

**DETERMINANTS OF AGRICULTURAL SECTOR PERFORMANCE
IN KENYA**

BY

KAMANDE DAVID MBUGUA

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Declaration

This research paper is my original work and has not been presented for a degree award in any other University.

Name: DAVID MBUGUA KAMANDE

Signature:



Date:

5th September 2009

Approval

This Research Paper has been submitted with our approval as University Supervisors.

Name: DR. GEORGE M. RUIGU

Signature:



Date:

5th September 2009

Name: DR. ODHIAMBO SULE

Signature



Date:

07th September 2009

DEDICATION

This piece of work is dedicated to my beloved father the late William Kamande Muiruri for his great inspiration in search of knowledge

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All the same I am responsible for any errors and omissions in this research paper.

ABSTRACT

Agriculture sector remains the backbone of the Kenya's economy since independence. There is correlation between agricultural growth and economic growth. The country has implemented several development plans with each identifying agriculture sector as among the important sectors that will lead to realization of set development goals. Agriculture in the country has experienced mixed performances from its robust growth rates in 1960s and 1970s to its dwindling growth in the late 1980s and 1990s. A number of initiatives have been pursued with an aim of improving performance of the agriculture sector and the economy as a whole. There is a need to establish appropriate policies that should be implemented to enable sustainable increase in the agricultural output. This study examined the factors that determine performance of agriculture sector in the country. The study utilized annual data for the period from 1968 to 2008. Agricultural gross domestic product was used as a measure of performance of the agriculture sector. A regression analysis was done using the ordinary least square (OLS) method to evaluate significance of the factors.

The study established that agriculture output is responsive to both price and non price factors. The price factors such as agriculture price index and input price index alone were found to be inadequate in explaining agricultural growth. It was established that non price factors including weather, adjusted exchanger rate, election violence and agricultural budgetary allocation were significant in explaining the agriculture output.

The study recommends that an integrated policy regarding enhanced support for the sector is required to enable agriculture sector to perform well.

ACRONYMS

- Ag. GDP- Agricultural Gross Domestic Product
- AIC- Akaike Information Criterion
- ECT- Error correction term
- COMESA- Common Market for Eastern and Southern Africa
- CUSUM- Cumulative Sum Test
- EAC- East Africa Community
- ECA- United Nations Economic Commission for Africa
- ERS- Economic Recovery Strategy for Wealth and Employment Creation
- GDP – Gross Domestic Product
- GOK- Government of Kenya
- KMC- Kenya Meat Commission
- MDG- Millennium Development Goals
- PRSP- Poverty Reduction Strategy Paper
- RESET- Ramsey Regression Equation Specification Error Test
- SAL- Structural adjustment lending
- SAP- Structural adjustment Programme
- SRA- Strategy for Revitalizing Agriculture

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CHAPTER ONE

1.0 Introduction

1.1.0 Background Information

The agriculture sector has been the engine of growth of the Kenyan economy and is likely to remain so in the foreseeable future. This sector is made up of four major sub-sectors, namely, industrial crops, food crops, horticulture and livestock and fisheries. The sector continues to be dominant in the economy and is a major contributor in the economy despite of its contribution in relative terms decreasing from 35% in 1963 to 24% in 2006 (Nyangito, 1998; GOK, 2007). The sector accounts for 62% of the total national employment (GOK, 2007). The majority of Kenyans live in rural areas and most of them are engaged in agriculture or agriculture related activities.

About 69 % of the country's population depends on agriculture for their livelihoods (GOK, 2007). This sector is the main foreign exchange earner; accounting approximately 60% of the exports earnings annually (GOK, 2007). It is estimated that 45% of the government's revenue is derived from this sector (GOK, 2007). Through links with manufacturing, distribution and the service sector, agriculture contributes a further 26% of the country's GDP (GOK, 2008).

Apart from agro- production, the sector provides 75% of raw materials for agro-based industries in Kenya (GOK, 2007) and is the growth engine for the non agricultural sector with a multiplier effect of 1.64 (Block and Timmer 1994). Lastly, the sector provides food to the most people in the country including industrial workers. Thus, agriculture sector is the single most important determinant of overall economic growth and its sluggish record in recent years is the principal factor underlying the poor economic performance of the country.

Increased production in the sector particularly that of smallholders can lead to rise in income which would further lead to increased consumption and savings which are prerequisites for expansion of the economy. Further, increased production of export crops

can provide higher foreign exchange earnings to finance importation of intermediate or capital goods. Growth of the sector can also stimulate forward and backward linkages with other sectors of the economy and can reduce reliance on imported raw materials. The above reasons make the sector to be singled out in all development plans as among the sectors expected to contribute significantly to realization of set development goals. In Vision 2030, the sector is among the six priority sectors that can raise the GDP growth rate to the region of 10 % in a number of years. The other sectors are tourism, wholesale and retail, trade, manufacturing and finance. The agriculture sector is expected to play the greatest role among the six sectors in poverty reduction as it provides livelihoods to most people.

1.1.1 Trends in agricultural performance of Kenya

One of the factors influencing the performance of the agricultural sector in Kenya are the policies used (Kimenyi, 1998). A diverse range of policies has been employed to foster growth of the agricultural sector in Kenya. The sector experienced an average growth rate of 6.4 percent between 1963 and 1972. The policies used then were based on the principles outlined in the *Sessional Paper No. 10* on African Socialism and its Application to Planning in Kenya which emphasized political equity, social justice, and human dignity. These principles were based on mixed economy and defined the state as the entity that not only maintains law and order but also outlines and implements social and economic programs in a bid to remedy historical and social inequalities. The immediate post independence policies were designed to revolutionise agriculture through land consolidation, extension services and training as well as introduction of modern methods of farming and marketing. Although the government controlled the economy during this period, the extent of control was not complete as that of the Soviet Union since the level of output was not determined by the state. The responsibility of formulating and implementing policies was vested in the Ministry of Agriculture but implementation of policies was undertaken by a plethora of institutions such as cooperative societies. The government undertook a major land reform where considerable amounts of the former white settlers' farms in medium and high potential areas were distributed to small- scale farmers. The Agriculture Development Corporation (ADC) was established to facilitate the land transfers and also to be a custodian of land for

undertaking agricultural research. The government then decided on most important commodity to promote, created incentive structures (such as pricing and marketing policies) favouring that commodity. The best examples of such decisions are the promotion of tea and coffee as export crops and maize as the major food crop in Kenya. The result was an expansion of monetized small-holder sector that contributed significantly to the total agricultural production and marketed volume especially in tea and coffee cash crops and maize. Overall, agriculture grew very rapidly with the export sub-sector outpacing the domestic sector. The policies responsible for this performance were land reforms, agricultural pricing and marketing, and public investments in research, extension, subsidized inputs and other agricultural services.

Table 1: Average GDP growth and agriculture GDP growth

Years	1964-1971	1972-1976	1977-1981	1982-1986	1987-1991	1992-1996	1996-2000	2001-2007
GDP Growth	7	4	6	4	4.3	2.5	2	4.1
Ag.GDP Growth	4.6	3.9	3.3	0.4	1.1	4.6	3.9	4.5

Source: Statistical abstracts (various issues)

The economy was to a great extent controlled by the government from 1960s to early 1990s. The country inherited a system of agricultural marketing of major commodities based on control by parastatals bodies. The cooperative societies also played a major role in production and marketing for most commodities. These were to assist in the procurement of production inputs and in the marketing of agricultural produce. Some parastatals such as Kenya Cooperative Creameries and the Kenya Planters Cooperative Union had to be reformed after independence to allow membership by African smallholders who were initially restricted. A majority of these co-operative societies were affiliated to the Kenya National Farmers Union (KNFU) and the Kenya Farmers Association (KFA). Other state-run farmer organizations that supported production and marketing of most commodities included Kenya Tea Development Authority (KTDA) for tea, National Irrigation Board for irrigated crops and National Cereals and Produce Board (NCPB) for cereals. The state regulated production and marketing of agricultural

commodities through its boards. These included the Sisal Board of Kenya, Coffee Board of Kenya, Tea Board of Kenya, Kenya Dairy Board, Kenya Meat Commission (KMC) and many others.

The average growth rate of the sector declined to 3% between mid-1970s and 1980. This was mainly due to mismanagement and corruption in marketing, limited land expansion of smallholder farming, limited development and use of new technologies, restriction on private trade and processing of commodities, and deteriorating infrastructure. These internal factors were compounded by the economic crisis caused by oil shocks of the 1970s, deterioration of terms of trade and unfavourable weather.

The country experienced drought from 1979-1982 and a more severe drought in 1984/85. There was also scarcity of Government investment in agriculture which adversely affected provision of services to farmers. From 1980 to 1990, the mean annual growth rate of the sector was 3.5%. This was the era when liberalized market policies were introduced under the structural adjustment programmes (SAPs) of World Bank and International Monetary Fund. The focus was on gradual price decontrols and promotion of private trade in marketing of agricultural commodities. Fundamental changes in the running of the economy were then based on *Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth* which proposed reduction of government controls on the economy. Substantial implementation of the policy reforms on liberalization was started in 1993. The cotton, sugar and maize markets were deregulated. There was also privatization of government services such provision of Artificial Insemination and cattle dips. Beef marketing and trading opened up at various county council levels while KMC closed down its operations until 2007 when it was revived by the government.

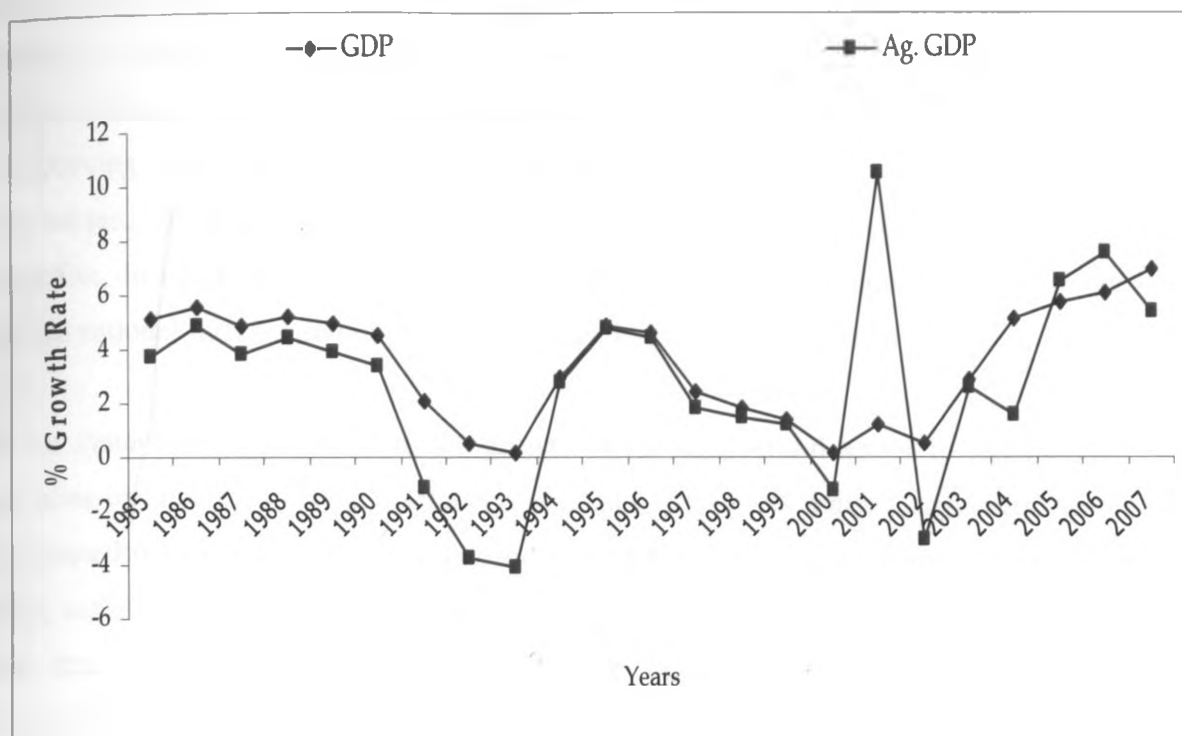
In the early 1990s, the growth rate ranged from minus 0.4% in 1991 to the lowest level of minus 4.1% in 1993. The reasons for decline in agricultural growth included: poor implementation of the policies, bad weather, deterioration of terms of trade between agricultural exports and imports, rapid population growth and shortage of land in the high and medium potential areas of agricultural production, and a decline in public investment

in agriculture in real terms which was about one third of the levels in the 1960s and 1970s (Nyangito and Kimenyi, 1996). The withholding of external aid on the advice of the World Bank and the International Monetary Fund in 1991 and 1992 was a factor which denied the country foreign exchange resources for financing imports including agricultural inputs and agricultural investment. Coupled with good weather conditions, an upsurge in agricultural growth rate in the 1990s was registered at 2.8% in 1994 followed by 4.8% in 1995.

The rate of growth declined from 4.4% in 1996 to 1.5% in 1999 and further to minus 1.2% in 2000. There followed a fluctuating performance in the sector which recorded 10.5% growth in 2001; then dropped to -3.0% in 2002 before recovering to 2.6% in 2003 and declining to 1.6% in 2004. This slowdown was attributed to poor performance in maize, coffee and pyrethrum sub-sectors. There was an impressive performance of the sector in 2005 when it recorded a 6.5% growth rate and further expanded to about 7.6% in 2006. The performance of the agricultural sector has been mixed over the time period and this has been seen as dependent on the policy reforms in a particular time period. These are best seen through analyzing the effect of various policies on the performance of the main sub-sectors (food and cash) of the agricultural sector. The effects are manifested in the volumes of the commodities produced and marketed and the prices received by producers.

The performance of agricultural sector has a strong correlation with the overall Kenyan economy as shown in figure 1 below such that whenever the sector has performed well, so has the general economy and vice versa.

Figure 1: GDP and AgGDP growth rates, 1985 – 2007



Source: Economic Review of Agriculture, Ministry of Agriculture 2008

1.1.2 Constraints to growth of the sector and efforts to deal with them

There are various constraints that have hampered the growth of the agricultural sector in Kenya. An important constraint concerns the fact that only 16% of the Kenyan land is of high and medium potential with adequate and reliable rainfall suitable for agriculture (GOK 2008). The rest of the land is either arid or semi-arid. The problem of land scarcity is magnified by episodes of severe regional droughts and consequent food shortages. Given the over-reliance on rain-fed agriculture, droughts severely undermine agricultural output.

Deterioration in terms of trade due to decline in world commodity prices has particularly impacted negatively on incomes from coffee, tea, sisal and pyrethrum farming. Tariffs and non-tariff barriers imposed by developed countries have made it difficult for developing countries to access their markets. Kenya is a signatory of a number of regional economic integration arrangements, notably EAC and COMESA. Under both

economic blocs, the country has made a number of commitments including tariff reduction and subsidy elimination. A case in point is the sugar and wheat industries which are expected to eliminate duty on imports from COMESA members. It may not be possible to provide certain support measures, particularly to uncompetitive sectors without challenge from member states of the regional organizations. A serious constraint to improving agricultural production is dilapidated infrastructure. The poor state of infrastructure, particularly rural access roads, adds directly to the cost of agricultural production. In some cases, the cost of transporting agricultural produce is sufficiently high that rational farmers do not produce at all even if all resources are available.

The tax system is unfavourable to the growth of the agricultural sector in Kenya. The high taxes on inputs including machinery, fuel and spare parts make Kenya agriculture less competitive internationally. Further more, the present local authorities procure cess for tea, coffee, sugar, maize, and livestock products, which is based on gross realizations rather than profits. Conflicts among population groups are critical to agricultural production, economic growth and poverty reduction. Kenya has had localized clashes especially during election years from the 1992 onwards. The conflicts are particularly destructive and have led to casualties, displacement and abandonment of productive activities. The worst conflict was experienced after the disputed 2007 elections which brought the economy to a standstill besides high number of deaths, displacement and destruction of property. The agriculture sector was severely affected and is yet to recover as many farmers are yet to resume their farm activities.

The declining level of agricultural production is threatened by HIV/AIDS pandemic. Most of the adults who are HIV positive are between the ages of 15 and 49; the age group that constitutes the majority of the labour force (Nyoro, 2002). Adverse effects of the disease include loss of labour supply due to deaths and absenteeism and decline in productivity due to ill health, treatment costs and funeral expenses. There is also related opportunity cost in terms of forgone production which is extremely high. Mortality and morbidity from HIV/AIDS will likely result in labour shortages for both farm and

domestic work and decline in agricultural output (GOK 2004). Other diseases such as malaria have serious negative consequences on agricultural productivity.

Use of modern technology in production among smallholders is still limited, although Kenya has a well developed research infrastructure. Equally important is the inadequate research- extension-farmer linkages and lack of demand- driven research. An out-dated legal and regulatory framework has served only to constrain agricultural development, trade and effective competition. This problem is expected to be addressed by the proposed consolidation of agricultural legislations in the Vision 2030. There have been recent reforms in tea, coffee and pyrethrum which are expected to address the issues affecting the crops. The rising population density has contributed to the subdivision of land to uneconomically small units, the reduction of the fallow periods and continuous cultivation, leading to the rapid depletion of soil nutrients, declining yields and environmental degradation. Inadequate storage facilities constrain marketability of perishable goods such as fish, dairy products, and vegetables. There is no comprehensive land policy covering use and administration, tenure and security, and delivery systems of land. This has resulted in low investment in the development of land, leading to environmental degradation.

The government has undertaken significant reforms especially in the last ten years. The liberalization process for some crops like pyrethrum and sugar is, however, yet to be completed leading to weak performance of those crops. Agricultural market information and infrastructure are poorly organized and institutionalized. The domestic market is small and fragmented, and lacks an effective market information system and infrastructure. Market prices of selected commodities are currently published in a few dailies. Widespread corruption in cooperatives and farmers organizations has led to collapse or weakening in terms of finances and manpower. Farmers therefore do not enjoy the advantages of economies of scale in dealing with credit and marketing of inputs and outputs.

There have been high levels of waste due to pre-harvest and post-harvest losses occasioned by pests and diseases and lack of proper handling and storage facilities. Smaller-holder farmers and pastoralists are unable to cope with pests and diseases mainly due to lack of finances, but quite a number of cases because they are not informed, reflecting weakness in the extension services system. The cost of key inputs such as seed and fertilizers has tended to be too high and cases of adulteration and other forms of corruption have increased. Farmers therefore have reduced use of quality inputs such as seeds, fertilizer and pesticides leading to lower output. Although in the recent past the government has made considerable progress in stabilizing the macro-economic environment, persistent large public sector borrowing requirements and high lending interest rates have discouraged investment in the agricultural sector. Many farmers have been impoverished by the high debt service and non-performing loans.

Kenya has not exploited the investment opportunities for activities that can add value to farm products. Most agricultural products are exported as raw materials. Investment opportunities for value adding activities through processing and packaging for agricultural commodities have not been exploited to increase incomes and off-farm employment. This is despite the fact that value adding to a crop like tea through packaging can fetch up to six times more revenue than unpacked tea (Nyangito, 2001). Efforts were made on value addition during the implementation of the Economic Recovery Strategy for Wealth and Employment Creation (ERS) although there was minimal achievement.

There is poor rationalization of policies and programmes related to agriculture and rural development which are currently spread across several ministries and other government agencies. There is no link between the Strategy for Revitalization of Agriculture (SRA) budget and the financial requirements for implementation of agriculture and rural development interventions within the MDG expenditure framework and yet both should be focusing on similar programmes. Other interventions such as food aid programmes, infrastructure (irrigation, energy, roads, environment etc) and farm credits are scattered in

different ministries and parastatals whose priority may not necessarily be agriculture and rural development, hence may not be effective. (Karanja and Nyoro, 2002).

1.2 Research Problem

Kenya *vision 2030* is the new country's development blueprint covering the period 2008 to 2030. It aims at making Kenya a newly industrializing, middle income country providing high quality of life for all its citizens by the year 2030. In this time frame, the country aims to increase and maintain annual GDP growth rates at 10%. The agriculture sector has been identified as among the priority sectors that will play an important role in the realization of this ambitious goal.

As indicated before, there is a close linkage between the agricultural sector and the overall economy of Kenya. However, the sector has performed poorly affecting almost all agriculture related farming activities in crop and livestock production. With the exception of horticulture, which has maintained an impressive growth performance, growth in all key cash crops has declined. Most notable is coffee, which has moved from its position as the country's highest foreign exchange earner to the fourth position.

The country has several advantages which it can exploit to build a robust and dynamic agricultural sector such as varied climate suitable for undertaking diversified and specialized niches such as horticulture, herbs, spices; fruits and lean beef. Kenya has a relatively well developed human resource capacity including institutions for training; vast fisheries and irrigation potential and location on major sea and air routes. Another advantage is that Kenya has large regional markets which have arisen through regional integration such as EAC and COMESA. Also a large sea front and airports and therefore the country can be a regional hub for exports to the Middle East and beyond.

As indicated above the country has enormous potential of improving the agricultural sector which will assist in achieving vision 2030 targets. This then raises the question; how can we raise the agricultural output of Kenya? This then necessitates a thorough analysis and knowledge of factors that influence output (growth) and their relative importance.

1.3 Objectives of the study

The overall objective of the study is to investigate the factors that determine performance of the agricultural sector in Kenya. The specific objectives are;

- a) To determine the factors that influences the performance of the agricultural sector in Kenya.
- b) To estimate the model that explains the performance of the agricultural sector in Kenya.
- c) Give policy recommendations based on (a) and (b) above.

1.4 The Significance of the study

The proportion of the sector's contribution to the economy has been declining over time and the trend is expected to continue as the economy develops as has been the case with the developed countries. The sector is the major source of capital transfer to the other sectors of the economy and it will still continue to be important in the economy even with its declining GDP contribution. In the Poverty Reduction Strategy Paper (PRSP), the development of the agricultural sector is considered as a top priority in the process of poverty reduction; for agriculture is one of the most important economic activities in which even the poor in the rural areas are engaged (GOK, 2004). The country's target is to reduce the proportion of the population below the basic poverty line from 56% in year 2000 to 26% by 2015 (GOK, 2004). This target (on poverty reduction) is part of Millennium Development Goal 1 *of Eradication of Extreme Poverty and Hunger by 2015*. Sustainable poverty reduction must be linked to economic growth. Poverty reducing growth usually primarily originates from agriculture (Kimenyi; 2002).

Another objective of PRSP policy document is to improve equity and participation. There is evidence that effective poverty reduction requires that there be significant reduction in income inequality. Poverty reduction calls for policies that meet the characteristics of growth with equity. There is need therefore to place priority on policies that enhance the incomes of the rural households mainly through agriculture.

In the same policy document, the government aims to reduce the number of people who are food-poor from 48.4% to 23.5% in 2008 and below 10% by 2015 (GOK, 2004). It is not possible to achieve the status of a food secure nation unless we produce more to feed

the population. This requires clear focus on issues concerning agricultural production. In addition, it is highly risky for a country to rely on external food sources over which it has no control over.

Under *vision 2030*, Kenya aims to become the provider of choice for basic manufactured goods in eastern and central Africa. This is to be done through improved competitiveness in manufacturing. This is an expansion of Sessional Paper No.2 of 1997 on Industrial Transformation to the Year 2020. The purpose of this Sessional Paper is to set out national policies and strategies that will lay the foundation of structural transformation required to enable Kenya to join the league of Newly Industrialized countries by the year 2020. The country's highest potential for manufacturing industries is in the agro-industries. As said before, 75% of raw materials for local industries emanates from agriculture, this needs to be maintained or improved. This can be achieved only through a vibrant agricultural sector. Also, the country aims at strategically increasing the level of value addition in niche exports by additional processing of local agricultural products. This equally calls for a vibrant agricultural sector.

According to ERS policy document, revitalizing agriculture as the engine of growth of Kenyan economy is important. This is because agriculture and agro-related activities account for over 50% of Kenya's GDP. The sector remains the main source of livelihood for the majority of Kenyan people. If the national objective of reviving and sustaining economic growth, creating employment opportunities and alleviating poverty are to be achieved, then the agricultural sector needs to be vibrant (GOK, 2004).

This study is important in that once the effect of each factor is known; it becomes easier for policy makers to formulate short-run and long-run projections for agricultural sector growth with the aim of achieving *Vision 2030* goals. This is because the study will show how the factors studied could be manipulated to achieve the desired results. The study could also help policy makers in evaluating the effects of various policies on agriculture.

The present study aims to build on the existing literature on the determinants of agriculture sector performance in Kenya. It is hoped that the findings of the study will help in formulating appropriate policies and programs to stimulate the agricultural sector and the overall economy. The results of the study could also be adopted by other developing countries facing similar problems of trying to stimulate the agricultural sector as the case of Kenya.

CHAPTER TWO

2.0 Literature Review

2.1 Theoretical literature Review

There are a number of studies regarding agricultural sector growth which have been done by a number of institutions and scholars. These Studies have mainly focused on marketing and pricing of agricultural goods. Agricultural growth is the outcome of a process in which farmers respond to improved farm profits. Changes in profits in turn, derive from the interplay of prices, improved infrastructure and better services, and enhanced technology (Binswanger, 1988).

Agricultural supply response represents the agricultural output response to changes in agricultural prices and more generally to agricultural incentives. Agricultural supply response can be analyzed from two points of view. The first of is the individual crop response where there is examination of the change in production of individual crop as their producer prices and the producer prices of substitute or complimentary crops change. Secondly, there is aggregate (overall) agricultural production relative to changes in aggregate agricultural price index. Individual crop supply response is higher than the aggregate supply response because for individual crops, it is easy to shift resources in response to relative price changes than shifting aggregate resources devoted for agriculture (Askari and Cummings, 1977). In the short run the aggregate supply response is low but it increases with time. Aggregate supply response is inversely proportional to the share of agriculture to the overall GDP (Valdes, 1989).

Brown (1978) analyzed the pricing policies in developing countries and noted the shifting terms of trade against agriculture. This was attributed to policies which depress prices of agricultural produce and increase manufactured goods prices with the aim of achieving rapid economic growth and better distribution of income. The assumption is that agricultural production is not very responsive to price changes and that large scale farmers are the beneficiaries of higher prices. It was noted that this led to fall in agricultural production which in turn led to poor performance of economic growth.

In 1981, the World Bank evaluated the agricultural development in sub-Saharan Africa in a study titled; 'Accelerated development in Sub-Saharan Africa'. Their findings were that the performance of the sector was poor and this led to slow economic growth of the region. The decline in agricultural growth was attributed to misallocation of investment, very large government operated schemes, economic policies such as pricing, marketing and international frameworks which were biased against agriculture. It was noted that the prices were too low; the input supplies irregular while marketing was noted to be uncompetitive and uncertain.

The Bank also analysed the pricing and marketing policy in Africa in 1985. It was noted that the second structural adjustment lending (SAL) in Kenya main focus had been improved marketing and pricing policies in order to provide enough incentives to farmers. Their findings were that despite SAL, agricultural production had not increased. They argued that the supply response of a given crop does not depend on the own price alone. They argued that the supply response also depends on price of inputs, level of technology as well as the price of the substitute crops.

De Wilde (1989) conducted a study whose results were similar to those of World Bank. From the research findings, pricing policies and distorted marketing were to blame for dismal performance of agricultural sector in sub-Saharan Africa. From the study, it was noted that these countries had used price intervention measures such as subsidies and fixed prices in order to boost agricultural production.

The study found farmers to be responsive to price changes. De Wilde, however, suggested that farmers' response to price depends on the degree to which they assign to food security and incomes, the type of commodities they produce, the significance of climatic factors in determining output and input prices.

Kruegar (1988) recognized that policies on import substitution and exchange rate have affected agricultural production negatively. He observed that many developing countries suppress agricultural commodity prices through government procurement policies, export

quotas and export taxation. These policies combined with subsidization of food imports act as a disincentive to local agricultural production.

Chhibber *et al* (1989) expressed similar views to those of World Bank. He felt that in many sub-Sahara Africa countries, the efforts to reduce disincentives in agriculture have been significant. He noted that considerable progress had been made in providing export incentives. He concluded that even though pricing policy is a fundamental element in the revival of agriculture, supportive measures have to be provided to reduce problems faced by agricultural producers in responding to higher prices

Macro-economic policies, such as exchange rate policies, trade policies etc affect farmer's real income. According to Jaeger (1990), these policies also influence the terms of trade between tradables and non tradables. They explained that exchange rate in most developing countries were overvalued. This study was done before a number of developing countries including Kenya implemented SAPs and liberalized their foreign exchange markets. Overvaluation of exchange rate makes domestic products including agricultural produce more expensive and hence less profitable. Policies aimed at altering the nominal exchange rate are known as exchange rate policies. In most developing countries, this modification normally takes the form of devaluation. Successful devaluation brings about the increase in producer incentives as they increase the price of tradable relative to non-tradable goods.

Cleaver (1988) compared the agricultural growth rates of sub-Saharan Africa under adjustment (with packages of exchange rate adjustments and price and fiscal reforms) with those not under adjustment. Agricultural performance in the two groups was about the same in 1970-80. The striking difference between the two groups clearly emerged over time favouring reforms and demonstrating the responsiveness of African agriculture to policy changes.

The performance of the agricultural sector is also influenced by other activities of the government in the economy in general and the agricultural sector in particular. The

government intervention, particularly in terms of consumption expenditure and investments affects agricultural incomes. Government expenditure can have direct and indirect impact on agricultural incomes. Expenditure that does not directly affect the sector include general public sector, defense and security, and social security. These may or may not be positively associated with agricultural growth. Government expenses that are complementary to private investment and are likely to affect agricultural growth include expenditure on health, education, roads, other transport and communication infrastructure, and a wide range of economic services. More specifically expenditure on research, extension and veterinary services, rural access roads, and provision of credit are likely to affect agricultural performance.

Another factor that has been found to have impact on performance of agriculture is accumulation of human capital. Romer (1986) has shown that accumulation of human capital can sustain growth. It is still debatable if education and training can have an impact on farm productivity. Some studies have found that education of both male and female do not systematically affect productivity. Instead, households with better educated males with higher off farm income divert labour resources away from farm activities towards non farm work. These households can increase demand for agricultural products since they have high incomes.

Agriculture in Sub-Saharan Africa relies heavily on climate except in countries where crops are grown under irrigation. Output in the agricultural sector is to a large extent closely related to rainfall. According to Nyoro (2002), drought (which is associated with poor rainfall) has become a recurrent phenomenon in Kenya occurring once in every three to five years. The association of agricultural growth to rainfall explains the wide range of variability in agricultural growth. Climate not only affects input use but also impacts on policies.

There is increasing consensus among researchers that overall trade environment and particularly trade policies affect agricultural performance. Researchers have argued that increased outward trade or openness contributes to economic growth through

specialization and intensification effects, greater economies of scale associated with larger markets, greater capacity utilization and rapid technological change. Trade also encourages learning by doing and innovation, leading to productivity growth. Trade policy can also affect growth and productivity through foreign exchange market.

2.2 Empirical Literature Review

Krueger et al (1981) conducted a study on sub-Saharan Africa export and food crop agriculture. A simple empirical equation was estimated for nine predominantly agricultural African countries. For all the countries, the estimated relative price coefficient was positive. The estimates showed that the relative prices are important determinants of overall agricultural output, particularly for Ghana and Kenya. Agricultural performance (output) exhibited a negative time trend for most of the countries. This reflected an unfavourable climate for agricultural investment that had been created, the deterioration of the infrastructure and support services available to the rural farmer and the growing lack of availability of cash goods to the rural sector. The weather variable was found to be an important determinant of total agricultural output. The study provides considerable evidence for positive aggregate supply response to changes in aggregate real producer price.

Binswanger (1989) identified structural adjustment policies as an important determinant of agricultural output. He observed that the aim of structural adjustment programmes (SAPs) was removal of overvalued exchange rates, abolition of subsidies, reduction of industrial protection and fiscal austerity. These policies therefore improve terms of trade for agricultural sector in favour of tradables. Binswanger's study compared the agricultural growth rates of sub-Saharan African countries under adjustments. The growth rate under adjustment was discovered to be higher. This shows that African agriculture is responsive to changes in policies. This view was however opposite of that of the United Nations Economic Commission for Africa (ECA). According to ECA, SAPs were inadequate in addressing the causes of Economic, financial and social problems facing African countries which were of structural nature.

Sharma (1992) analyzed the internal terms of trade of aggregate agricultural output in Kenya for 1972-1990 period. A linear and log-linear form of Nerlovian model was estimated using time series data. The terms of trade of agriculture, time trend, weather and lagged output were included. From the Nerlovian log-linear specification, the variables indicated positive response and explained 98% of the variation in aggregate farm output. The aggregate long-run terms of trade elasticity (0.16) was found to be twice the size of the short-run supply elasticity (0.08). The analysis suggested that farmers in Kenya do positively respond to favourable terms of trade for agriculture. The results showed the significance of non-price variables in raising agricultural outputs.

Elamin and Elmak (1997) studied the Sudanese agricultural supply response and analysed the impact of agricultural price incentives of the main adjustment programme. With regard to the efficacy of price incentives in stimulating aggregate agricultural output, the finding confirms the predominant view that increases in real farm price have positive but limited overall effect on agriculture. In their study, non-price factors appear to play a greater role in determining aggregate agricultural output. They argue that unless there is adequate provision of credit, public investment and improved infrastructure, the aggregate agricultural response to price incentives would be minimal. They estimated not only the aggregate agricultural output but also they disaggregated it into rain fed and irrigated production on the basis of modes of production, and into cereal and non cereal production on the basis of commodity composition which is assumed to have important policy implication for economic reforms. The study also attempted to improve data and econometric tests and incorporates some important non-price variables into the model, which are the most common problems, related to the aggregate agricultural supply response models.

McKay et al (1997) examined the supply response of agricultural output in Tanzania. The estimates suggested that agricultural supply response was quite high so that the potential for agricultural sector response to agricultural prices and marketing might be quite significant. The long-run elasticity of food crop output to relative prices was almost unity; both food and aggregate short-run response was estimated at about 0.35. The study

found liberalization of agricultural markets which increased the effective price paid to farmers, to be effective in promoting production. The study advocated complimentary interventions to improve infrastructure, marketing, access to inputs and credit and improved production technology to be necessary.

Nyangito and Okelo (1998) investigated Kenya's agricultural policy and the performance of the sector for the 1964-1996 periods. The agricultural policies used were divided into government controls and liberalized markets. The bipolar division of policies between government controls and free markets was found to have created problems in agricultural development.

During the era of controls, the government domination of production and marketing activities stifled development of the private sector and because of government inability to continuously support the activities financially and technically, there was a decline in agricultural growth and development as a whole especially during 1960s and early 1970s. On the other hand, when the government started to offload the activities, there was lack of harmony and co-ordination of the implementation process. This resulted in retarded growth and development of the agricultural sector because of the vacuum that existed as a result of a poorly developed private sector which also lacked the capacity to undertake the activities adequately. The horticultural sub sector experienced growth when the other sub sectors were declining after liberalization. This was mainly because the HCDA which was regulating the sub sector played a mere regulatory and facilitative role unlike in other commodities where regulatory authorities were acting as buyers and sellers.

Were and Njuguna (2002) examined the factors that influence Kenya's export volumes by disaggregating total exports of goods and services into three categories; traditional agricultural exports (tea and coffee) and other exports of goods and services. For each of the three categories of exports, an empirical model was specified along the standard trade models that incorporate real exchange rate (proxy for relative prices) and real foreign income (of major trading partners) as explanatory variables. An additional variable (investment as a proportion of GDP) was included as a proxy to capture the supply

constraints. An error correction formulation was used to distinguish between the long-run and short-run elasticities. The study found that potential for export supply response exists, even for sub-sectors like coffee where performance had been poor. The study concluded that flexibility in the exchange rate movements, in line with fundamentals of the economy, would be favourable.

Odhiambo and Nyagito (2003) reviewed studies that have attempted the measurement and analysis of agricultural productivity in Kenya. Their review concluded that most studies had not been rigorous and had not utilized advanced methodologies used elsewhere. The previous studies were found to have ignored issues on efficiency. Environmental concerns were also left out in the studies under review. They suggested that for future studies on agricultural productivity to be more relevant to policy formulation, focus should be devoted on determinants of agricultural growth and productivity than on trends.

Odhiambo et al (2004) analyzed the sources and determinants of agriculture growth and productivity in Kenya. This involved a trend analysis of agricultural output and inputs for the period 1965-2001. They used the growth accounting approach to examine sources of agricultural growth and investigated the determinants' of productivity growth using econometric techniques. They found out that the growth in agricultural output was largely due to growth in factors of production with labour being the most important source of growth. Capital and land were also found to have contributed to the growth of the sector. The study also found a close relationship between total factor productivity in agriculture and trade policy. The trade regime was found to have an impact on growth in the agricultural sector. There was also close relationship between climate and total factor productivity. Another important determinant of agricultural productivity from the analysis was government expenditure that goes to services such as research and extension.

2.3 Overview of Literature

The literature has revealed that many factors affect the performance of the agricultural sector. These factors include the aggregate producer price index, exchange rate

adjustment, weather patterns, structural adjustment policies and time trend. Other factors that influence the performance of the agricultural sector include; the economy's overall rate of investment, services such as bank services, human capital, public research and extension and credit.

From the literature above it is evident that agricultural response studies are diverse but mainly concentrate on two categories (Bond, 1983). These are: individual crops and aggregate supply response. There are a number of forms of supply response as a result of increased producer prices of a given commodity, for example, through increased productivity, reduced domestic consumption and possible increase in acreage, removal and replanting.

From the literature review, there are only few empirical studies that have been carried in Kenya and have been mostly on individual crop supply response. Furthermore, some of these studies, while using time series data did not perform certain important tests that are necessary to validate the outcome of the studies. The study by Sharma for example, did not carry out any stationarity tests which are important if one is to avoid spurious results. Additionally, these studies were carried long time ago and there have been new developments that have occurred in the agricultural sector such as liberalization and changes in the government budgetary allocation to the sector. The previous studies have also ignored risk factors which have effect on the supply response.

The study by Odhiambo et al (2004) concentrated much on the production function rather than the growth of the agriculture sector. There are also a number of short comings of the previous studies and this necessitates improved studies. There are few studies done in the country on the factors that determines the growth of the agricultural sector. The study hopes to be more comprehensive by studying many factors that affect the performance of the agriculture sector.

CHAPTER THREE

3.0 Methodology

3.1.0 Theoretical Framework

A production function is necessary to assess the contribution of inputs individually and jointly to the overall output. The function establishes the relationship between the physical quantity of output and specific combinations of physical quantity of inputs used in a production process. The neo-classical production function provides such a framework. It can be formulated as:

$$Y = f(X_1, X_2, X_3, \dots, X_n) \dots \dots \dots (1)$$

Where Y is the output and X_i are the inputs.

Most analyses of productivity have used the constant returns to scale agricultural production relationship with two factors of production- capital and labour. A typical two factor Cobb- Douglas (CD) production function can be specified as

$$Y = AK^\alpha L^\beta \dots \dots \dots (2)$$

Where Y, K, L is the output level, capital and labour inputs, respectively and A, α and β are parameters determining the production technology.

In the special case that $\alpha + \beta = 1$, the production technology is said to exhibit constant returns to scale, which deviates from reality.

The CD form however imposes a restrictive assumptions on the output elasticity of factor inputs. This can lead to incorrect conclusions in general if the specified parametric model is wrongly or inappropriately specified.

Given a neoclassical Cobb- Douglas production function, agricultural growth can be estimated (in logarithms) as the difference between output and a weighted average of the input use as;

$$\lambda_{ag} = \log Y_{ag} - \alpha \log K_{ag} - \beta \log L_{ag} - \delta \log N_{ag} \dots \dots \dots (3)$$

Where λ_{ag} is agricultural growth, while the rest are as defined. The weights are estimated econometrically as coefficients in the agricultural production function.

The above equations ignores risks in agriculture especially rainfall which has an effect in rain fed agriculture like in Kenya.

3.1.1 Model Specification

$$AGDP_t = f(PR_t, TR_t, ABAL_t, AER_t, W_t, SAP, IP, T_t, Sc, RD_t, Ev, Ma_t) \dots \dots \dots (4)$$

Where:

AGDP_t = Agricultural GDP

PR_t = Agriculture Price Index

TR_t = Trade ratio, meant to capture the degree of openness in the country and to reflect the changing policy episodes.

ABAL_t = Agricultural budget allocation

AER_t = Adjusted exchange rate

Sc = Schooling, meant to capture human capital development in agriculture.

W_t = Weather variable

SAP = Structural Adjustment Policy

IPT_t = Input price index

RD = Road length, meant to represent the development of infrastructure in the country.

Ma_t = Market access

Ev = Election Violence

T_t = Time trend

The above equation will be transformed into a logarithmic form for estimation purposes. The estimation is justified because it ensures that the errors are both homoskedastic and normally distributed (Leaver, 2004).

The equation to be estimated is: -

$$\ln AGDP_t = \alpha_0 + \alpha_1 \ln PR_t + \alpha_2 \ln TR_t + \alpha_3 \ln ABAL_t + \alpha_4 \ln AER_t + \alpha_5 W_t + \alpha_6 SAP_t - \alpha_7 \ln IPT_t + \alpha_8 \ln T_t + \alpha_9 \ln Sc + \alpha_{10} \ln RD_t + \alpha_{11} \ln Ma_t - Ev + U_t \dots \dots \dots (5)$$

An attempt has been made to capture time related effects collectively by introducing time-trend variable in the long-run equation. This is because historical data on infrastructure development, expenditure on agriculture research and extension, application of modern technique like fertilizers and improved planting material cannot be easily represented in the growth equation directly or indirectly. Cointegration and error correction technique have been used in this study.

3.2 Justification for using cointegration and error correction model

The use of co-integration and error – correction technique overcame the problem of spurious regression. The estimates of the long-run and short-run elasticities that satisfy the properties of the classical regression procedure will be distinct and consistent. This is because all variables in the ECM are integrated of order zero, 1 (0). The Griliches and Nerlovian models produce spurious regression, inconsistent and indistinct short-run and long-run elasticity estimates. An ECM specification represents a forward looking behaviour such that the solution of a dynamic optimization problem can be represented by an ECM.

3.3 Hypothesis of the study

We hypothesize that;

1. A positive relationship exists between agriculture price index and the agriculture GDP. This will be tested against the null hypothesis that there is a negative relationship between the two.
2. A positive relationship exists between trade ratio and agriculture GDP. This will be tested against the null hypothesis that there is a negative relationship between trade ratio and agriculture GDP.
3. A positive relationship exists between the government budgetary allocation and agriculture GDP . This will be tested against the null hypothesis of negative relationship between the two. It is expected that the more the budgetary allocation to the agricultural sector, the larger is the growth of the sector.
4. A positive relationship exists between the adjusted exchange rate and agriculture GDP. This will be tested against the null hypothesis of a negative relationship between the two. It is expected that when the local currency devaluates the sector performs well.
5. A positive relationship exists between the amount of rainfall and the agriculture GDP. This will be tested against the null hypothesis that there is a negative relationship between the amount of rainfall and the performance of the sector.
6. A positive relationship exists between the SAP and the agriculture GDP. This will be tested against the null hypothesis that negative relationship exists between SAP and the growth of the agricultural sector.

7. A negative relationship between the price of inputs and the agriculture GDP . This will be tested against the null hypothesis that a positive relationship exists between the two. The price indices of fertilizers will be taken as a proxy for the price of inputs. It is expected that the higher the price of inputs, the less the farmers can afford to buy and the lower is the agricultural production.
8. A positive relationship between the time trend and the agriculture GDP. This will be tested against the null hypothesis that a negative relationship exists between the two. We expect that the agricultural sector will perform well over the time due to technological innovation over time as well as the government investment in the sector and out of the sector such as infrastructure and security.
9. A positive relationship exists between schooling and agriculture GDP. This will be tested against the null hypothesis that there is a negative relationship with agriculture GDP.
10. A positive relationship exists between road length and agriculture GDP. This will be tested against the null hypothesis of negative relationship between the two.
11. A positive relationship exists between market access and agriculture GDP. This will be tested against the null hypothesis that there is a negative relationship between market access and agriculture GDP.
12. A negative relationship exists between election violence and agriculture GDP. This will be tested against the null hypothesis that there a positive relationship between election violence and agriculture GDP.

3.4 Sources of Data

The study used secondary data and it covered the period 1968-2008. The variables for computing trade ratio were obtained from World Bank publications and statistical abstracts. The consumer price index was collected from the Central Bank of Kenya. The annual government budgetary allocation and the RER data were extracted from GOK publications (various issues). The price indices of fertilizers and agriculture price index was collected from various issues of economic surveys and statistical abstracts. The rainfall data of major agricultural zones of Kenya was be obtained from meteorological

department in Nairobi. Schooling data, market access and road length were extracted from statistical abstracts and economic surveys.

3.5 Measurement of variables

Trade ratio variable was computed as the ratio of imports plus exports to the country's GDP. To get the price indices of fertilizers the index number splicing method was applied to convert the figures into a common base year. Splicing arises in order to make comparison possible. An average of the total rainfall of the major agricultural areas of Kenya was taken to represent the annual rainfall for the country in a given year. The rainfall was approximated by using a dummy variable to which a value of (1) was assigned, if there was adequate rainfall in that particular year otherwise a value of (0) if the rainfall was inadequate. SAP is also a dummy variable that assumed a value of 0 before the policy was introduced in 1993 and value of 1 when it was introduced. Market access was computed as the ratio of marketed agricultural output to that of the overall agricultural output. Election violence is also a dummy and it assumes 0 when there was violence and one when there was no violence.

3.6 Econometric Tests

Time-series data was used for the study. Macro-economic variables are non-stationary over time. Failure to distinguish between stationary and non-stationary variables may lead to spurious regression problem. The order of integration was tested by the use of Augmented Dickey Fuller (ADF) test. The order of integration is given by the number of times a series need to be differenced so as to make it stationary. If series are integrated of the same order, a linear combination can be estimated, and co-integration can be tested by examining the order of integration of this linear relationship. If the residuals from the linear combination of non-stationary series are stationary, then the series are cointegrated and the residual taken from the cointegrating regression are valid which are then built in an error correction model (ECM). The error correction term is known as the cointegrating term and it shows the speed with which short-term deviation is corrected gradually towards long-run equilibrium.

3.7 Diagnostic Tests

Diagnostic tests are typically used as a means of indicating model inadequacy or failure. For example, in the case of linear regression model which is estimated by OLS, a series of the assumptions requires for OLS to be the best linear unbiased estimator (BLUE) appear to be violated. These assumptions include the serially un-correlated and homoscedastic error-term, absence of correlation between the error-term and regressors and correct specification of the model. Applied econometric work can be viewed as consisting of a number of steps, including specification of the model(s) estimated and model evaluated.

Diagnostic testing plays an important role in the model evaluation stage of econometric studies (Otto, 1994). This study carried out various diagnostic tests including AR for autocorrelation of residues, the ARCH for heteroscedasticity of errors, normality test for distribution of the residues and the RESET test for the regression specification. In addition, the CUSUM test for stability was carried out.

3.8 Estimation Method

The ordinary least square (OLS) method was employed to run the regression using the E-views statistical program.

3.9 Limitations of the study

The study used secondary data. This type of data however, has got some limitation in that it might have errors because of bias, substitution, arithmetic and definition errors. This implies that the end results may not be accurate. Despite these shortcomings, the data will act as a guide in ensuring that we obtain reasonable results for our purpose.

CHAPTER FOUR

4.0 Data analysis and interpretation of results

It is important from a policy point of view to determine the factors that affect performance of the agriculture sector in Kenya. This is because of the vital role that the sector plays in the economy. This chapter presents the descriptive statistics and gives interpretations of the regression results.

4.1 Descriptive Statistics

Before embarking on the details of empirical issues, the data is examined whether it exhibits normality. Many statistical tests and intervals depend on normality assumptions. An analysis of the descriptive statistics can enable us determine the variables that are close to normal distribution. We use mean, median, skewness and kurtosis to describe the data which is summarized in the appendix of this study. In normally distributed data, the mean and the median should be equal. For the variables in this study, it is only time trend and trade ratio whose mean and median are equal indicating that the variables are normally distributed. If the mean is higher than the median the data has positively skewed distributions and if lower than the median then it has negatively skewed distributions. This is confirmed for agricultural price indices, budgetary allocation to the agriculture, the adjusted exchange rate road length and the input price index where we find that the mean is higher than the median and hence positively skewed. For the other variables, the mean is lower than the median hence negatively skewed.

Most economic data is skewed (non-normal), possibly due to the fact that economic data has a clear floor but not definite ceiling. This could also be due to the presence of outliers. Skewness for a normal distribution is zero. Skewness is the tilt in the distribution and should be within the -2 and +2 range for normally distributed series. The skewness of time trend is zero therefore the variable is normally distributed. For the other variables none has skewness of zero thereby confirming that they are not normally distributed. The Jarque –Bera statistic test is used to test normality of the series. It utilizes the mean based coefficient of skewness and Kurtosis to check normality of variable used.

Kurtosis is the peakedness of a distribution and should be within -3 and +3 range when data is normally distributed. Kurtosis is a measure of whether the distribution is peak or flat relative to a normal distribution. Data sets with high Kurtosis tend to have a distinct peak near the mean, decline rather rapidly and have heavy tails. Data sets with low Kurtosis tend to have a flat top near the mean rather than a sharp peak. A uniform distribution would be the extreme case. Kurtosis is also a measure of how outlier-prone a distribution is. The kurtosis for a normal distribution is 3. Distributions that are more outlier-prone have kurtosis less than 3.

Normality test use the null hypothesis of non-normality. The Jarque- Bera (JB) test was used to check normality in the variables. If the probability value is less than Jarque-Bera chi-square at the 5% level of significance the null hypothesis is not rejected. The test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. The standard deviation is the most common measure of statistical dispersion, measuring how widely spread the values in a data set is. If many data points are close to the mean, the standard deviation is small; if many data points are far from the mean, then the standard deviation is large. If all the data values are equal, then the standard deviation is zero. For the variables in this study, the standard deviations are large. This means that there are large variations in the data set.

Correlation tests are used to show collinearity between independent variables. The correlation results for the variables used in the analysis are displayed in the appendix of the study. According to Gujarati (2003), multicollinearity becomes a serious problem if the pair wise or zero-order correlation coefficient between two regressors is in excess of 0.8. The paper found out that there was high correlation among the various variables especially between the agriculture price index and other independent variables. This is likely to impair the normality of the residuals forming the long-run relationship. This effect has been reduced by the logarithmic transformation. The descriptive statistics among other things, give guide on which of the equation is more able to yield better results and highlight on possible problems to encounter. However there is need to supplement the statistics by more incisive analysis such as the correlation matrix. The

correlation matrix is an important indicator that tests the linear relationship, between the explanatory variables. The matrix also helps to determine the strength of the variables in the model, that is, which variable best explains the relationship between the agricultural output and its determinants. This is important and helps in deciding which variable(s) to drop from the equation. The correlation matrix of the variables is presented in the appendix of the study.

4.2 Unit root tests

Before carrying out the analysis, all the variables were tested for stationarity to ensure that they do not produce spurious results. These tests ensure that inferences based on the estimated parameters are consistent and valid. We start by graphing the variables to establish whether they have significant trends. The graphical results showed the presence of trend in all the variables. Non-stationarity of time series data has often been regarded as a problem in empirical analysis. Working with non-stationary variables leads to spurious regression results from which further inference is meaningless. The test for the order of integration is the first step in any cointegration analysis. An integrated series is non-stationary series. The Augmented Dickey –Fuller (ADF) test was used to test stationarity of the series. To ensure that we capture the inherent characteristics of time series, we determine the lag lengths using the Akaike Information Criterion (AIC). We choose the lag length that minimizes AIC. ADF tests for differences are only conducted for the variables which are found to have unit roots i.e. those which are not stationary at levels.

For the regression to make economic sense, the data need to be de trended by making it stationary. We also identify the order of integration for each variable by establishing the number of times it needs to be differenced to attain stationarity. In the ADF test, the null hypothesis of a unit root is rejected against the one-sided alternative if the t- statistic (ADF) is less than (lies to the left) of the critical value. The results of the test for the variables in levels are presented in the appendix of the study.

The test shows that except for trade ratio, no variable is stationary at all levels. The test shows that all the non stationary variables are stationary after first differencing. The next step after finding out the order of integration was to establish whether the non-stationary variables at levels are co-integrated. Differencing of the variables to achieve stationarity leads to loss of long-run properties. The concept of cointegration implies that if there is a long-run relationship between two or more non stationary variables, deviations from this long-run path is stationary. The Engle-Granger two step procedures was used to generate residuals from the long-run equation of the non-stationary variables, which were then tested using ADF test. The result of co-integrating regression is given below.

Table 4.1 (a): (Co-integrating regression, reporting the long-run relationship).

Dependent Variable: AGDP
Sample(adjusted): 1968 2007
Included observations: 40 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.5678	0.765433	4.876557	0.0345
W	0.334444	0.4917563	4.747157	0.0001
TR	1.344148	0.4986407	-0.026956	0.9787
Sc	0.13575	0.52665	-0.257767	0.7987
SAP	0.777824	0.2345764	0.288940	0.4748
RD	0.125780	0.1741444	-1.220700	0.5328
AER	0.580776	2.3985669	3.149312	0.0605
T	0.832859	0.192310	2.513174	0.0182
IPT	-0.929868	1.1020475	1.881262	0.0708
EV	-1.163683	0.2052974	-3.566828	0.0755
ABAL	0.229436	0.329473	2.980187	0.0335
Ma	0.191611	0.673550	-0.780856	0.4422
PR	0.35888	0.3954935	5.211106	0.0912
R-squared	0.689172	Mean dependent var	1.61E+08	
Adjusted R-squared	0.685161	S.D. dependent var	95943963	
S.E. of regression	11687282	Akaike info criterion	35.62310	
Sum squared resid	3.69E+15	Schwarz criterion	36.09714	
Log likelihood	-665.8389	F-statistic	246.6503	
Durbin-Watson stat	2.286054	Prob(F-statistic)	0.004560	

Where:

AGDP = Agricultural GDP

W = Weather variable

TR = Trade ratio

Sc = Schooling.

SAP= Structural Adjustment Policy

RD= Road length

AER= Adjusted exchange rate

T= Time trend

IPT= Input price index

EV= Election Violence

ABAL = Agricultural budget allocation

Ma = Market access

PR= Agriculture Price Index

The cointegration relationship is summarized in the table below

Table 4.1 (b): (Summary of the long-run Co-integrating regression,)

Variable	Elasticity	t-Statistics	Inference
Weather variable	0.334444	4.747157	Significant at 1% and 5%
Trade ratio	1.344148	-0.026956	Not significant
Schooling.	0.13575	-0.257767	Not significant
Structural Adjustment Policy	0.777824	0.288940	Not significant
Road length	0.125780	-1.220700	Not significant
Adjusted exchange rate	0.580776	3.149312	Significant at 1% and 5%
Time trend	0.832859	2.513174	Significant at 5%
Input price index	-0.929868	1.881262	Not significant
Election Violence	-1.163683	-3.566828	Significant at 1% and 5%
Agricultural budget allocation	0.229436	2.980187	Significant at 1% and 5%
Market access	0.191611	-0.780856	Not significant
Agriculture Price Index	0.35888	5.211106	Significant at 1% and 5%

The level of significance of a variable is determined by the absolute value of t-statistic. If it is above 2.57% the variable is significant at 1% and 5% and if the value is above 1.96, the variable is significant at 5%. If t-statistic is below 1.96 then the variable is

insignificant. From the long run model the weather variable is significant at both 1 and 5% level of significance. The trade ratio variable was found to be highly insignificant in explaining the performance of agriculture sector in Kenya. The level of schooling was found to have a positive effect in influencing the growth of agricultural sector. The variable was however found to be insignificant both at 1% and 5% level of significance. The structural adjustment program was found to be insignificant at both 1% and 5% level of significance. The road length and market access variables were also found to be insignificant in explaining agricultural growth in the country. The adjusted exchange rate variable was found to be highly significant at both 5% and 1% level of significance. Specifically, a 1 percent change in real exchange rate leads to 0.58% agriculture growth.

The time trend variable was also found to be significant in explaining agricultural growth in Kenya. The agricultural price index was found to be significant at both 1% and 5% levels of significance. From the results, a 1% change in the agricultural prices leads to 0.36% change in the agricultural output in Kenya. The agricultural prices therefore do influence the growth of the agricultural sector as expected. The government budgetary allocation to the agricultural sector was found to be significant both at the 1% and 5% level of significance in explaining agricultural growth. From the study, a 1% change in the budget allocated to the agricultural sector leads to 0.23% change in the agricultural output in the country. Election violence was found to impact on the growth of the agricultural sector in the country. The variable was found to be significant at both 1% and the 5% levels of significance. Years with violence associated with election were found to have lower agricultural growth rates.

Table 4.2: (Stationarity test for the residual of the Co-integrating regression).

ADF Test Statistic	-5.707219	1% Critical Value*	-2.6300
		5% Critical Value	-1.9507
		10% Critical Value	-1.6208

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RESID01)

Method: Least Squares

Sample(adjusted): 1968 2007

Included observations: 40 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-1.324531	0.232080	-5.707219	0.0000
D(RESID01(-1))	0.294523	0.165630	1.778193	0.0846
R-squared	0.564687	Mean dependent var	0.006030	
Adjusted R-squared	0.551496	S.D. dependent var	0.222784	
S.E. of regression	0.149200	Akaike info criterion	-0.911617	
Sum squared resid	0.734598	Schwarz criterion	-0.822740	
Log likelihood	17.95330	Durbin-Watson stat	2.097801	

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The critical values at 1%, 5% and 10% are greater than the ADF statistic. If the ADF test statistics is greater than the critical values, then the residuals are non stationary and cannot become the error correction term (ECT) and consequently an error correction model (ECM) is not adopted. If the residuals are found to be stationary i.e. the ADF test statistic is less than the critical values at 1%, 5% and 10% level of significance, then the residuals becomes the ECT and an error correction model (ECM) is adopted. The residuals above are stationary at 1%, 5% and 10% level of significance. Therefore the residuals becomes the ECT and the error correction formulation is adopted.. The ECT is derived from the above cointegrating regression and is expressed as:

$$ECT = 1 * AGDP + 23.5678 - 0.334440 * W + 1.344148 * TR + 0.13575 * Sc + 0.777024 * SAP + 0.125780 * RL + 0.580776 * AER + 0.832857 * T - 0.929868 * IPT - 1.163683 * EV + 0.229436 * ABAL + 0.359888 * API$$

The long-run relationship for agriculture growth is thus

$$\text{AGDP} = 23.5678 - 0.334440*W + 1.344148*TR + 0.13575*Sc + 0.777024*SAP + 0.125780*RL + 0.580776*AER + 0.832857*T - 0.929868*IPT - 1.163683*EV + 0.229436*ABAL + 0.359888*API$$

The Durbin-Watson (DW) statistics is used to test for serial correlation of variables in the model. In the study, the DW statistics is 2.286 for the long run and short run relationships while in the residuals it is 2.097. If the DW statistics is 2 then serial correlation is not a problem. If the DW statistics is equal to zero then serial correlation is a problem. In this study, the DW statistic is close to two implying that serial correlation is not a serious problem.

4.3 Error Correction Modeling

After accepting Co-integration, the next step was to re-specify the estimating equation to include the error correction term (ECT). This term captures the long run relationship. It reflects attempts to correct deviations from the long-run equilibrium and its coefficient can be interpreted as the speed of adjustment or the amount of disequilibrium transmitted each period to agriculture output. A high R^2 in the long-run regression equation is necessary to minimize the effect of small sample bias on the parameter of the co-integrating regression, which may otherwise be carried over to the estimates of the error-correction model. The result of the error correction model is represented in the table below.

Table 4.3 (An error correction model reporting the short-run relationship)

Dependent Variable: DAGDP
 Method: Least Squares
 Sample(adjusted): 1968 2007
 Included observations: 40 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
W	0.3344440	0.21756.	4.747157	0.0761
TR	-0.34.4148	0.46407	-0.026956	0.9787
DSc	2.50552.3	3.6759.5	-0.955810	0.3476
SAP	0.777824.	0.24574	0.288940	0.7748
DRD	0.22578.0	1.0144.4	3.220700	0.0328
DAER	0..58077.6	0.3266.9	4.149312	0.0605
T	2.832859.	0.33010.	2.513174	0.0182
DIPT	-0.029995	0.015256	-1.566074	0.0615
EV	0.463683	2.0597.4	2.566828	0.5755
DABA	0.229436.	3.24713.	3.280187	0.0357
DMa	0.246944	0.312458	1.878465	0.0289
DPR	1.0598.88	9.5455.5	5.011106	0.0912
ECM(t-1)	-0.756878	0.45678	3.24567	0.0023
R-squared	0.669172	Mean dependent var	1.61E+08	
Adjusted R-squared	0.655161	S.D. dependent var	95943963	
S.E. of regression	11687282	Akaike info criterion	35.62310	
Sum squared resid	3.69E+15	Schwarz criterion	36.09714	
Log likelihood	-665.8389	F-statistic	246.6503	
Durbin-Watson stat	2.286054	Prob(F-statistic)	0.001320	

From the short run model the trade ratio was found to be insignificant in explaining agricultural growth in Kenya. The variable was found to be insignificant at both the 1% and 5% levels of significance. We conclude that trade ratio is not significant in explaining agricultural growth in the country. The schooling variable was found to be insignificant at 5% in explaining the growth of the agricultural growth in the country. A 1% increase in the schooling leads to 2.5% increase in the agricultural output. The structural adjustment programs were found to be insignificant in explaining agricultural growth in the country. The variable was found to be insignificant at both 1% and 5% levels of significance. Even though SAP variable had the expected sign it is insignificant. Perhaps this suggests that SAP policies do not function in the Sub-Saharan Africa countries due to other factors such as market imperfections.

The adjusted exchange rate variable was found to be significant at both 5% and 1% levels of significance. Specifically, a 1% improvement in the adjusted exchange rate leads to 0.58% change in the agricultural output. The time trend variable also turned out to be significant in explaining the agricultural growth in the country. The variable was found to be significant at both 1% and 5% levels of significance. The input price indices turned out to be insignificant in explaining agricultural output in the country. A 1% increase in the input price indices over the time leads to 0.02% decline in the agricultural output. The election violence variable was found to be significant in explaining performance of agricultural sector at the 5% level of significance only while the government budgetary allocation to the agricultural sector also turned to be significant in explaining agricultural performance in the country both at 1% and 5% levels of significance. A 1% increase in the budgetary allocation to the agricultural sector leads to 0.23% increase in the agricultural sector output in the country. The market access was found to be insignificant in explaining performance of the Kenyan agriculture sector. The agricultural price index was found to be significant at 5% in explaining agricultural output in the country. An increase in the agricultural price index by 1% leads to 1.1% increase in the growth of the agricultural sector.

The lagged error correction term (ECT), included in the agricultural growth model to capture the long run dynamics between the co-integrating series is correctly signed (negative) and statistically significant. It indicates a rapid response of growth to deviations from long-run relationship with each of the variables. In particular, negative deviations from the stationary relationship are “corrected” by increases in growth. The coefficient 0.76 is stable and statistically significant. This indicates the speed of adjustment of 76% from the agricultural growth in the previous year to equilibrium rate of agricultural price index. This is high and implies that the deviations from the long-run equilibrium path are almost corrected in one time period.

4.4 Diagnostic tests

The error correction model was subjected to a number of diagnostic tests in order to evaluate its validity. The diagnostic tests outcome were satisfactory. These were the LM-autocorrection which supplements the DW-statistics, the ARCH (Autoregressive Conditional Heteroscedasticity), the Jarque-Bera test for normality of the residuals and the RESET test for specification of the regression. In addition to the above tests, CUSUM test was done. The results obtained revealed that the parameters were stable and the model could be used for forecasting at the 5% level. Apart from Jarque-Bera normality test, which is distributed as chi-square statistics, the rest of diagnostic tests utilized the F-statistic distribution.

CHAPTER FIVE

5.0 Conclusion and Policy Implications

5.1 Summary and Conclusion

The study set out to identify and analyze the determinants of performance of the agriculture sector in Kenya for the period 1968-2008. The study looked at both price and non-price factors influencing performance of the agriculture sector in Kenya including the weather, trade ratio, school enrollment, structural adjustment programs, the real exchange rates, road length, time trend, the input price index, election violence, market access, the agricultural budgetary allocation and the agricultural price indices. An error correction model was used to analyze the long-run and short-run effects of various factors determining the agricultural growth in the country. The trade ratio, market access schooling and the structural adjustment programs were insignificant in explaining the performance of the agriculture sector in Kenya. The other variables included in the model were found to be significant determinants of agricultural output in the long-run. In the short-run model, the trade ratio, market access, structural adjustment and the schooling turned to be insignificant in explaining the agricultural growth in the country. The agricultural price indexes have a positive influence on the agricultural growth in the country both in the short-run and in the long-run. The agricultural budgetary allocation, the input price index, the election violence were all found to be significant in explaining the agricultural output in Kenya. The study also found the time trend, adjusted exchange rate and road length to be significant in explaining the agricultural output in Kenya. Overall, the variables in the model explain 67% of the agricultural growth in Kenya over the study period.

5.2 Policy Implications

In a number of African countries including Kenya, the agriculture sector is performing below capacity. Most of these countries record reduced agricultural growths and are therefore facing an imminent food crisis, rising unemployment and increased poverty. Whereas at independence most of these economies were self-sufficient in food production due to a well performing agricultural sector, a combination of factors

including rapid population growth, increasing oil prices, adverse weather, poor macro-economic and sectoral performance, and declining public investment in infrastructure have undermined the capacity of these economies to register improved agricultural growth. This has in turn undermined the capacity of these economies to supply sufficient food from domestic resources. The ultimate effect of this is reflected in the decline in the per capita food production, increased poverty and civil strife. Enhancing existing strategies to pursue improved agricultural growth in Kenya and formulating new ones is therefore indispensable for enhancing food-security, peace and health.

Findings of the study indicate that, in Kenya over the study period, the agricultural output is responsive to both the price and non-price factors. Nevertheless, given the negative influence of price in the short-run, the study seems to suggest that the agricultural price indexes alone are inadequate to influence the agricultural growth. This is because the sector may be facing other constraints such as poor infrastructure which cannot be addressed by price incentives alone. A compatible and integrated policy regarding the enhanced support for the agricultural sector may be required to enable the agriculture sector to perform well. Therefore, the integration of simultaneous agricultural prices and input policy in relation to agricultural growth is essential to ensure that the sector provides food security, employment, income as well as playing a role in poverty reduction.

A stable macro-economic environment as captured by the adjusted exchange rate is important for agricultural growth. Adverse macro-economic conditions can lead to stagnation and decline in the agricultural sector. Policies towards stabilizing the economy and ensuring growth are crucial if we are to ensure a well performing agricultural sector in the country. In this regard, the government needs to re-look at its budgetary process to ensure that resources are allocated to core projects which have future benefits. The government should also keep in check the population growth which increases demand on public expenditure for health, education and other necessities. This in turn causes a serious decline in public investments in farmer support services such as research, extension and credit. This can be done by aggressively implementing the family planning

programs which seem to have slowed down in the last decade. Secondly, the government needs to re-visit the success in the agricultural sector between 1960 and 1985 and seek to replicate them. Much of this success can be attributed to political leadership that encouraged creation of an institutional framework and policy environment that supported and sustained agricultural productivity growth. This was done by engaging both public and private sector organizations resulting in the achievement of national food policy objectives and overall agricultural growth.

Drought has a significant negative effect on agricultural growth. Persistent drought has resulted to low agricultural output and declining growth of the agricultural sector. This has in turn resulted in major food shortages which compromise rural and urban welfare and threaten food security. But globally, weather patterns are changing and the effects of global warming are only likely to make the situation worse. With a huge amount of Kenya's agricultural activities pegged on rainfall, the country is likely to face dwindling output from rain-fed agriculture and hence the agricultural sector as a whole is set to bear the brunt. There is a need for the country to develop an early warning system and quick response mechanism to reduce the negative effects of adverse weather conditions. The country should also reduce reliance on rain fed agriculture and invest in irrigation farming. Kenya receives more rainfall than a number of countries but its agriculture sector performs worse compared to such countries for example Egypt. There is also a need for concerted efforts to develop highly drought resistant crop varieties. Similarly strategies to recycle soil nutrients should be developed to address the issue of deteriorating soil fertility. The government should also put in place measures to conserve its dwindling forest cover which if unchecked will have very disastrous effect on the agriculture sector.

The study also suggests that the price of inputs affect the performance of the agricultural sector. The Kenyan economy is liberalized but the government should prevent farmers from exploitation from cartels that sell inputs especially fertilizers. Appropriate policies should be put in place on how the government should intervene when such cases occur. One of the ways in which this issue is expected to be addressed is in the Fertilizer Cost

Reduction initiative which is one of the flagship Programmes in the Vision 2030. Poor seed quality continues to find its way in to the market and this negatively affects agricultural growth. The government therefore needs to step up monitoring of the activities of input vendors and deal firmly with those found to be selling poor quality inputs. This goes hand in hand with the need for continued research to develop and adopt high yielding crop varieties that can be adapted to wide range agro-climatic conditions.

The study has shown that violence that occurs in the country have adverse effect on the performance of the agriculture sector. This problem cannot be fully addressed by deploying security agents. There is need for the government to take radical measures in addressing the root cause of this problem. Land issue is featured prominently as among the causes of the violence. A comprehensive land policy addressing land problems that have been facing this country since colonial times should be implemented. As a starting point, the land policy that has been approved by the cabinet should be finalized and its implementation commenced. Any problem arising from the policy should be addressed to further improve it as it is being implemented rather than to wait and develop the policy for a longer time than it has taken.

There is also a need to improve extension service system and increase its effectiveness in its promotion of modern agriculture. The extension staff should be up to date with the country needs and provide extension service to enable the country to achieve its desired goals. This can enable farmers to switch from competing (substitute crop ventures) and traditional crops to more high income yielding crops. The link between research, extension and the farmers should be improved by enhancing private sector participation in extension service delivery among other things. The government should increase its investment in agricultural research to facilitate development of advanced agricultural production technologies.

Infrastructure has effect on the performance of the agriculture sector as the study has shown that road improvement leads to better performance of the sector. There is need to improve road network in the country especially in rural areas. This will reduce the cost of

production thereby improving the competitiveness of the country in the international market. Also the country should invest in value addition to increase agricultural income. This can be done through public private partnership.

5.3 Limitations of the study

This study focused on the performance of the agriculture sector for the period 1968-2008. Data availability and reliability was a major limitation for the study. Lack of data resulted in collection of data from various sources. This may sometimes result in some inconsistencies given different data compilation techniques. Gaps in available data further resulted in the need to update the missing data from the various sources as well as the use of proxies rather than the most appropriate measure. For instance, a dummy variable for weather was used instead of the actual amount of rainfall received. The study had a severe limitation in that there was no variable that could represent technology in agriculture. The variable used to represent this was time trend which cannot be able to isolate effects of the technology alone on the sector. Another limitation of the study is failure to break down the budgetary allocation on agriculture sector such as on research, extension etc. The study was nevertheless the results of the study are informative and identify a number of issues that are of concern.

5.4 Suggestion for further Research

The limitations of this study necessitate improved research that takes care of the weaknesses identified. With reliable data for rainfall, technological improvement disaggregated budgetary allocation to the agriculture sector and a comprehensive variable for infrastructure, such a study would have more reliable findings. A research analyzing agricultural growth options among the different sub sectors of the agriculture and also among the different sectors of the economy can also be used as a basis to determine the investment options in the sector as well as in the whole economy. This study can give direction on agricultural enterprises that can be promoted and which can give the highest returns.

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Appendix

Appendix 1: Summary of unit root tests

Table – Unit root tests at levels

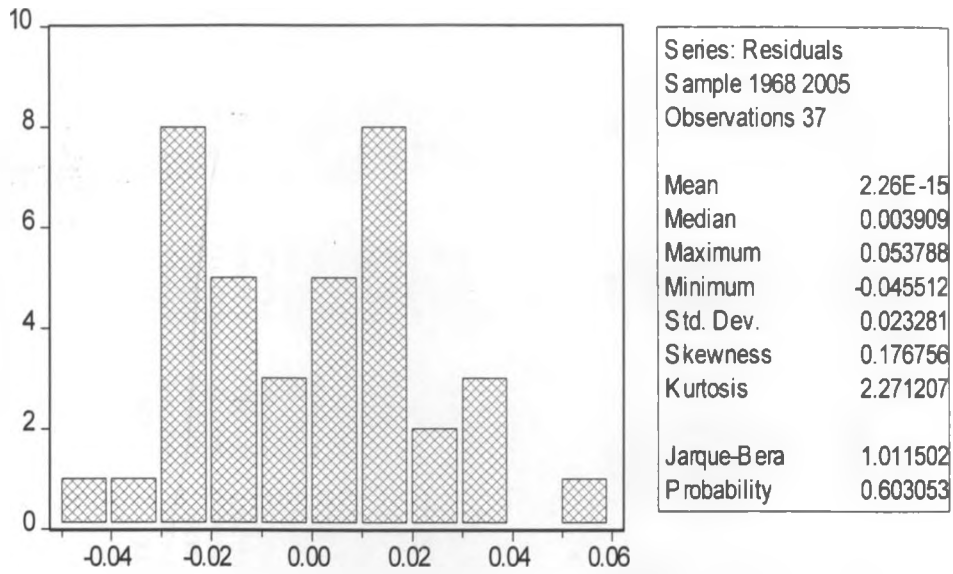
Variable	ADF Statistics	1% critical value	5% critical value	comments
AGDP	-0.670992	-3.6067	-2.9378	Non stationary
ABAL	1.751571	-3.6067	-2.9378	Non stationary
API	0.501587	-3.6067	-2.9378	Non stationary
IPI	-2.107345	-3.6067	-2.9378	Non stationary
MRK	0.329105	-3.6228	-2.9446	Non stationary
AER	-0.245173	-3.6067	-2.9378	Non stationary
SCH	0.221222	-3.6067	-2.9378	Non stationary
RD	-2.772182	-3.6067	-2.9378	Non stationary
TR	-3.704323	-3.6067	-2.9378	Stationary

Unit root tests at first difference

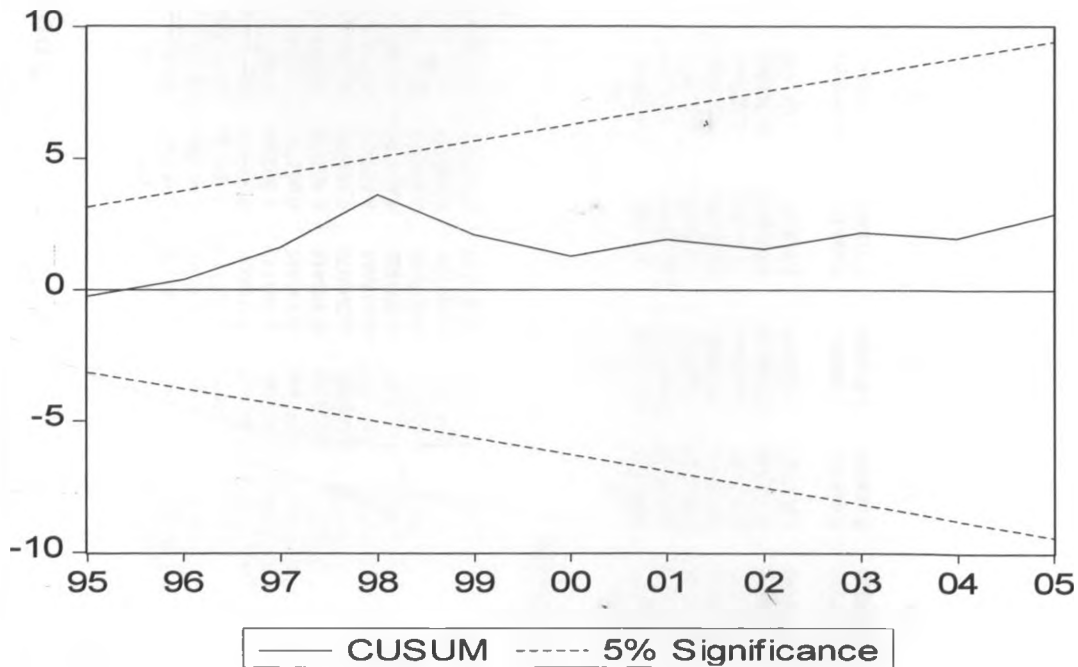
Variable	ADF Statistics	1% critical value	5% critical value	Order of integration
AGDP	-4.110069	-3.6117	-2.9399	1(1)
ABAL	-3.746451	-3.6117	-2.9399	1(1)
API	-4.579653	-3.6117	-2.9399	1(1)
IPI	-4.916834	-3.6117	-2.9399	1(1)
MRK	-8.582770	-3.6289	-2.9472	1(1)
AER	-5.502748	-3.6117	-2.9399	1(1)
SCH	-6.971055	-3.6117	-2.9399	1(1)
RD	-3.657264	-3.6117	-2.9399	1(1)

Source: Eviews computation

Appendix 2: Normality test



CUSUM Test



Appendix 3

Correlation matrix

	AGDP	ABAL	PR	EV	IPT	W	T	TR	SCH	RD	SAP	AER	MA
AGDP	1.000000	0.890810	0.863697	-0.133370	0.452805	-0.138864	0.982808	0.063607	0.912675	0.918494	0.737578	0.953622	0.950202
ABAL	0.890810	1.000000	0.954782	-0.231080	0.492266	-0.133551	0.932724	0.194210	0.850764	0.830562	0.901208	0.937033	0.947657
PR	0.863697	0.954782	1.000000	-0.265510	0.539132	-0.192848	0.918268	0.189798	0.821731	0.821111	0.944907	0.914156	0.923217
EV	-0.133370	-0.231080	-0.265510	1.000000	-0.505473	-0.150445	-0.193448	-0.206079	-0.118661	-0.247848	-0.093408	-0.082705	-0.165224
IPT	0.452805	0.492266	0.539132	-0.505473	1.000000	-0.092717	0.508318	0.355975	0.419097	0.619751	0.495705	0.506910	0.437550
W	-0.138864	-0.133551	-0.192848	-0.150445	-0.092717	1.000000	-0.209014	-0.196544	-0.222769	-0.219468	-0.190534	-0.245722	-0.185911
T	0.982808	0.932724	0.918268	-0.193448	0.508318	-0.209014	1.000000	0.141275	0.922842	0.935796	0.805387	0.975779	0.974361
TR	0.063607	0.194210	0.189798	-0.206079	0.355975	-0.196544	0.141275	1.000000	0.147056	0.111753	0.207236	0.179261	0.118807
SCH	0.912675	0.850764	0.821731	-0.118661	0.419097	-0.222769	0.922842	0.147056	1.000000	0.865369	0.712019	0.913985	0.884103
SAP	0.737578	0.901208	0.944907	-0.093408	0.495705	-0.190534	0.805387	0.207236	0.712019	0.706165	1.000000	0.851107	0.831033
RD	0.918494	0.830562	0.821111	-0.247848	0.619751	-0.219468	0.935796	0.111753	0.865369	1.000000	0.706165	0.891816	0.887704
AER	0.953622	0.937033	0.914156	-0.082705	0.506910	-0.245722	0.975779	0.179261	0.913985	0.891816	1.000000	0.851107	0.957461
MA	0.950202	0.947657	0.923217	-0.165224	0.437550	-0.185911	0.974361	0.118807	0.884103	0.887704	0.831033	1.000000	1.000000

Descriptive statistics

	AGDP	ABAL	PR	W	T	TR	SCH	SAP	RD	AER	IPT	MA	EV
Mean	208034.6	3903.761	288.4158	0.710526	18.50000	0.489336	105512.1	0.315789	56400.91	117.1052	152.1711	1.61E+08	0.947368
Median	215617.3	2878.500	161.3500	1.000000	18.50000	0.490906	116997.5	0.000000	54524.55	105.8695	100.0000	1.51E+08	1.000000
Maximum	299749.0	11130.00	789.4000	1.000000	37.00000	0.650617	209276.0	1.000000	63942.30	250.3310	613.8000	3.50E+08	1.000000
Minimum	119220.4	252.3000	26.68000	0.000000	0.000000	0.213865	0.000000	0.000000	40865.00	13.89000	25.36000	30072656	0.000000
Std. Dev.	47510.66	3403.590	275.4583	0.459606	11.11306	0.103641	59355.53	0.471069	6970.288	73.83239	150.7129	95943963	0.226294
Skewness	-0.066376	0.588621	0.718386	-0.928414	0.000000	-0.764866	-0.219756	0.792594	-0.434746	0.183315	1.737598	0.433400	-4.006938
Kurtosis	2.003039	1.900700	1.835522	1.861953	1.798337	3.693430	1.864937	1.628205	2.122738	1.907824	5.003624	2.010094	17.05556
Jarque-Bera Probability	1.601626 0.448964	4.107736 0.128238	5.415515 0.066686	7.509691 0.023404	2.286325 0.318809	4.466468 0.107181	2.345769 0.309473	6.958183 0.030835	2.415542 0.298863	2.101507 0.349674	25.47821 0.000003	2.741157 0.253960	414.4864 0.000000
Observations	38	38	38	38	38	38	38	38	38	38	38	38	38