Source; Gitu (1992) for 1970 to 1988; Government of Kenya MOALDM (1996) for 1989 to 1995; a - Yield figures are own estimates.

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Maize production and yield in Kenya varies with agro-ecological zones which differ due to diversities of altitude, rainfall, temperature and soils. With respect to maize production, Kenya can be divided into Eastern and Western regions/zones. Odhiambo (1994) observes that the Western region comprising the Rift-Valley, Western and Nyanza Provinces produces over 60% of the country's maize while the rest of the country produces about 40% or less. Estimates show that the Rift-Valley Province leads the rest of the provinces with 45-50% of the national maize output, followed by Western Province with about 15%, Nyanza (12-15 %), Eastern (8-14%), Central (8-10%) and Coast (2-5%) (Odhiambo, 1994 citing Ackello-Ogutu and Odhiambo, 1986 and Gitu, 1992).

Due to agro-ecological diversity, some parts of the country have two growing seasons whereas others have one related to bimodal and monomodal patterns of rainfall. The lengths of growing seasons also differ. With the exception of Rift-Valley and parts of the Coast province, all other areas have at least two harvests in an year (Maritim, 1982; Kliest, 1985).

Unreliability and poor distribution of rainfall greatly affects the crop in some arid and semi-arid parts of Eastern. Coast and the Rift-Valley Provinces to the extent that some seasonal harvests fail altogether. North Eastern Province is too arid to be suitable for rain fed agriculture. In most of the Rift-Valley Province, maize is normally planted once during the long rains beginning in March

through April and harvested in September through October. Virtually all smallholders in maize growing areas plant some maize in the long rains and harvest in July through September. During the short rains beginning in October (essentially the long and more reliable rains for most of Eastern Province) about 65% of farmers plant maize (Odhiambo, 1994 citing Ackello-Ogutu and Odhiambo, 1986). Harvest then occurs in December through February for this short rains crop.

2.2.3 Regional Maize Sufficiency

The Western surplus zone comprises of the Rift-Valley districts of Trans-Nzoia, Uasin-Gishu, Nandi, Nakuru, Kericho, and part of Kajiado district (Oloitokitok) which is an occasional surplus area, Western province districts of Kakamega and Bungoma, and Nyanza province districts of South-Nyanza and Kisii (Odhiambo, 1994; Argwings-Khodek, 1992; Mukumbu and Monke, 1993). With the exception of Nyandarua district in Central province which is a maize surplus area, and Meru and Embu in Eastern province that are occasional surplus districts, the Eastern maize zone is a deficit region (Ephanto, 1992; Odhiambo, 1994; Maritim, 1982; Kliest, 1985).

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2.3 Organisation of the Kenyan Maize Market

On average, rural households (which make up 75% of the population), procure 40% of their maize requirements from the market and the rest from their own production (Ephanto 1992; Maritim, 1982). Given the variations in maize production and sufficiency in Kenya, it is necessary that a continuous flow of grain from the western surplus to the eastern deficit zone and major urban areas be maintained, to ensure availability.

2.3.1 Market Structure

As mentioned earlier the Kenyan maize market is characterised by duality with NCPB serving mainly the large scale producers and millers and the informal market serving the bulk of small scale farmers and rural consumers. There is evidence that with market liberalisation the market share of NCPB has been gradually declining from 40% of marketed output before the liberalisation program began to 30% in 1991-1992 partial liberalisation period (Odhiambo,1994). It is expected that the market share of NCPB will shrink even further with full liberalisation.

Odhiambo (1994) estimates that 70% of the smallholders sell their maize through the informal system and only 30% have access to NCPB. On the other hand large scale farmers sell 70% of their marketed output to NCPB. The

board was meant to handle all marketed maize but even in the strict control period it was unable to do so. The task of NCPB of providing maize to deficit areas and stabilizing prices was left to the informal market as 90% of all quantities sold to NCPB went to maize millers (Meilink, 1987; Maritim, 1982).

2.3.2 Maize Marketing Flows and Channels[3]

Generally maize flows from the Western surplus to the surrounding deficit areas and to the Eastern deficit zone. Other than that flow of maize occurs from the occasional surplus areas of the (otherwise) Eastern deficit zone to the chronic (or near chronic) deficit areas of the same zone.

The NCPB buys maize from surplus areas and stores it in (the boards) stores in those areas or transports it by rail or by road using its appointed agents, to stores in deficit areas (NCPB, 1996). The stores are open to purchase of small volumes of maize by the public although the main buyers are millers. The NCPB's appointed agents also operate stores where they are supposed to buy maize from small scale producers in surplus areas and sell to consumers in deficit areas. Maritim (1982) however observes that this channel has been very unreliable and some consumers in deficit areas did not know of any NCPB agents.

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[3]For a detailed description of the marketing channels, see Odhiambo (1994).

In the informal system the key participants are small scale market traders and medium to large scale lorry traders or wholesalers (Maritim; 1982; Argwings-Kodhek, 1992). The lorry traders and wholesalers buy maize from surplus areas both near and far. Argwings-Kodhek observes that lorry traders move maize between areas as far apart as Oloitokitok and Kitale (a distance of about 720 km) so long as a profit margin exists. The author also shows that there is a lot of movement between the Western surplus zone and the Eastern deficit zone. In the wholesale trade, maize is sold in 90 Kilogram bags. In the retail setting 2 kilogram *Kimbo* or *Cowboy* tins commonly known as *gorogoros* seem to be universal units of measure although 1 kilogram such tins are also used in some parts of the country (Odhiambo, 1994).

2.3.3 International Trade in Maize

Kenya is about self-sufficient in maize in most years. Over the years occasional surpluses have called for exports and deficits have necessitated imports. Such international trade has been solely in the hands of the NCPB until full domestic market liberalisation in December 1993. Table 2.2 shows the volume of the NCPB's exports between 1984 and 1995. Unfortunately imports data were not available.

Table 2.2: International trade in maize; exports by NCPB

Year	Exports (90 kg bags)
1984/85	0
1985/86	1120
1986/87	239259
1987/88	105731
1988/89	269964
1989/90	170694
1990/91	75653
1991/92	0
1992/93	0
1993/94	0
1994/95	0

Source: NCPB (1996)

In the post-liberalisation period the private sector (mainly millers and middlemen), has joined in the international trade. However, intermittent bans to private sector participation in this trade have been the norm, eroding the sectors confidence in the state's handling of this trade and contributing to domestic market inefficiency. Nevertheles millers imported 905,000 metric tons of maize in 1994 (NCPB, 1996) mainly from South Africa and Zimbabwe albeit with heavy dumping duty.

Kenya's past participation in international trade not withstanding the possibility of the country becoming a regular maize exporter are slim. The nation's maize

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requirements are increasing with increase in population. Although acreage is unlikely to increase significantly given current pressure on land, yields may increase with new technology. However, this increase is unlikely to overcome the increasing requirements in normal years. Moreover Kenya's maize producing districts are at least about 500 km from the coast and high transport and production costs coupled with fluctuating production levels offset its participation in international maize trade (Odhiambo, 1994; Shlutter, 1984).

2.3.4 Maize Storage

Both in the pre and post-liberalisation periods, the NCPB has operated more than 100 depots scattered all over the country (Odhiambo, 1994) with a total storage capacity of 20 million bags equivalent to about 1.8 million tons (NCPB, 1996). This storage network of silos, conventional stores and cyprus bins has been used largely for storage of maize and wheat. According to NCPB sources, quite often only half of the capacity is in use, the rest being idle or being utilised by relief institutions.

In the pre-liberalisation period the private sector in general including millers was not allowed to store Maize. The government viewed storage by middlemen including millers as maize stored in unsafe hands which could be smuggled out of the country or used for purposes other than human consumption (Argwings-Kodhek, 1994; Maritim, 1982). This kind of policy undercuts the ability of the

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millers and the informal market to store maize. Paradoxically, one of the arguments against market liberalisation has been that the private sector does not have the capacity (including enough storage) and commitment for the trade in maize.

Nevertheless, there is plenty of storage capacity in the hands of farmers and traders and the potential for creation of more capacity exists. Sasaki (1995)observes that physical capacity is not a binding constraint for farmers in storing maize on the farm and shows that small scale farmers have the capacity and large scale farmers would probably be able to finance building stores if necessary. He further observes that some farmers are setting up new stores. Indeed small scale farmers have always stored their maize both for domestic consumption and for sale (Maritim, 1982; Argwings-Kodhek, 1994; Mukumbu, and Monke, 1993).

Traders on the other hand have tended to store maize for spatial arbitrage other than temporal arbitrage that would be more of the case in the free market (Argwings-Kodhek, 1992; Mukumbu and Monke, 1993). The reasons for this are obvious given the market restrictions prevalent before full liberalisation and the risks and uncertainties involved in storing large quantities of maize for long periods. But it is definitely a pointer to the potential among traders for even greater storage levels for temporal arbitrage.

Currently, NCPB has been under pressure to release some of its stores to the private sector. The board has actually hired out some 11 depots, 5 to famine relief agencies the rest to third parties particularly farmers and is re-advertising more (NCPB, 1996). However the board is not offering strategically placed facilities particularly in surplus areas to the private sector but is only offering facilities in deficit areas (NCPB, 1996; Ojiambo, 1996). Such depots may not be very suitable for trade and may explain why the private sector is not taking the offer seriously.

2.3.5 Market Information[4]

One of the assumptions of a perfectly competitive market is that there is perfect flow of information. This underscores the role of information in marketing. In maize marketing, farmers need information on prices and supply of inputs, expected produce prices, and government regulations relating to production and marketing. Traders require information on prices of maize, demand and supply situation, spatial and seasonal price variations both in the current and the future periods and government regulations related particularly to procurement and movement of maize. Consumers and millers require information on prices and their variation in space and time and any regulations governing the market.

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[4] This sub-section draws mainly from discussions made with staff at both Central Bureau of Statistics (CBS) and the Marketing Information Branch (MIB) of the Ministry of Agriculture, Livestock Development and Marketing (MoALDM) during the period of data collection for this thesis.

There are several sources of information about maize marketing in Kenya.
Odhiambo (1994) outlines them as follows:

(i)   The mass media.

      - Radio and Television.

      - Daily Newspapers.

(ii)   Extension Workers.

(iii)   Provincial administration - Provincial Commissioners, District
Commissioners, District Officers, chiefs etc.

(iv)   Market Participants.

(v)   Transporters.

(vi)   Superintendents and Supervisors in local government market places.

(vii)   Special government publications such as:

      - MIB/CBS monthly market Bulletin.

      - The Kenya gazette.

The Marketing Information Branch (MIB) of the Ministry of Agriculture
Livestock Development and Marketing (MoALDM) and the Agricultural
Statistics Section of Central Bureau of Statistics (CBS/ASS) are the major
sources of market information. The two bodies collaborate through the Market
Information System (MIS) co-sponsored for the last few years by USAID and
the government.

The MIB collects early morning wholesale prices of about 40 commodities in the major markets in Kenya during the week days. These prices are then faxed to the MIB headquarters in Nairobi where they are entered into a computer data base. The same prices are tabulated and faxed by noon to the 2 major newspapers 'The Nation' and 'The Standard' and the Kenya Broadcasting corporation (KBC).

The newspapers (particularly The Nation) print out the tables from Tuesday through Saturday. The state owned radio station, Kenya Broadcasting Corporation (KBC) announces the prices after the 1300 hours news bulletin and sometimes after the 1900 hours bulletin too. But KBC price broadcasts are on and off and sometimes disappear for many months before resuming.

The CBS/ASS collects weekly retail prices of about 9 crops including maize, beans, irish-potatoes, cabbages and tomatoes. The information is mainly used for calculation of consumer price indexes. The MIS a joint venture of CBS/ASS and MIB began publishing a `Monthly Market Bulletin' in mid 1993. The Bulletin carries an overview of the past months market situation for major crops, a brief description of price collection methodology together with graphs and tables showing price trends for a few crops. The bulletin concentrates on urban market prices and is distributed mainly to personnel in the MOALDM, CBS, Marketing and Statistics Staff at district level (Odhiambo, 1994). The MIS bulletin which was issued free of charge was supposed to begin selling at

Ksh 100 early in 1994 to meet production costs (GOK/MIS, 1993). During collection of data for this thesis early 1996 the bulletin was not being published and had not been released for several months.

It seems that market information available in Kenya is insufficient as a backbone for informed decision making among maize market participants. Quite often information is availed intermitently and covers major urban markets only. Most of the market information available in Kenya has to do with prices. Very little information on forecasts, or market regulations is disseminated. The information system certainly requires improvement if it is to contribute effectively to increasing the efficiency of food/agricultural marketing in Kenya.

CHAPTER III

LITERATURE REVIEW

This chapter provides a review of literature on the Kenyan maize market regulation and reform plus market liberalisation and its policy implications mainly in Kenya. Also reviewed is the use of market integration as a measure of market efficiency, and existing literature on causality among commodity markets. The review also explores studies on structural factors that affect market integration. But before discussing these issues, a review of the well known structural adjustment programs as they relate to market liberalisation in Sub-Saharan Africa is needed.

3.1 Structural Adjustment Programs and their Relation to Market Liberalisation

As pointed out earlier economic stagnation in many African countries led to the adoption of the World Bank sponsored Structural Adjustment Programs (SAPs) beginning mid 1980s. Grain market liberalisation has often been one of the conditionalities tied to structural adjustment funding.

Structural adjustment refers to reforms of policies and institutions covering microeconomic (such as taxes and tariffs), macroeconomic (fiscal policy), and institutional interventions; these changes are designed to improve resource allocation, increase economic efficiency, expand growth potential, and increase resilience to shocks (World bank, 1988). These adjustments which have been mainly the World Bank and IMF's solutions to economic problems of developing countries (World Bank, 1992), have been necessary both to respond to various shocks (external or internal) and to rectify inappropriate policies that have hampered economic performance of the said countries (World Bank, 1990). Structural adjustments have invariably involved lending from the said institutions generally to support import financing and sectoral changes (World Bank, 1990).

Short term adjustments are associated with stabilization programs usually identified with the IMF and operate mostly upon demand, while medium to long-term adjustments are associated with structural adjustment programs of the World Bank which typically operate on the supply side (Green and Faber, 1994; and Mule, n.d). The World Banks programs initially concentrated on the production structure but later spread its conditionalities into institutional reform (Green and Faber, 1994). Reviewing adjustment in seven African countries including Kenya, World Bank staff Faruqee and Husain (1994) observe that in the said countries, 'adjustment programmes generally included reforms to:

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- establish a market determined exchange rate.

- bring fiscal deficit under control and privatise public investment.

- liberalise trade and tariff policy, liberalise agricultural price and marketing, deregulate internal prices, and similar measures.

- improve financial sector policy.

- improve the efficiency of public enterprises and labour markets.

- improve the coverage and quality of social services'.

The conditions that led Kenya to go for structural adjustment loans have been outlined elsewhere in this thesis. In Kenya, SAPs began being implemented around 1986 and liberalisation of the maize market began in 1988. In most cases, structural and sectoral adjustment lending has been tied to conditionalities that the recepient governments have been required to fulfill before the funds are disbursed. On liberalisation of agricultural prices and marketing, SAP reforms sought to disengage the government from marketing and processing activities (Swamy, 1994). Swamy further observes that in the grain market, reforms had the stated aim of having all trade managed by the private sector with deregulated prices, in which case the NCPB would maintain a limited stock for price stabilization and floor prices as the farmers' buyer of last resort. But as pointed out earlier, the governments commitment to this and other reforms was at best intermittent.

3.2   Maize Market Regulation and Reform

This sub-section covers a brief discussion on the maize market regulation along with the implications of the same, before delving into the recent reform.

3.2.1 Maize Market Regulation

In Kenya, food and agricultural prices were for a long time set by the 'price controller' in the treasury until 1986 when a price decontrol programme began to be implemented (Meilink, 1987). Controlled commodities included maize, wheat flour, milk, rice, sugar, cooking oil, and beef. Government interventions in the maize market predate World War II. They can be traced back to the 'Defence Regulations' of 1944 and the 'Maize Marketing Bill' of 1958 (Hesselmark, 1977). The Marketing Bill led to the formation of the Maize Marketing Board now the National Cereals and Produce Board. The original (1944) maize market regulations had the clear objective to produce and export surplus for the allied war effort (Hesselmark, 1977). After the war however, the maize control organisation continued to exist and has existed to the present day albeit under different names.

The Kenya government had for many years argued for continued market control based on fears that price instability would lead to a decline in production and that market failures would lead to exploitation of the producers

and consumers by middlemen. Market control of maize was a major component of risk sharing arrangement between European maize farmers and the colonial government in the pre-independence era, and a means of securing and resettling loans in post independence era (Argwings-Kodhek, 1994; Hesselmark, 1977). With time however, some policy changes took place but until the start of the Cereal Sector Reform program (CSRP) in 1986, the maize market had been under diverse restrictions. The most notable of these restrictions are movement controls, price controls and in the milling front issuing of milling quotas.

Movement controls restricted private transfer of maize across district and provincial boundaries without a permit from the NCPB. Pan-territorial and pan-seasonal prices were established annually by a price review committee for every level of the marketing chain (Argwings-Kodhek, Mukumbu and Monke, 1993). Such price controls provided very narrow profit margins and served as dis-incentives for private traders. Registration of mills and allocation of milling quotas was the mandate of NCPB. The main constraint to entry into large scale Maize milling was the license from NCPB required for construction and operation. This license could take four or more years to acquire (Mukumbu, 1992), definitely posing an indirect barrier to entry.

By and large the situation under maize market control was one of monopoly under the NCPB. The board purchased about 25% of total maize annual national production and 45% of total marketed output (Mukumbu, 1992;

NCPB. 1996).

The original stipulated role of the NCPB was to hold minimum stocks of grain for smoothing sharp price increases in consumer prices in poor harvest years and to be a buyer of last resort for producers. In practice, however, the NCPB was a buyer of first resort operating at prices close to and sometimes higher than import parity (Meilink, 1987; Swamy, 1994) and pushing out possible private trade contenders. Yet the board was unable to implement its pan-territorial and pan-seasonal maize prices and to supply particularly the rural population with maize despite its favoured position. Thus it left 55% of maize marketed output to the informal and 'illegal' market operated by private traders albeit under very restrictive and implicitly very high cost circumstances.

International trade in maize was also in the hands of the NCPB, which alone had the mandate to either export or import this commodity. Until December 1993 the private sector was not allowed to enter the international maize market. To this day the governments comitment to allowing private sector participation in International trade in maize has at best been on and off.

The NCPB's high deficits would be largely attributed to losses in international trade, not to mention national inconveniences when the board exported maize just prior to famine imports and food aid periods (Argwings-Kodhek, 1994; shlutter, 1984). Paradoxically even in the post-liberation period the NCPB has

continued this practice. In March 1996 for instance the board was still exporting four million bags of maize (NCPB, 1996; Ojiambo, 1996) even after a national alarm on impeding maize deficit due to poor harvest in 1995 and a subsequent ban on exports in January 1996. Incidentally even after freeing the market of controls government interventions in international trade remains to this day. The aforementioned ban on private sector exports coupled with the fact that the NCPB was allowed to continue exporting maize during the same period is sufficient testimony to this.

3.2.2 Implications of Market Regulation for Market Efficiency and National Resource allocation

The end result of state market interventions has been the existence of a dual marketing arrangement composed of the official market supported by NCPB and with its official (subsidised) prices that reach the urban consumer population and the informal arrangement with prices set by market forces that has prevailed for the majority of Kenyans - the rural folk. This has implied induced food insecurity for the rural populace. Several authors most notably Argwings-Kodhek (1992), Maritim (1982) and Meilink (1987) highlight on this duality.

Restricted maize movement has resulted in substantial price variations even between adjacent rural markets (Meilink, 1987; Maritim, 1994). Such price

differentials could be attributed not only to the distance between such markets but also to the permit costs which were sometimes as high as 32% of transport costs (Argwings-Kodhek, 1992).

The transport permits were not only expensive but rarely issued and the risk of bribes, jail or fine for carrying more than the legal capacity or offering bribes to some incorruptible policemen raised the price differentials even further. Thus policy driven market inefficiency led to some degree of food insecurity particularly in pre-harvest periods when the rural populace could not acquire grain at affordable prices, mis-allocation of public resources and loss of (social) welfare particularly for the majority of the rural poor.

On the milling front the board sold more than 80% of its stocks to large-scale sifted maize millers and provided more than 70% of the mills' maize grain requirements (Mukumbu, 1994). The board was mandated to license any new milling company and through its set prices implicitly dictated the situation of mills in the consumption zones adjacent to NCPB silos. Pan-territorial and pan-seasonal prices and small trade margins meant that locating firms away from consumers would be impeded by too high transport costs. Mukumbu (1992) for example shows that 76.5% of the large-scale milling capacity is located in the maize deficit zones.

This has resulted in excess (and idle) milling capacity due to spacial monopolies created by uniform prices. It is estimated that the current sifted maize meal production capacity is 1,135,884 tons, which is more than five times the national requirement estimated at 255,103 tons (Mukumbu, 1992). The funds used to create this kind of capacity have in essence gone to waste.

Millers faced problems of delay in registration and procurement of maize from the boards stores. The latter would often result in loss of consumer confidence and market share (Mukumbu, 1992). Mukumbu also points out that the poor quality of maize delivered to the mills and long delays in payment of millers underweight implied high costs to the millers.

Post-liberalisation studies (Mukumbu, 1994; NCPB, 1995) point out that consumer preference is shifting from the refined sifted maize meal to the whole meal, locally referred to as *posho*. Indeed Mukumbu and Jayne (1995) view the assumed preference for the former to have been policy driven rather than real. Past policy particularly the low consumer prices of sifted maize meal rendered it more affordable and an obvious option particularly for the urban consumers. In essence the implied consumer subsidies were a mis-allocation of public funds as they hindered free articulation of consumer preference which seems to be for the lower cost posho.

On the macroeconomic front the implications of NCPB's monopoly and subsequent market distortions have been wide and far reaching. The board has been a major drain on government budget and the economy as a whole. All along, the high producer prices and low consumer prices (Meilink, 1987), high transport and other operational costs have been met by the government (Swamy, 1994; Maritim, 1982) with a big drain on the budget.

In international trade, the board has experienced problems too, and often incurred heavy losses in subsidising the international trade. By the end of 1988 financial year Ksh 2.538 billion (75%) of the Ksh 3.394 billion total accumulated deficit of NCPB for the previous 3 years could be attributed to international trade (Argwings-Kodhek, 1994, citing Koitaba 1989). Besides such losses NCPB has been blamed quite often for miss-timing exports that take place just prior to heavy imports and food aid (Argwings-Kodhek, 1994; shlutter, 1984).

Swamy (1994) estimates that NCPB's deficit as a percentage of government expenditure was 1.3 in 1983-1984 and grew to 2.3 in 1991-92. He observes that by 1987, the board had an accumulated debt exceeding 5% of GDP which was 'written off' or taken over and paid by the government. Argwings-Kodhek (1994) observes that subsidies to the board had grown to account for 20% of the public sector budget deficit in the last decade.

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It is no wonder then that external donors notably the World Bank, EEC, USAID and the IMF have been concerned with the cereal sector reform. This is evident from the conditionalities for disbursement of their funds that were actually related to the sectoral reform (Argwings Kodhek, 1994). Most of these funds were structural adjustment loans and it is understandable that the international community was tired of seeing their funds sinking to the sustaining of recurrent expenditures of a marketing board whose efficiency was going downhill daily.

3.2.3 Maize Market Reform

Donor institutions were not the first to point out the need for reform of the maize market. Demands for a free market date back to the 1960s, as do recommendations for reduced role of the NCPB (Hesselmerk, 1977). Swamy (1994) observes that the presence of the NCPB continued to be pervasive, despite recommendations of at least seven commissions since 1942, to reduce the role of the state in grain marketing.

In 1985 the Cereal Sector Reform Program (CSRP) was launched aimed at gradually increasing the private sector's participation in the cereals market and later freeing the market altogether (Mukumbu, 1994). The cereal board's role was to be reduced to holding strategic reserves to smooth out sharp consumer price rises in poor harvest years and to be a buyer of last resort, maintaining

floor prices for producers (Swamy, 1994).

Swamy(1994) cites design flaws and lack of commitment as having been impediments to this reform. The board continued to buy maize at prices close to import parity and subsequently it remained the buyer of first resort for farmers. Proponents of market reform may have underestimated the role of various interest groups that would opt for marketing board's monopoly.

Argwings-Kodhek (1994): Mukumbu and Monke (1993) observe that most often urban consumers will be well cared for by state marketing board. They further add that some members of the government benefit from the boards in the form of employment opportunities or transfers associated with rent seeking. In the Kenyan situation where NCPB got 70% of its maize supply from large scale farms (Odhiambo, 1994), any turn of events in the maize market would be carefully watched by the rich (and almost always politically well connected) large-farm owners. For instance, in October 1992 just two months to the multiparty elections, the maize movement controls were fully reimposed after years of gradual removal, only to be removed again a year later. Mukumbu (1994) observes that this reimposition may reflect concerns about the loss of a powerful political and economic tool that has been used to gain and repay political favours.

According to the GOK/EEC five year action plan which started in 1988, partial liberalisation was to progress gradually to full grain market liberalisation by 1993 (Odhiambo, 1994). The EEC sponsored Cereal Sector Reform Program (CSRP) went on well for beans and wheat markets which were fully liberalised by the end of 1992. However the maize market reform has been very slow and controversial involving deviations from the program and opposition from powerful political groups (Argwings-Kodhek, 1994; Mukumbu, 1992; Odhiambo, 1994; Swamy, 1994).

Before the start of the CSRP, individuals were allowed to move only two-90 kilogram bags of maize per trip. This was raised to 4 bags in 1988, under the CSRP. The limit of maize movement without a permit was raised to 40 bags in 1988/89 and later to 44 bags in February 1991. In April 1992, the restriction limit was raised to 88 bags but the 2 bag rule of pre-CSRP was reimposed in October 1992 just prior to the multiparty elections two months later. The scenario persisted up to October 1993 when the limit was raised again to 88 bags before a final full market liberalisation was instituted on 27th December 1993. In the milling industry, millers were allowed to procure up to 20% of their maize requirements directly from farmers or traders and the remaining 80% from the NCPB in 1988/89 (Odhiambo, 1994). This was raised to 30% and 70% respectively in 1990/91 (Mukumbu, 1992) before a final decontrol in December 1993.

The World Bank, USAID and EEC through CSRP had over US $ 300 million in aid earmarked for Kenya, but this was tied to grain market liberalisation (Argwings-Kodhek, 1994). In 1991 the donor institutions suspended aid disbursement to Kenya for failing to meet aid-related conditionalities among them being market liberalisation.

By the end of the day the donors seem to have prevailed and the maize market was freed of all controls. The questions that need to be addressed now relate to the implications of this reform not only on the maize market but also on policy - this practice could have far reaching effects not only on the maize market but also on other sectors of the economy.

At the beginning of 1996, NCPB was going through restructuring to enable it carry out the new role of being the buyer and seller of last resort, and keeping a strategic grain reserve of 3 million bags (NCPB, 1996). The same source observed that government intentions were to fully commercialise the NCPB by the end of the year and it is in this respect that the board was reducing its storage capacity and had reduced its staff from 4150 to 3000 by the end of March 1996. How the NCPB could be fully commercialised and at the same time remain a buyer and seller of last resort is not clear.

3.3   Market Liberalisation and its Policy Implications

Various studies have been carried out to assess the effects of maize market liberalisation in Kenya. Prior to full market liberalisation, Mukumbu (1992) in a literature review of the maize milling industry's structure, costs and trading margins to evaluate the costs and efficiency implications of market liberalisation on the industry. The author concluded that market regulations has resulted in excess investment (capacity) in the sifted maize milling industry, that transportation and storage costs under a liberalised market were likely to favour location of large-scale mills in surplus regions, increased capacity utilisation and lower maize meal prices.

In a follow up study, Mukumbu (1994) examined the maize consumer and milling industry response to maize market reform in Kenya using cross-sectional data from a Nairobi maize consumption survey (done in October 1993) and an updated millers data base of his 1992 study. The results showed that only 20% of the consumers had a strong preference for the (then) state subsidised but more expensive sifted maize meal, and that in a liberalised market scenario posho mills would be able to supply (more preferred) maize meal at prices far below those charged by sifted maize millers and pose enough competition to prevent maize meal prices from rising much due to large scale firms cartels. Mukumbu further observed that expected expansion of small maize mills would increase employment and incomes and that during transitory

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food crisis, food subsidies targeting posho consumers would allow less leakages to food secure households, hence be a more cost-effective way of addressing food security problems of low income urban households than was the case under market regulation.

Mukumbu and Jayne (1995) used the Mukumbu (1994) data and estimated a logit model to quantify the importance of factors likely to affect a Nairobi household's decision to consume posho meal. Revelations of their study are similar to those realised by Mukumbu (1992 and 1994). Among other things the authors observed that only a very small proportion of the urban consumers in Nairobi had a preference for sifted maize meal and argued that an increased demand for posho would reduce the volume of imported maize required to meet domestic needs.

The National Cereals and Produce Board carried out a survey in November 1995 to find out why the board was experiencing a maize glut and large millers were experiencing low stock turn overs despite low imports. The findings of NCPB's study seem to support the observations made earlier. The survey covered 40 percent of posho millers, about 3/4 of sifted maize millers and a random sample of urban maize meal consumers. The study revealed that 90% of the consumers preferred posho to other forms of maize meal and that market liberalisation had caused the capacity of large sifted maize millers to drop by 80-90% primarily due to the competition offered by small emerging posho

(hammer) millers, 36% of which had come up in the last 3 years.

A number of studies have been carried out that assess the efficiency of the maize market both in the pre and post-liberalisation periods based on market integration. Maritim (1982) studied the structure and performance of the maize marketing system on the basis of a 1976/77 market survey done by the Market Development Project of the then Ministry of Agriculture and a 1977/78 price information survey by CBS. Maritim used wholesale price correlations among rural markets and concluded that the markets were poorly integrated implying an inefficient pricing mechanism. He observed higher segmentation among regions where (NCPB) licensed traders had a huge market power. Maritim suggested that the market structure was such that where the licensed traders wielded great power they could have been colluding thereby contributing to market inefficiency. Apart from collusion, the author attributed inefficiency to the tight movements controls.

Odhiambo (1994) used correlation coefficients of weekly wholesale prices from MIB/MIS covering 1992 and 1993, to evaluate performance of the maize market on the basis of spatial integration[5]. The analysis showed high correlation coefficients between markets which would imply high market integration and market efficiency even during market control. This anomaly (that markets could

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[5]The section that carries this analysis is attributed to Phillip Steffen of the Kenya Marketing Development Program.

be integrated even during market control) can be attributed to the limitations of the methodology used, which are outlined elsewhere in this thesis.

Sasaki (1995) used monthly wholesale prices, and compared 1992 pre-liberalisation period with 1994 post-liberalisation period based on absolute values of the differences between each 2 markets. The author observed that in 182 out of 231 cases, there were lower price differences in 1994 than in 1992. A non-parametric signs test gave strong evidence that price differences had narrowed and Sasaki viewed liberalisation as one of the possible causes for this positive change.

In Malawi, Goletti and Babu (1994) used correlation coefficients of monthly retail price levels, differences and cointegration techniques to measure market integration. Comparing results in the period before and after liberalisation of the maize market, the authors concluded that liberalisation has increased market integration. There were more markets that were highly correlated (using levels and first differences) and cointegrated (from the cointegration model) in the post-liberalisation period.

3.4 Review of Past Methodologies and Theoretical Underpinnings of the Models

3.4.1 Market Integration Analysis

Spatial market integration refers to the extent to which prices in one market respond to price fluctuations in other markets. The concept of market integration derives from the idea of a perfectly competitive market. A perfectly competitive market is one which has a large number of buyers and sellers, perfect flow of information particularly on prices, homogeneity of product, and no barriers to entry of market participants. Such a market is said to be efficient and a 'single price' will prevail in all spatially separated markets. Prices will only differ in relation to storage and transfer costs incurred as commodity moves from one market to another. That being the case, changes in commodity prices will be transmitted from one local market to the other, so that in the long-run prices fluctuate together. Thus co-movement of prices is the intuition behind market integration. Various methods have been used to determine market integration in the past most notably correlation of price levels, correlation of price differences, and cointegration analysis.

3.4.1.1   Correlation of Price Levels

The coefficients of bivariate correlation of prices in spatially separated markets provide the classical tool for measuring market integration (for example Lele, 1971 for India; Farruk, 1970 for Bangladesh; Maritim, 1982 for Kenya). The magnitude and significance of the correlation coefficients have been used to indicate the level of market integration.

Correlation coefficients range between $+1.00$ and -1.00. The higher the coefficient the higher the degree of integration. A correlation coefficient of 1.00 could imply perfect market integration resulting for perfectly competitive markets, unless a priori knowledge provides reasons for suspecting a monopolists dominance and/or manipulation of the market. Own and other peoples (Odhiambo, 1994) observation of the market in the post-liberalisation period, already discussed earlier, provide no basis for suspecting this. Moreover even in the pre-liberalisation period, the gross inability of the NCPB to maintain pan-territorial and pan-seasonal prices (Maritim, 1982; Meilink, 1987; Argwings-Khodek, 1992) would imply a more segmented than integrated market. A negative coefficient indicating a negative linear relationship between markets, would imply some degree of segmentation and the absence of market integration.

Several authors have used correlation of price levels as a measure of market

integration including: Goletti and Babu (1994) in Malawi; Odhiambo(1994) in Kenya; and Maritim (1982) in Kenya too. Except in the last study, authors report quite high coefficients which would imply high market integration. Nevertheless, use of correlation coefficients has been challenged the most prominent concern being that price levels, like most economic time series are usually non-stationary, that is, they have non-constant variance, mean and covariance. Other arguments against use of the coefficients are that they mask the presence of synchronous factors such as inflation, seasonality, population growth and public policy (Goletti, 1994; Odhiambo; 1994; Baharumshah and Habibulah, 1994). This being the case, coefficients derived from such correlations would simply be spurious and any conclusions drawn from such analysis would be baseless.

Various studies have suggested ways to overcome the said shortcomings of correlation of price levels. Maritim (1982) suggests using only coefficients of 0.7 or above, Odhiambo (1994) suggests that coefficients below 0.9 may be suspect and others suggest use of price differences instead (Goletti, 1994; Goletti and Babu, 1994). The aforesaid limitations and suggestions notwithstanding, bivariate correlation coefficients continue to be used as a measure of market integration. This study employed the same method not so much as a tool for examining market efficiency but with the aim of comparing the results with those of other methods.

3.4.1.2   Correlation of Price Differences

Besides correlation of price levels, correlation of first price differences has also been used to examine market integration in past studies. Goletti (1994) has applied correlation of first price differences to examine integration of rice markets in Bangladesh. The author's findings are that 50% of the markets are integrated indicating a moderate degree of integration among the rice markets. Goletti and Babu (1994) use the same technique to measure integration among maize markets in Malawi. In their study, correlation coefficients are quite low, a thing which as they observed suggests low degree of integration.

In Egypt, Goletti, Badiane and Sil (1994), assess the impact of market reform on integration for wheat, rice and maize using correlation of first price differences. They observe that coefficients are generally higher in the period after reform than they are in the period before showing that reform has increased market integration and had a positive impact on market efficiency.

Besides correlation of price levels, bivariate correlation of price differences was used in this current study to measure market integration. Price differences help to interpret market integration as interdependence of price changes. Besides, differencing removes trends and quite often induces stationarity in an otherwise non-stationary series hence solves problems of spurious · correlations. Correlation of price differences is therefore undoubtedly a superior technique

to correlation of price levels.

3.4.1.3 Cointegration Analysis

Time series methods of measuring market integration have been introduced and used in recent studies. Cointegration techniques developed by Engle and Granger in the 1980s' have been used extensively in the study of market integration for instance by Goodwin and Schroeder (1991), Goletti Ahmed and Farid (1995), and Baharumshah and Habibulah (1994).

Cointegration implies the co-movement of two time series so that in the long-run there is a constant linear relation between the two (Engle and Granger, 1991). Use of cointegration in market integration is based on the idea of stationarity. If a time series is stationary, its mean, variance and covariance are independent of time (Gujarati, 1995). Regressions done using non-stationary time series give spurious results and t and F statistics that can not be relied on for inference.

Time series data usually exhibit non-stationarity. Cointegration techniques not only provide measures of market integration, they also overcome the problem of non-stationarity among economic time series. Two economic series are said to be cointegrated if there is some linear combination of them that is stationary.

The concept of cointegration may be presented as follows:

If a series X_t is non-stationary but its first difference is stationary, then it is said to be integrated of order one or simply integrated, and could be represented as $X_t \sim I(1)$[6]. Otherwise if X_t is stationary it is said to be integrated of order zero and denoted as $X_t \sim I(0)$.

If two time series X_t and Y_t are both I(1) then in most cases the linear combination $Y_t - \alpha - \beta X_t = \epsilon_t$ is also I(1). But, it is possible that ϵ_t is *stationary*, or I(0). This will only happen if the 'trends' in X_t and Y_t cancel out when $\epsilon_t = Y_t - \alpha - \beta X_t$ is formed. If and only if this is the case then X_t and Y_t are said to be cointegrated with β as the *cointegrating parameter/coefficient* [7]. In general a pair of series X_t and Y_t are said to be cointegrated if they are individually I(d) (where d is the order of integration), but there exists a linear combination of them, $\epsilon_t = Y_t - \alpha - \beta X_t$, that is I(0).

The task in cointegration analysis is therefore two fold. The first part is to find out if each of a pair of time series is stationary and if either or both are not stationary, to difference the series until stationarity is achieved. Secondly, if and only if, the two series have the same order of integration (whether or not they are individually I(0)), to regress one on the other and find out if the error

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[6] Integration or economic integration here means the number of times the series needs to be differenced before attaining stationarity.

[7] See Griffith, Hill and Judge (1992) and Gujarati (1995) for further discussion of this concept.

term is stationary or I(0).

A number of authors have used cointegration analysis in the study of market integration. Goletti and Babu (1994) use cointegration techniques in their analysis of maize market integration in Malawi. The authors worked with data that covered both the period before and after market reforms. The *Augmented Dickey-Fuller (ADF) test* revealed that all series were I(1), and that most of the markets were integrated with the period after reform having more integrated markets than the period before.

Goletti, Badiane and Sil (1994) employed the same techniques on wheat, maize and rice data across Egyptian markets. All the series were I(1), and most of them had a long term stable relationship showing that the market had little segmentation.

Cointegration techniques have also been used to determine economic integration in studies with no marketing aspects. Abdulai and Rieder (1996) used *Dickey Fuller* (DF) and Augmented Dickey-Fuller (ADF) procedures to examine the order of economic integration in their study of price policy and cocoa supply in Ghana. Their data gave mixed results with some series being I(0) and others I(1).

Literature provides several techniques that could be used in examining the above. These include: the *autocorrelation functions* (correlogram); several *Unit-root tests* such as the *Dickey-Fuller(DF) test* , the *Phillips-Perron test*, the *Johannsen and Juselius*, and the *cointegrating Regression Durbin-Watson test*[8].

This study used the Dickey-Fuller tests and specifically a latter version of the same the Augmented Dickey-Fuller tests for analysis. This test was chosen for its straight forwardness, widespread usage, and availability of the relevant critical values.

4.1.2 Causality Testing: The Central Market Hypothesis

The central market hypothesis derives from the concept of *causality* which means *contributing to predictability* (Goletti and Babu, 1994) or simply *precedence* (Madalla, 1988) If past prices of one market A can be used to forecast the prices in an other market B, then market A prices are said to cause market B prices. If market A prices cause prices of several markets, then market A can be interpreted to be a central market. Thus a central market is one whose past prices can be used to forecast prices in other markets. A weaker version of centrality exists where price changes are restricted to a region, so that there are regional centres (Goletti and Babu, 1994).

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[8]See Gujarati (1995) and White (1993) for further discussion.

Causality could be unidirectional where A causes B (or vice versa) without the reverse being true, it could be bidirectional where A causes B and the reverse is true or there could be independence where no series Granger causes the other (Gujarati, 1995). There is a central market if prices in that market Granger cause prices in other markets in a unidirectional way. The presence of central markets would invariably mean that there is radial transmission of prices (and price changes). Central markets could be targeted in times of food shortage to transmit price signals to other locations.

Several tests have been developed and used to test for causality among economic time series including the Granger test, and Sims' test (Madalla, 1988). The Granger causality test is based on the assumption that the past is key to the present. Thus considering two series (Y_t) and (X_t), the series X_t fails to *Granger Cause* Y_t if in a regression of Y_t on lagged X's and lagged Y's, the coefficients of the latter are zero (Madalla, 1988). On the other hand Sim's test is based on the assumption that the future can not cause the present, so that regressing Y on lagged, current and lead values of X, if X is to cause Y, then the sum of the coefficients of the lead X terms must be statistically equal to zero(Gujarati, 1995). As Gujarati observes, the choice between Sim's and Granger causality tests is not clear. However, the Granger test is more widely used, and is simpler.

The traditional Granger and Sim's tests seem rather lenient. In recent past error correction representations have been used to test for causality for instance by Goletti and Babu (1994); Goletti, Badiane and Sil (1994). Goletti and Babu (1994) using an error correction mechanism(ECM) in studying the maize in Malawi observe central markets in major cities. Goletti, Badiane and Sil (1994) use a similar approach in their study of Egyptian maize and wheat market s and get similar results - central markets are located in major urban areas although the capital, Cairo is not central. The later observation is explained by the fact that the capital is very close to two other markets that overshadow its importance. Mendoza and Rosegrant (1992) use the traditional Granger causality test for determining central markets for corn in the Phillipines. The authors observe Manila, the capital to be central.

The link between cointegration and error correction is that two cointegrated series can be represented using an error correction mechanism - the (short term) disequilibrium in one period is corrected in the next period. Cointegration implies that the system follows an error correction representation and conversely an error correction system has cointegrated variables (Engle and Granger, 1991).

The error correction mechanisms (ECMs) are more stringent as compared to Granger and Sim's tests, because they include use of longer lags to capture the dynamics of short-run adjustment towards long-run equilibrium. The Error

correction representation of the Granger test was used in this study, to test whether there are any central markets for maize in Kenya, find out where they are located and shed light on how liberalisation has affected location of these central markets.

3.4.3 Assessing Structural Determinants of Market Integration

Market integration is the result of the actions of traders as well as the operating environment determined by the infrastructure available for trading and the policies affecting price transmission. Because markets are complex institutions, it is not enough to rely solely on price information to assess market integration and subsequently market performance.

The impact of the Kenyan Rural Access Road Program (Rhodes, 1993) is a case that shows how some factors may affect market integration. Rhodes observes that evaluation of this programm showed a 51% rise in sale of farm produce in the areas sorrounding the rehabilitated access roads. The same author predicts improved movement of commodities between markets linked by rural roads under rehabilitation by the Kenya Marketing Development Program. The author observes increased traffic on roads already rehabilitated and expansion of cultivated land in areas across which the roads pass.

Market integration and performance are a result of numerous factors including marketing infrastructure, policy and production characteristics. Marketing infrastructure relates to transportation, storage and communication (as these contribute to lowering transaction costs), and credit. Policy relates to such things as price stabilization and grain movement control. Production affects market integration through the degree of dissimilarity in commodity self-sufficiency among markets. High transport costs may be due to long distances between two localities or due to poor roads that call for high vehicle maintenance and time costs or even due to social disturbances that cause undue delays and risks hence increase costs.

Price stabilization policy (storage and subsequent release) affects market integration in a complex way. If may either enhance price co-movement as grain releases offset seasonal and annual fluctuations or it may hinder price transmission by obscuring price signals, particularly so if it is unpredictable. Distribution of maize stores and more so stocking practices that polarise regions into deficit and surplus zones, could even enhance trade between these 'dissimilar' areas and enhance market integration so long as there are no commodity movement restrictions.

Production affects market integration in that, dissimilar markets are likely to be more integrated than similar markets. By creating deficit and surplus regions albeit for short periods, production shocks may enhance market integration. But

severe and longer term production shocks like floods that disrupt other factors e.g., transportation could also cut off deficit and surplus regions hence hinder price transmission. Social disturbances affect market integration as they disrupt transportation and trade thus segmenting the markets. Serious social disturbances could even de-link two markets one from the other.

Thus although the market may be liberalised, such factors as unusable roads, poor telephone facilities, social unrests and intermittent policy changes may hinder effective transmission of price signals among spatially separated markets. It is important to find out what factors besides liberalisation affect market efficiency. Implementing corrective measures on factors with negative effects and enhancing factors with positive effect, would go a long way in enhancing market efficiency and society welfare.

Very few studies have focused on this vital aspect of market integration. Goletti (1994) and Goletti, Ahmed and Farid (1995) use a linear regression model to assess the contribution of various structural factors to the integration of the rice market in Bangladesh. In both studies, the coefficient of correlation of price differences, the cointegration coefficient, a long-term measure of market integration, and a composite measure of market integration involving magnitude and speed of adjustment, were regressed on the various factors thought to influence market integration. These factors were distance between markets, density of road network, density of rail network, number of strikes, telephone

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line density, density of bank network, price stabilisation policy measured by the absolute value of correlation of prices and end-of-period public grain stocks in each district, production dissimilarity between districts, and number of production shocks such as floods drought and cyclones. Both studies observed that road infrastructure, production dissimilarity and production shocks affected market integration positively; distance between markets and strikes had a negative effect: stabilization policy had positive effects with some measures of market integration and a negative effects with others; railway density, bank branches and telephone density gave dubious results.

This study used an approach that is similar to that used by Goletti(1994) and Goletti, Ahmed and Farid (1995) but with some modifications in the variables. Multiple regression and bivariate correlation were used to model and represent structural determinants of market integration. The coefficient of correlation of price differences and the cointegration coefficients were regressed (separately) on the various factors thought to affect market integration as outlined later in the methodology. This was only done for the period after full liberalisation.

CHAPTER IV

METHODOLOGY

This chapter describes the methodology used to meet the objectives of the study and test the stated hypotheses. It begins with a discussion of the theoretical underpinnings of the models and then goes on to a description of the analytical models. The section goes on to description of the data and data limitations, before closing with discussion of the analytical procedures involved.

4.2 The Models

4.2.1 The Cointegration Model

A cointegration model was used to study long run relationships among price series, to pursue the first objective of the study and to test the hypothesis that market liberalisation has increased the efficiency of maize marketing in Kenya. The model is based on a linear relationship among time series commodity prices:

(1) $$P_{i,t} = \alpha + \beta P_{j,t} + \mu_t$$

where $P_{i,t}$ denotes the retail commodity price at time t and location i, $P_{j,t}$ denotes the retail commodity price at time t and location j, α and β are parameters to be estimated (β is the cointegration parameter), and μ_t is the error term.

Commodity prices are usually non-stationary. However, this does not pose a problem as long as the error term μ_t is stationary for this implies that price changes in a market i do not drift far apart in the long run from another market j, or are cointegrated.

A two step procedure for evaluating the properties of a pair of non-stationary economic time series data following Engle and Granger (1991) is used. The first step - the *unit root test*, separates and tests for order of economic integration, i.e., the number of times the series needs to be differenced before transforming it into a stationary series. The finding of a unit root in time series data indicates non-stationarity. This test uses the *Augmented Dickey-Fuller* procedure.

For a price series $P_{i,t}$, two forms of the augmented Dickey-Fuller regression equations can be estimated to test for a unit root;

$$(2) \qquad \Delta P_{i,t} = \delta_0 + \delta_1 P_{i,t-1} + \sum_{h=1}^{m} \phi_h \Delta P_{i,t-h} + \upsilon_t$$

$$(3) \qquad \Delta P_{i,t} = \delta_0 + \delta_1 P_{i,t-1} + \delta_2 t + \sum_{h=1}^{m} \phi_h \Delta P_{i,t-h} + \upsilon_t$$

where υ_t for $t = 1, \ldots, n$ is assumed to be Gaussian white noise, Δ is the difference operator; m is the number of lags; and the δ's, and ϕ's are parameters to be estimated. Equation (2) is with-constant, no trend and (3) is with-constant and trend. The number of lagged terms m is chosen to ensure the errors are uncorrelated. The null hypothesis is that cointegration coefficient,

$\delta_i = 0$, that is, there is a unit root in P_i (P_i is non-stationary).

The second step involves testing the error term μ_t of the OLS regression (1) between two series (of the same order of economic integration) for stationarity. This follows the same ADF procedure as in equation 3. If the null hypothesis that the two series are not cointegrated is not accepted it implies that the series are interdependent or that there is non-segmentation between the two.

4.2.2 The Causality Error Correction Model

The hypothesis of cointegration implies existence of an error correction representation. Such a representation can be used to test for causality. The model outlined hereafter was used to fulfil the second objective of the study and to test the hypothesis that central markets for maize in Kenya are located in the major consumption zones. According to Engle and Granger (1991), the following modified Error Correction Mechanism (ECM) can be used to represent two series that are cointegrated:

$$\Delta p_{i,t} = \beta_0^i + \beta_1^i \, p_{i,t-1} + \beta_2^i \, p_{j,t-1} + \sum_{k=1}^{k=m_i} \gamma_k^i \Delta p_{i,t-k}$$

(4)

$$+ \sum_{h=0}^{h=n_i} \delta_h^i \Delta p_{j,t-h} + \mu_t$$

where: Δ is the difference operator; m_i and n_i are the number of lags; the β's, δ and γ are parameters to be estimated and μ_t is the error term. The error

correction mechanism is provided by the sum of the third and fourth terms with their joint coefficient representing the error correction term (Engle and Granger, 1991; Abdulai and Rieder, 1996). The length of the lags is chosen so as to minimise the Schwarz criteria (Gujarati, 1995). Following Goletti and Babu (1994), the null hypothesis of causality from market j to market i can be tested as follows:

$$H_0 : \beta_2' \neq 0 \qquad \delta_h' = 0 \qquad h = 0, 1, \ldots, n$$

4.2.3 The Structural Determinants Model

As said earlier, analysis of the determinants of market integration was done using bivariate correlation and a multiple regression model. This model was used to pursue the third objective of the study. The various components of the regression model are outlined hereafter.

Transportation infrastructure and costs were incorporated in the model by introducing the road distance between markets denoted by $ROAD_{ij}$, density of tarmac roads per square kilometre in the districts of the markets that were being compared denoted by TAR_{ij}. Communication was measured by the per capita density of post offices offering telegraph services (as a proxy) denoted by $POST_{ij}$. It was intended that density of telephone lines be used but this data was not available.

Credit availability was measured by the density per square kilometre of commercial bank branches and denoted by $CREDIT_{ij}$. Policy with regard to price stabilization storage was measured by the absolute value of the per cent difference of year end (an average between 1993/94 and 1994/95) NCPB maize stocks in the districts of the markets. This is denoted by $POLICY_{ij}$.

As stated earlier, dissimilar markets in terms of levels of production are likely to be more integrated than similar markets. Dissimilarity was captured by the absolute value of the percentage difference in production per capita between the market districts, denoted by $PRODN_{ij}$. Unfortunately data covering the post-liberalisation period was not available and averages for the period between 1987/88 and 1990/91 were used with the assumption that the differences between districts have generally been maintained in later years.

Production shocks were not captured due to lack of sufficient data. Social unrest was captured as the number of strikes in the districts of the market link and along the main roads connecting the two markets. This is denoted by $SOCIAL_{ij}$. Market structure has often been viewed as a determinant of market integration and would have been represented in this model. However, data on this would be variable was not available.

The model can be represented as follows:
For each pair of markets, i and j, let INT_{ij} denote a measure of market

integration that is either correlation of price differences a_{ij}, or the cointegration coefficient b_{ij}.

Then the equation estimated can be expressed as:

(5) $INT_{ij} = f(TAR_{ij}, ROAD_{ij}, POLICY_{ij}, CREDIT_{ij}, PRODN_{ij}, POST_{ij}, SOCIAL_{ij})$

The expected signs are as follows:

Variable	Expected sign
Distance between markets	-
Tar road density	+
Credit availability	+
Policy	+/-
Production dissimilarity	+
Post office density	+
Social unrest	-

As with most cross-sectional data, problems of heteroscedasticity and multicollinearity and were expected. Heteroscedasticity would imply that the estimators though not biased would no longer be minimum (or efficient) and therefore not BLUE, according to Gujarati (1995, pp.389). Problems of heteroscedasticity would be solved by logarithm transformations or even use of generalised least square techniques. Multicollinearlity would result in estimators that have large variances and covariances and therefore make estimation difficult. Although the estimators would be BLUE, there would be no unique solution. Multicollinearity would be solved by dropping the variable(s) causing it, collecting more data, or using transformations such as differences among other approaches.

4.3   Data Description and Sources

4.3.1 Maize Price Data

Weekly retail price data for 13 markets covering 5 out of the 8 provinces of Kenya have been used in this analysis. The price data were collected from CBS/ASS in Nairobi. It was intended that at least 16 markets, 2 from each province be used but most price series had too large gaps such that usable series covered by 5 provinces.

The CBS has been collecting retail price data since around 1976 mainly for use in calculating CPI. Over the years the number and location of markets has been varied. As at March 1996 the bureau was collecting data from 64 markets scattered in all the provinces covering urban and rural areas.   Price data are collected on major market days (markets have at least one day in a week). Enumerators observe 5 to 8 transactions for each crop and record the actual price in kilograms. Prices are then averaged to arrive at weekly prices and sent to Nairobi for entry into a computer data base. It was intended that no 2 markets covered should be in the same districts but again due to missing links in the series this could not be avoided. Even then only 13 markets were considered useful at last.

Data were divided into pre and post-liberalisation periods where liberalisation stands for full maize market liberalisation. The pre-liberalisation set spans the period between January 1992 and December 1993. The set covers 100 weeks but has 35 weeks with missing values thus only the remaining 65 complete 6 weeks have been used in the analysis. The post-liberalisation set covers the period between February 1994 and March 1996. The series has 109 weeks, 24 with missing values hence 85 observations have been used.

Markets covered include *Limuru*, *Thika*, *Endarasha* (Central Province), *Embu*, *Ishiara*, *Kianjai* (Eastern Province), *Daraja-mbili*, *Riochanda*, *Sondu* (Nyanza Province), *Kapsabet*, *Kitale* (Rift Valley), *Kimilili* and *Busia* (Western Province). The markets are distributed as follows: Limuru, Thika, and Endarasha are located in the maize deficit Eastern zone, whereas Embu, Ishiara, and Kianjai are located in occassional surplus areas of the same zone. Daraja-mbili, Riochanda, Sondu Kapsabet, Kitale and Kimilili are located in the maize surplus Western zone and Busia is located in a deficit area of the same zone.

4.3.2 Data on Determinants of Market Integration

Data on the structural factors were collected from various sources particularly government ministries. Most data on district sizes are from Government of Kenya (1985) with a few are from district development reports. District

boundaries used are therefore as at 1985. Data on district roads networks was collected from the Ministry of Transport and Communication (MoTCOM) headquarters (in Nairobi). Data on post offices was compiled from the booklet 'Post Offices in Kenya'- a 1995 publication of the Kenya Posts and Telecommunications Corporation provided from the corporations survey section. The number of commercial banks per district was arrived at by compiling data mainly from annual reports of five major banking institutions namely Commercial, National, Barclays, Standard and Chartered and Cooperative bank.

District maize production data were compiled from Gitu (1992) and district public stocks data was collected from NCPB headquarters in Nairobi. District population figures were compiled from various District development Plans for the period 1993-1996. The counts of social disturbances, (labour unrests, market closures socio-political strikes/demonstrations) were compiled from issues of the three main daily newspapers namely `The Nation', `Kenya Times' and `The Standard'. Enough care was taken to avoid double counting. Road and Rail distances between markets were computed from the `Bartholomew Kenya and Tanzania World Travel Map'.

4.3.3 Data Limitations

The major limitations have to do with data inadequacy which, although it may not compromise the results of this study limits the extent to which the objectives can be achieved: First, the price data was lacking in price series for key areas most notably Mombasa, Nairobi and Garissa, the whole of Ukambani, Nakuru. The first four are chronic deficit areas, and the last is a key surplus area. Lack of data for Nairobi is considered to be a big limitation since the city has in past studies been shown to play a key role in sending price signals and was expected to be a central market in this study.

A sequel to the aforementioned limitations is that even the other markets for which price series were available were not well distributed across the various regions. The result is that markets used include Limuru and Thika in the same district and hardly 80 kms apart as well as Daraja-mbili and Riochanda. Secondly, data on number of telephone lines per district, annual district maize production figures and production shocks that were proposed to be used were not available. This problem was most prevalent for most of the districts.

4.4   Empirical Estimation

Data analysis was done using Statistical Package for Social Scientists (SPSS)and Shazam. As stated earlier data has been divided into two major periods, i.e. pre and post-liberalisation periods. Analysis has been done and comparison made between results for these two periods to capture the effect of market liberalisation.   Regression and correlation analysis was been done for the structural determinants of market integration.

CHAPTER V

RESULTS AND DISCUSSIONS

The purpose of this study was to examine the implications of market liberalisation on market efficiency and agricultural policy in Kenya and make relevant policy recommendations. Specifically the study sought:

(1) to examine the effects of maize marketing liberalisation on market integration and segmentation,

(2) to determine causality among maize markets and provide information on central markets for maize in Kenya,

(3) to examine structural determinants of the integration of maize markets in kenya and,

(4) to discuss the implications of maize marketing liberalisation for food/agricultural policy and to make recommendations for policy formulation.

The following hypotheses were tested;

(1) Market liberalisation has increased the efficiency of maize marketing in

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Kenya;

(2) *central markets* for maize in Kenya are located in the major consumption

zones.

The results presented hereafter tackle each objective in turn while presenting

the results of hypotheses tests at the same time. In examining the implications

of market integration and segmentation, the traditional bivariate correlation

analysis has been used, and augmented by correlation of price differences.

Besides, the study has moved a step further into cointegration analysis.   At

each stage, results cover the pre and post-liberalisation periods except for

analysis of the determinants of integration which covers only the post-

liberalisation period.

The coefficient of correlation for price levels and differences are reported in

tables A1.1 and A1.2 in the appendix. Table 1.1 and 1.2 provide the results of

stationarity tests for the pre and post-liberalisation periods respectively, and

Table 5.3 and 5.4 show the results for the cointegration regression for the pre

and post-liberalisation period respectively.   A comparison of the various

measures of market integration is given in Table 5.5. A summary of the

causality testing for both pre and post-liberalisation periods is given in Table

5.6, the detailed results for the same being provided in tables A3 and A 4 in the

appendix. Results for the analysis of structural determinants of market

integration are provided in Table 5.7.

From the results, we may not reject the hypothesis that market liberalisation has increased the efficiecy of maize markets in Kenya. However these results do not allow us to accept the hypothesis that central markets for maize in Kenya are located in major consumption zones.

5.1 Market Integration

Correlation and cointegration analysis was done to pursue the first objective and to test the hypothesis that market liberalisation has increased the efficiency of maize marketing in Kenya .

5.1.1 Correlation of Price Levels

The coefficients of correlation for (maize) price levels and differences between the 13 markets of study are reported in Tables A 1.1 and A 1.2 in the appendix. As said earlier, the strength of the relationship between two markets is portrayed by the size of the correlation coefficient - the larger the coefficient the stronger the relationship. Negative coefficients indicate a certain degree of segmentation among markets. The correlation coefficients for price levels were quite high and as said in the literature review this may be due to such factors as time trend, seasonality, and inflation which may cause the correlations to be dubious. These results have to be viewed with this in mind.

The coefficients for price levels were higher for the post-liberalisation period than for the pre-liberalisation period. Whereas in the post-liberalisation period all (78) coefficients were significant (at both 1% and 5%), 58 (73%) and 69 (91%) of the coefficients were significant at 1% and 5% respectively in the pre-liberalisation period.

The coefficients ranged from 0.8678 for the Kimilili-Kitale link to 0.0211 for the Busia-Embu link, in the pre-liberalisation period, and from 0.9778 for the Daraja-mbili-Sondu link to 0.2941 for the Kimilili-Kianjai link in the post-liberalisation period.

Based on the magnitude of positive coefficients, Ishiara had the strongest links with other markets implying the most integrated, while Kapsabet had the weakest links implying the least integrated in the pre-liberalisation period. Conversely, Limuru and Embu had the strongest links implying the most integrated while Kianjai had the weakest links, implying the least integrated in the post-liberalisation period. An interesting observation is that the links of Busia-Kianjai and Busia-Embu that had small and insignificant coefficients in the pre-liberalisation period, had quite larger and significant coefficients in the post-liberalisation period. Even the weak links with Kapsabet improved a great deal in the post-liberalisation period as evidenced by the higher coefficients.

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The correlation coefficients for both the pre and post-liberalisation periods had positive signs indicating that, as the prices in one market increase, prices in the other market(s) increase too and the reverse is true. One may consider this to be an indicator of inflation or even market integration. But this may not necessarily be the case given the non-stationary nature of price series.

While bearing in mind the aforementioned limitations of using correlation coefficients, the results seemed to point to greater market integration in the post-liberalisation period as compared to the period before. This may imply that maize market liberalisation has increased market integration in the post liberalisation period. Thus we may not reject the hypothesis that market liberalisation has increased the efficiency of maize marketing in Kenya efficiency.

5.1.2 Correlation of Price Differences

Differencing is meant to remove stochastic trend, non-stationarity, and related problems. Thus the correlation coefficients of the price differences are considered to be better indicators of market integration than the coefficients of the price levels. Results for the correlation of first differences are provided in Table A 1.2 in the appendix.

The correlation coefficients for the first price differences like those of the levels were higher for the post-liberalisation period than for the pre-liberalisation period. In the post-liberalisation period 13 (17%) and 20 (26%) of the coefficients were significant at both 1% and 5% respectively. Whereas in the pre-liberalisation period 9 (12%) and 17 (22%) of the coefficients were significant at 1% and 5% respectively.

The coefficients were as expected smaller than those of correlation of price levels ranging from -0.3879 for the Busia-Kitale link to 0.4701 for the Ishiara Limuru-link, in the pre-liberalisation period, and from -0.1475 for the Kapsabet -kianjai link to 0.5577 for the Kimilili-Sondu link in the post-liberalisation period.

The magnitude of the average value of the coefficients indicates that Limuru had the strongest links with other markets, which may imply that it was the most integrated, while Riochanda had the weakest links implying the least integrated in the pre-liberalisation period. In the post-liberalisation period, Sondu had the strongest links implying the most integrated, while Kianjai had the weakest links, implying the least integrated in the post-liberalisation period.

Generally, both the number of significant links and the magnitude of the coefficients increased in the post-liberalisation period. This may suggest greater market integration in the post-liberalisation period as compared to the pre-

liberalisation period, implying that maize market liberalisation has increased market efficiency.

5.1.3 Cointegration Analysis

It is important to define the criteria used to label a market link as segmented or integrated, using the cointegration model. A link between markets A and B is said segmented if there is no cointegration in either direction or rather if regressing series A on series B and regressing B on A, both yield non-stationary error terms. This implies that if there is cointegration in at least one direction, then the link is considered to be integrated. This argument follows Engle and Granger (1991). Following this definition, results from the cointegration model were quite similar to those from correlation of price differences, but differed a great deal than those from the correlation of price levels.

The first step in cointegration analysis, the unit root test, showed that all price (levels) series had coefficients that were smaller than the critical value (in absolute terms). Thus the unit root hypothesis may not be rejected and this indicates that both pre and post-liberalisation data had non-stationary series (Tables 5.1/5.2). However, all the series attained stationarity after the first differencing or they were I(1) - the coefficients were larger than the critical values at both 5% and 10% levels of significance and so they could be

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Table 5.1: Stationarity tests for pre-liberalisation period

Price Levels			First Differences	
Market	Cointegration Coefficient	No of lags	Cointegration Coefficient	No.of lags
Limuru	-1.89	0	-5.99	1
Thika	-1.78	2	-5.98	2
Endarasha	-1.84	6	-6.54	1
Embu	-1.17	5	-3.85	5
Ishiara	-2.07	0	-3.33	4
Kianjai	-2.21	0	-4.96	2
Daraja-mbili	-0.29	1	-6.32	1
Sondu	-2.24	2	-5.71	2
Riochanda	-1.94	1	-4.50	3
Kapsabet	-0.08	0	-6.65	1
Kitale	-2.19	1	-6.72	2
Kimilili	-2.24	0	-4.22	1
Busia	-1.75	1	-6.63	2

Note: The Augmented Dickey-Fuller test was done for each price series. The 5% and 10% critical values are -2.86 and -2.57 respectively.

Table 5.2: Stationarity tests for post-liberalisation period

Price levels			First differences	
Market	Cointegration coefficient	No.of lags	Cointegration coefficient	No.of lags
Limuru	-1.08	1	-9.23	1
Thika	-1.55	3	-10.27	1
Endarasha	-1.45	8	-15.68	0
Embu	-1.21	2	-19.25	0
Ishiara	-1.04	8	-6.43	1
Kianjai	-2.43	0	-22.20	0
Daraja-mbili	-1.06	0	-18.82	0
Sondu	-1.86	8	-22.52	0
Riochanda	-1.38	1	-13.38	0
Kapsabet	-1.28	3	-16.11	0
Kitale	-1.80	0	-18.49	0
Kimilili	-1.29	0	-15.76	0
Busia	-1.49	0	-18.68	0

Note: The Augmented Dickey-Fuller test was done for each price series. The 5% and 10% critical values are -2.86 and -2.57 respectively.

cointegrated.

In the second step involving cointegration regression, all the series were tested, since they all had the same order of integration, I(1). The test results (Tables 5.3 and 5.4) show that most markets are not integrated in either period. However, there are more links that are cointegrated in the post-liberalisation period than in the former.

Table 5.3: Integrated market links; pre-liberalisation period[a]

Link	Market i	Market j	Coefficient (β_i)	Coefficient (β_j)
1	Limuru	Thika	-3.44	-3.69*
2	Limuru	Endarasha	-3.79	-3.50
3	Thika	Endarasha	-1.92	-4.00*
4	Thika	Ishiara	-3.93	-3.88
5	Thika	Daraja-mbili	-3.59*	-1.41
6	Thika	Riochanda	-1.86	-3.57
7	Thika	Kitale	-3.18	-2.41
8	Endarasha	Ishiara	-4.16	-5.19
9	Embu	Ishiara	-2.98	-3.48
10	Embu	Kianjai	-3.20	-3.04
11	Ishiara	Kianjai	-2.56	-3.72
12	Ishiara	Daraja-mbili	-3.05	-0.80
13	Kianjai	Kapsabet	-2.47	-1.25
14	Sondu	Daraja-mbili	-3.54	-0.77
15	Sondu	Busia	-3.13	-2.85
16	Riochanda	Daraja-mbili	-3.61	-2.56
17	Riochanda	Kapsabet	-3.73	-3.22
18	Riochanda	Busia	-3.15	-2.18
19	Kapsabet	Daraja-mbili	-4.25	-3.17

[a] An integrated link between market i and market j is one for which either of the (cointegration) coefficients β_i or β_j is above the critical value. Where trend variable is required to induce stationarity, the values are marked with asterik. The critical values (for P≤0.01) are -4.32 and -3.9 with and without trend respectively, -3.78 and -3.34 (for P≤0.05) with and without trend respectively

Table 5.4: Integrated market links: post-liberalisation period[a]

Link	Market i	Market j	Coefficient (β_{ij})	Coefficient (β_{ji})
1	Limuru	Thika	-2 89	-3 09
2	Limuru	Ishiara	-1.84	-3 58
3	Limuru	Kianjai	-1.01	-3 05
4	Limuru	Riochanda	-2 98	-3.42
5	Limuru	Kitale	-2.21	-3 63
6	Limuru	Busia	-3 06*	-2.08
7	Thika	Embu	-3 46	-2 95
8	Thika	Ishiara	-3.52	-2.96
9	Thika	Daraja-mbili	-3.26	-3.10
10	Thika	Sondu	-3 30	-3 30
11	Thika	Riochanda	-3.16	-2.49
12	Endarasha	Embu	-2.66	-3.37
13	Endarasha	Kitale	-2.47	-3.10
14	Embu	Ishiara	-3.25	-2.50
15	Embu	Daraja-mbili	-3.35	-4 14
16	Embu	Riochanda	-3.58	-3.37
17	Ishiara	Sondu	-3 32	-3.07
18	Ishiara	Riochanda	-3 26	-2.91
19	Ishiara	Kapsabet	-3.31	-2.78
20	Kianjai	Daraja-mbili	-3 05	-1 06
21	Kianjai	Sondu	-4.02*	-1.07
22	Daraja-mbili	Riochanda	-4 86	-4.79
23	Daraja-mbili	Kapsabet	-3.50	-2.72
24	Sondu	Riochanda	-5 49	-5 33
25	Sondu	Busia	-3.78*	-3.66*
26	Riochanda	Kapsabet	-3.09	2.75
27	Riochanda	Kimilili	-3 59*	-2 90
28	Riochanda	Busia	-5.12*	-4.76*

[a] An integrated link between market i and market j is one for which either of the (cointegration) coefficients β_{ij} or β_{ji} is above the critical value. Where trend variable is required to induce stationarity, the values are marked with asterisk. The critical values (for P≤0 01) are -4 32 and -3.9 with and without trend respectively, -3 78 and -3.34 (for P≤0.05) with and without trend respectively

At a liberal 10% level of significance, there were 28 (or 36%) integrated links in the period after full liberalisation as compared to 19 (24%) links in the former period. At the more strict 5% level 15 (24%) links were integrated in the post-liberalisation period as compared to 11 (or 14%) links in the pre-liberalisation period. Markets differ in the number of links that were

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cointegrated. In the pre-liberalisation period Ishiara and Thika took the lead with six integrated links each, while Kitale and Kimilili had none. In the post-liberalisation period Riochanda with eight had the most, followed by Limuru, Thika and Ishiara with six cointegrated links each. Kimilili with one and Kitale with two had the smallest number of integrated links.

An important observation is that markets with the largest number of integrated links in the pre-liberalisation period also had the largest number in the post-liberalisation period, and the reverse was true. Limuru was an odd market in this case - the number of integrated links rises from two in the pre-liberalisation period to six in the post-liberalisation period. There was a common denominator for all the markets however, namely, that the number of integrated links increased with market liberalisation. These results seem to indicate that market liberalisation has increased market integration hence also market efficiency. A summary of the results is presented in Table 5.5, together with results from the bivariate correlations for comparison purposes.

5.1.4 Comparison of the Measures of Market Integration

A comparison of the various measures of market integration is provided inTable 5.5. Whereas it may be considered acceptable to compare results from the correlation of price differences with those from the cointegration model, it may not be the case in comparing the results from these two methods with those

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from correlation of price levels. The price differences were stationary, as were the error terms that were used in classifying a link as integrated in the cointegration model, but the price levels were non-stationary and their correlations gave results that are considered to be suspect as observed earlier. Nevertheless, as mentioned in the literature review, correlation of price differences has been used in measuring market integration in the past and it is for this reason results from this method are included here.

Table 5.5: Comparison of the various measures of market integration by liberalisation period: Percentage of Integrated links

Measure	Probability	Pre-Liberalisation	Post- Liberalisation
Correlation of Levels	0.01	73	100
	0.05	91	100
	0.10	96	100
Correlation of Differences	0.01	12	17
	0.05	22	26
	0.10	27	35
Cointegration Coefficient	0.01	4	5
	0.05	14	19
	0.10	24	36

Irrespective of the period, the coefficients of correlation for the (stationary) price differences were lower than those for the (non-stationary) price levels. On the other hand results from the cointegration analysis seemed to be more similar to those from the correlation of price differences with respect to the proportion of significant links, but quite different from the correlation of price levels as depicted in Table 5.5. This may be related to the similarities of the first two methods mentioned earlier.

Whereas all the correlation coefficients for the price levels had positive signs, the signs for the coefficients of price differences were mixed, i.e, either positive or negative. As said earlier the negative signs for correlation of price differences indicate market segmentation. There was very little similarity between the various measures of market integration insofar as their indication of the particular markets that were integrated is concerned. There was no common factor for all the three measures in this regard. Both the correlation of price levels and the correlation of price differences indicate that Kianjai had the least integrated links in the post-liberalisation period whereas both the correlation of price levels and cointegration analysis indicated that Ishiara and Limuru had some of the most integrated links in the pre and post-liberalisation periods respectively.

In comparing the various measures of integration, the number of integrated links varies with the level of significance, as the summary of results (Table 5.5) shows. The post-liberalisation period seems to have had more integrated links at higher confidence intervals. However, taking the moderate significant level of 5%, correlation coefficients of price levels showed that all the market links were integrated in the post-liberalisation period as compared to 91% in the period prior to (full) liberalisation. Correlation of price differences on the other hand showed about 22% non-segmented market links in the pre-liberalisation period and 26% in the post-liberalisation period.

Conversely, cointegration analysis showed about 19% integrated links in the post-liberalisation period as compared to 14% in the former. In both periods, the proportion of integrated markets seemed to diminish as more stringent measures of market integration are applied to the data. Thus correlation of the levels showed the highest followed by correlation of differences and then cointegration regression. However, the results from correlation of price levels should be taken with the caution raised earlier - the non-stationary nature of price levels makes their correlations to be suspect. These results put into question exclusive reliance on one measure of market integration and particular if that measure is correlation coefficients of price levels (given that most price series are non-stationary).

5.2   Causality Testing

To fulfil the second objective of the study and to test the hypothesis that central markets for maize in kenya are located in the major consumption areas, causality testing was carried out. This was only done for cointegrated markets - the assumption is that only cointegrated markets can have a causal relationship. Once more, most market that were tested for causality passed the test. A summary of the results is presented in Tables 5.6 and a broader form in the appendix (Tables A3 and A4).

Table 5.6: Summary of causality testing[b]

Link	Market I	Market j	Direction of causality
Pre-liberalisation period			
1	Limuru	Thika	→
2	Limuru	Endarasha	→
3	Thika	Endarasha	→ ←
4	Thika	Ishiara	→ ←
5	Thika	Daraja-mbili	→ ←
6	Endarasha	Ishiara	→ ←
7	Embu	Ishiara	→
8	Embu	Kianjai	→ ←
9	Ishiara	Kianjai	→
10	Ishiara	Daraja-mbili	→
11	Kianjai	Kapsabet	→
12	Sondu	Daraja-mbili	→ ←
13	Sondu	Busia	→ ←
14	Riochanda	Kapsabet	→
15	Riochanda	Busia	→
16	Kapsabet	Daraja-mbili	→
Post-liberalisation period			
1	Limuru	Ishiara	→
2	Limuru	Riochanda	→
3	Limuru	Kitale	→
4	Limuru	Busia	→
5	Thika	Embu	→
6	Thika	Ishiara	→
7	Thika	Daraja-mbili	→
8	Thika	Sondu	→ ←
9	Thika	Riochanda	→
10	Endarasha	Embu	→
11	Endarasha	Kitale	→
12	Embu	Ishiara	→
13	Embu	Daraja-mbili	→
14	Embu	Riochanda	→
15	Ishiara	Riochanda	→
16	Ishiara	Kapsabet	→
17	Daraja-mbili	Riochanda	→
18	Daraja-mbili	Kapsabet	→ ←
19	Sondu	Riochanda	→
20	Riochanda	Kapsabet	→
21	Riochanda	Busia	→

b. The direction of arrow indicates direction of causality. Arrows in both directions indicate bidirectional causality.
Only links with significant causality have been tabulated.

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Causality in the pre-liberalisation period was more bi-directional than in the post-liberalisation period, indicating a greater tendency towards the emergence of strong central markets in the post-liberalisation period. This may be viewed as a positive effect of liberalisation on market integration.

In the pre-liberalisation period there was no distinct central market that unidirectionally causes many markets. However Daraja-mbili was central to two markets while Thika, Endarasha, Ishiara, Riochanda and Kapsabet were central to one market each. Causality tests showed Riochanda as a central market during the period after full market liberalisation. The market Granger caused six markets namely, Limuru, Thika, Embu and Ishiara in the Eastern zone and Daraja-mbili and Sondu in the Western zone. Other `influential' markets included Embu, Daraja-mbili, Kapsabet, Kitale and Busia each of which were central to two markets, and Limuru which was central to one market.

Although there were central markets in both production and consumption zones, the surprise may be that the distinctly central market of Riochanda is located in the production zone. This is contrary to the findings of Mendoza and Rosegrant (1992) in Philippines and Goletti and Babu (1994) in Malawi who showed central markets in major urban centres which are essentially consumption areas. But again the limitations of the data used, particularly the fact that major urban markets were missed out, must be borne in mind when viewing these results. Nonetheless, the results showed that we can not reject the

null hypothesis that central markets for maize in Kenya are not located in consumption zones.

5.3   Determinants of Market Integration

Markets are complex institutions and as such integration and performance of maize markets is a result of not just the regulation of the market or the activities of traders, but also by other factors in the market environment. So far we have attempted to look at market liberalisation as it affects market efficiency measuring this by market integration. The analysis thus far has been based only on prices of maize in various local markets in the country. This part of the discussion focuses on factors of market integration other than liberalisation that have a bearing on market integration and market efficiency.

To fulfil the third objective of the study, analysis of determinants of market integration was done. Analysis of the said factors was done using bivariate correlation and a multiple regression model (equation 5). The regression analysis involved regressing the coefficient of correlation of price differences (a_{ij}), and the cointegration coefficient (b_{ij}), separately, on the structural determinant, as represented in equation 5. The results are presented in Table 5.7.

The problem of multicollinearity among the independent variables was encountered during analysis. This was taken care of by transformation of variables, basically by dividing all the variables except the dependant variable by $CREDIT_{ij}$, the variable that was responsible for most of the collinearity and using the reciprocal of the same variable ($CREDIT_{ij}$) instead of the variable itself.

It is notable that the equation had rather small R^2 (and adjusted $R^{2)}$ - a measure of goodness of fit. Despite this limitation, the model is considered useful because it explains the effect of some important factors on market integration and provides empirical evidence that is lacking for agricultural markets in Kenya. This particular model on the structural determinants of market integration is not unique in having the said limitation. Goletti, Ahmed and Farid (1995) in their regression model for the determinants of market integration get an R^2 of 0.29 and 0.37 with correlation coefficients of first differences and coefficients of cointegraion as dependant variables respectively. This may imply that either structural determinants of market integration are not well understood so that many useful factors are often left out of the models, or that the said factors are difficult to model.

The signs of the various factors did not differ among the measures of market integration. This is an interesting coincidence and one which may not always be the case. For instance Goletti, Ahmed and Farid (1995), showed differing

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signs for the various measures in their study of the rice market in Bangladesh. As shown in Table 5.7 the variable *post office* was significantly positive at 10% as measured by the correlation of price differences. Although the number of post offices offering telegraphic services may not be a very good proxy for information access, it is interesting to see that this could positively affect market efficiency.

Table 5.7: Determinants of market integration

Dependant variable	Correlation Coefficient			Cointegration Coefficient		
Independent Variable	Estimate	t-value	ρ	Estimate	t-value	ρ
Post offices	0.1427	2.055*	0.3906*	0.6190	1.250	0.1324
Social disturbances	-0.0001	-0.204	-0.3647**	-0.0000	-0.613	-0.2817
Tar road density	0.0001	0.057	-0.2474	0.0092	0.522	-0.1046
Credit availability	-0.0005	-1.668	-0.2959*	-0.0055	-2.487**	-0.3327*
Distance	0.0000	0.175	-0.2515	0.0000	1.018	-0.2302
Production dissimilarity	0.0000	1.186	-0.1149	0.0000	1.049	-0.0772
Public stock dissimilarity	0.0000	1.264	-0.1415	0.0000	1.956	-0.1154
Constant	0.0062	0.039		2.2425	2.098**	
N	24			24		
R^2	0.4348			0.3676		
Adjusted R^2	0.1520			0.0909		
DW	2.4184			2.1479		

Note: ρ - correlation with the dependent variable. Figures marked with asterik are significance levels; * - at 10%, ** - at 5%.

Price stabilisation policy (entailing public stocks) measured by public stocks dissimilarity had zero effect on market integration - neither positive nor negative. This is in line with the mixed expectations expressed in literature review. It shows that the activities of NCPB in stabilising prices by storage may not have been a hindrance or a help to market integration.

Credit availability as represented by the number of banks had a significant and negative effect on market integration contrary to expectation. Attempts to drop the variable from the model proved futile, as this drastically reduced the R^2 showing that the variable belonged to the model. These results seem to agree with the observations of Goletti (1994) in his analysis of the determinants of market integration for the rice market in Bangladesh. The author used banks as a proxy for credit and got a negative sign on the variable as well. Goletti (1994) suggests using total amount of bank loans by district as an indicator of credit avalability. Banks may be there but they may fail to give credit to maize traders for diverse reasons. On the other hand maize traders may be relying on own funds and/or on informal sources of credit. Further research may be required to solve the puzzle that these results create with respect to this variable.

The number of strikes representing social unrest had a negative impact on market integration as expected. Social disturbances disrupt marketing activities and de-link markets. Tarmac road density was positive though insignificant and this was expected since improved market physical connections enhance market integration.

Production dissimilarity though insignificant was positive. As said earlier, dissimilar areas are thought to be in a better position to trade than similar zones, hence the positive impact. One interesting variable is distance which though expected to be negative, was actually positive though very small. Long

distances de-link spatially separated markets as transportation costs become too high. The positive sign on this variable may be due to the correlation between dissimilarity in production and distance. For instance, the eastern deficit markets depend so heavily on western surplus markets than on neighbouring deficit markets. So it may not be surprising that distance seems to enhance market integration contrary to expectations and common theory.

CHAPTER VI

CONCLUSIONS, IMPLICATIONS AND POLICY RECOMMENDATIONS

The overall objective of this research was to examine the implications of maize marketing liberalisation on market efficiency and agricultural policy in Kenya and to make recommendations for policy. To this end this thesis has examined several issues relating to liberalisation of the maize market in Kenya going back to the period prior to domestic full market decontrol in December 1993. The hypotheses that market liberalisation has increased the efficiency of maize marketing in Kenya; and that central markets for maize in kenya are located in the major consumption zones, were tested.

In the literature review, related studies on the liberalisation of the maize market in Kenya have been explored and an analysis on integration of maize markets performed. This analysis was based not only on the traditional correlation of price levels but on more econometrically acceptable correlation of price differences and use of cointegration techniques. A search for a central market(s) for maize was carried out using an error correction mechanism.

However because of the complexity of the market institution, and an appreciation of the fact that market integration would be affected by factors

other than policy, the thesis has also examined structural factors that determine the level of integration among maize markets in Kenya.

Generally the lessons that emerge from this research are that market liberalisation has increased the efficiency of the maize market in Kenya and that liberalisation alone can not guarantee continued and increased efficiency of the market. There are factors including social unrest and transport infrastructure (Table 5.7), that need to be looked into if this efficiency gains are going to be maintained and furthered. Another finding is that central markets for maize in kenya are located in major production zones contrary to expectations.

Market liberalisation seems to have increased the number and proportion of markets that are integrated as shown by both the correlation of price differences and the cointegration analysis (Table 5.5). Thus we may not reject the hypothesis that liberalisation has enhanced market efficiency. Free trade may have allowed better articulation of the price mechanism and unhindered transmission of the right signals that enhance market efficiency.

Another result of the liberalisation policy and subsequent free operation of the price mechanism to set prices has been a tendency to move towards a more 'organised' market system. This is evidenced by the apparent drift from the haphazard multidirectional Granger causality among maize markets towards the emergence of central markets (Table 5.6).

The Causality test (Table 5.6) however does not allow us to accept the hypothesis of location of central market(s) in consumption zones. The Kisii district production zone market of Riochanda emerges as a central market, implying that it transmits price signals to a number of other markets. These unexpected results may be attributed omission of major consumption zone markets in the study due to data unavailability as mentioned in chapter five.

The major conclusion that may be drawn from the analysis of the determinants of market integration is that there is some agreement between the various measures of market integration insofar as the response to the determinants of market integration is concerned. However this may not be the case always. This analysis shows that social unrests affect market integration negatively whereas production dissimilarity, availability of market information and good road networks affect market integration positively.

The main limitations of this research relate to lack of adequate data both for the maize prices and the determinants of market integration. Very significant urban markets were left out of the analysis for lack of usable time series. Data on some structural factors of market integration was either unavailable altogether or lacking for some districts.

Another point to note is that particularly for the period after full liberalisation, the data covers a rather short time. It would be important to carry out a similar study two or three years from now when the liberalisation scenario particularly as regards government policy has stabilised, and more data is available. It is also possible that monthly time series could yield better results (more integrated links) than weekly data since averaging may get rid of some of the short term shocks. Using wholesale prices and comparing the results might also shed more light on the behaviour of the maize market in Kenya. The said limitations notwithstanding, a number of conclusions can be drawn from the study.

Given the shortfalls of this research already mentioned, there is need for future and further research that will hopefully incorporate longer data series and data of a wider spectrum of markets and structural factors. The implications of this research should therefore be looked at with that in mind.

These implications include first that the efforts taken so far to liberalise the maize market have been well utilised by private traders who have made efforts to run the market towards greater efficiency. With that, the past fears that the private sector would be unable to run the market to the detriment of consumers and producers are unwarranted.

This being the case then, the National Cereals and Produce Board should relinquish its past role as a maize market monopoly and become the actual

buyer and seller of last resort and the maintainer of strategic reserve that it was meant to be. The current situation where NCPB is playing a lesser role must have saved and should continue to save the Kenyan taxpayer significantly in terms of (miss-allocated) subsidies no longer given, and high operation costs foregone. The NCPBs social function of being the buyer and seller of last resort and maintainer of strategic reserve is justifiable for a third world economy like Kenya, that still has a significant proportion of the population dependant on agriculture and where sudden climatic changes often adversely affect production of the staple food crop, maize. This often calls for provision of famine relief. The government will no doubt continue to meet the social costs associated with this kind of welfare fuctions carried out by the NCPB.

Another implication that is linked to the aforementioned one emerges though more specifically from the literature review than from this study. International trade in maize could benefit from liberalisation in the same way as the domestic market. Preferential treatment of NCPB in international trade will only continue costing the tax payer heavily instead of rendering him service, as the loses incurred and the implicit costs of inefficiency outlined in the literature review are met by the government.

The third implication which emerges mainly form literature is that the consumer contrary to pre-liberalisation fears is not left to starve but instead he has a cheaper, more nutritious and preferred source of food from the whole

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grain meal. The rural folk, formerly subjected poorly available and expensive food grain, the result of a controlled and inefficient marketing system are now able to reap the benefits of market liberalisations. These benefits include greater access to food as movement restrictions have been removed and possibly at more affordable prices that are supported by a more competitive and efficient market. This in essence, is increased food security.

Several recommendations need to be made. The first one is that the Kenya government should give continued commitment and support to the liberalisation program, particularly given its good performance thus far.

Repetition of past practice of renegading on policy will not help the private sector to effectively and efficiently run the agricultural marketing system. This instead creates lack of private sector confidence in the government which hinders growth in investment and hampers movement towards more efficient agricultural markets. The private trader needs to be assured that he has a future in whatever agricultural commodity market he may be involved in.

Secondly, efforts should always be made to mediate between and reconcile disagreeing workers and communities thus reducing the occurrence of social and/or political unrests which hamper market integration and contribute to inefficiency of markets. Thirdly, good road networks and information access systems (particularly to traders) should be put in place and maintained as these

enhance market efficiency. In this regard, the Marketing Information System ought to streamline its operations to ensure reliable data is not only collected but also relayed to the market participants in time.

Lastly, undue preferential treatment of NCPB particularly with regard to the international trade in maize, and haphazard bans on the trade are not in the best interest of the Kenya maize market and in the case of the later on international relations. Such practices ought to be discarded completely.

Adopting all or even part of these recommendations will ensure the existence of a better environment that enables the agricultural and more specifically the maize marketing system, to move towards greater efficiency.

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Table A 1.1: Correlation of price levels

Pre-liberalisation period

	Limuru	Thika	Endarasha	Embu	Ishiara	Kianjai	Daraja-mbili	Sondu	Riochanda	Kapsabet	Kitale	Kimilili	Busia
Limuru	1 0000**+												
Thika	6626**+	1.0000**+											
Endarasha	7831**+	8027**+	1 0000**+										
Embu	4830**+	6612**+	6849**+	1.0000**+									
Ishiara	8071**+	8137**+	.8402**+	7485**+	1 0000**+								
Kianjai	5216**+	7229**+	6458**+	7441**+	7358**+	1.0000**+							
Daraja-mbili	6500**+	5837**+	6759**+	4150**+	5928**+	4038**+	1 0000**+						
Sondu	3632**+	2814**	3032**+	2767**	3860**+	1554	6284**+	1.0000**+					
Riochanda	4928**+	4459**+	5253**+	2603**	4350**+	2374**	8050**+	6802**+	1 0000**+				
Kapsabet	2351**	2568**	2696**	2926**+	.2277**	1639*	4847**+	.2415**	3321**+	1.0000**+			
Kitale	7911**+	.4331**+	6147**+	3242**+	5668**+	.3188**+	6050**+	4010**+	4365**+	1647*	1.0000**+		
Kimilili	7530**+	4139**+	5113**+	1782*	5244**+	.2121**	5787**+	.3819**+	4224**+	1798*	8678**+	1 0000**+	
Busia	5514**+	2891**+	2416**	0211	2793**	0827	6822**+	6201**+	6541**+	2522**	.5435**+	6143**+	1.0000**+

Post-liberalisation period

	Limuru	Thika	Endarasha	Embu	Ishiara	Kianjai	Daraja-mbili	Sondu	Riochanda	Kapsabet	Kitale	Kimilili	Busia
Limuru	1 0000**+												
Thika	7580**+	1 0000**+											
Endarasha	8186**+	6505**+	1.0000**+										
Embu	9193**+	8006**+	8250**+	1.0000**+									
Ishiara	.8475**+	.8014**+	8136**+	.9163**+	1.0000**+								
Kianjai	4041**+	4879**+	5598**+	5735**+	6375**+	1.0000**+							
Daraja-mbili	9206**+	7961**+	8106**+	9214**+	8944**+	5371**+	1 0000**+						
Sondu	9230**+	8124**+	8229**+	9131**+	8701**+	5204**+	9778**+	1.0000**+					
Riochanda	9186**+	7838**+	7853**+	9089**+	8517**+	4439**+	9683**+	9728**+	1.0000**+				
Kapsabet	9004**+	6688**+	8723**+	8748**+	8170**+	4186**+	8054**+	7988**+	7961**+	1.0000**+			
Kitale	9217**+	6763**+	8335**+	8867**+	8308**+	3924**+	8627**+	.8501**+	8426**+	8533**+	1 0000**+		
Kimilili	8886**+	6870**+	6928**+	.8243**+	7400**+	2941**+	9233**+	9203**+	9227**+	7063**+	8450**+	1 0000**+	
Busia	8310**+	.6136**+	7024**+	7963**+	6920**+	3466**+	8945**+	8928**+	.9061**+	6449**+	7992**+	9302**+	1.0000**+

Number of cases 92 1-tailed Signif **+ - 0 01 ** - 0.05 * - 0.10

Table A1.2: Correlation of price differences

Pre-lieralisation period

	Limuru	Thika	Endarasha	Embu	Ishiara	Kianjai	Daraja-mbili	Sondu	Riochanda	Kapsabet	Kitale	Kimilili	Busia
Limuru	1.0000**+												
Thika	.1271	1.0000**+											
Endarasha	.1523	.0984	1.0000**+										
Embu	.0244	-.0041	-.1354	1.0000**+									
Ishiara	.4701**+	.1801*	.0067	.2148	1.0000**+								
Kianjai	.3582**+	.3012**+	.0426	.0031	.1550	1.0000**+							
Daraja-mbili	.0867	.0808	.2582**+	-.0919	-.0532	.0170	1.0000**+						
Sondu	-.0151	-.1249	-.1696*	.2903**+	.1582	-.0869	-.0539	1.0000**+					
Riochanda	-.1741*	.0660	.0196	-.1749*	-.2349**	-.1605	.1134	.1166	1.0000**+				
Kapsabet	.0633	-.0395	-.0772	.1683*	-.0507	-.0028	.1167	-.0069	-.0005	1.0000**+			
Kitale	.0793	-.1671*	.3092**+	-.0338	.1108	-.0273	-.0045	-.0679	-.3092**+	-.0172	1.0000**+		
Kimilili	.3131**+	.0378	.2912**+	-.1688*	.2369**	.0089	.2898**	-.0024	-.1325	-.1383	.2735**	1.0000**+	
Busia	.3328**+	.2023*	-.3579**+	.2369**	.1898*	.2573**	.0513	.2655**	.2591**	.0181	-.3879**+	-.0542	1.0000**+

Post-liberalisation period

	Limuru	Thika	Endarasha	Embu	Ishiara	Kianjai	Daraja-mbili	Sondu	Riochanda	Kapsabet	Kitale	Kimilili	Busia
Limuru	1.0000**+												
Thika	.2368**	1.0000**+											
Endarasha	.0949	.1739*	1.0000**+										
Embu	.0406	.0320	-.0941	1.0000**+									
Ishiara	.0672	.0914	.1126	.1778**	1.0000**+								
Kianjai	.0312	.1118	.0287	.0756	-.0770	1.0000**+							
Daraja-mbili	.1545*	.1026	.1360*	-.0738	.0417	.1220	1.0000**+						
Sondu	.2712**+	.0633	.2851**+	.0274	.0900	.2154**	.4980**+	1.0000**+					
Riochanda	.1489*	.1349	.1259	.1347	.1646*	.0041	.4939**+	.5529**+	1.0000**+				
Kapsabet	.0518	-.1001	.1230	.2056**	-.0101	-.1475*	-.0695	-.1164	-.0277	1.0000**+			
Kitale	.2669**+	.1053	.2007**	.1095	.2099**	.0671	-.0012	.0642	-.0514	.1463*	1.0000**+		
Kimilili	.0501	.0029	.1552*	.0969	.0379	.0688	.5226**+	.5577**+	.4839**+	-.0187	.0919	1.0000**+	
Busia	.2012**	.0449	.0618	-.0341	-.0804	.0507	.3326**+	.3986**+	.3353**+	.0168	-.0520	.3055**+	1.0000**+

No of cases 64 and 91 for pre-liberalisation and post-liberalisation period respectively. 1-tailed Signif: ** - 0.01 ** - 0.05 * - 0.10

Appendix 2: Coefficients of the Error Correction Model

Table A 2.1: Causality testing: Pre-liberalisation period

Link	Market i	Market j	Estimate β_{2ij}	Estimate $\Sigma\delta_{b1j}$	Estimate β_{2ji}	Estimate $\Sigma\delta_{bji}$	Direction of causality
1	Limuru	Thika	0.015 (0.193)	0.159 (0.124)	0.320+** (3.024)	-0.382 (-1.510)	-
2	Limuru	Endarasha	0.004 (0.024)	0.072 (0.378)	0.256+** (4.180)	-0.087 (-0.633)	-
3	Thika	Endarasha	0.537+** (3.589)	-0.549 (-2.082)	0.268+** (3.508)	-0.248 (-2.448)	- -
4	Thika	Ishiara	0.295** (2.544)	-0.246 (-1.098)	0.328** (2.454)	-0.142 (0.856)	- -
5	Thika	Daraja-mbili	0.365+** (2.897)	-0.541 (-1.866)	0.510+** (3.097)	-2.221 (-0.678)	- -
6	Thika	Riochanda	0.305+** (3.187)	-0.496** (-2.468)	0.054 (-0.590)	-0.062 (-0.356)	0
7	Thika	Kitale	0.041 (0.644)	-0.010 (-0.082)	0.160 (1.389)	0.081 (0.201)	0 .
8	Endarasha	Ishiara	0.261+** (3.726)	-0.001 (-0.009)	0.415** (2.449)	-0.266 (-1.093)	- -
9	Embu	Ishiara	0.339+** (3.803)	-0.313 (-1.623)	-0.101 (-0.099)	0.132 (-0.693)	-
10	Embu	Kianjai	0.232** (2.091)	0.018 (0.095)	0.322+** (2.936)	-2.133 (-1.069)	- -
11	Ishiara	Kianjai	0.001 (0.061)	0.073 (0.397)	0.247+** (2.780)	0.033 (0.172)	-
12	Ishiara	Daraja-mbili	0.304** (2.609)	-0.171 (-0.674)	0.006 (0.040)	0.050 (0.895)	-
13	Kianjai	Kapsabet	0.172* (1.908)	-0.222 (-1.563)	0.577 (0.868)	-0.118 (-0.069)	-
14	Sondu	Daraja-mbili	0.431+** (3.111)	0.107 (0.361)	0.379+ (3.709)	-0.149 (-1.120)	- -
15	Sondu	Busia	0.277** (2.219)	-0.078 (-0.351)	0.304** (2.66)	-0.248 (1.330)	- -

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Table A 2.1 continued

Link	Market i	Market j	Estimate β_{2ij}	Estimate $\Sigma\delta_{hij}$	Estimate β_{2ji}	Estimate $\Sigma\delta_{hji}$	Direction of causalit
16	Riochanda	Daraja-mbili	0.324* (1.845)	-0.060 (-1.196)	0.543+** (5.518)	-0.367** (-2.819)	0
17	Riochanda	Kapsabet	-0.049 (-0.427)	0.0879 (0.051)	2.404+** (3.055)	-3.045 (-1.884)	-
18	Riochanda	Busia	0.130 (1.032)	-0.323 (-1.443)	0.307+** (2.928)	-0.215 (-1.181)	-
19	Kapsabet	Daraja-mbili	3.452+** (3.639)	-0.203 (-0.087)	-0.027 (-0.331)	0.028 (0.239)	-

Note: Market j is said to Granger cause market i if β_{2ij} is significant and $\Sigma\delta_h$ is not significant. The direction of the arrow indicates the direction o causality. Causality is bidirectional where the arrows face bot directions. Lack of causality in either direction is indicated by a zero Significant levels are indicated as: * - 10%, ** - 5% ,**+ - 1%. The 5 level has been used for hypothesis testing in this case. β_{2ij} and $\Sigma\delta_h$ represent the first and second terms in the null hypothesis for equatio 4 respectively. The t-statistics in parentheses.

Link	Market i	Market j	Estimate β_{2ij}	Estimate $\Sigma\delta_{nij}$	Estimate β_{2ji}	Estimate $\Sigma\delta_{nji}$	Direction of causality
1	Daraja-mbili	Riochanda	0.343+** (4.305)	0.034 (0.004)	-0.077 (0.559)	0.306* (1.840)	-
2	Daraja-mbili	Kapsabet	0.137+** (2.677)	0.120 (0.969)	0.137+ (2.677)	0.120 (0.969)	- -
3	Riochanda	Kapsabet	-0.028 (-0.707)	0.190** (2.080)	0.108** (2.629)	0.127 (1.113)	-
4	Riochanda	Kimilili	0.120 (0.009)	0.274* (1.996)	0.110* (1.853)	0.096 (0.740)	0
5	Riochanda	Busia	-0.300+ (-3.021)	0.078 (0.565)	-0.014 (-0.165)	0.456** (2.664)	-
6	Sondu	Busia	0.120* (1.853)	0.064 (0.551)	0.129 (1.311)	0.169 (0.020)	0
7	Sondu	Riochanda	-0.230* (-1.910)	0.835** (3.357)	0.384+** (2.797)	0.027 (0.178)	-
8	Endarasha	Embu	0.114** (2.517)	-0.169 (-1.648)	0.075 (1.632)	-0.049 (-0.507)	-
9	Endarasha	Kitale	0.178+** (2.902)	0.004 (0.028)	-0.470 (-0.069)	-0.470 (-0.682)	-
10	Thika	Embu	0.192+** (2.999)	0.055 (0.417)	-0.073 (0.997)	-0.157 (-0.858)	-
11	Thika	Ishiara	0.139+** (2.668)	0.036 (0.330)	-0.158 (1.562)	-0.082 (0.582)	-
12	Thika	Daraja-mbili	0.152+** (2.703)	0.050 (-0.351)	0.107* (1.691)	-0.265 (-1.682)	-
13	Thika	Sondu	0.138** (2.65)	-0.037 (-0.293)	0.165+** (2.57)	-0.379 (-2.34)	- -
14	Thika	Riochanda	0.118** (2.557)	-0.067 (-0.510)	0.079 (1.111)	0.001 (0.007)	-
15	Embu	Daraja-mbili	0.246+** (3.924)	0.088 (0.881)	0.056 (0.738)	0.018 (0.186)	-
16	Embu	Ishiara	-0.009 (-0.008)	-0.010 (-0.115)	0.499+** (4.581)	-0.177 (1.195)	-

Link	Market i	Market j	Estimate β_{2ij}	Estimate $\Sigma\delta_{hij}$	Estimate β_{2ji}	Estimate $\Sigma\delta_{hji}$	Direction of causality
17	Embu	Riochanda	0.169+** (3.428)	0.339 (0.033)	-0.008 (-0.100)	0.104 (0.849)	←
18	Ishiara	Sondu	0.243+** (3.485)	-0.171 (-1.205)	0.006 (0.050)	-0.098 (-1.386)	0
19	Ishiara	Riochanda	0.208+** (3.323)	-0.298* (-2.004)	0.169 (0.334)	0.010 (-0.115)	←
20	Ishiara	Kapsabet	0.130** (2.305)	0.067 (0.564)	0.047 (0.938)	-0.193 (-1.241)	←
21	Kianjai	Daraja-mbili	0.024* (1.741)	-0.096 (-0.509)	-0.021 (-0.480)	-0.089 (-0.826)	0
22	Kianjai	Sondu	0.077** (-1.985)	-0.228** (-2.468)	-0.790 (-0.033)	-0.113 (-0.980)	0
23	Limuru	Thika	0.170** (2.258)	-0.678** (-2.474)	0.112* (1.861)	0.007 (0.004)	0
24	Limuru	Ishiara	0.089* (1.816)	-0.257* (-1.692)	0.241+** (2.983)	-0.026 (-0.187)	←
25	Limuru	Kianjai	0.005 (0.105)	-0.904 (-0.753)	-0.165 (-0.014)	-0.456** (-2.664)	0
26	Limuru	Riochanda	0.250+** (4.722)	-0.039 (-0.388)	-0.047 (-0.574)	0.088 (0.746)	←
27	Limuru	Kitale	0.235** (2.659)	0.044 (0.295)	0.093* (1.675)	0.033 (0.382)	←
28	Limuru	Busia	-0.248+** (4.813)	-0.196* (-1.715)	-0.071* (-1.378)	-0.147 (-1.379)	←

Note: Market j is said to Granger cause market i if β_{2ij} is significant and $\Sigma\delta_{hij}$ is not significant. The direction of the arrow indicates the direction of causality. Causality is bidirectional where the arrows face both directions. Lack of causality in either direction is indicated by a zero. Significant levels are indicated as: * - 10%, ** - 5% ,**+ - 1%. The 5% level has been used for hypothesis testing in this case. β_{2ij} and $\Sigma\delta_{hij}$ represent the first and second terms in the null hypothesis for equation 4 respectively. The t-statistics in parentheses.