FINANCIAL INTEGRATION AND MACROECONOMIC VOLATILITY IN KENYA

OSWERA NANCY ADHIAMBO

X50/73242/2012

A Research Project Submitted to the School of Economics, University of Nairobi, in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Arts in Economics.

November, 2013

DECLARATION

This Research Project is my original work and has not been presented for the award of a degree in any other University.

Signature …… Date ……

OSWERA NANCY ADHIAMBO

This Research Project has been submitted for examination with our approval as University Supervisors.

Signature ……. Date……..……

DR. BETHUEL KINYANJUI

Signature …… Date……...

DR. PURNA SAMANTA

TABLE OF CONTENTS

DEDICATION

This research paper is dedicated to my family especially my dear mother Herine Ogalo, late father Apollo Oswera and siblings Nevian, Nelice, Vinter, Cynthia, Billy and Daniel. Thanks for your unconditional support throughout the Master of Arts program.

ACKNOWLEDGEMENT

I am very grateful to God almighty who gave the inspiration, strength and health to do this work. To Him is the glory forever. I am thankful to my supervisors Dr. Bethuel Kinyanjui and Dr. Purna Samanta who patiently guided me through the proposal stage and completion of this research project. I am indebted to Owen who assisted me in data analysis which enabled me to complete this project in time.

I would like to pass my gratitude to African Economic Research Consortium (AERC) and the Government of Kenya (GoK) for sponsoring my postgraduate studies together with the University of Nairobi, School of Economics in particular for according me favorable environment to study during the entire period.

My immense appreciation goes to my entire family whose unconditional support led me to the completion of this work, especially my mother Herine Ogalo who through her determination and great sacrifice for many years has enabled me to go through my academic life. To her I say thank you and God bless you.

I appreciate the support of my colleagues who gave me useful information which assisted in completing this work especially Kirwa and Yvonne. Indeed I am grateful to you all and to many other friends and relatives, whose names I cannot mention individually I entrust God to reward you abundantly.

ABSTRACT

Kenya has witnessed increased financial integration following financial liberalization in the late 1980s which led to increased foreign private capital flows. On one hand financial integration is considered to complement domestic investment, enhance economic growth and reduce macroeconomic volatility by promoting credit and risk sharing. However, on the other hand private capital can enhance macroeconomic volatility by exposing domestic market to external volatility. Kenya has experienced low and volatile economic growth in the past four decades even in the phase of increased private capital flows in the 2000s. It is therefore necessary to identify the effect of financial integration on macroeconomic volatility in Kenya.

In order to address this issue this study estimated a VAR model using secondary time series data for the period 1970 to 2011 to identify the effect of financial integration on macroeconomic volatility using foreign private investment flows as a measure of financial integration and output, investment and private consumption volatility as measures of macroeconomic volatility. The study found that financial integration reduces investment volatility but has no effect on output and private consumption volatility. This shows that the country has not reaped the full benefits of financial integration with respect to reducing consumption and output volatility. It is therefore essential that policy makers formulate policies that enhance financial integration which in turn reduces macroeconomic volatility in Kenya.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADF	Augmented Dicky-Fuller
AIC	Akaike Information Criterion
CBK	Central Bank of Kenya
CMA	Capital Market Authority
DF-GLS	Dickey- Fuller Generalized Least Squares
ECCU	East Caribbean Currency Union
FDI	Foreign Direct Investment
FPI	Foreign Private Investment
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
IV	Instrumental Variable
KNBS	Kenya National Bureau of Statistics
KPSS	Kwiatkowski Phillips Schmidt Shin
LFIEs	Less Financially Integrated Economies
MENA	Middle East and North Africa
MFIEs	More Financially Integrated Economies
NSE	Nairobi Security Exchange
OLS	Ordinary Least Squares
R&D	Research and Development
RoK	Republic of Kenya
MDGs	Millennium Development Goals
VAR	Vector Auotoregressive
WDI	World Development Indicators

CHAPTER ONE

1.0 INTRODUCTION

Financial integration[1] has increased in developing countries in the past three decades following external financial liberalization in the 1980s. This led to a significant increase in capital flows from developed to developing countries as they have become more open to international trade (Kose *et al*, 2003). Due to openness, developing countries are considered to benefit from financial integration through complementing domestic investment and lowering consumption volatility by allowing consumption smoothing providing opportunities for risk diversification. In addition, financial integration lowers output volatility if it promotes production diversification but increases output volatility if promotes production specialization (Eozenou 2008).

However, financial integration can also increase macroeconomic volatility in developing countries the phase of global financial crisis as it exposes the country to large and sudden reversal of capital flows[2]. This is worsened by developing countries' structural characteristics and policy environment which make them more susceptible to shocks coming from other countries (*op.cit*. 2003, Kari, 2004 and *op.cit.* 2008).

Empirical studies that have examined the effect of financial integration on economic growth have found inclusive results. For example Edison, Levine, Ricci and Slok (2002) found that financial integration does not enhance economic growth while Epaulard and Pommeret (2005), Moritz and Thomas (2010) and Friedrich, Schnabel and Zettelmeyer (2013) show that it enhances economic growth. Moritz and Thomas (2010) show that financial integration had

[1] Kari, (2004) defines financial integration as incorporating domestic financial market into international markets.

[2]Kari, (2004) defines macroeconomic volatility as fluctuations in aggregate economic performance from one period to another.

positive effect on economic growth via the investment channel in the first era of globalization but not in the contemporary times. This is because the first era was marked with development finance while the contemporary time is marked with diversification finance and limited net capital flows.

There is no country level study that has been done on Kenya with respect to the link between financial integration and macroeconomic volatility. However, panel studies that have been done categorizes Kenya as less financially integrated, relatively financially developed and low income country give mixed results[3]. Based on these results there is need to carry out country specific study. Kose *et al* (2003) considered between country volatility but ignored within country volatility while Eozenou (2008) considered within country volatility and his findings are similar to those of Kose *et al* (2003) who did not factor within country volatility. They found that there is no link between financial integration and output volatility and that financial integration increased consumption volatility for less financially integrated economies and less financially developed economies but reduced consumption volatility for more financially integrated economies.

Also the studies that have been done cover the period 1960-2000 when Kenya was less financial integrated. This study includes the 2000s when the country witnessed substantial increase in foreign capital investment flows as shown in figure 1.1 below.

[3]Kose *et al*, (2003) and Eozenou, (2008)

This study uses time series secondary data for the period 1970-2011 to identify the effect of financial integration on macroeconomic volatility. A VAR model is used to estimate the relationship between financial integration and macroeconomic volatility. The structure of the rest of the paper is as follows; the next section gives an overview of Kenya's macroeconomic performance focusing on financial integration and macroeconomic volatility. Chapter two provides a review of literature both theoretical and empirical. Chapter three discusses data and methodology. Chapter four discusses the main findings and chapter five presents the study conclusion.

1.1 An over view of financial integration and macroeconomic volatility in Kenya

This section discusses the level of financial integration and macroeconomic fluctuations in terms of output, investment and private consumption growth rates in the last four decades.

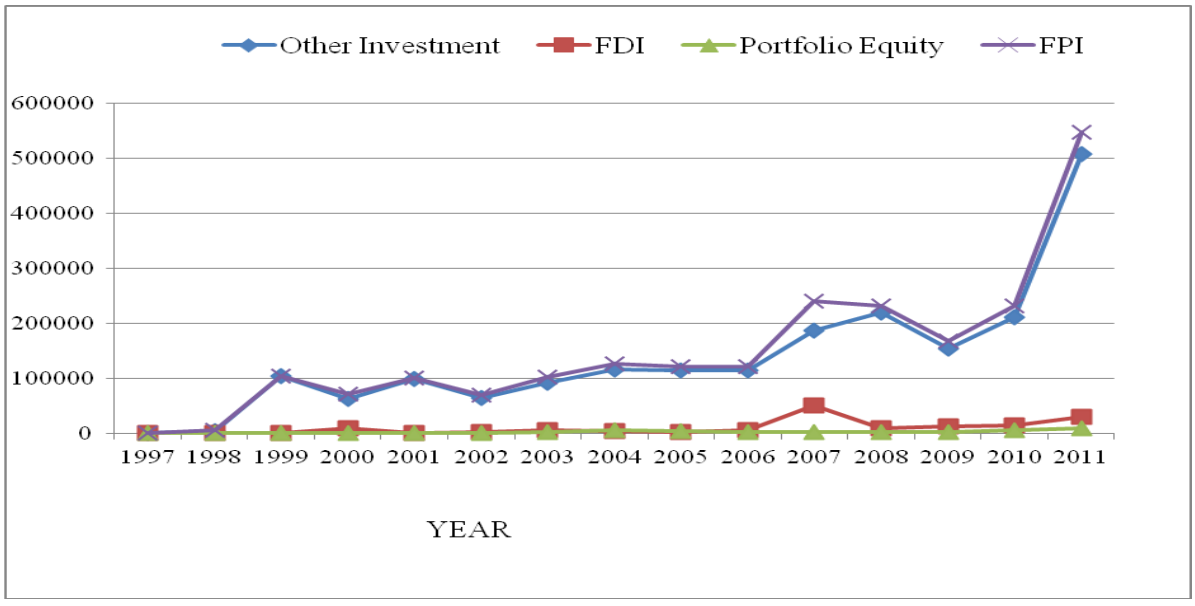
1.1.1 Financial integration

There are two indicators of financial integration namely *de jure* and *de facto* indicators. The *de jure* indicator includes restriction of capital account transactions and the *de facto* indicators include current account deficit, net foreign assets, FDI flows, portfolio equity investment flows and public borrowing (*op.cit*., 2003, Kari, 2004 and *op.cit*., 2008). This study uses gross capital flows as a *de facto* indicator of financial integration which is a combination of FDI flows, portfolio Equity flows and other investment flows. This is because the *de jure* indicator does not change over time compared to *de facto* indicator and does not capture the actual capital flow (*ibid.*, 2008). The study uses gross capital flows because it gives a broader assessment of financial openness as they capture the openness of other financial market segment (Buch *et al*,

2005). The gross capital flows include both foreign assets and liabilities (Lane Milesi-Ferretti 2003).

In Kenya gross capital flows or foreign private investment (FPI) consists of FDI, portfolio equity investment and other investments with other investment taking larger proportion followed by FDI and portfolio equity investment. Other investment flows in Kenya has significantly increased since 1997 from 389 million Kenya shillings to 507846 million Kenya shillings in 2011 apart from a slight decline in 2000 while FDI flows has increased over the years from 51 million Kenya shillings in 1997 to 30612 million Kenya shillings with a slight decline in 1998 and 1999 and portfolio equity has significantly increased from 100 million Kenya shillings in 1997 to 9326 million Kenya shillings in 2011 with a slight decline in 1998 and 1999 as shown in figure 1.1 below.

Figure 1.1: The trend of FPI flows in million Kenya shillings from 1997 to 2011



Sources: Author's compilation using data from KNBS Statistical Abstracts and Economic Surveys for various years

Kenya witnessed significant increase in FPI flows from 20.5 million Kenya shillings in 1970 to 173.4 million Kenya shillings in 1979. However, there was a decline in FPI in the 1980s and early 1990s. This was as a result of numerous factors; including deteriorating economic performance, political instability, rising cost of doing business, declining economic growth, corruption, poor governance and policy environment that made investment unattractive to both foreign and domestic investors (Ngugi and Kabubo, 1998 and Ndung'u and Ngugi, 1999).

To enhance FPI inflow there was need to ensure high economic growth by adopting sound macroeconomic policies focusing on good governance, political stability, financial sector reforms and investment promotion in the country. This is because financial sector plays an important role in facilitating economic growth in Kenya via providing better intermediation between investment and savings in the economy. In order to facilitate financial sector development and enhance economic growth, Kenya conducted financial liberalization in the late 1980s following poor economic performance in the 1980s as a result of economic management by controls adopted in the 1970s in response to balance of payment crisis in the 1970s (*op.cit.*, 1998 and *op.cit.*, 1999).

There were several reforms done in the financial sector so as to facilitate efficiency and create market oriented financial system. Kenya adopted low interest rate policy controlled by the government at independence which was first reviewed in 1974 and later in 1989 with full liberalization in 1991. These were meant to increase savings and investment level necessary to accelerate economic growth. The exchange rate regime was changed from fixed to crawling to dual system of exchange regime with official exchange rate and foreign exchange bearer certificate and to floating exchange rate in1982, 1990 and 1993 respectively. The exchange rate

reforms were done to promote exchange rate stability necessary to facilitate economic growth (*op.cit., 1*998 and *op.cit.,* 1999).

In order to stimulate development of capital markets several measures were taken; CMA was established in 1990, full liberalization of treasury bills in 1991, double taxation on dividend was eliminated, stamps duties on retail shares were abolished, tax deductibility of all cost incurred in issuing shares debentures and bonds was introduced, establishment of secondary market for foreign exchange and capital account liberalization in 1995 whereby foreign participation was allowed in stock market such that foreigners were allowed to invest up to 20% of inward portfolio investment and own up to 40 % of the local company quoted in NSE *(op. cit.,* 1998 and *op.cit.,* 1999*).*This intensified foreign participation in the NSE Such that by December, 2012 foreign investors dominated the equity market accounting averagely for 49% of the total traded equity[4].

Besides Kenya enacted an investment promotion act 2004 so as to facilitate foreign and domestic investment needed to accelerate economic growth and development. Through the Act, Kenya has encouraged foreign investment by introducing incentive packages to foreign investors. The aim of investment promotion act 2004 was to encourage foreign investment and facilitate the issuance of licenses and permits for foreign investors. The licenses are both general and industry specific[5].This led to a significant increase in FPI inflow in Kenya.

[4] NSE, 2012, NSE monthly trading highlights

[5] RoK, 2004, 'Investment Promotion Act 2004

After experiencing low FPI flows in the 1980s and early 1990s there was an increase in FPI flows in the late 1990s onwards apart from a slight decline in 2000 and 2002 following financial sector reforms when FPI flows increased from 120.64 million in 1994 Kenya shillings to 547,784 million Kenya shillings in 2011 as shown in figure 1.1 above. However, the overall picture indicates that the country has not been able to perform well in terms of attracting private foreign capital. According to O'Connell *et al* (2010) Kenya assumed an open capital account expecting to encourage portfolio diversification opportunities for domestic residents, attract more foreign finance and stimulate financial development in the country but this has not been the case since FPI flows in Kenya remains relatively low by the standard of Kenyan's comparatively liberal policy regime.

Considering Kenya's poor performance in terms of attracting foreign private investment there is need of promoting foreign private investment in Kenya. This can be done by enhancing economic and political stability, robust institutions and infrastructures and bilateral trade agreements since these factors are considered to promote foreign private investment (Kinuthia, 2010 and World Bank, 2013)

1.1.2 Output volatility

After independence in 1963 Kenya enjoyed remarkable economic growth with an average annual growth rate of 6.6% per annum in the first decade *(op.cit.,* 1998, *op.cit.,* 1999 and Mwega and Ndungu, 2002). This was as a result of various factors like encouraging smallholder agricultural production, favorable macroeconomic policy that encouraged both public and private investment and political stability. After experiencing high economic growth in a decade the economy began

to perform poorly in the late 1970s due to both internal and external factors. For the last four decades Kenya has experienced low and volatile economic growth.

In the late 1970s economic management was based on control in response to balance of payment problems that the country was facing as a result of poor policies especially mismanagement of 1976/77 coffee boom. The oil crisis in the 1973/74 and 1979 led to high inflation rate which reduced economic growth. The country was affected by severe drought in 1979 which reduced economic growth (*op.cit.,* 1998, *op.cit.,* 1999 and *op.cit.,* 2002).

The 1980s was characterized by sluggish economic performance recording average growth rate of 4.2% per annum emanating from the impact of 1979 oil price shock, 1982 military coup attempt, a severe drought in 1983/84, 1986 mini coffee boom, a decrease in oil prices and good weather in the late 1980s (*op.cit.,* 2002*).*

However, the 1990s recorded worsening economic performance with an average growth rate of 2.2% per annum. This resulted from 1991/92 drought, increased oil price because of the Gulf War, 1991-1993 and 1997-2000 aid embargo, ethnic clashes witnessed in the 1992 and 1997 general election and bad weather conditions characterized by El Nino rains in 1997/98 which was followed by major drought leading to power rationing in 2000 *(op.cit.,* 2002*).*

In the last decade (2000-2010) however, Kenya experienced better economic performance with average annual growth rate of 3.6%. There was accelerated economic growth from 2000 up to 2007 when the economy grew from 0.6% to 7.0% however; this was disrupted by post election violence in 2008 in which economic growth declined to 1.5%. Recovery was hampered by both

internal and external factors like drought in 2007/08, high food and fuel prices, global economic and financial crisis[6].

1.1.3 Investment volatility

In the last four decades Kenya has experienced volatile investment growth with the 1980s experiencing the lowest investment growth of 2.1% per annum and the 2000s experiencing the highest investment growth of 8.9 % per annum which was attributed to the enactment of investment promotion act 2004[7] while the 1970s and 1990s had an average investment growth of 6.2% and 3.1% per annum respectively as shown in figure 1.2 below.

1.1.4 Private consumption volatility

Private consumption growth declined from an average of 7.9% to 5.9 and to 3% in the 1970s, 1980s and 1990s respectively before increasing to 4.1% in the 2000s. The decline in the 1990s can be attributed to poor economic performance witnessed in the 1990s as shown in figure 1.2 below.

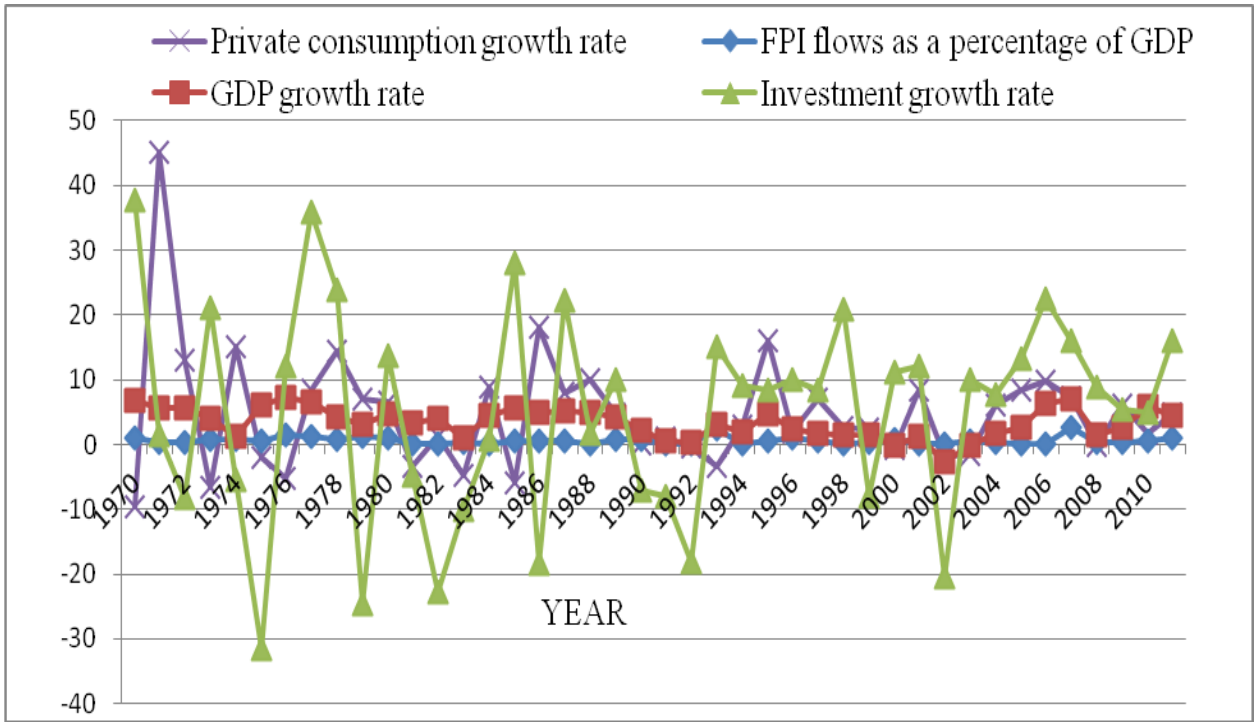
Figure 1.2 below indicates Kenya's macroeconomic performance in view of fluctuations in FPI as a percentage of GDP, output, investment and private consumption annual growth rates from 1970 to 2011. From figure 1.2 we can see that investment growth and consumption growth are more volatile than output growth while FPI as a percentage of GDP has been relatively low but has increased in the last decade and has been fluctuating. It can also be seen from figure 1.2 that

[6] RoK, 2010, 'Draft Progress in attainment of MDGs and way forward towards achieving MDGs by 2015 in Kenya

[7] RoK, 2004, 'Investment Promotion Act 2004

the fluctuations in economic growth, investment growth, private consumption and private capital flows were high in the1970s, 1980s and 1990s but reduced in the 2000s. Though financial integration is expected to complement investment and promote macroeconomic stability by promoting credit and risk sharing between countries however, it can cause macroeconomic instability by exposing the domestic market to external volatility (O'Connell *et al*, 2010).It is important to study whether macroeconomic instability witnessed in Kenya can be attributed to foreign private capital flow in Kenya.

Figure 1. 2: Financial integration and macroeconomic volatility from 1970 to 2011



Sources: Author's compilation using data from KNBS Statistical Abstracts and Economic Surveys and World Bank Data (WDI) for various years.

1.2 Problem statement

Kenya has experienced low and volatile economic growth in the past four decades with better performance in the last decade (2000-2010). According to Ramey and Ramey (1995) volatility reduces growth and is detrimental to welfare of the poor. The current level of real GDP growth of 4.7% in 2012 and is projected to be 5.5% in 2013 in Kenya is worrying and this should be an issue of concern given Kenya's ambitious vision 2030 of achieving and maintaining a sustained economic growth of 10% per annum for the next 25 years[8].

Besides Kenya has relatively developed capital market and low investment therefore limited access to finance; this inhibits investment and therefore economic growth by extension since domestic investment stimulates economic growth (Oezenou, 2008, Moritz and Thomas, 2010 and Naser, 2013). The level of domestic investment in Kenya has been low and volatile such that in 2004 gross investment was 17.1% of GDP increasing slightly to 21% of GDP in 2011 compared to the vision 2030 target of 30% of GDP[9]. The low levels of domestic investment can be complemented by financial integration which facilitates foreign capital inflow augmenting domestic capital and therefore increasing economic growth as past studies show that it has a positive effect on economic growth (Epaulard and Pommeret, 2005, *ibid.*, 2010 and Friedrich, Schnabel and Zettelmeyer, 2013)

According to O'Connell *et al*, 2010 private capital can be a source of macroeconomic stability by promoting credit and risk sharing between countries. However, it can cause macroeconomic

[8] RoK, 2010, 'Draft Progress in attainment of MDGs and way forward towards achieving MDGs by 2015 in Kenya

[9] CBK, 2012, Monthly economic review December 2012

instability by exposing domestic market to external volatility. It is therefore important to identify the effect of financial integration on macroeconomic volatility in Kenya considering the potential benefits of financial integration to developing countries, the fact that financial integration can enhance macroeconomic volatility in these countries and the important role of macroeconomic stability on economic growth so as to ascertain whether macroeconomic volatility witnessed in Kenya can be attributed to financial integration.

1.3 Research question

This study seeks to answer the following question,

What is the effect of financial integration on macroeconomic volatility in Kenya?

1.4 Objectives of the study

The main objective of this study is to identify the effect of financial integration on macroeconomic volatility in Kenya.

1.4.1 Specific objectives

Specific objectives include;

i. To identify the effect of financial integration on investment growth volatility

ii. To identify the effect of financial integration of consumption growth volatility

iii. To identify the effect of financial integration on output growth volatility

iv. To compare the various effects of financial integration on macroeconomic volatility

1.5 Justification and significance of the study

There are few empirical studies[10] that have been conducted to identify the effect of financial integration on macroeconomic volatility in both developed and developing countries. Many of these studies are cross-section and panel studies. The outcomes of these studies vary depending on the aspect of volatility in consideration with some finding positive link, negative link and others find no link between financial integration and volatility. There are no country level studies that have been done on Kenya with respect to the effect of financial integration on macroeconomic volatility however the few panel studies that have been done give mixed results.

It is in bridging the identified gaps that this paper seeks to find the effect of financial integration on macroeconomic volatility in Kenya given that Kenya is an open economy. The finding of this study will be important to policy makers as it will enable them formulate policies that reduces volatility given that volatility reduces economic growth and is detrimental to welfare of the poor and the fact that macroeconomic stability plays an important role in economic growth.

1.6 Study scope and limitations

This study covers the period 1970 to 2011 because it is the period in which data is available and the county witnessed significant increase in FPI flows especially in the last decade. The study does not consider how financial integration affects economic growth and how macroeconomic volatility affects economic growth as these are not within the scope of this study. It is important to study the effect of financial integration on economic growth and how macroeconomic volatility affects economic growth so as to make informed policy decision.

[10] Razin and Rose, (1992) Kose et al, (2003), Eozenou, 2008 among others

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This section consists of both theoretical and empirical literature review. In this section we begin with theoretical literature review followed by empirical literature review and finally an overview of literature.

2.2 Theoretical literature review

The effect of financial integration on macroeconomic volatility has been studied using general equilibrium model (Sutherland 1996, Hagen and Zhang 2006 and *op.cit.,* 2007). The general equilibrium model assumes a world economy consisting of two identical countries, called home and foreign; each country is populated by a range of identical households and firms; the households consume and invest in different assets and supply labour to the firms. The model assumes that firms are perfectly competitive; own capital and issue equity that is traded on the domestic stock market and that the financial markets in the two countries are not perfectly integrated. Therefore the domestic consumers can hold wealth in three forms; domestic bonds, domestic money and foreign bonds and that domestic consumer can costlessly adjust holding of domestic bonds but incur cost in the adjustment of foreign asset holdings while foreign consumer can costlessly adjust foreign bond holding but incur cost in domestic bond adjustment.

The model assumes that the households have identical preferences, maximize utility, choose their consumption in each period and allocate their savings between the available arrays of financial

assets to maximize expected lifetime utility. Therefore the first order conditions for consumer's maximization problem and the firm's maximization problem gives, the optimal labour supply, optimal consumption expenditure, optimal wage rate, optimal price level and optimal international transfer of funds (*op.cit*., 1996 and *op.cit.,* 2007). However, the general equilibrium model is constructed on the assumption that goods and labour markets clear hence the model can give wrong information as it fails to consider other imperfections in the economic system (*ibid.* 1996).

On one hand financial integration is expected to lower macroeconomic volatility as it lowers consumption volatility by allowing for risk sharing among households thereby smoothing consumption over time via trade in international assets and to lower output volatility by promoting production diversification. On the other hand financial integration is expected to increase macroeconomic volatility as it increases output volatility if it promotes production specialization based on comparative advantage considerations, thereby making countries more susceptible to industry-specific shocks and increase consumption volatility if it allows for over trading in international assets (Razin and Rose 1992, *op.cit.,* 2003 Evans and Hnatkovska, 2007 and *op.cit.*, 2008).

Financial integration provides enhanced investment opportunities and allows countries to diversify country- specific productive shocks therefore increased financial integration increases investment volatility. Investment theory predicts that increased financial integration would increase investment volatility as the substitution between investments at home and abroad become larger (*op.cit*. 1992). Financial integration can also increase business cycle volatility if it

worsens distortions resulting from credit market imperfections associated with weak domestic financial institutions (*op.cit.* 2008).

Sutherland (1996) used stochastic dynamic equilibrium business cycle model to show that the link between financial market integration and business cycle volatility depend on the nature of the underlying shocks in the economy. He investigated whether financial market integration leads to greater volatility of economic variables and found that increased financial integration reduces interest rate volatility but increases nominal and real exchange rate volatility which lead to increased output volatility and reduced consumption volatility. He also found that financial market integration with perfect capital mobility stabilizes consumption and output volatility by stabilizing interest rates and exchange rates in case of demand shocks but increase short-run consumption volatility and nominal exchange rate and reduces short-run output volatility, nominal and real interest in case of permanent labour shocks.

Hagen and Zhang (2006) analyzed the effect of financial openness on macroeconomic volatility in a small open economy using a real dynamic equilibrium model. The economy has two types of domestic agents; households (less productive agent) and entrepreneurs (more productive agent) using land as a productive asset and the productive agents borrow funds a broad with land as collateral. Households are risk averse and entrepreneurs' projects are subjected to idiosyncratic shocks while foreign investors are risk neutral and entrepreneurs borrow from households via domestic mutual funds. The model is subjected to foreign interest rate shock, productivity shock, and the terms of trade shock. They found a non monotonic relationship between increase in

financial openness and macroeconomic volatility with respect to three shocks with or without domestic financial frictions.

Evans and Hnatkovska (2007) studied the effect of financial integration on macroeconomic volatility and welfare using two country general equilibrium model. They examined a two-sector (tradable and nontradable), two economies whereby there is international trade in stocks and bonds and markets are incomplete. They considered equilibrium under financial autarky (FA), low financial integration (LI) and high financial integration (HI). They found that financial integration increases the correlation pattern between the intertemporal marginal rates of substitution for home country and foreign country indicating increased risk sharing but which is incomplete and that high financial integration reduces consumption and output volatility and improves welfare while low financial integration increases consumption and output volatility and lead to welfare loss.

2.3 Empirical literature review

The empirical studies on the effect of financial integration on macroeconomic volatility include;

Razin and Rose (1992) used IV method using panel data to investigate the relationship between business cycle volatility and openness for 130 countries. They found that there was no significant link between openness and business cycle volatility. The results are similar to those of Kose *et al* (2003), Kari (2004) and Eozenou, (2008).

Kose *et al* (2003) studied the effect of financial integration on macroeconomic volatility for 76 countries grouped as MFIEs and LFIEs for the period 1960-1999. They found no significant link

between financial integration and output volatility but show that output volatility has declined in the 1990s as compared to the three preceding decades. However, consumption growth volatility increased for MFIEs in the 1990s when financial integration increased considerably and the relationship was non-linear. This is contrary to theoretical prediction of consumption smoothing from international risk sharing opportunities. This positive relationship holds for financial integration of up to a threshold of 50% after which it becomes negative.

Kari (2004) used annual data for period 1986-2003 for each of the ECCU countries to study the effect of financial integration on macroeconomic volatility in ECCU. He estimated fixed effects model by generalized least square method using cross-sectional weights. He found no stable link between financial integration and output volatility in ECCU. However, financial integration was found to lower consumption volatility but increases investment volatility.

Buch, Dopke and Piedzioch (2005) studied how financial market integration may influence the impact of macroeconomic shocks on business cycle volatility using stochastic dynamic equilibrium business cycle model. They used panel data set for 24 countries for the period 1960-2000. They found no stable link between financial openness and business cycle volatility over the years. They gave two explanations for the missing link; parameter instability and the nature of shock in the economy. To factor parameter instability they regressed cross-section data for 1970s, 1980s and 1990s and found that financial openness increased business cycle volatility in the 1970s and but reduced it in the 1990s indicating that causes of business volatility have changed over the years. To consider the impact of underlying shocks they analyzed various policy regimes and found that monetary policy (interest rate) volatility increases output volatility

while fiscal policy (government spending) volatility reduces output volatility with financial openness.

Eozenou (2008) used GMM-IV panel method to determine whether domestic financial conditions matter in explaining the link between financial integration and macroeconomic volatility for 90 countries for the period 1960-2000 using panel data. He found that financial integration has no effect on output volatility but has on consumption volatility depending on the level of financial development. Financial integration increases consumption volatility for countries with low level of financial development but reduces consumption volatility for countries with high level of financial development. The level of financial development (credit to private sector as a share of GDP) at which the country benefits from consumption smoothing is 55-60% for absolute consumption volatility and 65-70% for relative consumption volatility. Kenya has a relatively developed financial sector (below 35%) hence financial integration increases private consumption volatility.

Simon (2005) empirically examined the effect of international financial integration on macroeconomic volatility in the 8 developing economies of MENA region for the period 1980-2002. He found that financial openness proxied by both capital and current account restriction and gross capital flows to GDP increase output and consumption volatility such that more open MENA economies face more volatile output and consumption indicating that the economies have not benefited from consumption smoothing benefits of financial integration. However, for less financially integrated MENA economies current account restriction is associated with declining

output and consumption volatility but capital account restrictions are not associated with declining consumption and output volatility.

Kose *et al* (2006) used panel data for 85 industrial and developing countries to study how trade and financial integration affect the relationship between growth and volatility. They found that trade and financial integration weaken the negative growth-volatility relationship such that countries that are more open to trade and global capital seem to face a less severe tradeoff between growth and volatility. They also found that more financially integrated economies appear to have a positive growth-volatility relationship while less financially integrated countries appear to have a negative growth-volatility relationship.

Chen and Wang (2009) empirically investigated the effect of financial openness on macroeconomic volatility for 35 industrial and developing countries for the period 1970–2003. They found that capital outflows reduce output and consumption volatility significantly but capital inflows increase the fluctuations in consumption and output growth. However the effect of financial openness on volatility seems to vary with country grouping with capital inflows reducing volatility for industrial countries but not for developing countries. They did not consider the net effect of capital flows but investigate separately the effect of capital inflows and outflows and also used a different measure of volatility which is conditional variance. This could explain the different results from other empirical studies that used gross capital flows as financial integration indicator and standard deviation as a measure of volatility.

2.4 Overview of literature review

Many empirical studies on the effect of financial integration on macroeconomic volatility found no significant link between financial integration and business cycle or output volatility though they used different methods; consider different country groupings, different periods and different measures of financial integration and volatility. However, these studies found significant link between financial integration and consumption volatility which is non linear. According to Hagen and Zhang (2006) there may be no a significant linear estimate on the relationship between financial openness and macroeconomic volatility if the empirical data of countries with different degrees of financial openness are pooled together as the underlying relationship is rather flat and non-monotonic.

Though theory does not give clear prediction on the effect of financial integration on macroeconomic volatility it is evident from empirical studies that the effect of financial integration on macroeconomic volatility depends on several factors; the degree of financial integration, level of financial sector development, the nature of the underlying shocks in the economy and the level of development of the economy. Since many of the empirical studies reviewed are cross section and panel studies it is important to carry out country level study to identify how financial integration affects macroeconomic volatility given that these factors vary across countries.

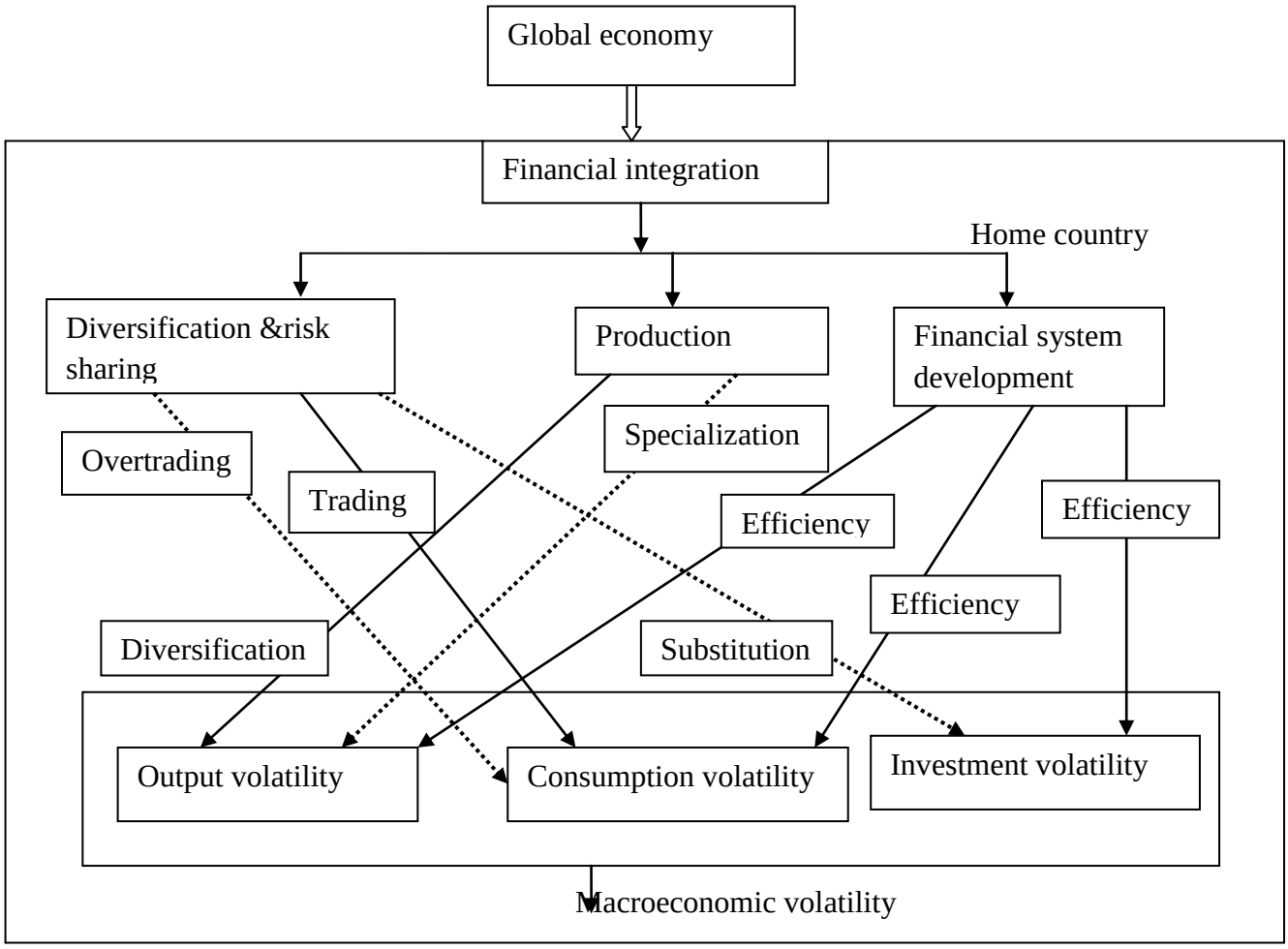
CHAPTER THREE

3.0 METHODOLOGY

This section covers the theoretical framework, empirical model and the data that was used in this study.

3.1Theoretical framework

Figure 3.1: The link between financial integration and macroeconomic volatility



Source: Author's compilation based on theoretical literature

Figure 3.1 above indicates the link between financial integration and macroeconomic volatility. The solid lines show that financial integration reduces macroeconomic volatility while the dotted lines show that financial integration increases macroeconomic volatility.

Financial integration affects a country's macroeconomic volatility through diversification and risk sharing, production and financial sector development as shown in figure 3.1 above. Financial integration lowers macroeconomic volatility via diversification and risk sharing in that it allows for consumption smoothing over time via trade in international assets hence reducing consumption volatility however, if it allows for over trading in international assets it leads to increased consumption volatility thereby increasing macroeconomic volatility. Diversification and risk sharing can also provide enhanced investment opportunities by allowing countries to diversify country specific productive shocks leading to increased investment volatility thereby increasing macroeconomic volatility. This is because investment theory predicts that increased financial integration would increase investment volatility as it increases the substitution between investments at home and abroad (*op.cit.* 1992, *op.cit.* 2003, *op.cit.* 2007 and *op.cit.* 2008).

Financial integration lowers macroeconomic volatility by promoting production diversification leading to reduced output volatility however; it increases macroeconomic volatility as it increases output volatility if it promotes production specialization on the basis of comparative advantage, thus exposing countries to industry specific shocks (*op.cit*. 1992, *op.cit.* 2003, *op.cit.* 2007 and *op.cit.* 2008).

Financial integration reduces macroeconomic volatility by promoting financial sector development which enhances efficiency in domestic financial markets leading to increased

investment and output growth but it can increase macroeconomic volatility if it worsens distortions resulting from credit market imperfections associated with weak domestic financial institutions (*op.cit.* 2008).

Macroeconomic fluctuations have been explained using endogenous neoclassical production function and aggregate demand and aggregate supply (AD-AS) model whereby fluctuations in the economy results from demand and supply shocks hitting the economy (*op.cit.* 1996, Mankiw, 2002, *op. cit.*, 2006, and *op.cit.* 2007).

3.1.1 Endogenous growth model

This study uses endogenous growth model to show how FPI affect macroeconomic volatility. The study adopted Lensink and Morrissey (2006) endogenous growth model based on Barro and Sala-i-Martin (2003, Chapter 6) who modeled FDI flows, volatility and growth to explain how FPI affects growth positively and FPI volatility affects growth negatively. FPI affects long run economic growth through technological progress in which technological progress is viewed as an expansion of the number of varieties of capital goods. The model assumes an economy with three agents; final output producers who hire capital goods and labor to produce the final output; innovators who produce capital goods, and households who maximize utility subject to budget constraint.

Final output producers

The model assumes a constant return to scale production function for the final output in the form

$$Y_i = AL^{(1-\alpha)}.\sum_{j=1}^{N} K_{ij}^{\alpha}, 0 < \alpha < 1 \quad \text{.....1}$$

Where is Y is output, L is labor input, K_j is service flows from each capital good j, N is the varieties of capital goods produced by the innovators, A is a measure of productivity or efficiency and α is marginal productivity of capital. The model assume that capital goods depreciate fully in each period, so that they behave like non-durable intermediate goods so that we have

$$Y_i = AL_i^{(1-\alpha)} NK_i^{\alpha} \quad \text{.....2}$$

To determine the quantity of capital goods demanded by final output producers we equate the marginal productivity of the j^{th} capital good to the price of capital good, P_j.

$$\partial Y / \partial K_{ij} = A\alpha L^{(1-\alpha)} K^{(\alpha-1)} = P_j \quad \text{.....3}$$

The demand for capital good j by firm i is given by

$$K_{ij} = L_i \left(\frac{A\alpha}{P_j}\right)^{(1/1-\alpha)} \quad \text{..... 4}$$

Research firms or innovators of new capital good

The model assumes that innovators have monopoly rights over the production and sale of the capital goods, production costs of K, after it has been invented, equal 1 in each period, and that the rate of return (interest rate, r) is constant between times v and t. The present value, V (t) of the returns from inventing (and producing in several periods), capital good j equals (where K_j is the total quantity produced at each date) is given by

$$V(t) = \int_t^{\infty} (P_j - 1) K_j e^{-r(v-t)} dv \quad \ldots\ldots 5$$

The innovator sets P_j by optimizing V (t). Since K_j is independent of time, this implies optimizing (P_j-1) K_j, where K_j is the total quantity demanded by different producers i($K_j = \sum K_{ij}$). The optimization process gives P_j=1/α >1 (where 1/α is the mark up price) which gives the quantity demanded for each variety K as

$$K_i = K = LA^{1/(1-\alpha)} \alpha^{2/(1-\alpha)} \quad \ldots\ldots 6$$

Using the value of P_j, equation 6 and 5 can be written as

$$V(t) = LA^{1/(1-\alpha)} \left(\frac{1-\alpha}{\alpha}\right) \alpha^{2/(1-\alpha)} \int_t^{\infty} e^{-r(v-t)} dv \quad \ldots\ldots 7$$

The model assumes that the cost (η) of inventing new capital good is constant and at equilibrium with positive R&D and increasing N, and that $V(t) = \eta$ then equation 7 can be written as

$$r = \left(\frac{1}{\eta}\right) LA^{1/(1-\alpha)} \left(\frac{1-\alpha}{\alpha}\right) \alpha^{2/(1-\alpha)} \quad \ldots\ldots 8$$

FPI is then introduced instead of FDI as modeled by Lensink and Morrissey (2006). The model assumes that the cost of production contains two parts and that in each period there are fixed maintenance costs assumed equal to 1 and fixed set up costs. The costs of innovation are assumed to be same for all goods. The model assumes further that the cost of discovering new capital goods depend on the ratio of goods produced in other countries to those produced

domestically. This ratio is a proxy for FPI such that a higher ratio of goods produced in other countries implying more FPI which would lead to a decline in the costs of innovation. The costs of discovering a new good is modeled as $\eta = f(FPI), where \frac{\partial \eta}{\partial FPI} < 0$

To account for uncertainty with respect to FPI, the model assumes that FPI is stochastic and is modeled as

$FPI = \mu(FPI) + \varepsilon$ Where μFPI is mean of FPI and ε is an error term. The certainty equivalent of the expected value of FPI is given by

$FPI = \mu(FPI) - 0.5B\sigma^2(FPI)$ Where B is the coefficient of absolute risk aversion and σ^2FPI is the variance in FPI inflows. Taking into account the certainty equivalent value of FPI and assuming that the rate of return on assets (r) is constant and free entry equation 8 can be written as

$$r = \left[\frac{L}{f[\mu(FPI) - 0.5B\sigma^2(FPI)]}\right] A^{1/(1-\alpha)} \left(\frac{1-\alpha}{\alpha}\right) \sigma^{2/1-\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Equation 9 indicates that an increase in FPI leads to an increase in r while an increase in the variance of FPI leads to a decrease in r.

Households

The households maximize utility over infinite horizon

$$U = \int_0^{\infty} \left(\frac{C^{1-\theta}-1}{1-\theta}\right).e^{\rho t}dt \quad \text{..... 10}$$

Where C is consumption and ρ is the discount rate. The optimization process subject to the budget constraint for households gives the growth rate of consumption as

$g_c = \left(\frac{1}{\theta}\right)(r-\rho)$ Where, θ is the elasticity of marginal utility.

In the steady state consumption growth rate is equal to output growth rate ($g = g_c$) and using equation 9 output growth can be written as

$$g = \frac{1}{\theta}\left[\left(\frac{L}{f[\mu(FPI)-0.5B\sigma^2(FPI)]}\right)A^{1/(1-\alpha)}\left(\frac{1-\alpha}{\alpha}\right)\sigma^{2/(1-\alpha)} - \rho\right] \quad \text{..... 11}$$

From equation 11 we can see that increase in FPI leads to an increase in output growth rate (g). On one hand an increase in FPI lowers set up cost and raises the return on assets (r) and the increase in r leads to increase in saving and hence increase investment which translates to high output growth and consumption growth. However on the other hand an increase in volatility of FPI increases set up cost and lowers rate of return which reduces output growth, consumption and savings.

3.2 Empirical model specification

Equation 11 shows that output and consumption growth are functions of FPI such that fluctuations in FPI leads to fluctuations in output, consumption and investment growth. In this estimation the study follows the approach used by Kari, (2004) since his study focused on

developing countries only unlike other studies that focused on both developing and developed countries[11]. Since there are three dependent variables a VAR model was estimated because the three measures of macroeconomic volatility might have significant influence on each other. A VAR model therefore takes care of endogeneity that might exist between the dependent variables (Greene, 2003).

The model can be specified as

$$lnV_{it} = A + \alpha_1 lnV_{it-1} + \alpha_2 lnV_{it-2} + \beta_1 \ln FI + \beta_2 \ln X_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 12$$

Where V_{it} is a vector of endogenous variables, A is vector of fixed parameters, α and β are a vector of parameters, FI is financial integration, X_t are a set of control variables and ε_t is the white noise error term which captures other explanatory variables not included in the model.

There are several factors that have been identified to influence macroeconomic volatility. They include trade openness, government expenditure, government tax revenue, size of the government, volatility of inflation rate, financial sector development, financial integration, volatility of terms of trade, volatility of exchange rate, black market premium and civil liberty index among others (*op.cit.* 2003, *op.cit.* 2008 and Spiliopoulus, 2010). For this study financial sector development, trade openness, inflation rate volatility and terms of trade volatility were included as a set of control variables. The set of control variables included are chosen based on past studies in which they have been statistically significant and on the availability of data. Besides the variables have low correlation as shown in table 4.2 in the next chapter.

[11] Kose et al, 2003 and Eozenou, 2008

Volatility is modeled using standard deviation of the variables whose volatility is being generated. Modeling volatility using standard deviation involves regressing a variable (y) on its one-year lagged variable together with an intercept and a linear time trend and calculating the standard deviation of u_t as indicated in equation 13 (Lensink and Morrisey, 2006).

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 Trend + u_t \quad \text{.....13}$$

3.3 Definition and measurement of variables

Table 3.1 shows a description of variables that is used in this study.

This study used annual secondary time series data for the period 1970 to 2011 to identify the effect of financial integration on macroeconomic volatility in Kenya. The choice of the period is informed on the basis of availability of data and that it is the period in which the country has experienced volatile economic growth and private foreign investment flow.

The estimated coefficients of the explanatory variables are expected to have the following relationships with the dependent variables as indicated in Table 3.2.

Table 3.1 : Variables used

Variables	Description	Sources
Output volatility	Standard deviation of GDP percentage growth rate.	KNBS
Private consumption volatility	Standard deviation of Household final expenditure percentage growth rate.	World Bank (WDI)
Investment volatility	Standard deviation of Gross Capital Formation percentage growth rate.	World Bank (WDI)
Financial integration	Sum of FDI, portfolio equity and other investments flows (assets and liabilities) as a share of GDP in million KSHs.	KNBS
Financial sector development	M2 as a percentage of GDP.	World Bank (WDI)
Trade Openness	Trade Openness (imports and exports of goods and services as a share of GDP in million US$).	World Bank (WDI)
Inflation rate volatility	Standard deviation of annual percentage inflation rate.	KNBS
Terms of trade volatility	Standard deviation of terms of trade.	KNBS

Table 3.2: The expected relationship

Variables	Output Volatility	Private Consumption Volatility	Investment Volatility
Financial Integration	Negative or Positive	Negative or Positive	Positive
Financial Development	Negative	Negative	Negative
Trade Openness	Positive	Positive	Positive
Terms of Trade Volatility	Positive	Positive	Positive
Inflation Volatility	Positive	Positive	Positive

3.4 Estimation procedure

Since the study used time series data; a unit root test was conducted before estimation to ensure efficient estimates. Time series analysis assumes that the underlying time series is stationary. However the underlying time series may be non stationary and this can lead to spurious regression (Granger and Newbold, 1974). A unit root test was first conducted to determine whether the underlying time series is stationary or not using DF-GLS test proposed by Elliot, Rothenberg and Stock (1996) which is similar to ADF test based on Dickey and Fuller (1979) where the following regression is estimated. This is because DF-GLS test has best overall performance with respect to small sample size and power than ADF test when the series has unknown mean or trend (*ibid*., 1996 and Baum, 2005).

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t$$

Where Δ is the first difference operator, $\delta = (\rho - 1)$ and $-1 \leq \rho \leq 1$. If $\delta = 0$ then $\rho = 1$ implying that there is a unit root problem or time series is non stationary but if $\rho < 1$ then the underlying time series is stationary. The null hypothesis is that there is unit root ($\delta = 0$) that is non stationary time series while alternative hypothesis is stationary time series (Gujarati, 2004).

Besides DF-GLS test a KPSS unit root test which assumes a null hypothesis of level and trend stationarity against an alternative of unit root proposed by Kwiatkowski, Phillips, Schmidt and Shin (1992) was done.

According to Perron (1989) the presence of structural break in a series may lead to ADF test biased towards non rejection of unit root null hypothesis. It is therefore important to do unit root test that allows for structural breaks. Perron and Vogelsang (1992) proposed unit root test that allows for exogenous structural break in the series while Zivot and Andrews (1992) treat the structural break as endogenous. A unit root test using Zivot and Andrews unit root test that allows for one structural break based on additive outlier (AO) model and innovative outlier (IO) model proposed by Perron and Vogelsang (1992) was conducted.

The number of lagged difference terms included is determined by AIC criteria. The idea is to include many lagged difference terms so as to ensure that the error term is serially uncorrelated. The AIC was used to determine the number of lags as it performs better for smaller sample and produces the least probability of underestimation (Khim-Sen, 2004).AIC is specified as below

$$AIC_p = \pi\left[\left(ln\sigma_p^2\right)\right] + 2p$$

Since the log of trade openness and financial development were non stationary at level but stationary at first difference a Johansen cointegration test was conducted to test for cointegration. Two variables are cointegrated if they have long- term relationship between them. Johansen cointegration test is based on VAR integrated of order (k) given by

$$X_t = \prod_1 X_{t-1} + \cdots + \prod_k X_{t-k} + \varepsilon_t$$

Where X_t is a vector of variables integrated of order one and is non stationary at level but its first difference is stationary. The Johansen approach is preferred to the regression approach as it takes into account the error structure of underlying process which the regression estimates do not

(Johansen, 1988). The Johansen cointegration test uses trace statistics and maximum Eigen values. The null hypothesis is that variables are cointegrated against the alternative that variables are not cointegrated.

A VAR model was estimated to determine the effect of financial integration on macroeconomic volatility. Estimation and data analysis was done with STATA regression software package.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 Introduction

This section covers the analysis and findings of the study. It consists of descriptive statistics, unit root test, estimation and interpretation of results.

4.2 Descriptive statistics

Table 4.1 present the characteristic and distribution of variables used in the analysis. From the table it can be seen that gdp and investment are skewed to the left implying that the left tail is longer while private consumption, financial integration, financial development, trade openness, inflation rate and terms of trade are skewed to the right implying that the right tail is longer. It can also be seen that private consumption, financial integration, financial development, inflation rate and terms of trade have a leptokurtic distribution with values concentrated around the mean and thicker tails while gdp, investment and trade openness have platykurtic distribution with values widely spread around the mean. From table 4.1 it can be seen that financial integration has been very low with highest value of 0.89 as a ratio of GDP and that investment has the highest deviation compared to other variables. Table 4.2 shows the correlation matrix for the variables used in this analysis and figure 4.2 to 4.8 in appendix 1 shows the trends in variables used in the analysis.

Table 4.1: Summary statistics

Variable	Observation	Mean	Std.Dev	Min	Max	Kurtosis	Skewness
Gross Domestic Product	42	3.39	2.32	-2.6	7.30	2.43	-0.28
Investment	42	5.27	16.08	-31.50	37.75	2.69	-0.31
Private Consumption	42	4.82	9.08	-9.52	44.94	10.18	2.02
Financial Integration	42	0.09	0.17	$5.15E^{-04}$	0.89	16.16	3.59
Financial development	42	34.47	6.12	25.71	50.98	3.22	0.82
Trade Openness	42	0.60	0.07	0.48	0.75	2.20	0.31
Inflation Rate	42	12.27	8.17	1.60	46.00	8.39	1.93
Terms of Trade	42	87.93	12.37	71.00	131.00	4.66	1.05

Source: Computation from STATA software

Table 4.2 indicates the correlation between variables used in this study. The entries on the main diagonal give the correlation between one variable and itself while the entries off the main diagonal give pair-wise correlation among the variables. The pair-wise correlation is very low indicating that there is no problem of collinearity.

Table 4.2: Correlation matrix

Variables	GDP	I	PC	FI	FD	TRO	TOT	INF
Gross Domestic Product (GDP)	1.00							
Investment (I)	0.34	1.00						
Private Consumption (PC)	0.22	-0.07	1.00					
Financial Integration (FI)	-0.19	-0.02	-0.08	1.00				
Financial Development (FD)	-0.17	0.19	-0.05	0.34	1.00			
Trade openness (TRO)	0.28	0.18	0.06	-0.11	0.31	1.00		
Terms of Trade (TOT)	0.30	0.35	0.20	-0.12	-0.06	0.05	1.00	
Inflation Rate (INF)	-0.12	-0.09	-0.26	-0.14	0.02	0.38	-0.04	1.00

Source: Computation from STATA Software

4.3 Estimation and Interpretation of Result

4.3.1 Baseline regression

Table 4.3: The OLS results

Variables	Model 1(VGDP)		Model 2 (VI)		Model 3 (VPC)	
	Coefficients	t values	Coefficients	t values	Coefficients	t values
Log of Financial Integration	-0.04	-1.97	$-7.95E^{-03}$	-0.05	0.02	0.59
Log of Financial Development	0.31	0.90	-2.01	-1.38	-0.99	-3.47***
Log of Trade Openness	-0.36	-0.82	1.54	0.84	0.37	1.04
Inflation Rate Volatility	0.12	1.93*	-0.01	-0.05	0.03	0.65
Terms of Trade Volatility	-0.08	-0.04	-3.12	-0.37	-4.02	-2.46**
Constant	-1.35	-0.01	8.34	1.30	4.01	3.65***
R^2	0.16		0.08		0.33	
No. of observation	41		41		41	
F(5, 35)	1.36		0.57		3.509	
Prob>F	0.26		0.72		0.01	

The ***, ** and * indicate 1%, 5% and 10% level of significance respectively.

An OLS baseline regression for three dependent variables; VGDP, VI and VPC was estimated and results presented in Table 4.3 above. The OLS regression results do not give meaningful results for instance R^2 is very low in model 1, model 2, and model 3 having the values of 0.16, 0.08 and 0.33 respectively and no variable is statistically significant for model 2. In model 1 only inflation volatility is statistically significant at 10% level of significance however, in model 3 financial development and terms of trade volatility are statistically significant at 1% and 5% level of significance respectively. However, the OLS regression result cannot be relied on since regressing non stationary time series leads to spurious regression (Granger and Newbold, 1974).

The spurious regression gives inefficient estimates as they increase the explanatory powers of the model and understate the standard errors. In order to get meaningful regression we conduct unit root test to ascertain the order of integration of the variables under consideration.

4.2.2 Unit root test

Table 4.4: Unit root test result

Variables	DF-GLS		KPSS		ZANDREWS	
	Level	Difference	Level	Difference	Level	Difference
GDP Volatility	-6.90 (0)		0.05 (0)		-9.68 (2002)	
Investment Volatility	-7.31 (0)		0.06 (0)		-13.14 (1977)	
Private Consumption Volatility	-3.12 (3)	-4.50 (2)	0.10 (3)		-9.11 (1983)	
Log of Financial Integration	-1.37 (4)	-4.78 (3)	0.18 (4)	0.07 (3)	-5.64 (1994)	
Log of Financial Development	-2.21 (1)	-7.13 (0)	0.21 (1)	0.03 (0)	-3.66 (1980)	-7.74 (1979)
Log of Trade Openness	-2.59 (1)	-7.37 (0)	0.18 (1)	0.03 (0)	-3.93 (1997)	-7.88 (1996)
Inflation Rate Volatility	-6.24 (0)		0.09 (0)		-7.10 (1993)	
Terms of Trade Volatility	-7.38 (0)		0.04 (0)		-9.27 (1979)	

The DF-GLS critical values are 1%: -3.77, 5%: -3.190 and 10%: -2.89 while the KPSS critical values are 10%: 0.119, 5%: 0.146, 2.5%: 0.176 and 1%: 0.216 and ZANDREWS critical values are 1%: -5.57 and 5%: -5.08. The values in bracket for DF-GLS and KPSS test indicate the number of lags used while those for zandrews test indicate the years when structural breaks took place.

Time series analysis assumes that the underlying time series is stationary. However the underlying time series may be non-stationary and this can lead to spurious regression as indicated by OLS regression result. Unit root tests were conducted to determine whether the

underlying time series are stationary or not using DF-GLS test unit root test, KPSS stationary test and ZANDREWS test.

Table 4.4 above indicates the results from unit root test using various tests. The DF-GLS unit root test result indicates that volatility of GDP, investment, inflation rate, and terms of trade are stationary at level while volatility of private consumption, log of financial integration, financial development and trade openness are non-stationary at level but stationary at first difference. The KPSS stationarity test result indicates that volatility of GDP, investment, private consumption, inflation rate, and terms of trade are stationary at level while log of financial integration, financial development and trade openness are not stationary at level but stationary at first difference.

Allowing for structural break in both level and trend using ZANDREWS unit root test shows that all the variables were stationary at level with a break except log of financial development and trade openness are non-stationary at level but stationary at first difference. The ZANDREWS unit root test indicates that there were structural breaks in the 1977, 1979, 1983, 1994, 1996, 1997 and 2002. To take care of structural breaks a dummy variable that assumes structural breaks from 1977 onwards was introduced. These structural breaks can be attributed to 1976/77 coffee boom, 1979 oil crisis, severe drought in 1979 and 1983/84, exchange rate liberalization in 1993 and political uncertainty prior to 2002 general election before regime change from KANU to NARC (*op.cit.*,1998, *op.cit.*,1999 and *op.cit.*, 2002).

4.2.3 Cointegration test

Since the log of financial development and trade openness are non stationary at level but stationary at first difference after allowing for structural break a cointegration test was conducted using Johansen cointegration test to ascertain whether they have a long term relationship. Table 4.4 indicates that there is no long term relationship between log of trade openness and financial development which imply that there is no long term relationship between the two variables. A VAR model was then estimated with the first difference of log of financial development and trade openness and all other variables at level.

Table 4.5: Cointegration test results

Max Rank	Trace statistics	Critical values (95%)	Max statistics	Critical values (95%)
0	11.07*	15.41	11.06	14.07
1	0.01	3.76	0.01	3.76

Source: Computation from STATA software

4.2.4 VAR estimation results and interpretation

Table 4.6 indicates the results obtained when a VAR model was estimated.

Table 4. 6: VAR estimation results

Variables	Model 1 (VGDP)		Model 2(VI)		Model 3 (VPC)	
	Coefficient	Z statistics	Coefficient	Z statistics	Coefficient	Z statistics
L1.GDP Volatility	-0.04	-0.30	0.29	0.74	0.01	0.11
L2.GDP Volatility	0.05	0.33	-0.02	-0.05	-0.06	-0.60
L1.Investment Volatility	-0.04	-0.82	-0.45	-3.69***	0.11	3.71***
L2.Investment Volatility	$-5.3E^{-03}$	-0.08	0.43	2.58**	0.03	0.63
L1.Private Consumption Volatility	-0.22	-0.94	-2.10	-3.38***	0.16	1.09
L2.Private Consumption Volatility	-0.20	-0.90	0.58	1.00	0.29	1.95*
Log of Financial Integration	-0.04	-1.27	-0.16	-1.82*	-0.02	-0.82
D1Log of Financial Development	0.38	0.50	3.31	1.68*	0.20	0.40
D1Log of Trade Openness	0.02	0.04	-2.68	-2.15**	0.05	0.16
Inflation Rate Volatility	0.11	1.96*	-0.04	-0.24	0.03	0.73
Terms of Trade Volatility	0.28	0.09	-5.83	-0.69	-3.92	-1.84*
Dummy	-0.27	-1.12	-3.42	-5.29***	0.02	0.13
Constant	0.28	0.98	3.33	4.42***	$-3.85E^{-04}$	-0.02
R^2	0.18		0.65		0.49	
Chi2	8.84		73.43		37.28	
P> Chi2	0.72		0.00		0.00	
Log Likelihood = 35.53						
No. of Observation = 39						

The ***, ** and * indicate 1%, 5% and 10% level of significance respectively.

Table 4.5 indicates that;

The model explains 18%, 65% and 49% of the variability in output, investment and consumption volatility respectively.

The first lag of investment volatility has a significant positive and negative effect on private consumption and investment volatility respectively but the second lag of investment volatility has a significant positive effect on investment volatility only. Therefore past values of investment volatility have a significant effect on investment and private consumption but not output volatility such that a percentage increase on the first lag of investment volatility leads to 0.45% decrease and 0.11% increase in investment and private consumption volatility respectively and a percentage increase the second lag of investment volatility leads to a 0.43% increase in investment volatility.

The first lag of private consumption volatility has a significant negative effect on investment volatility but second lag of private consumption has a positive significant effect on private consumption volatility. Therefore past values of private consumption have a significant effect on investment and private consumption volatility and not on output volatility such that a percentage increase in first lag of private consumption leads to a 2.1% decrease in investment volatility and a percentage increase in the second lag of private consumption leads to a 0.29% increase in private consumption volatility.

Financial integration has no effect on output and private consumption volatility but a significant negative effect on investment volatility. This finding is similar to those of Razin and Rose (1992), Kose *et al*, (2003), Kari, (2004), Buch *et al*, (2005) and Eozenou, (2008) who found no significant effect of financial integration on output volatility. However, they found that financial integration had a significant effect on consumption volatility which is contrary to the findings of this study. This is an indication that the country has not been able to reap the full benefits of

financial integration with respect to reducing consumption and output volatility. Though there is no statistically significant effect on output and private consumption volatility, there is a statistically significant negative effect on investment volatility such that a percentage increase in financial integration leads to 0.17% decrease in investment volatility. This is contrary to the findings of Kari, (2004) who found a positive effect. This can be because financial integration in Kenya does not increase substitution between investment at home and abroad as predicted by investment theory (*op.cit*., 1992).

Financial sector development has a significant positive effect on investment but not on output and private consumption volatility. A percentage increase in financial development leads to 3.31% increase in investment volatility. This finding is similar to that of Kari (2004) who found that financial development increases investment volatility but contrary to those of Kose *et al* (2003), Simon (2005) and Oezenou, (2008). This is contrary to the expected effect and this can be attributed to the fact Kenya's financial sector is not fully developed and therefore not adequate to reduce investment volatility.

Trade openness has a significant negative effect on investment volatility but has no effect on output and private consumption volatility. A percentage increase in trade openness leads to 2.68% decrease in investment volatility. This is contrary to the finding of Kose *et al* (2003), Kari (2004), Simon (2005) and Oezenou (2008) who found that trade openness increase consumption and output volatility. This is because trade openness is expected to expose the economy to adverse external shocks which increases volatility. It seems that trade openness does not enhance adverse external shocks in the country.

Inflation rate volatility has a positive statistically significant effect on output volatility but not on investment and private consumption volatility such that a percentage increase in inflation rate volatility leads to a 0.11% increase in output volatility. This is similar to the findings of Simon (2005) however; he found a significant positive effect of inflation volatility on private consumption volatility.

Terms of trade volatility has a significant negative effect on private consumption volatility but not on output and investment volatility an indication that terms of trade volatility does not expose the country to external shocks. A percentage increase in terms of trade leads to a 3.92% decrease in private consumption volatility. This is contrary to those of Simon (20050 and Buch *et al* 2005) who found terms of trade volatility increases consumption and output volatility as terms of trade volatility makes a country to be vulnerable to external shocks.

The dummy variable is negative and is statistically significant for investment volatility but not for output and private consumption volatility indicating that structural breaks that took place from 1977onwards had a statistically significant effect on investment volatility. The structural breaks therefore shifts the investment volatility intercept downwards.

Granger causality test result

Table 4.6 indicates the granger causality test for the dependent variables. The result shows that investment and private consumption volatility do not granger cause output volatility and that output volatility does not granger cause investment and private consumption volatility but investment volatility and private consumption granger cause each other. This justifies the

estimation of a VAR model since investment and private consumption volatility influences each other.

Table 4.7: Granger causality test result

GDP Volatility Equation			Investment Volatility Equation			Private Consumption Volatility Equation		
Variable	Chi2	P value	Variable	Chi2	P value	Variable	Chi2	P value
Investment Volatility	0.69	0.71	GDP Volatility	0.56	0.76	GDP Volatility	0.39	0.83
			Private Consumption Volatility	14.26	0.00			
Private Consumption Volatility	1.42	0.49				Investment Volatility	14.89	0.00
			All	14.69	0.01	All	15.37	0.00
All	1.62	0.81						

4.2.5 Diagnostic tests

After estimation diagnostic test were conducted to ascertain the validity of the VAR model used in the estimation. The diagnostic tests presented below indicate that the overall model does not suffer from serial correlation and that the model is stable.

Test for serial correlation

Table 4.8 indicates that there is no serial correlation in the model at one and two lags since the p-values are greater than 5% level of significance.

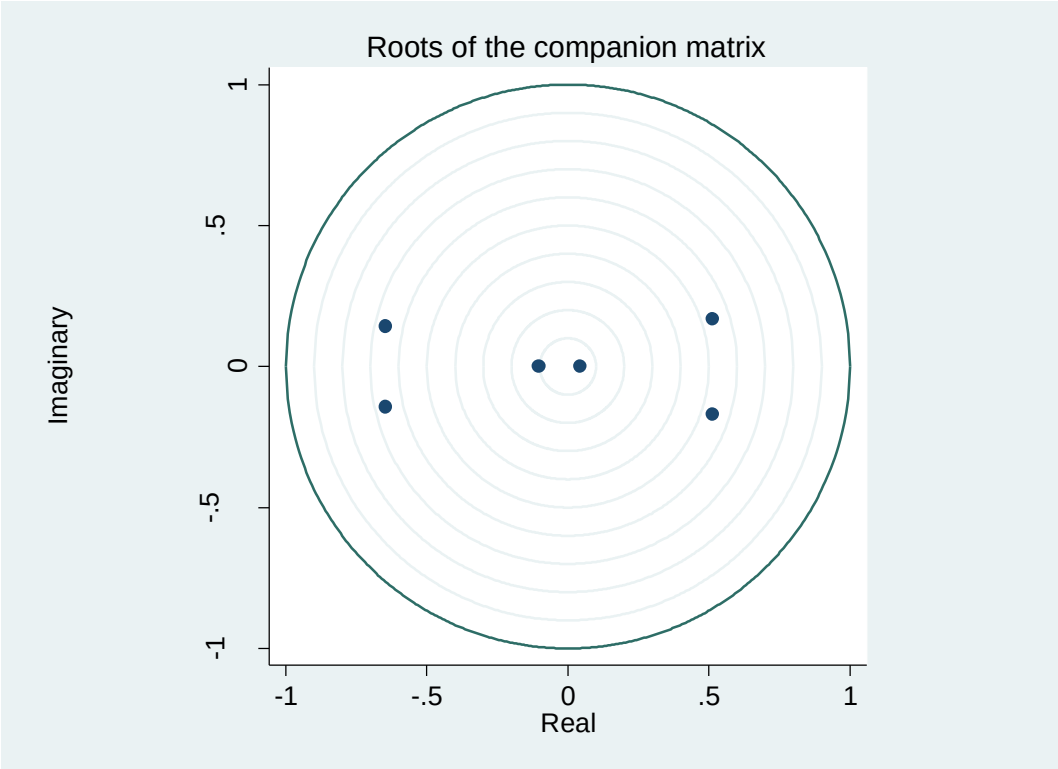
Table 4.8: Autocorrelation test result

Lag	Chi2	P value
1	10.97	0.28
2	10.96	0.28

Test for model stability

Table 4.9 in appendix 2 indicates that the model is stable since the Eigen values in their modulus are less than one and all the Eigen values lie within the unit circle as shown by unit circle in figure 4.10 below.

Figure 4. 1: Unit circle stability test result



Normality test

The Jarque Bera, skewness and kurtosis tests for normality indicate that the residuals are not normally distributed as shown table 4.9 below. This can be because some variables are not normally distributed since the data used in this analysis are from different sources and therefore

the data generating could be different. This implies that the estimated coefficients may not give the exact effect of financial integration on macroeconomic volatility.

Table 4.9: Normality test result

Equation	Jarque Bera		Skewness			Kurtosis		
	Chi2	P value	Skewness	Chi2	P value	Kurtosis	Chi2	P value
GDP Volatility	728.48	0.00	3.94	100.68	0.00	22.66	627.81	0.00
Investment Volatility	27.23	0.00	1.06	7.36	0.01	6.50	19.86	0.00
Private Consumption Volatility	11.35	0.00	1.14	8.46	0.00	4.33	2.89	0.09
All	767.06	0.00		116.49	0.00		650.57	0.00

CHAPTER FIVE

5.0 CONCLUSION

In order to evaluate the costs and benefits of financial integration in Kenya it is important to consider how financial integration influences macroeconomic volatility. This is because Kenya has witnessed increased financial integration in form of increased foreign private capital flows since the early 1990s following financial liberalization. This study has attempted to explore how financial integration affects macroeconomic volatility using secondary time series data for the period 1970 to 2011 estimating a VAR model. The study found that financial integration reduces investment volatility but has no effect on output and private consumption volatility.

The study also found that past values of investment volatility have a significant effect on private consumption, past values of private consumption volatility have significant effect on investment and private consumption volatility, inflation volatility increases output volatility, financial sector development increases investment volatility, structural breaks had a negative effect on investment growth and trade openness and terms of trade volatility reduce private consumption volatility. Since private consumption and investment volatility influence each other it is necessary for policy makers to formulate policies that reduces investment and private consumption volatility and as they have important welfare effect on households and firms.

This study shows that Kenya has benefited from financial integration in terms of reducing investment volatility however; the country has not realized the full benefit of financial integration in terms of reduced output and private consumption volatility which result from production diversification and risk sharing. This is an indication of lack of access to international

financial markets by ordinary households (Kari, 2004) considering that Kenya is not fully integrated into the global financial markets. It is against this background that this study advances for Kenya to be more financially integrated into the global financial markets in order to reap the full benefits of financial integration in terms of production diversification, risk sharing and consumption smoothing. However, there is need for further analysis on the factors influencing financial integration and on how financial integration affects economic growth in Kenya so as to be able to make informed policy decision with respect to financial integration.

Financial sector development is expected to reduce investment volatility via promoting efficiency in financial market however; this is not the case indicating that domestic financial sector is not fully developed. It is clear that Kenya has not reaped the full benefits of financial sector development in terms of reducing macroeconomic volatility. It is therefore necessary for policy makers to formulate policies that facilitate domestic financial sector development so as to ensure that the country reaps the full benefits of domestic financial sector development.

It is also clear that the double digit inflation rate that country experienced over the years has been detrimental to the economy as its volatility has led to increased output volatility. It is therefore important for policy makers formulate macroeconomic policies that reduce inflation volatility as it increases output volatility which is detrimental to economic growth and welfare of the poor.

Trade openness and terms of trade volatility seem to reduce private consumption indicating that trade openness does not expose the economy to adverse external shocks and that terms of trade fluctuation has been mild. It is necessary for policy makers to formulate policies that promote trade openness as the study shows that it reduces investment volatility.

This study indicates that by promoting financial and trade integration and adopting sound macroeconomic policies alongside structural reforms Kenya will be able to reap the full benefits associated with financial and trade integration.

REFERENCE

Barro, RJ & Sala-i-Martin, X 2003, Economic growth, MacGraw Hill Companies, pp. 285-313.

Baum, CF 2005, 'Stata: The language of choice for time-series analysis, *The Stata Journal*, No.1, pp.46-63.

Buch, CM, Döpke, J & Pierdzioch, C 2005, 'Financial openness and business cycle volatility', *Journal of International Money and Finance,* Vol. 24, No.5, pp. 744-765.

Chen, S & Wang, C 2009, 'Financial openness and macroeconomic volatility: An empirical investigation', pp. 1-23

Dickey, DA & Fuller, W 1979, 'Distribution of estimators for autoregressive time series with a unit root', *Journal of American Statistical Association,* Vol.74, issue 366, pp. 427-431.

Edison, JH, Levine, R, Ricci, L & Sløk, T 2002, 'International financial integration and economic growth', *Journal of International Money and Finance,* Vol. 21, No.6, pp. 749-776.

Elliot, G, Rothenberg, TJ & Stock, JH 1996, 'Efficient tests for an autoregressive unit root', *Econometrica* 64, No.4, pp.813-836.

Eozenou, P 2008, 'Financial integration and macroeconomic volatility: Does financial development matter?' pp. 1-36.

Epaulard, A & Pommeret, A 2005, 'Financial integration, growth, and volatility', *IMF Working paper* No. 05/67, pp. 1-38.

Evans, MDD & Hnatkovska, V 2007, 'Financial integration, macroeconomic volatility and welfare', *Journal of the European Economic Association,* Vol. 5, No. 2-3, pp. 500-508.

Friedrich, C Schnabel, I & Zettelmeyer, J 2013, 'Financial integration and growth – Why is emerging Europe different?' *Journal of International Economics,* Vol. 89, No. 2, pp. 522-538.

Granger, CWJ & Newbold, P 1974, 'Spurious regression in econometrics', Journal of Econometrics, 2, pp.111-120.

Green WH, 2003, Econometric analysis, Prentice Hall, pp. 591

Gujarati, DN 2004, Basic Econometrics, MacGraw Hill Companies, pp. 792-830.

Hagen, J & Zhang, H 2006, 'Financial openness and macroeconomic volatility', *ZEI Working Paper*, pp. 1-33.

http://Data.Worldbank.org. World Data Bank, Data Catalogue World Development indicators and Global Development Finance,' Viewed on Wednesday 03/04/2013.

Johansen, S 1988, 'Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, Vol.12, pp.231-254.

Kari, G 2004, 'Financial integration and macroeconomic volatility in the ECCU', proceedings of the 36th Annual monetary studies conference, pp. 1-29.

Kenya National Bureau of Statistics, Economic Survey (Various years).

Kenya National Bureau of Statistics, Statistical Abstract (Various years).

Khim-Sen, VL 2004, 'Which lag length selection criteria should we employ?', *Economic Bulletin*, Vol.3, No.33, pp.1-9.

Kinuthia BK, 2010, 'Determinants of foreign direct investment in Kenya: New evidence, pp. 1-19.

Kose, MA, Prasad ES & Terrones, ME 2003, 'Financial integration and macroeconomic volatility', *IMF Staff Papers*, Vol. 50, pp.119-142.

Kose, MA, Prasad ES & Terrones, ME 2006, 'How does trade and financial integration affect the relationship between growth and volatility?' *Journal of International Economics,* Vol.69, No. 1, pp. 176-202.

Kwiatkowski, D Phillips, PCB Schmidt, P & Shin, Y 1992, 'Testing the null hypothesis of stationarity against the alternative of unit root: How sure are we that economic time series has unit root root? *Journal of Econometrics*, Vol. 54, pp.159-178.

Lensink, R & Morrissey, O 2006, 'Foreign direct investment: Flows, volatility and impact on growth in developing countries', *Review of International Economics*, pp. 1-32.

Mankiw, NG 2002, 'Macroeconomics', Worth Publishers, pp. 238-255.

Moritz, S & Thomas, MS 2010, 'Financial integration, investment, and economic growth: Evidence from two eras of financial globalization', *The Review of Economics and Statistics*, Vol. 92, No. 4, pp. 756-768.

Mwega, FM & Ndung'u, NS 2002, 'Explaining African economic growth performance: The Case of Kenya', *AERC Working Paper* No. 3, pp. 1-44

Naser, T 2010, 'Domestic investment as a drive of economic growth in Libya', *International Conference on Applied Economics*, pp. 759-767.

Ndung'u, NS. & Ngugi, RW 1999, 'Adjustment and liberalization in Kenya: The financial and foreign exchange markets', *Journal of International Development,* Vol.11, pp.465-491.

Ngugi, RW & Kabubo, JM 1998, 'Financial sector reforms and interest rate liberalization: The Kenya experience,' *AERC Research Paper* No. 72, pp. 6-57.

O'Connell, SA, Maturu BO, Mwega, FM, Ndung'u, NS & Ngugi RW 2010, 'Capital mobility, monetary Policy, and exchange rate management in Kenya', pp. 1-4.

Perron, P & Vogelsang, TJ 1992, 'Nonstationarity and level shift with an application to purchasing power parity, *Journal of Business and Economic Statistics*, Vol. 10 No.3, pp. 301-320.

Perron, P 1989, 'The great crash, the oil price shock and the unit root hypothesis, *Econometrica*, Vol.57 No.6, pp.1361-1401.

Ramey, G & Ramey VA 1995, 'Cross-country evidence on the link between volatility and growth', *The American Economic Review*, Vol. 5, No. 85, pp. 1138-1151.

Razin, A & Rose, AA 1992, 'Business cycle volatility and openness: An exploratory Cross-section analysis', *National Bureau of Economic Research Working Paper Series*, Working Paper No.4208, pp.1-33.

Simon, N 2005, 'Financial market integration and macroeconomic volatility in the MENA region: An empirical investigation', *Review of Middle East Economics and Statistics*, Vol. 3, No. 3, pp. 231-255.

Spiliopoulus, L 2010, 'The determinants of macroeconomic volatility: A Bayesian model averaging approach', pp. 1-34.

Sutherland, A 1996, 'Financial market integration and macroeconomic volatility', *The* S*candinavian Journal of Economics*, Vol.4, No. 98, pp. 521-539.

World Bank, 2013, 'Time to shift gears Accelerating growth and poverty in new Kenya,' Kenya economic update, Edition No.8, pp.27.

Zivot, A & Andrews, DWK 1992, 'Further evidence of the great crash, the oil-price shock, and the unit root hypothesis', *Journal of Business and Economic Statistics*, Vol.10, No.3, pp. 251-270.

APPENDICES

APPENDIX 1

Figure 4.2 shows the trends in GDP growth rate and volatility of GDP. The overall picture indicates that over the years the country has experienced fluctuation in GDP growth rate with the early 2000 experiencing the worst decline. This could be attributed to political uncertainty prior to the 2002 general election and poor macroeconomic policies.

Figure 4.2: Gross domestic product growth rate and GDP volatility

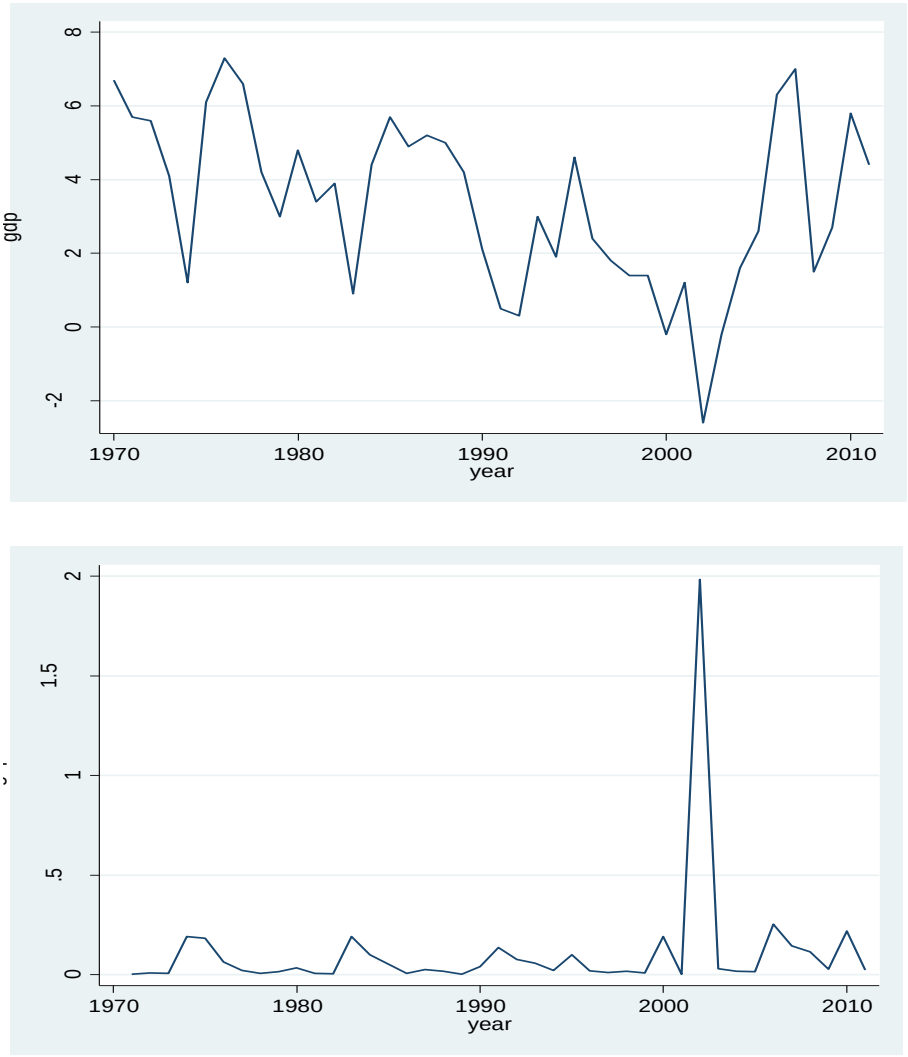


Figure 4.3 shows the trend in domestic investment and investment volatility over the years. The overall picture indicates that the country has experienced fluctuation in domestic investment with the mid-1970s experiencing the highest decline. The volatility of domestic investment has been mild apart from the high volatility in the mid-1970s when there was the 1979 oil crisis and severe drought.

Figure 4.3: Investment growth rate and investment volatility

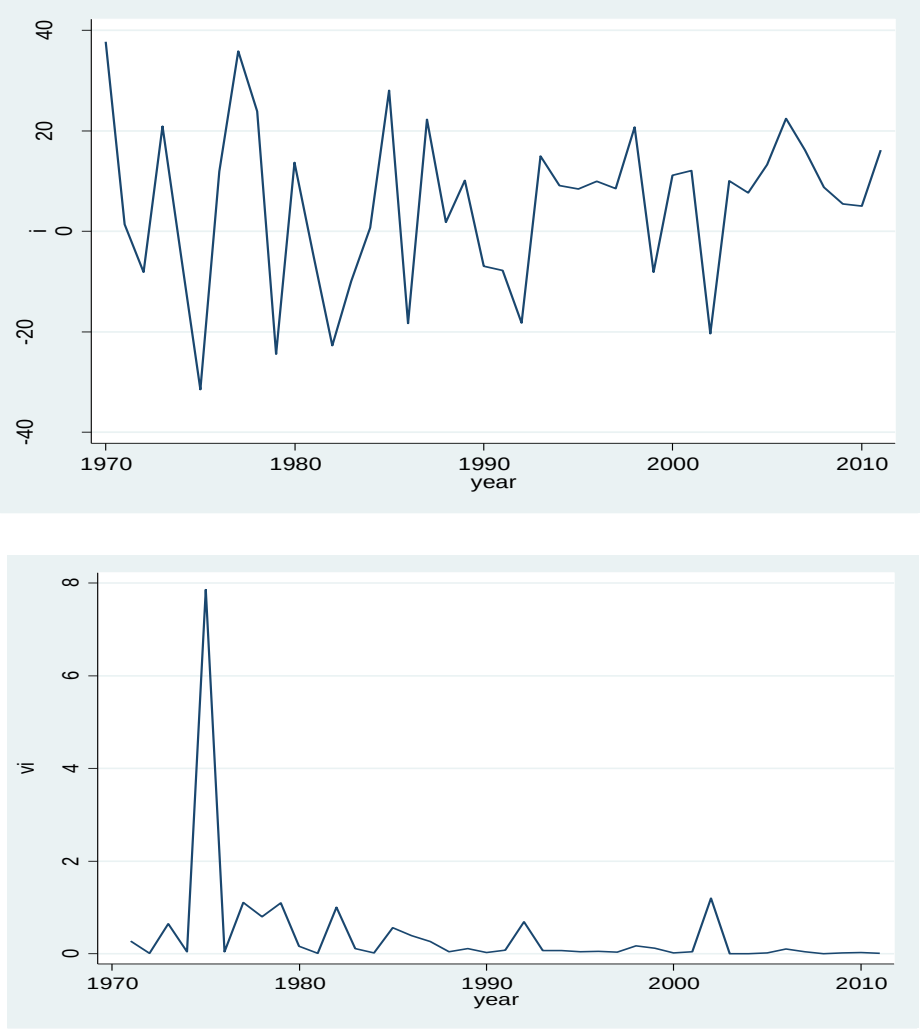
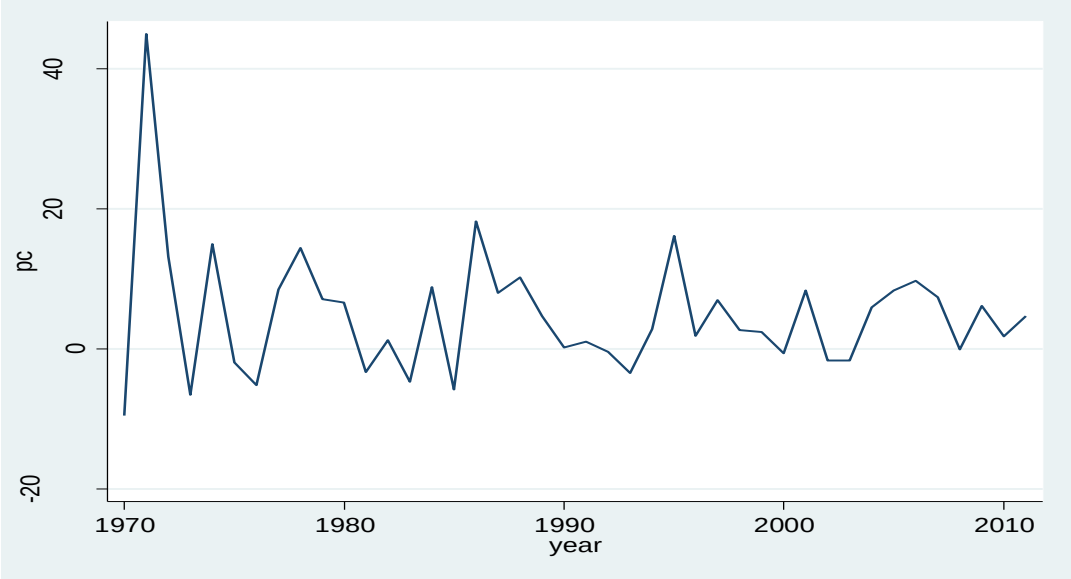


Figure 4.4 shows the trends in private consumption and private consumption volatility. In the 1970s and 1980s there was high fluctuation in private consumption however, there was mild fluctuation from the 1990s onwards.

Figure 4.4: Private consumption growth rate and private consumption volatility



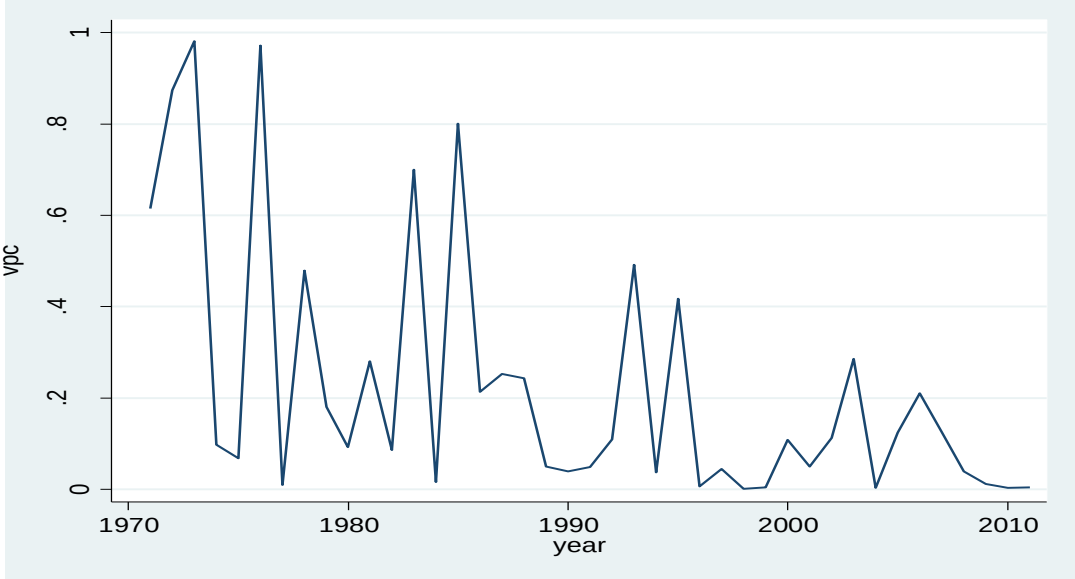


Figure 4.5 shows the trends in inflation rate and volatility in inflation rate over the years. There has been high fluctuation in inflation rate since the mid-1990s up to date following the oil crisis in 1990 which led increase in inflation.

Figure 4.5: Inflation rate and inflation rate volatility

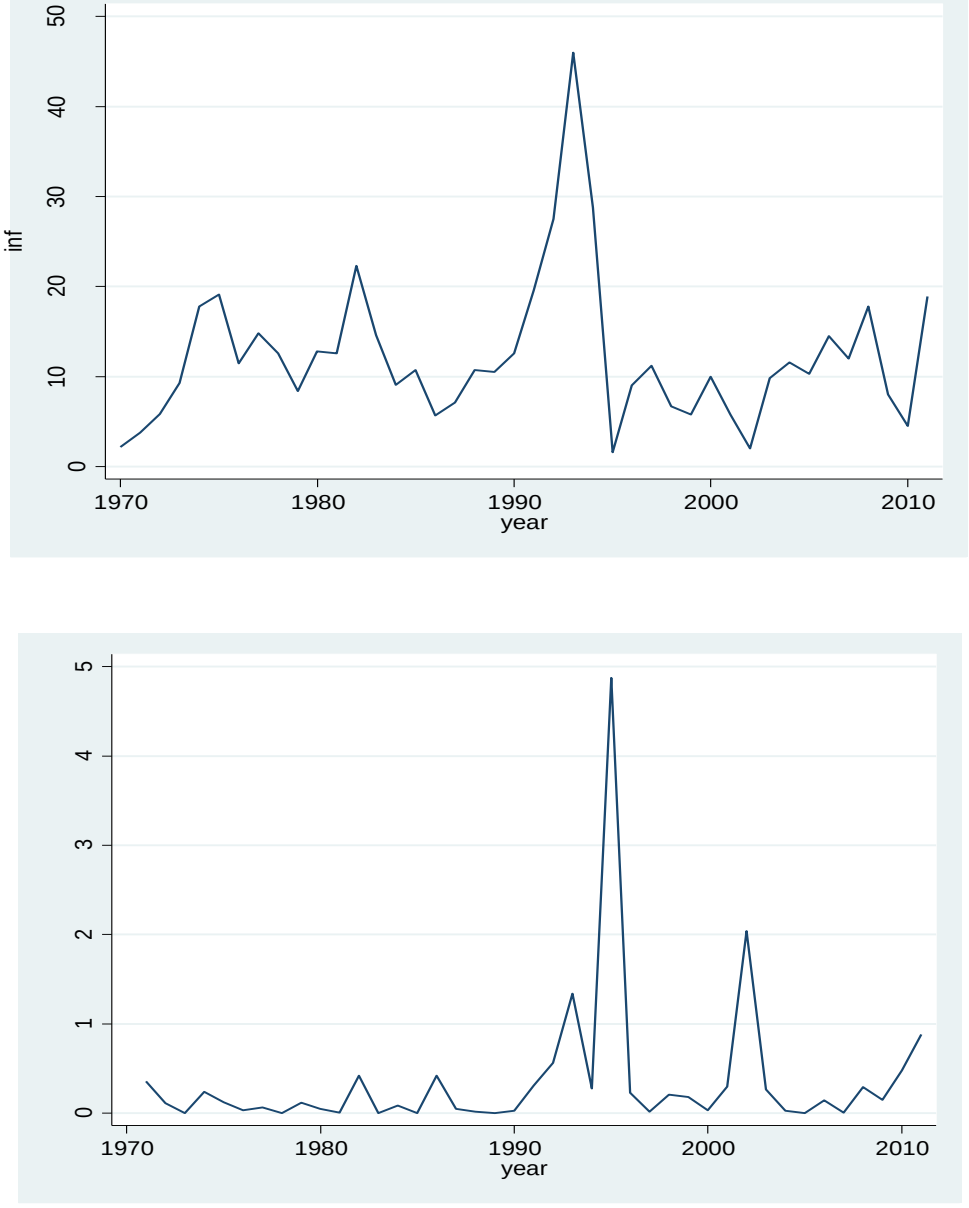
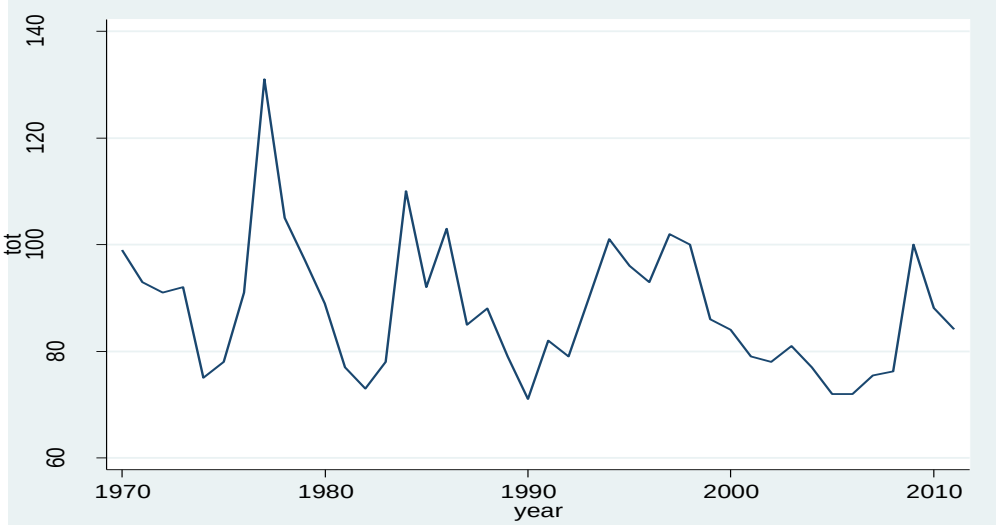


Figure 4.6 shows the trends in terms of trade and terms of trade volatility over the years. The fluctuation in terms of trade has been mild apart from 1977 and 1986 when there were coffee booms.

Figure 4.6: Terms of trade and terms of trade volatility



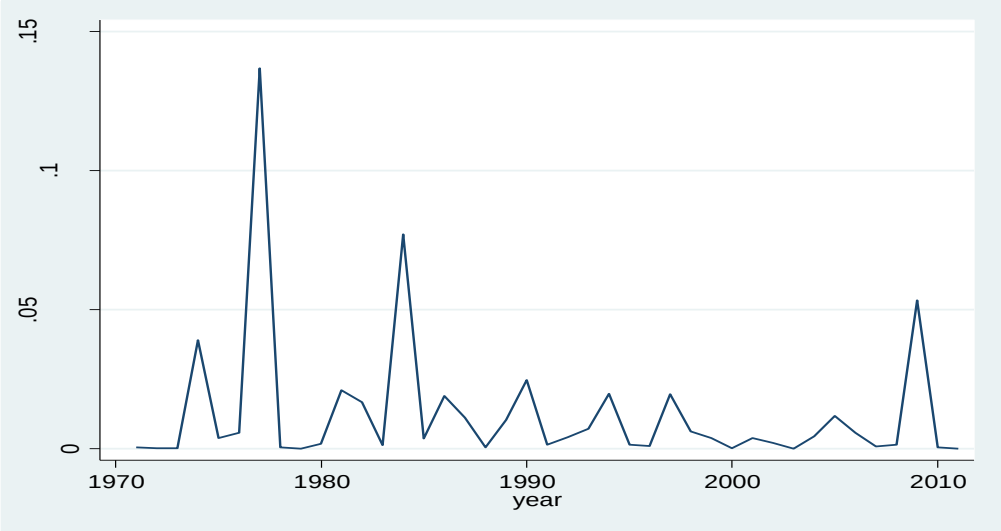


Figure 4.7 shows the trends in financial integration and financial development over the years. There have been mild fluctuations in FPI while financial development has been increasing over the years.

Figure 4.7: Financial integration and financial development

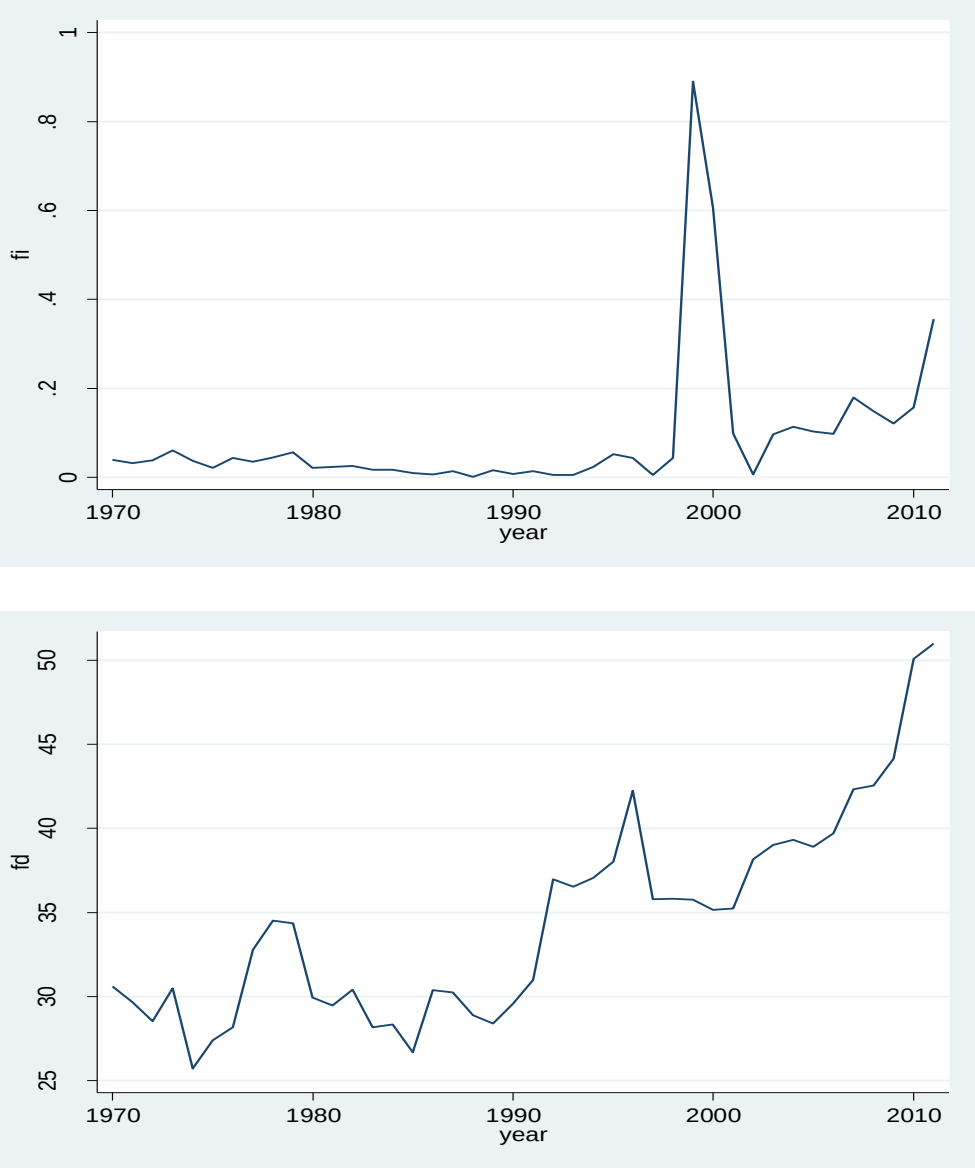
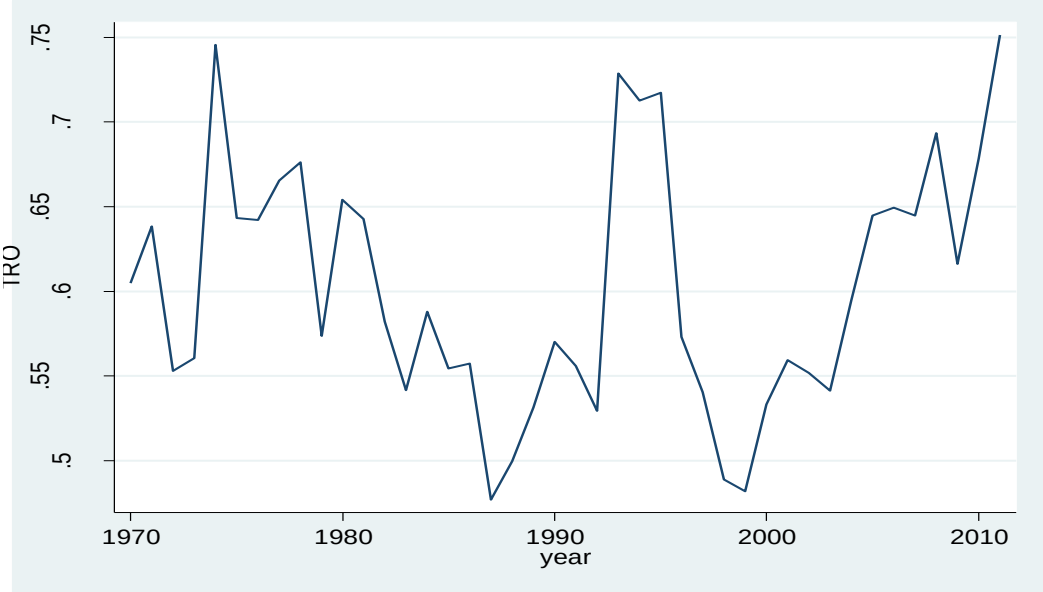


Figure 4.8 indicates the trend in trade openness over the years and it shows that trade openness has been fluctuating over the years with highest decline in the early 2000s.

Figure 4. 8: Trade openness



Appendix 2

Table 4.10: Model stability test result

Eigen values	Modulus
-0.65 + 0.14 -0.65 - 0.14	0.66 0.66
0.51 + 0.17	0.54
0.51 – 0.17	0.54
-0.10	0.10
0.04	0.04

APPENDIX 3

Table 4.11: The data used in the study

Year	GDP	I	PC	FI	INF	TOT	TRO	FD
1970	6.7	37.7489	-9.52414	0.039152	2.19	99	0.604896	30.61
1971	5.7	1.40756	44.9427	0.031598	3.78	93	0.638285	29.67
1972	5.6	-8.16517	13.1392	0.037923	5.83	91	0.553149	28.54
1973	4.1	20.939	-6.56798	0.060125	9.28	92	0.560685	30.49
1974	1.2	-5.38392	14.9554	0.037637	17.81	75	0.745734	25.71
1975	6.1	-31.5018	-1.95901	0.02065	19.12	78	0.643353	27.39
1976	7.3	11.9337	-5.15786	0.04396	11.45	91	0.642061	28.18
1977	6.6	35.8392	8.50265	0.035011	14.82	131	0.66552	32.79
1978	4.2	23.8618	14.404	0.04474	12.6	105	0.676235	34.53
1979	3	-24.4937	7.11813	0.056039	8.4	97	0.573642	34.35
1980	4.8	13.6531	6.61369	0.020812	12.8	89	0.654168	29.93
1981	3.4	-4.72319	-3.27939	0.022979	12.6	77	0.642802	29.47
1982	3.9	-22.7208	1.26452	0.025095	22.3	73	0.582157	30.42
1983	0.9	-9.94744	-4.71541	0.017184	14.6	78	0.541627	28.18
1984	4.4	0.71702	8.80828	0.017453	9.1	110	0.588039	28.34
1985	5.7	28.0278	-5.78711	0.00918	10.7	92	0.554454	26.68
1986	4.9	-18.3595	18.1823	0.006618	5.7	103	0.557414	30.39
1987	5.2	22.2414	8.00759	0.014113	7.1	85	0.477028	30.24
1988	5	1.76442	10.1835	0.000515	10.7	88	0.49975	28.9
1989	4.2	10.1332	4.71746	0.016166	10.5	79	0.531564	28.4
1990	2.1	-6.9949	0.210423	0.006915	12.6	71	0.570209	29.58
1991	0.5	-7.84506	1.01197	0.01365	19.6	82	0.555977	30.98
1992	0.3	-18.2237	-0.41488	0.004923	27.5	79	0.529309	36.98
1993	3	14.9691	-3.43521	0.005107	46	90	0.728585	36.52
1994	1.9	9.08739	2.81051	0.023413	28.8	101	0.712661	37.07
1995	4.6	8.40414	16.1152	0.051835	1.6	96	0.717457	38.02
1996	2.4	9.98311	1.8501	0.042994	9	93	0.573121	42.23
1997	1.8	8.54734	6.94957	0.004728	11.2	102	0.540571	35.79
1998	1.4	20.7832	2.72001	0.043932	6.7	100	0.488972	35.81
1999	1.4	-8.13428	2.39498	0.890122	5.8	86	0.481923	35.77
2000	-0.2	11.1141	-0.63086	0.604945	10	84	0.53309	35.16
2001	1.2	12.1214	8.34812	0.098673	5.8	79	0.559468	35.24
2002	-2.6	-20.3742	-1.66626	0.006731	2	78	0.551727	38.16
2003	-0.2	10.0056	-1.64766	0.096695	9.8	81	0.541323	39.02

2004	1.6	7.62753	5.94459	0.113574	11.6	77	0.59477	39.33
2005	2.6	13.2405	8.33629	0.102999	10.3	72	0.644789	38.91
2006	6.3	22.4524	9.75139	0.097633	14.5	72	0.649442	39.71
2007	7	16.127	7.34655	0.179334	12	75.5	0.644777	42.32
2008	1.5	8.78909	-0.0535	0.149138	17.8	76.2	0.693549	42.54
2009	2.7	5.46276	6.12624	0.121075	8	100	0.616282	44.14
2010	5.8	5.01508	1.81812	0.156642	4.5	88.1	0.678547	50.08
2011	4.4	16.1235	4.70693	0.355724	18.9	84.1	0.751311	50.9802