

**EXCHANGE RATE EXPOSURE OF EAST AFRICAN
STOCK MARKETS**

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DECLARATION

This research project is my original work and to the best of my knowledge has not been presented for the award of degree in any other university.

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DEDICATION

To my dear parents, Duncan Maina and Eudias Wairimu, for always ensuring I had the best.

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However, the views expressed in this study are mine and hence I assume sole responsibility for any errors and omissions.

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ABBREVIATIONS

APT	Arbitrage Pricing Theory
ARIMA	Autoregressive Integrated Moving Average
ASEA	The African Securities Exchanges Association
BOT	Bank of Tanzania
BOU	Bank of Uganda
CAPM	Capital Asset Pricing Model
CBK	Central Bank of Kenya
CMA	Capital Markets Authority
DSE	Dar es Salaam Stock Exchange
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GJR-GARCH	Glaesten-Jagannathan-Runkle Generalized Autoregressive Conditional Heteroscedasticity
GLS	Generalized Least Squares
GNP	Gross National Product
IAPM	International Asset Pricing Model
IAPT	International Arbitrage Pricing Theory
IMF	The International Monetary Fund
KSHS	Kenyan Shillings
LSDV	Least Squares Dummy Variables
MGARCH	Multivariate Generalized Autoregressive Conditional Heteroscedasticity
NSE	Nairobi Securities Exchange
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
SUR	Seemingly Unrelated Regression
TSHS	Tanzanian Shillings
US\$	United States Dollar
USE	Uganda Securities Exchange
USHS	Ugandan Shillings

ABSTRACT

The study examines the exchange rate exposure of East African stock markets. It aimed at identifying whether the stock markets are exposed to changes and volatility of US\$ exchange rate and through which mechanisms does this exposure occur. The study considered three stock markets in East Africa during the period January 2009 to April 2014 using Arbitrage Pricing Theory (APT) and panel data estimation techniques. The unexpected factors were obtained using Autoregressive Integrated Moving Averages (ARIMA) and volatility was estimated by GARCH (1,1) model.

The results reveal that the stock markets are exposed positively to unexpected US\$ exchange rate changes and negatively to the volatility of exchange rate. Moreover, a deeper financial market and a less open economy reduce exchange rate exposure. Hence in formulation of monetary policies exchange rate should be put into consideration and also policies that promotes financial markets should be encouraged.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Post Bretton Woods System era is characterized by the move from a fixed exchange rate regime to a floating exchange rate regime (Garber, 1993). Adoption of a floating exchange rate regime tolerates greater exchange rate volatility and hence exposure to exchange rate risks (Dutttagupta et al., 2006). Hutson and O'Driscoll (2010) defines exchange rate exposure as the sensitivity of a specific investment value to changes in exchange rate.

In 1980's, the IMF and World Bank introduced structural adjustment programs (SAPs) facility as a condition for granting loans to poor countries. One of the prerequisite was the financial sector reforms which required development and liberalization of the financial markets especially the stock market¹. Stock market liberalization involves allowing foreigners to trade on country's shares with no restriction. Blair (2000) states that stock market liberalization leads to a reduction in the aggregate cost of equity thus increasing investment, due to cost sharing of risks between domestic and foreign investors.

Just like any market with international involvement, the stock market is susceptible to changes in foreign exchange rate. Goods market theory suggests that under floating exchange rates, changes

¹ The stock market is a market where shares are issued and traded through exchange or over the counter.

in exchange rates affects firms' competitiveness. Depreciation favors exports and appreciation reduces the competitiveness of export markets and hence a negative effect on domestic stock market. Jumah and Kunst (2001) and Friberg and Nydahl (1999) found that stock markets are exposed to exchange rate changes. Friberg and Nydahl (1999) noted that this exposure of stock market can be interpreted as exposure of listed firms.

Empirical studies have analyzed exchange rate exposure at a firm-level, industry-level and country-level. For instance, Asaolu (2011); Ahmadi et al. (2012); Chaieb and Mazzota (2013); Hansen and Hyde (2010) among others found that firms are exposed to exchange rate movement. Only a few studies consider a countrywide analysis of exchange rate exposure (Entorf et al., 2011 and Patro et al., 2002). Also some studies find exposure at stock market level (Friberg and Nydahl, 1999; and Jumah and Kunst, 2001). However, studies have mixed results and this is known as exchange rate exposure puzzle (Bartram and Bodnar, 2007).

Also empirical studies find firm and country specific factors that are mechanism of exposure. Gatopoulos (2010) found that firm specific and country specific factors explain 55% and 30% of exchange rate exposure respectively. Firm-specific factors are proxies for firm's hedging need such as international involvement (Hansen and Hyde, 2010; Demirhan and Atyb, 2013; and Chaieb and Mazzota, 2013). Country-specific factors include openness (Friberg and Nydahl, 1999), depth of financial markets, current account balance and ability of government to stabilize the currency (Gatopoulos, 2010).

In Africa there are two studies – Asaolu (2011) and Salifu et al. (2007) – that researched exposure at firm level. However, in East Africa there is no study that links exchange rate exposure and stock markets. This study aims to fill this gap.

The next section gives an overview of macroeconomic environment and financial markets in East Africa. A discussion of some major macroeconomic variables, the status and development of the exchange rate and stock markets of selected East African countries is given.

1.2 An Overview of Macroeconomic Environment and Financial Markets in East Africa

The section discusses the macroeconomic environment and financial markets in East Africa². The first section consists of the macroeconomic environment and then the financial markets are discussed in the next section.

1.2.1 Macroeconomic Environment in East Africa

The macroeconomic environment in East Africa has been changing over time. For instance in terms of GDP growth, Tanzania had the highest growth in 2013, which was an increase of 1.4 % from 2012. Uganda was the second highest with an increase of 71%, while Kenya experienced an increase of 2.2 % in 2013. Inflation was highest in Tanzania and lowest in Uganda in 2013.

² The countries considered in this study are Kenya, Uganda and Tanzania. Rwanda and Burundi are excluded because there is no stock market in Burundi and Rwanda's stock market is small having started in 2011.

Both Tanzania and Uganda had a double digit inflation in both 2011 and 2012, but Kenya had double digit inflation only in 2011 which declined by 33% in 2012.

Table 1.1: Macroeconomic Environment in East Africa from 2008 to 2013

Year	GDP Growth			Inflation		
	Kenya	Uganda	Tanzania	Kenya	Uganda	Tanzania
2008	1.50	8.70	7.40	26.20	12.10	10.30
2009	2.70	7.30	6.00	9.20	13.00	12.10
2010	5.80	5.90	7.00	4.00	4.00	6.20
2011	4.40	6.60	6.40	14.00	18.70	12.70
2012	4.60	3.40	6.90	9.40	14.00	16.00
2013	4.70	5.80	7.00	5.70	5.50	7.90

Data Source: World Bank Database (2013)

1.2.2 Financial Markets in East Africa

Financial markets consist of money markets for short-term securities and capital markets for long-term securities. According to Levine (1997) the financial market facilitates trading, hedging, diversification and pooling of risks. However, the role of financial markets in developing countries has been constrained by the fact that majority of them are in their earlier stages of development, with a low number of listed companies, low capitalization and little diversity among market participants (Yartey and Adjasi, 2007). According to Mlambo and Biekpe (2007) and Ndikumana (2001) these markets are characterized by greater dependence on foreign capital, weak institutional frameworks and poor market infrastructures.

Exchange Rate Market

An exchange rate market is a market for trading of currencies and this is where exchange rate³ is determined. The exchange rate market is not centralized and trading takes place over the counter in various banks and forex bureaus. Communication is through computer terminals, telephone and other telecommunication devices. The determination of exchange rate in the market depends on the exchange rate regime adopted by each country which can range from fixed to floating. Kenya, Uganda and Tanzania operate a managed floating exchange rate system which they adopted in the mid 1990's (Adam et al., 2012).

Kenya's foreign exchange market was liberalized in the 1990s. Previously, the exchange rate regime was a crawling peg based on real exchange rate rule. In 1990s, a dual system with an official rate and a market rate based on the foreign exchange bearer certificate was adopted. In 1994 a floating exchange rate regime was adopted when the government removed restrictions on current account transactions (Maehle et al., 2013).

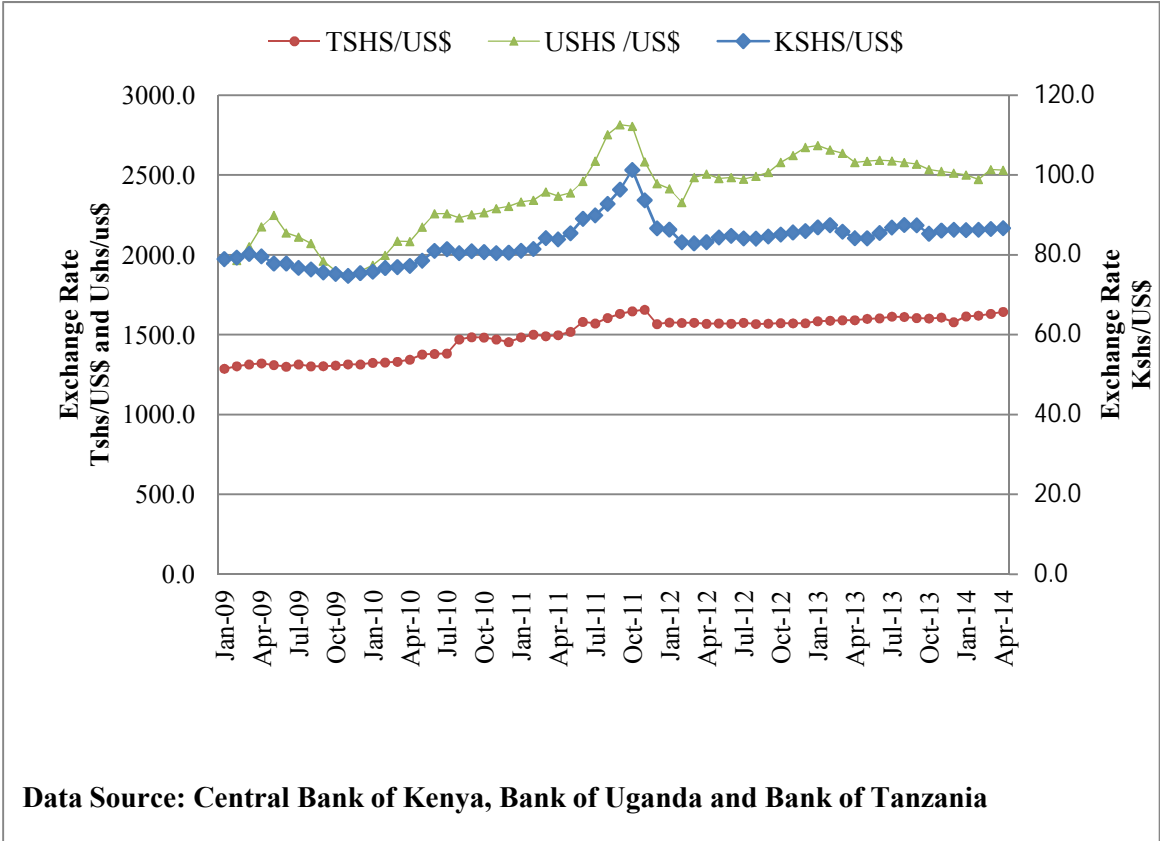
The exchange rate management system in Uganda was initiated by a managed float in 1981 then a dual system in 1982. Weekly auctions were adopted with the merging of two windows in 1984 and a dual system was adopted again in 1986 then a crawling peg in July 1989. In 1993, the introduction of interbank foreign market completed the liberalization process (Ego and Sebudde, 2003). In Tanzania, the foreign exchange act enacted in 1992 liberalized the external trade and

³ An exchange rate is the price of a country's currency in term of another country.

enabled market determined exchange rate. In 1993 the Bank of Tanzania began auctioning foreign exchange as a tool for liquidity management as well as for determination of market-based exchange rate.

Figure 1.1 shows the movement of monthly nominal exchange rate for Kenya, Uganda and Tanzania to US\$ from January 2009 to April 2014.

Figure 1.1: Monthly Nominal Exchange Rate against US\$ from January to April 2014



The three countries’ exchange rate against US\$ depreciated at a high rate in 2011. This can be attributed domestically to increase in food and energy prices and internationally to the Euro crisis (CBK, 2012; BOT, 2011; and BOU, 2011). USHS/US\$ depreciation was more than other

currencies, with an increase of as high as Ushs.2814/US\$ in September 2011. Kenya-US\$ exchange rate depreciated to Kshs.101.3 in October 2011, the highest it had ever experienced during the period. In Tanzania the highest depreciation was experienced in November 2011 of Tshs.1650/ US\$.

Stock Markets in East Africa

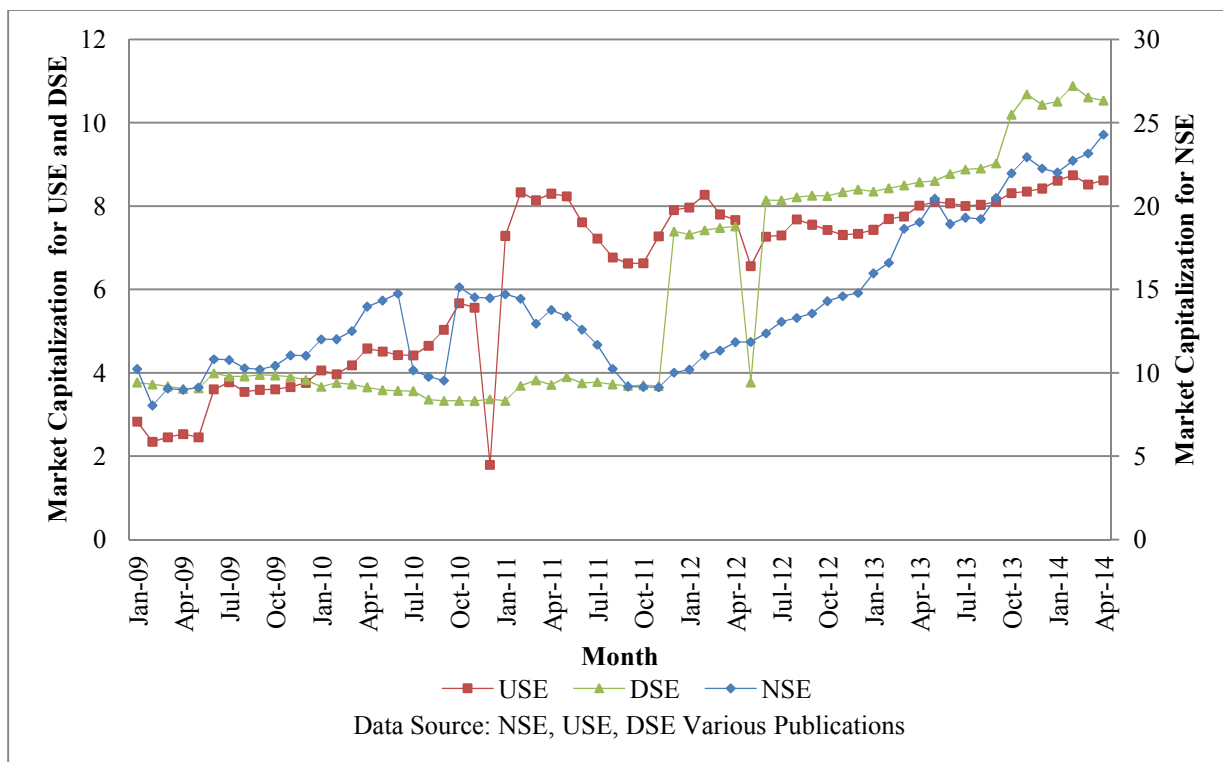
In East Africa only Kenya, Uganda, Tanzania and Rwanda have stock markets. These markets consist of the equity and the bond markets. Kenya was the first country to have a stock market in East Africa. The Nairobi Stock Exchange (NSE) can be traced back to 1920's when trading in shares began. However, the trading was informal through gentleman's agreement and no formal trading floor. In 1954, the NSE began as a voluntary association of brokers registered under Societies Act (NSE, 2013). For some time the NSE operated as a regional market for East African community. However, in 1967 nationalization measures by Tanzania and unilateral decision by Uganda to be excluded from the territories of exchange control made the regional trading difficult (Ngugi, 2003).

In 1977, the East African Community collapsed leading to delisting of non-Kenyan companies. This necessitated Uganda and Tanzania to form stock exchanges. Dar es Salaam Stock Exchange was constituted in 1996 and started trading in April 1998 (DSE, 2013) and according to Ziorklui et al. (2001) this paved a way for development of capital market in Tanzania. The Uganda Securities Exchange was formed in 1994 and formally began its operation in 1995 when it issued its first bond (USE, 2013). Currently, there are 61, 17 and 16 listed companies in NSE, USE and

DSE respectively; with eight companies cross listed in both NSE and USE and five companies cross-listed in both NSE and DSE.

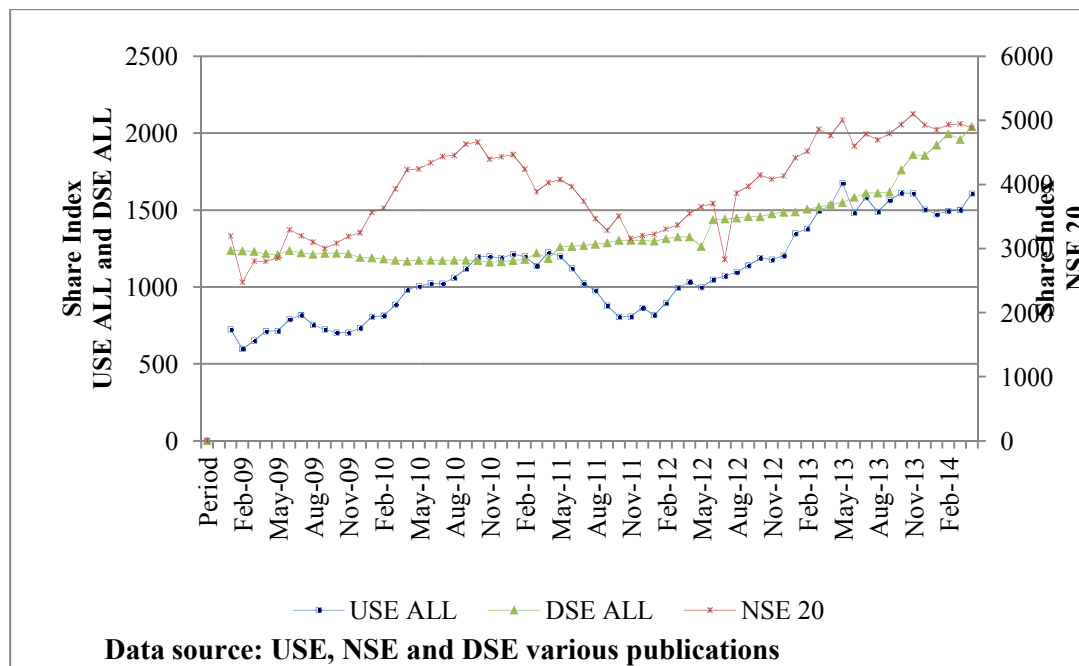
Yartey and Adjasi (2007) observed that although the stock exchanges have continued to grow they are still small compared to those of emerging markets in terms of listed companies and market capitalization. In Africa, only South Africa has been able to reach the world’s market capitalization requirement (CMA, 2010). Figure 1.2 shows the market capitalization of the three stock markets in US\$.

Figure 1.2: Stock Market Capitalization in US\$ from January to April 2014



The three stock markets’ capitalization has been fluctuating with the highest decline experienced in October 2011 for NSE, January 2011 for USE and April 2012 for DSE. Also the stock market performance as shown by various stock market indices has been varying as shown by figure 1.3.

Figure 1.3: Stock Market Indices from January 2009 to April 2014



The NSE 20 share index started with a low of 2475 in February 2009 which increased by 88% in September 2010. However, a decline of 32% was experienced in November 2011 then market later recovered achieving a high of 5007 in May 2013. DSE all share index was relatively stable with a decrease in April 2012 but recovered in May 2012 with an increase of 8%. The USE all share index increased to 1676 in May 2013 the highest it ever achieved during January 2009 to April 2014.

Stock market liberalization in form of foreign portfolio flows and cross-listing was introduced as one of the measures to improve the performance of these markets. Nyang'oro (2013) noted that foreign portfolio flows improve the market returns hence improving the stock market performance. Adelegan (2008) observes that the performance of a stock market with regional cross- listing is better than that without and this also facilitates its deepening. Table 1.2 shows

the net foreign portfolio equity flow in US\$ from 2009 to 2012. Kenya and Tanzania have experienced net inflow throughout the period while Uganda has some net outflows.

Table 1.2: Net Foreign Portfolio Flow in Thousands US\$ from 2009-2014

Year	Kenya	Uganda	Tanzania
2009	2,636	131,061	3,039
2010	22,106	-70,492	3,191
2011	20,122	105,513	3,350
2012	25,832	4,518	3,518

Data Source: World Bank Database (2013)

1.3 Statement of the Research Problem

Stock markets in East Africa play a major role in growth and development in these regions (Osamwonyi and Kasimu (2013); Olweny and Kimani (2011)). However, their contribution has been constrained by their low capitalization and illiquid nature (Massele et al. (2013); Nyasha and Odhiambo (2014)). Stock market liberalization in form of foreign portfolio flow and cross listing is one of the measures adopted to improve the values of these markets. For instance, in 2011, foreign investors accounted for 36.7% and 51.8% of total investors in Tanzania and Kenya respectively. Also Uganda experienced the highest net foreign portfolio flow in 2011. The number of cross listed companies has also continued to increase.

Nevertheless, stock market liberalization has made the returns to be more volatile and also exposes the market to macroeconomic shocks from other economies such as exchange rate risk hence increasing the risk base. Kenya, Uganda and Tanzania operate a managed floating

exchange rate system which tolerates greater volatility and this spill over to the stock markets adding to the volatility. The fluctuations in exchange rate affect the competitiveness of firms which has an impact on their stock prices which affects the stock market values. In 2011, during the exchange rate crisis the stock markets values declined by 28%, 27% and 12% for Kenya, Uganda and Tanzania respectively. During the same period the countries experienced increased volatility in other macroeconomic variables for instance inflation was double digit.

Kenya, Uganda and Tanzania are yet to develop a derivative market which can be used in reducing such risks like exchange rate risk. Allayannis and Ofek (2001) notes that use of derivatives reduce the exchange rate exposure of firms. Also the three countries are yet to fully integrate their stock markets despite the cross listing and this poses a challenge when trading in such shares. Thus there is possibility of exposure to exchange rate risk from other countries outside and within the region which is accelerated by the fact that the countries are small and open.

In Africa, studies⁴ examined the exchange rate exposure at firm level in Ghana and Nigeria. Their findings are that firms are exposed to exchange rate changes. However, they did not look at the mechanisms of exchange rate exposure. The concern to policy makers is whether the East African Stock markets are exposed to exchange rate fluctuations, the mechanisms of exchange rate exposure and measures that should be taken to hedge such exposures. The study therefore, is

⁴ Asaolu (2011) and Salifu et al. (2007).

aimed at investigating the exchange rate exposure of stock markets and the mechanisms of exchange rate exposure.

1.4 Research Questions

In the analysis of exchange rate exposure of stock market in East Africa, the study will seek to answer the following questions:-

- i. What is the extent of exchange rate exposure of East African Stock markets?
- ii. What are the mechanisms through which exchange rate exposure affect stock markets?
- iii. What policy measures should the government adopt to protect and/or reduce exchange rate exposure of stock markets?

1.5 Objectives of the Study

The overall objective of this study is to examine the exchange rate exposure of East African stock markets.

The specific objectives of the study are:

- i. To investigate the extent of exchange rate exposure of East African stock markets
- ii. To examine the mechanisms of exchange rate exposure in the stock markets
- iii. Draw policy implications from the findings of the study.

1.6 Justification of the Study

The stock markets in East Africa are contemplating to start dealing in derivatives, for instance NSE. Also the plans to integrate the East African Stock markets to a common market are

underway. The findings of the study will show why such measures are important as integration in case of cross listing and derivative markets will help to reduce exposure.

The study is of importance to Government, researchers, investors and portfolio managers. The concern to investors and portfolio manager is whether stock markets are exposed to exchange rate risk. This acts as a guideline in making rational investment decision so as to increase returns and minimize risk through diversification. The level of development and performance of financial markets is important as this plays a major role in economic growth. Therefore, the government is interested in the implication of monetary policy, such as exchange rate regime in place, has on the stock market values and development.

The study also fills the gap in the literature as no such study has been undertaken for East Africa and hence acts as a springboard for further research.

1.7 Scope of the Study

The study covers the period from January 2009 to April 2014; this is the period after the 2008 financial crisis. The period is important as the effect of financial crisis was felt through exchange rate changes and also the euro and exchange rate crisis were experienced during this period. The study considers economic exposure of the selected stock markets to US\$ exchange rate changes.

1.8 Organization of the Rest of the Paper

The rest of the research paper is organized as follows: Chapter two contains the theoretical and empirical literature review. Chapter three describes the methodology followed. Chapter four gives the empirical results and finally chapter five summarizes and concludes the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This section consists of both the theoretical, empirical literature review and finally an overview of the reviewed literature.

2.2 Linkage between Foreign Exchange Rate and Stock Market

The link between foreign exchange market and stock market is explained through goods market theory and portfolio balance approach. The two theories state that the exchange rate and stock prices determine each other. Dornbusch and Fischer (1980) developed the goods market theory which states that changes in exchange rate affects the international competitiveness of an open economy and hence the profitability of the firm. It shows that as many firms borrow in foreign currencies for their operations, a change in exchange rate affects the cost of funds and the value of their earnings affecting their share prices. According to this theory the direction of causality is from exchange rates to stock prices. Piccilo (2009) and Kisaka and Mwasaru (2012) investigated the causality direction of exchange rate and stock market: their findings were that there is a unidirectional causality from exchange rate to share prices.

The portfolio balance approach by Branson et al. (1977) states that a well performing stock market will attract capital inflows leading to increases in demand for and hence an appreciation of home currency. The direction of causality is stock prices to exchange rates. The theory assumes perfect non-substitutability between domestic and foreign bonds. Therefore firms and individuals balance and modify their portfolio among domestic and foreign bonds as conditions

change. It is in the process of equilibrating demand and supply of financial assets that exchange rate changes. Empirical studies find bidirectional causality (Sulku, 2011 and Parsva and Lean, 2011). However, there are studies that find no causality (Zia and Rahman, 2011).

2.3 Exchange Rate Exposure and its Various Aspects

The evidence of exchange rate exposure on the stock market can also be explained by deviations from international parity theories⁵ (Adler and Dumas, 1983). These theories link exchange rate, interest rate and inflation. Most theories of exchange rate determination are based on the fact that these theories hold and if they fail to hold it means there is fluctuation of exchange rate from its equilibrium value. Adler and Dumas (1983) defined exchange rate exposure as the sensitivities of market value of the firm's equity to exchange rates. This definition enables exchange rate exposure to be measured using the asset pricing theories such as the capital asset pricing theory and arbitrage pricing theory

Capital asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965) is based on theory of portfolio choice developed by Markowitz (1959). CAPM implies that expected return on a security is linearly related to its beta that is a measure of risk. Jorion (1990) examined exchange

⁵ International parity theories consist of purchasing power parity theory, interest parity theory and international fisher effect. Harvey (2004) note deviations from these parity conditions are based on transactions costs and the fact that assets from different countries are not perfectly correlated. Also most of these conditions hold in the short run (Adler and Lehman, 1983).

rate exposure by augmenting the CAPM to include exchange rate changes and found only fifteen of 287 firms of US multinationals exposed.

At stock market-level, Friberg and Nydahl (1999) examined exchange rate exposure of stock markets in eleven industrialized countries from 1973 to 1996 following Jorion (1990). They used monthly effective trade-weighted exchange rate and ordinary least squares. They found positive exposure for most countries but which was insignificant in some countries. Also inclusion of world stock index increased the explanatory power of exchange rate exposure. Jumah and Kunst (2001) found exposure to US\$ in Germany, Japan and UK markets using multivariate GARCH from November 1990 to May 2000.

At country level, Entorf et al. (2011) using Zellner's SUR estimated the exchange rate exposure of 27 nations. They found countries are exposed with emerging countries having a higher risk exposure. Patro et al. (2002) examined exposure of sixteen OECD countries using GARCH, two factors international asset pricing model (IAPM) and pooled panel regression. They found eight countries were exposed at 5% level and two countries at 10% level.

Other studies looked at exposure at firm level in both developed and developing countries. In developed countries, Parlapiano and Alexeev (2012), Bartram et al. (2010), Alssayah and Krishnamurti (2013) and Hansen and Hyde (2010) followed Jorion (1990). They found firms were exposed to various exchange rate changes and exposure was either positive or negative depending on the currency. In most cases only few firms exhibited exposure. Bartram et al. (2010) argues this could be due to firms passing through part of currency changes to consumer and also utilizing both operational and financial hedges.

In Africa, Asaolu (2011) and Salifu et al. (2007) examined exchange rate exposure of listed firms in Nigeria and Ghana respectively. They both used Jorion (1990) model and ordinary least squares. Asaolu (2011) found most firms are exposed with 88% to US\$, 75.2% to UK pounds and 53.8% to Euro. They found no difference in exposure depending on whether the firm was in financial or non-financial sector. Salifu et al. (2007) found 55%, 35%, 25% and 35% of the firms are exposed to US\$, UK Pounds, Euro and Nominal effective exchange rate (NEER) respectively. On sector analysis they found manufacturing and retail had great exposure while financial sector was not exposed. In both cases, they found that firms were negatively exposed to US\$ and positively to UK Pounds.

To overcome the shortcomings of CAPM, the arbitrage pricing theory (APT) was developed by Ross (1976) and extended to international setting by Solnik (1983). APT specifies that expected returns and some market-wide or industry-wide factors have a linear relationship. Jorion (1991) applied APT to the study of exchange rate exposure where exchange rate changes were included as one of the factors. They found firms were exposed and exchange rate risk was priced in the stock market.

Entorf and Jamin (2007) and Alssayah and Krishnamurti (2013) studied exposure using APT. They argued that the low exposure experienced using augmented CAPM could be due to the omitted macroeconomic variables. Entorf and Jamin (2007) found that 26 of German listed corporations were positively exposed in APT and 28 are positively exposed in augmented CAPM. However, when they subdivided the data into sub-period the augmented CAPM exposure was insignificant whereas APT was highly significant.

Further studies tried to investigate whether exposure varies over time by modifying the methodologies. This was done by using rolling windows, dummy variables, dividing the data into sub-periods and ARCH family of models. Doukas et al. (2003) used unconditional and conditional multifactor pricing model and found exposure but not to the lagged exchange rate changes, it was time varying and priced in Japanese stock markets. Tai (2010) using MGARCH found that in the unconditional model, exposure was only significant at 10% level, but with the conditional model they found 10 industries were exposed. They also found that exposure was time varying but not priced in Japanese stock market. Also Miao et al. (2013) using panel model with both fixed and random effects found significant exposure in seven of sixteen industries that was also evident in non-exporters. They also found size asymmetry and time-variation in exposure in the new exchange rate regime.

The time variation can also be affected by exchange rate volatility which is the second moment exposure. Ahmadi et al. (2012) investigated whether stock returns are affected by exchange rate volatility in different industries of Tehran stock exchange using GJR-GARCH (1,1) model. They found a strong evidence of exposure both in first and second moment. Demirhan and Atyb (2013) studied exposure of textile and leather firms in Istanbul stock exchange from 2005 to 2011 using Jorion (1990) and GARCH analysis. They found 40% of the firms were exposed to both US Dollar and Euro. They also found that Dollar exposure did not change even after the crisis but Euro exposure dropped.

Gatopoulos (2010) studied exposure of 870 firms in 37 countries from January 1994 to December 2008. They used rolling windows regression to control for time-varying nature of exposure. They found more than a half of the firms had significant exposure with 90% being

negative. Also there was a huge difference in exposure depending on whether the firm was from developed or emerging market; developed markets were negatively affected by appreciation whereas it was vice versa in emerging markets.

Another aspect that was used to explain low exposure in earlier studies is the fact that exposure is different for depreciation and appreciation of exchange rate. According to Koutmos and Knif (2009) this can be explained by pricing-to-market behavior, hysteresis, asymmetric hedging and pass through effects. To capture this aspect studies use the ARCH family of models and dummy variables.

Varga (2012) and Koutmos and Knif (2009) using daily returns and GJR-GARCH to capture asymmetry found there is asymmetry and non-linearity in exposure both due to exchange rate changes and volatility. Brooks et al. (2010) tried to capture time variation and asymmetry in both exchange rate and market returns by use of dummy variables. They found time-varying asymmetric exposure in utility sector, time-varying exposure in energy and material sector and asymmetric effects in the technology sector.

2.4 Mechanisms of Exchange Rate Exposure

The monetary approach to exchange rate determination states that exchange rate is determined by economic fundamentals. It assumes that there is perfect substitutability between domestic and foreign bonds and also that the purchasing power parity (PPP) theory is valid. Thus exchange rate exposure can be explained by various economic factors which can be firm specific or country specific (Gatopolous, 2010). Firm-specific factors include size, international involvement, growth opportunities and country of origin

International involvement is measured by foreign trade, income, assets and debt. Chaieb and Mazzotta (2013) and El-Masry et al. (2007) found that international involvement increases exposure. However, Hansen and Hyde (2010) argued that the level of tradable exposure cannot be used to explain exposure as firms hedge by matching its foreign assets and income to foreign debt. According to Parlapiano and Alexeev (2012) effect on exposure through international involvement depends on the type of country. Gatopoulos (2010) found that foreign sales increase exposure in developed countries but in emerging countries it acts as a hedger.

The size of the firm can also explain exposure but studies' findings are contradictory. Chaieb and Mazzotta (2013) found that the smaller the firm the higher the exposure while El-Masry et al. (2007) and Parlapiano and Alexeev (2012) finds higher exposure in large capitalization firms.

At country level exposure is explained by macroeconomic factors such as financial markets depth, openness and balance of trade. Gatopoulos (2010) found that a deep financial market reduces exposure. Friberg and Nydahl (1999) argue that the more Open an economy is the higher the exchange rate exposure. Further, the level of exports and imports (Entorf and Jamin, 2007 and Patro et al., 2002) determines exchange rate exposure.

Finally, there are two approaches used to study the mechanisms of exposure that is the cross-sectional analysis in case of static exposure and panel approach in case where exposure is time-varying. Patro et al. (2002) and Gatopoulos (2010) used a panel regression method while most of studies that try to explain exposure at firm level use cross-sectional analysis.

2.5 Overview of the Literature

Theoretically, exchange rate exposure can be explained by the deviations from international parity conditions which are due to market imperfections and transaction costs. Empirically, various studies examine exchange rate exposure at firm, industry, stock market and at country level but in most cases it is weak. In most studies exchange rate exposure is calculated by regressing measure of firm or market value on changes in exchange rates as suggested by Adler and Dumas (1984). Most studies used Jorion (1990) augmented CAPM others APT. The regression methods vary from time series to panel approach. To account for time variation in exchange rate exposure, GARCH, rolling windows regression and dummy variables are applied. To capture asymmetry in exchange rate exposure studies use dummy variables and GJR-GARCH model.

On mechanisms, they can be sub-divided into country-specific and firm-specific factors. Most studies regress the exposure coefficient and various factors cross-sectionally in case of static model or panel approach in cases where exposure is estimated as time varying. From the literature reviewed only a few studies examines exposure at stock market level. Also the findings of exposure and its mechanisms are mixed. Thus, this study will use a panel approach to estimate exchange rate exposure and its mechanisms at stock markets level.

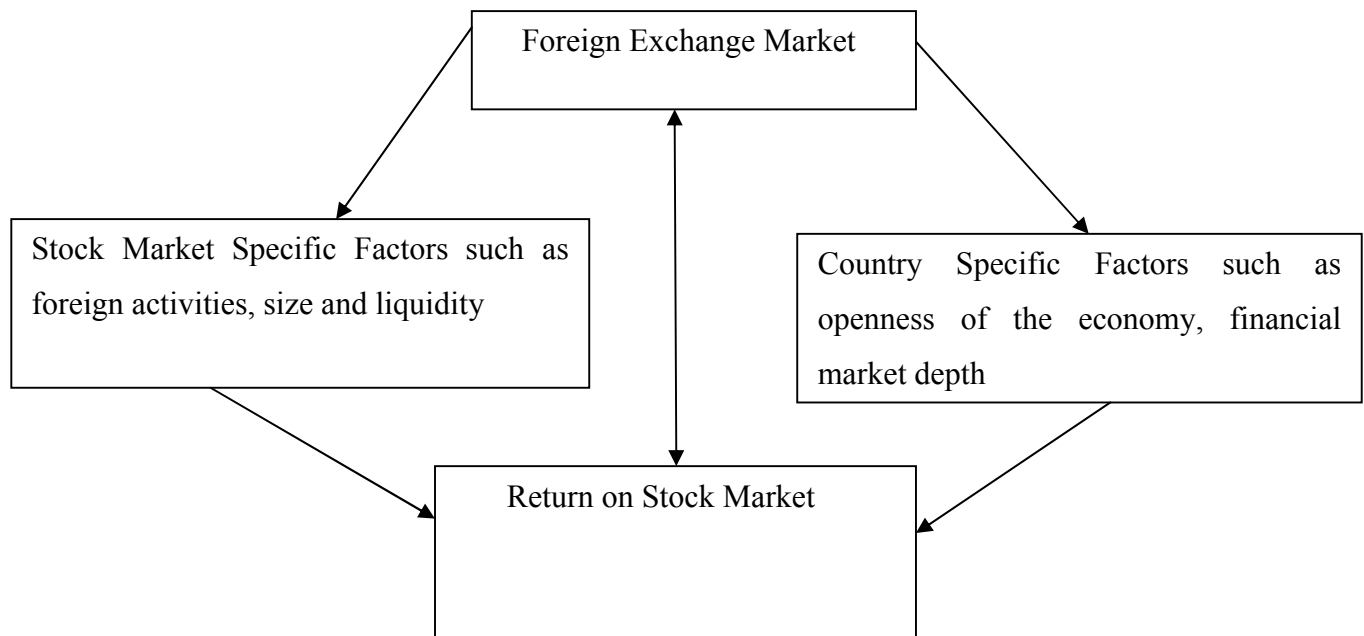
CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

The value of a stock market is measured by aggregate returns it is able to generate. The return is a reward for risk which can be systematic or unsystematic. Unsystematic risk can be diversified thus investors cannot be rewarded for bearing such risks but systematic risk must be rewarded. Change in exchange rate is an example of systematic risk and hence should be captured in the returns (Tai, 2010). To capture exchange rate risk a factor model can be adopted to express returns as a function of exchange rate changes. Doukas et al. (2003) using a factor model found exchange rate risk is priced in Japanese stock markets. Figure 3.1 shows the interaction between stock market and exchange rate markets.

Figure 3.1: Interaction between Stock and Exchange Rate Market



Source: Author's own compilation based on the reviewed literature

Whether the stock market is exposed to changes in exchange rate markets depends on its characteristics and also the country's characteristics (Patro et al., 2002). The stock markets characteristics include the foreign involvement, size and liquidity while the country factors include openness and financial market depth. The goods market and portfolio approach suggest there is a causal linkage between exchange rate and stock market which can be bidirectional or unidirectional.

3.2 Theoretical Framework

Exchange rate exposure can be measured by the regression coefficient between stock returns and exchange rate changes (Adler and Dumas, 1983). To investigate the exchange rate exposure and its mechanisms in stock markets the Arbitrage pricing theory (APT) is used. This is because APT enables specification of returns as a linear function of various factors and it is less restrictive compared to CAPM. APT model was developed by Ross (1976) and extended by Solnik (1983) to international setting. It specifies a linear relationship between expected returns and some market-wide or industry-wide factors. It is based on the assumption that the return on a security consists of expected and unexpected part.

$$R = E(R) + U \tag{1}$$

Where R is the actual return on a security, E(R) is the expected return on a security and U is the unexpected security's return. The unexpected return can be subdivided into systematic (m) and unsystematic risk (e).

$$R = E(R) + m + e \tag{2}$$

The systematic risk is the one that affects the whole market, also known as the market risk, and is captured by the factors like GNP, inflation, interest rates etc. Thus m can be replaced by a factor F .

$$R = E(R) + \beta F + e \quad (3)$$

Equation 3 is known as the factor or market model and β measures the sensitivity of stock returns to changes in the factor. The model can also include many factors to be known as the multifactor model as shown in equation 4

$$R_i = E(R)_i + \sum_{i=1}^k \beta_i F_i + e_i \quad (4)$$

According to APT if securities satisfy a linear factor structure their expected returns must also satisfy the same factor structure.

$$E(R)_i = R_f + \sum_{i=1}^k \lambda_i \beta_i \quad (5)$$

Where R_f is the risk-free rate, λ_i is the excess return ($R_m - R_f$) where R_m is the market return and β_i is the measure of risk.

In APT the return of a portfolio consists of the weighted average of expected returns, betas multiplied by the factors and the unsystematic risk.

$$R_P = \sum_{i=1}^k w_i E(R)_i + \left(\sum_{i=1}^k w_i \beta_i \right) F_i + \sum_{i=1}^k w_i e_i \quad (6)$$

If a portfolio is well diversified there is no unsystematic risk for individual security because this risk has already been diversified away. Thus the return on market portfolio can be expressed as:-

$$R_p = E(R)_p + \beta_p F + e_p \quad (7)$$

Where β_p is the weighted average of all β 's and e_p is the portfolio's unsystematic risk which is uncorrelated with the factors (F). APT assumes that expected return follow a factor model as asset returns. Thus the expected return of portfolio follows a model similar to equation (5). Since this study focuses on the whole market as the portfolio, the return on stock market as measured by the market index is generated by the following multifactor model

$$R_p = \beta_{p0} + \beta_{p1} F_1 + \beta_{p2} F_2 + \dots + \beta_{pk} F_k + e_p \quad (8)$$

In APT model changes in exchange rate is included as one of the factors. Jorion (1991) studied exchange rate exposure using two factors and a multifactor APT. In both cases they introduced exchange rate changes as another factor. Various other studies have followed suit (Entorf and Jamin, 2007 and Alssayah and Krishnamurti, 2013 among others)

Solnik (1983) developed the international arbitrage pricing theory (IAPT). They noted that in existence of a risk free asset, for exchange rate fluctuations to affect asset returns it must follow the same factors. For instance, the macroeconomic factors that affect returns also influence exchange rate changes, Thus exchange rate exposure; s_j can be expressed as a linear factor model

$$s_j = \delta_0 + \sum_{j=1}^k \delta_j F_j + \varepsilon_j \quad (9)$$

Where s_j is the exchange rate exposure, δ_j 's measures the sensitivities to the factors and F_j are factors causing exchange rate exposure and ε_j is the disturbance term.

However, APT does not specify the factors to be included in the model; it depends on the researcher's discretion (Straumann and Giridi, 2007). There are two major approaches used in selecting factors- the statistical and theoretical approach. The statistical approach consists of factor analysis and principal components method. Theoretical approach involves specifying financial market and macroeconomic variables that are thought to capture the systematic risk and also firm characteristics that can explain sensitivity to systematic risk. This study used theoretical approach to select factors since it is focusing on exposure at the aggregate level, the stock market and also the factors included are based on exchange rate exposure literature.

3.3 Empirical Model Specification

To estimate exchange rate exposure and its mechanisms the study followed a two stage approach as suggested by Jorion (1990). In the first stage, exchange rate exposure was estimated using a standard panel APT model specified below.

$$R_{it}^m = \beta_0 + \beta_1 R_{it}^e + \beta_2 R_{it}^w + e_{it} \quad (10)$$

Where R_{it}^m is the stock return on market i at time t , R_{it}^e is the unexpected change in exchange rate for country i at time t , R^w is the unexpected return on the world stock index, β 's are parameters to be estimated, β_0 is the intercept, β_1 is the exchange rate exposure and β_2 is the exposure to world stock market risk and e_{it} is the disturbance term.

Jamin and Entorf (2007) note that significance of exposure may be suppressed and parameter estimate may be misleading due to omission of relevant macroeconomic risk. Thus the study included the following macroeconomic factors: inflation (INF^U), (Entorf and Jamin, 2007), interest rates spread (IR^{Spread}) and money supply (MS) (Doukas et al., 2003). Model 10 is modified to include these factors.

$$R_{it}^m = \beta_0 + \beta_1 R_{it}^e + \beta_2 R_{it}^w + \beta_3 IR_{it}^{Spread} + \beta_4 INF_{it}^U + \beta_5 MS_{it} + e_{it} \quad (11)$$

According to APT only unexpected part of a factor affects returns; ARIMA was used to obtain the unexpected factors. Studies find that exchange rate is time varying, to account for time variation the study followed Patro et al. (2002) and employed the autoregressive conditional heteroscedasticity (ARCH) models. The ARCH models developed by Engle (1982) and the generalized autoregressive conditional heteroscedasticity (GARCH) models by Bollerslev (1986) assumes that variances vary over time. The study used the GARCH (1, 1) to model the time varying exchange rate exposure. Equation 12 is the conditional mean equation while equation 13 gives the conditional variance equation for exchange rate changes.

$$R_{it}^e = b_0 + b_1 R_{it-1}^e + v_{it} \quad (12)$$

$$h_{it} = \eta + \alpha v_{it-1}^2 + \psi h_{it-1} \quad (13)$$

Where h_{it} is the conditional variance, η is a constant, v_{it-1}^2 is the squared residuals of the previous month obtained from the mean equation and h_{it-1} is the forecasted conditional

variance. α and ψ are constants where $\alpha > 0$, $\psi > 0$, $\alpha + \psi < 1$. The study followed Brooks et al. (2010) and modified equation 11 to

$$R_{it}^m = \beta_0 + \beta_1 R_{it}^e + a R_{it}^e / h_{it} + \beta_2 R_{it}^w + \beta_3 IR^{Spread}_{it} + \beta_4 INF^U_{it} + \beta_5 MS_{it} + e_{it} \quad (14)$$

Equation 14 is the model that was estimated where R_{it}^e / h_{it} is the exchange rate volatility and the time varying exchange rate exposure β_{1it} was estimated as follows

$$\beta_{1it} = \beta_1 + a / h_{it} \quad (15)$$

The second stage involved estimating mechanisms of exchange rate exposure through a panel regression of β_{1it} obtained in equation 15 on various stock market specific factors (Jorion, 1990 and Schena, 2007 among others) and country specific factors (Patro et al., 2002 and Gatopoulos, 2010 among others). The study considered the following factors:- market capitalization (Mcap) to signify the size of each market, openness as measured by imports plus exports and level of domestic debt to signify the depth of financial markets (Fdepth). The study used unexpected part of the variables which was obtained by ARIMA. The study estimated equation 16 and δ 's measured sensitivity of exposure to these factors.

$$\beta_{1it} = \delta_0 + \delta_1 Mcap_{it} + \delta_2 openness_{it} + \delta_3 Fdepth_{it} + \varepsilon_{it} \quad (16)$$

3.4 Data Sources and Measurement of Variables

Table 3.1: Variable Descriptions and Data Sources

Variable	Description	Source	Period
Stock Market Return (R^m)	Logarithmic difference of stock market price index. It is the dependent variable in stage one.	NSE,USE,DSE	Jan-09 – Apr14
Exchange rate Changes (R^e)	Unexpected percentage change of exchange rate for US\$.	CBK, BOU, BOT	Jan-09 – Apr14
Return on world stock market index (R^w)	Unexpected logarithmic difference of MSCI world index. It is used to control for world macroeconomic environment.	Morgan and Stanley International Website	Jan-09 – Apr14
Interest Rate Spread (IR^{Spread})	Unexpected difference between lending and deposit rate. It is used to measure investors' future expectations.	CBK, BOU, BOT	Jan-09 – Apr14
Inflation (INF^U)	Unexpected percentage change in the monthly CPI. It measures the changes in the domestic macroeconomic environment.	KNBS, BOU, BOT	Jan-09 – Apr14
Money Supply (MS)	Unexpected percentage change in Broad Money (M2). It is an indicator of a country's monetary policy.	CBK, BOU, BOT	Jan-09 – Apr14
Exchange rate Exposure (β_{lit})	Time varying coefficient obtained in stage one equation 15. It is the dependent variable in the mechanisms of exchange rate exposure.	Estimated from stage one.	Jan-09 – Apr14
Market Capitalization (Mcap)	Unexpected percentage change in market capitalization in US\$. It is a proxy for stock market size.	NSE, USE,DSE	Jan-09 – Apr14
Openness	Unexpected percentage change in sum of exports and imports in US\$. A measure of liberalization of the economy.	CBK, BOU, BOT	Jan-09 – Apr14
Financial Market Depth (Fdepth)	Unexpected percentage change in the level of domestic debt. It is a measure of development of financial markets.	CBK, BOU, BOT	Jan-09 – Apr14

3.5 Expected Relationship.

We expect exchange rate changes to affect returns negatively or positively depending on appreciation or depreciation of exchange rate (Raihan, 2013). In case of Return on the world index we expect it to affect stock returns positively (Entorf et al., 2011). Interest rate spread (IR^{Spread}), inflation (INF^U) and Money Supply (MS) are used to control for changes in the domestic macroeconomic environment. We expect both interest rate spread and inflation to have negative relationships with stock market return (Entorf and Jamin, 2007). Finally, we expect money supply and stock market returns to be positively related (Doukas et al., 2003).

In estimating the mechanisms of exchange rate exposure the study used market capitalization, openness and financial market depth. We expect market capitalization to be positively related to exposure (Parlapiano and Alaxeev, 2012). Openness and exchange rate exposure are expected to be positively related based on Friberg and Nydahl (1999). Finally, financial market depth is expected to be negatively related to exchange rate exposure (Gatopoulos, 2010).

3.6 Estimation Procedure

The study adopted panel regression estimation technique in estimating exchange rate exposure and its mechanisms. This is because panel data allows for greater flexibility in modeling individual heterogeneity (Wooldridge, 2002). There are two methods: pooled OLS and the error components model.

The pooled OLS method involves stacking data together over i and t and does not take advantage of the individual heterogeneity that is the individual-specific effects $\mu_i=0$. The pooled model can

also be formulated in terms of deviation from group means to be known as within-groups or in terms of group means referred to as between-groups.

If $\mu_i \neq 0$ the estimates obtained from OLS will not be the best estimates, in such a case it is advisable to employ the error components models. The error components models consist of the fixed effect and random effect model⁶. The error components can be divided into two or three components to obtain a one-way or two-way error component model. The fixed effects model (FEM) is where the time-specific (α_t) and individual-specific (μ_i) effects are fixed parameters to be estimated.

$$y_{it} = \varphi + X_{it}'\beta + \mu_i + \zeta_{it}$$

The fixed effects model can be estimated by first differencing or dummy variable regression. The random effects model (REM) is where the time-specific effects (α_t) and individual-specific effects (μ_i) are random parameters with zero mean and constant variances. Where in both cases ζ_{it} is the error term which is independent and identically distributed (i.i.d) with mean of zero and constant variance.

$$y_{it} = \varphi + X_{it}'\beta + \mu_i + \alpha_t + \zeta_{it}$$

⁶ The classification into fixed effect and random effect is based on the correlation between the unobserved individual effects and the explanatory variables.

The random effects model can be estimated using generalized least squares regression (GLS) or maximum likelihood. The study chose between fixed and random effects model.

3.7 Choice between Random and Fixed Effects Model

Hausman (1978) test was carried out to determine whether to use fixed or random effect model. In this test the null hypothesis is random effects model and rejection means use of fixed effects model. Hausman test statistic can be computed from the difference between the REM and FEM estimators where in such a case it is said to have a chi-squared distribution or using the usual F test.

3.8 Diagnostic Tests

Descriptive data analysis and statistical tests were carried out to ensure the model is in its correct form. A normality test was done through analysis of skewness and kurtosis. Also the data spread, mean and variance covariance were also determined. We tested for cross section dependence, serial correlation, heteroscedasticity and unit roots.

The heteroscedasticity is a problem of fixed effects model, where the null hypothesis is the error term is homoscedastic. The Wald test to test for group wise heteroscedasticity was used. Stationarity of variables was tested by Im-Pesaran-Shin (IPS) test as this does not require the panel to be strongly balanced and allows for individual heterogeneity. Cross section dependence was tested by Breusch-Pagan Lagrange multiplier test and serial correlation by Wooldridge test.

CHAPTER FOUR

4.0 EMPIRICAL RESULTS

4.1 Introduction

The chapter presents the descriptive statistics of the variables used in estimation as well as the empirical results and a discussion of the findings.

4.2 Descriptive Statistics and Correlation

Since APT suggests unexpected part of a factor can affect returns, the unexpected variables are residuals obtained from ARIMA framework. This is done by examining the autocorrelation function (ACF) and partial correlation function (PACF) to determine the best lag and then various models are chosen. Finally the best fit model is chosen using Akaike information criteria (AIC) and Bayesian information criteria (BIC). The Augmented Dickey Fuller (ADF) test suggests that all our variables are stationary hence integrated of order zero. Table 4.1 shows the ADF unit roots tests and various ARIMA models used to forecast the unexpected variables. Also the conditional variances which are used to model volatility are obtained by GARCH (1, 1) by use of monthly data for Kenya and weekly data which is then averaged to obtain monthly conditional variance for Uganda and Tanzania. This is because there were no ARCH-effects in monthly data. Table 4.2 shows the test results for ARCH-effects for both monthly and weekly data and figure A1 shows volatility clustering.

Table 4.1: ADF Unit Roots Results and ARIMA Models for Independent Variables

	Kenya				
Variable	No Trend	Trend	Probability	Comments	ARIMA Models
R ^e	-5.60	5.56	0.00	Stationary	ARIMA(1,0,1)
R ^w	-7.70	-7.62	0.00	Stationary	ARIMA(1,0,1)
IR ^{Spread}	-10.45	-10.43	0.00	Stationary	ARIMA(0,0,1)
INF ^U	-7.95	-8.25	0.00	Stationary	ARIMA (0,0,0)
MS	-6.54	-6.48	0.00	Stationary	ARIMA(0,0,1)
Mcap	-8.40	-8.38	0.00	Stationary	ARIMA(2,0,0)
Openness	-14.58	-14.45	0.00	Stationary	ARIMA(2,0,0)
Fdepth	-8.78	-8.78	0.00	Stationary	ARIMA(2,0,0)
	Uganda				
R ^e	-5.00	-5.01	0.00	Stationary	ARIMA(1,0,1)
R ^w	-7.68	-7.62	0.00	Stationary	ARIMA(1,0,1)
IR ^{Spread}	-11.48	-11.65	0.00	Stationary	ARIMA(0,0,1)
INF ^U	-5.11	-5.08	0.00	Stationary	ARIMA(0,0,1)
MS	-8.58	-8.50	0.00	Stationary	ARIMA(0,0,1)
Mcap	-9.39	-9.36	0.00	Stationary	ARIMA(0,0,0)
Openness	-14.53	-14.54	0.00	Stationary	ARIMA(1,0,0)
Fdepth	-4.11	-4.60	0.00	Stationary	ARIMA(1,0,0)
	Tanzania				
R ^e	-7.94	-7.96	0.00	Stationary	ARIMA(1,0,0)
R ^w	-7.68	-7.62	0.00	Stationary	ARIMA(1,0,1)
IR ^{Spread}	-12.15	-12.06	0.00	Stationary	ARIMA(1,0,1)
INF ^U	-7.67	-7.64	0.00	Stationary	ARIMA(0,0,0)
MS	-7.41	-7.34	0.00	Stationary	ARIMA(0,0,1)
Mcap	-10.37	-10.36	0.00	Stationary	ARIMA(0,0,1)
Openness	-12.08	-11.99	0.00	Stationary	ARIMA(1,0,0)
Fdepth	-11.06	-10.96	0.00	Stationary	ARIMA(1,0,1)

Table 4.2: Test for ARCH-effects in Exchange Rate Changes.

	Monthly Exchange Rate Changes		Weekly Exchange Rate Changes	
	Chi2	P-Value	Chi2	P-Value
Kenya	8.785	0.003	0.028	0.868
Uganda	0.018	0.892	16.430	0.000
Tanzania	0.250	0.617	16.982	0.000

Table 4.3 shows the descriptive statistic of the variables used in estimation. The overall mean of the stock market return (R^m), exchange rate changes (R^e), return on world index (R^w), Interest rate spread (IR^{Spread}), money supply (MS) and financial market depth (Fdepth) is positive. The rest of the variables have negative overall mean with R^e , R^w , IR^{Spread} , INF^U , MS, Mcap, Openness and Fdepth being equal or close to zero. The table further shows the test for normality using skewness and kurtosis. All variables except money supply (MS), market capitalization (Mcap) and openness are negatively skewed and the kurtosis is not equal to three thus the variables are not normally distributed. Also the kurtosis shows the distribution is highly peaked hence leptokurtic distribution.

Table 4.3: Descriptive Statistics for Pooled Panel

Variable	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
R^m	0.0035	0.0260	-0.1165	0.1351	-0.4304	9.8776
R^e	0.0000	0.0194	-0.0959	0.0795	-0.5518	8.9492
$R^{e/h_{it}}$	-62.909	442.756	-2821.69	1175.928	-3.1317	17.7846
R^w	0.0000	0.0207	-0.0510	0.0407	-0.4967	3.0735
IR^{Spread}	0.0001	0.0071	-0.0316	0.0233	-0.2139	5.8496
INF^U	-0.0004	0.0391	-0.4499	0.0504	-9.5646	103.01
MS	-0.0001	0.0246	-0.0779	0.0790	0.2869	4.4308
β_{lit}	0.1492	0.0572	-0.1165	0.1803	-2.8924	11.3691
Mcap	-0.0006	0.2589	-0.7435	2.9349	8.0315	89.3343
Openness	-0.0002	0.0908	-0.3315	0.3501	0.0794	4.8408
(Fdepth)	0.0011	0.0770	-0.8028	0.4136	-5.0401	67.1723
R^m - Stock market return, R^e - Exchange rate changes, $R^{e/h_{it}}$ - Exchange rate volatility, R^w - Return on world index, IR^{Spread} - Interest rate spread, INF^U - Inflation, MS- Money supply, β_{lit} - Exchange rate exposure, Mcap- Market capitalization and Fdepth- Financial market depth						

Table 4.4 shows the correlation between the variables used in estimation. Stock market return is positively related to exchange rate changes (R^e), return on world index (R^w), inflation (INF^U) and money supply (MS) and its negatively related to all other variables. In terms of exchange rate changes, uncertainty in the three markets is created by the exchange rate volatility rather than changes. The table also shows that exposure is positively related to market capitalization, openness and financial market depth. This shows all the three independent variables increases exposure. Most of the correlations are low apart from the correlation between exchange rate changes and money supply which is 0.634 but it is not greater than 0.8 hence not severe.

Table 4.4: Correlation between Variables

	R^m	R^e	R^e/h_{it}	R^w	IR^{Spread}	INF^U	MS	β_{lit}	Mcap	Openness	Fdepth
R^m	1.0000										
R^e	0.0497	1.0000									
R^e/h_{it}	-0.0267	0.3046	1.0000								
R^w	0.3242	-0.0822	-0.0818	1.0000							
IR^{Spread}	-0.0527	-0.0432	-0.0071	-0.0199	1.0000						
INF^U	0.1355	0.0196	-0.0100	0.0483	0.034	1.0000					
MS	0.0291	-0.6342	-0.1422	0.0389	0.0072	-0.048	1.0000				
β_{lit}	-0.0067	0.0510	0.5634	-0.1578	0.0327	-0.0541	-0.0324	1.0000			
Mcap	0.1876	-0.0361	-0.0221	0.0537	0.0094	0.0412	0.0551	0.0268	1.0000		
Openness	-0.0409	0.2090	0.0441	-0.1685	-0.0612	0.0226	-0.0231	0.0901	0.0086	1.0000	
Fdepth	0.0163	0.1352	0.0974	0.0445	0.0032	-0.0487	-0.0081	0.0052	-0.0069	0.0564	1.0000
R^m – Stock market return, R^e – Exchange rate Changes, R^e/h_{it} - Exchange rate volatility, R^w - Return on world index, IR^{Spread} –interest rate spread, INF^U – inflation, MS- Money supply, β_{lit} - Exchange rate exposure, Mcap- market capitalization, Fdepth- Financial market depth											

4.3 Diagnostic Tests

4.3.1 Stationarity Test

The presence or absence of unit roots is tested using the Im-Pesaran-Shin (IPShin) test and Clemente-Montanes-Reyes (Clemo) unit root test. IPShin is used because it takes advantage of individual specific effects whereas Clemo test allows for structural breaks. The null hypothesis for IPShin test is that all panels contain unit roots and the alternative is that some panels are stationary. Table 4.5 shows the results for the IPShin test. For all variables the test statistic is less than the critical value at all significance levels hence stationary. Further, Clemo test confirms variables are stationary and there were significant structural breaks in August 2010 and October 2012 for Fdepth and IR^{Spread} for Kenya respectively. In Uganda structural breaks were experienced for R^e in October 2011 and in July 2011 Fdepth and Openness experienced a break. In Tanzania only R^m had a break in August 2013.

Table 4.5: Results for Stationarity Test

Im-Pesaran-Shin(IPShin) Test			
Variable	No Trend	5% Critical Value	Comments
R^m	-8.5706	-2.15	Stationary
R^e	-7.7679	-2.15	Stationary
R^e/h_{it}	-8.1965	-2.15	Stationary
R^w	-7.9729	-2.15	Stationary
IR^{Spread}	-8.0726	-2.15	Stationary
INF^U	-7.9141	-2.15	Stationary
MS	-7.7869	-2.15	Stationary
β_{lit}	-5.0414	-2.15	Stationary
Mcap	-7.8912	-2.15	Stationary
Openness	-7.7407	-2.15	Stationary
Fdepth	-6.311	-2.15	Stationary

4.3.2 Heteroscedasticity in Fixed Effects Model

The Wald test of groupwise heteroscedasticity is used to test for heteroscedasticity in the fixed effects model. This is because heteroscedasticity is more prone in the fixed effects model than in random effects model. The test statistics are 92.67 and 16032.29 in exchange rate exposure and mechanism models respectively. Further, the probabilities are less than 0.05; hence we reject the null hypothesis thus presence of groupwise heteroscedasticity. This will be corrected by using robust standard errors in the regression model.

Ho: $\sigma(i)^2 = \sigma^2$ for all i.		
	Chi2(3)	Prob>Chi2
Exchange rate Exposure	92.67	0.0000
Mechanisms	16032.29	0.0000

4.3.3 Cross-sectional Dependence

Cross-sectional dependence occurs when the error varies across cross-sections. This is tested using the Breusch-Pagan LM test. The null hypothesis is that the residuals across entities are not correlated. In case of exchange rate exposure model the chi-squared is 13.5 and its probability is 0.0037 which is less than 5%. Therefore, we reject the null hypothesis hence cross section dependence in the fixed effects model. This is corrected by using Driscoll and Kraay standard errors in estimation. In mechanisms model the chi-squared is 7.22 and its probability is 0.0652 > 0.05 hence cross sectional independence.

Ho: Residuals across entities are not correlated		
	Chi2(3)	Prob>Chi2
Exchange Rate Exposure	13.5	0.0037
Mechanisms	7.22	0.0652

4.3.4 Serial Correlation Test

Serial correlation is tested using the Wooldridge test for autocorrelation in panel data. The null hypothesis is that there is no first order autocorrelation. In exchange rate exposure the F statistic is 1.442 and its probability is $0.3527 > 5\%$ hence we do not reject the null hypothesis, thus no serial correlation. Whereas in the mechanisms the F statistic is 8615.69 and its probability is $0.0001 < 0.05$, hence we reject the null hypothesis thus presence of serial correlation. This is corrected by using Driscoll and Kraay standard errors in the estimation.

Ho: No first order autocorrelation		
	F(1,2)	Prob>F
Exchange Rate Exposure	1.442	0.3527
Mechanisms	8615.69	0.0001

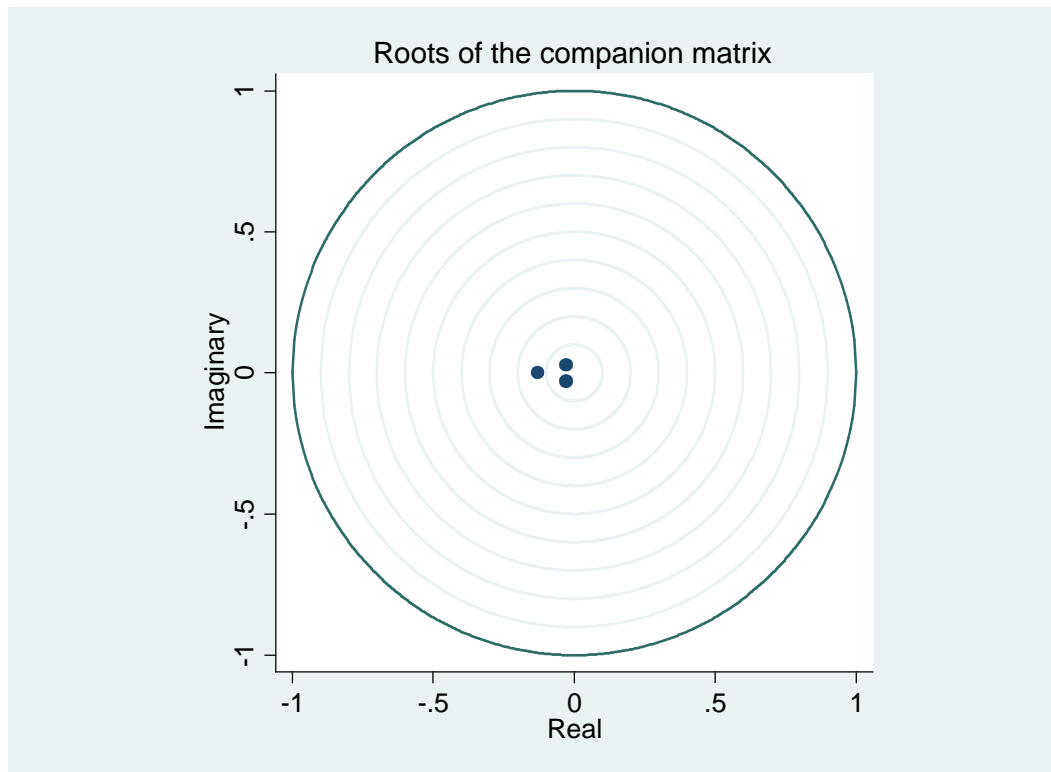
4.3.5 Granger Causality Test for Stock and Exchange Rate Market

Table 4.6 indicates the Granger causality test for stock market returns, exchange rate changes and exchange rate volatility. In the three equations we do not reject the null hypothesis in the panel, hence the three variables do not granger cause each other. Figure 4.1 shows the VAR model for panel is stable as all the Eigen values are inside the unit circle and this is further confirmed by modulus of the Eigen values which is less than one as shown by table A1. However, when the test is done for each country we reject the null hypothesis in case of Tanzania. Both exchange rate changes and volatility granger cause stock market returns.

Table 4.6: Granger Causality Test Results

Stock Market Return Equation			Exchange Rate Changes Equation			Exchange Rate Volatility Equation		
Panel								
Variable	Chi2	P-Value	Variable	Chi2	P-Value	Variable	Chi2	P-Value
Exchange Rate Changes	1.51	0.22	Stock Market Returns	0.15	0.7	Stock Market Returns	0.08	0.78
Exchange Rate Volatility	0.26	0.61	Exchange Rate Volatility	0.12	0.73	Exchange Rate Changes	0.12	0.73
ALL	1.53	0.47	ALL	0.28	0.87	ALL	0.20	0.90
Kenya								
Variable	Chi2	P-Value	Variable	Chi2	P-Value	Variable	Chi2	P-Value
Exchange Rate Changes	0.52	0.47	Stock Market Returns	0.96	0.33	Stock Market Returns	0.59	0.44
Exchange Rate Volatility	0.26	0.87	Exchange Rate Volatility	0.35	0.55	Exchange Rate Changes	0.00	0.99
ALL	1.41	0.49	ALL	1.20	0.55	ALL	0.61	0.74
Uganda								
Variable	Chi2	P-Value	Variable	Chi2	P-Value	Variable	Chi2	P-Value
Exchange Rate Changes	0.63	0.73	Stock Market Returns	2.58	0.27	Stock Market Returns	0.11	0.95
Exchange Rate Volatility	0.60	0.74	Exchange Rate Volatility	3.07	0.22	Exchange Rate Changes	3.10	0.21
ALL	0.76	0.94	ALL	5.90	0.21	ALL	3.35	0.50
Tanzania								
Variable	Chi2	P-Value	Variable	Chi2	P-Value	Variable	Chi2	P-Value
Exchange Rate Changes	0.25	0.88	Stock Market Returns	2.73	0.26	Stock Market Returns	0.64	0.73
Exchange Rate Volatility	8.2	0.02	Exchange Rate Volatility	1.33	0.51	Exchange Rate Changes	0.30	0.86
ALL	11.26	0.02	ALL	5.02	0.27	ALL	0.94	0.92

Figure 4.1: Unit Circle Test for Stability of VAR model



4.4 Regression Results for Exchange Rate Exposure

Table 4.7 shows regression results for equation 14 as shown by model 1 and which is further corrected for omitted variables by model 2 this is shown by Ramsey reset test results. In model 2 stock market volatility, predicted interest rate spread and domestic treasury bills rate are included as other variables that can affect returns. Stock market volatility is obtained by GARCH (1,1) and it increases uncertainty in the stock market. Domestic treasury bills rate is a measure of risk free rate and it should increase returns. The table presents results of the pooled, fixed effects and random effects. Structural breaks are corrected by use of dummy variables but their results are not significant, hence they are excluded from final models. Despite R^2 being below 50% only

one model does not show joint significance as measured by the Wald test in case of random effects model and F test for pooled regression and fixed effects model.

To further choose between fixed and random effects model Hausman specification test is used. This is based on the null hypothesis that differences in coefficients are not systematic. Table A2 shows that the Hausman statistic is 3.58 and its probability is 0.1671 > 5% hence we do not reject the null hypothesis and thus random effects model is chosen. Since there is cross sectional dependence and groupwise heteroscedasticity in the fixed effects model this is corrected by robust and Driscoll-Kraay standard errors to correct for this. The reported statistics are based on random effects model 2.

Table 4.7: Exchange Rate Exposure Regression Results

Dependent Variable: Stock Market Return (R^m)

	Pooled		Random		Fixed	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
R^e	0.21*** (0.13)	0.21*** (0.12)	0.21*** (0.13)	0.21* (0.12)	0.21*** (0.12)	0.21** (0.05)
R^e/h_{it}	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00* (0.00)	-0.00 (0.00)	-0.00 (0.00)
R^w	0.41* (0.09)	0.36* (0.09)	0.41* (0.10)	0.36* (0.15)	0.41* (0.12)	0.33** (0.07)
IR^{Spread}	-0.17 (0.25)	-0.26 (0.25)	-0.17 (0.27)	-0.26 (0.23)	-0.17 (0.22)	-0.23 (0.21)
INF^U	0.08 (0.08)	0.09 (0.04)	0.08* (0.04)	0.09 (0.11)	0.08 (0.08)	0.09 (0.11)
MS	0.12 (0.08)	0.13 (0.09)	0.12 (0.09)	0.13* (0.04)	0.12 (0.09)	0.12* (0.07)
Rmht	-	4.94* (1.75)	-	4.94* (2.21)	-	5.61** (0.83)
Prespread	-	0.11*** (0.06)	-	0.11* (0.04)	-	0.24*** (0.07)
DTBR	-	-0.01 (0.01)	-	-0.01 (0.01)	-	-0.01 (0.01)
Constant	0.00*** (0.00)	-0.01*** (0.00)	0.00*** (0.00)	-0.01*** (0.00)	0.00**** (0.03)	-0.03*** (0.01)
Hetero.	15.74[0.00]	0.39[0.53]	-	-	83.37[0.00]	62.88[0.00]
Serial.corr	1.442[0.35]	1.195[0.39]	-	-	-	-
Ramsey test	7.21[0.00]	1.12[0.34]	-	-	-	-
F	3.71[0.00]	4.94[0.00]	-	-	3.05[0.27]	23.38[0.04]
Hausman	-	-	-	3.58(0.17)	-	-
Wald χ^2	-	-	24.11[0.00]	16.40[0.00]	-	-
R^2	13.58	19.64	13.58	19.64	13.61	21.07
No. of obsv.	192	192	192	192	192	192
R^e - Unexpected exchange rate changes, R^e/h_{it} - Exchange rate volatility, R^w - Unexpected return on world index, IR^{Spread} - interest rate spread, INF^U - unexpected inflation, MS- unexpected money supply, Rmht- stock market volatility, Prespread- predicted interest rate spread, DTBR- domestic treasury bills rate.						
Significance- *1% , **5%, ***10%, Standard errors are shown in the parenthesis while probabilities are shown in the square brackets.						

In the random effects model, it was revealed that the stock markets are significantly and positively exposed to unexpected US\$ exchange rate changes. Further, it is significantly and negatively exposed to volatility of US\$ exchange rate. Return on world index, money supply,

predicted interest rate spread and stock market volatility are positively and significantly related to stock market returns. This implies that as either exchange rate changes, return on world index, predicted interest rate spread, stock market volatility and/or money supply increases, the stock market returns increases. Whereas as exchange rate volatility increases the stock market returns reduces. However, in the fixed effects model 2 only money supply loses its significance. Only return on world index and stock market volatility are significant in the pooled model 2.

4.4.1 Discussion of Empirical Results

The exchange rate creates uncertainty through its changes and volatility. The results shows that the East African stock markets are positively exposed to unexpected US\$ exchange rate changes. These results concur with Gatopoulos (2010) who found a positive and significant exposure. This shows that the East African stock markets benefits from exchange rate changes. East African stock markets are negatively exposed to the volatility of exchange rate. This is similar to Ahmadi et al. (2012) who found negative relationship between stock returns and exchange rate volatility. Therefore, what creates adverse effects in the stock market are not changes in exchange rates but rather the volatility. This further confirms that the exchange rate exposure varies over time as measured by the volatility.

Unexpected return on world index has a significant and positive impact on stock markets. These findings are similar to Entorf et al. (2011) who found a positive and significant exposure to the world stock market returns. The study used this variable to control for macroeconomic influence from the rest of the world. Its positive sign implies that a favorable macroeconomic environment from the rest of the world causes the stock market returns to increase. This can also be explained

by the level of integration of the stock markets and it shows that the world and the domestic stock markets are highly integrated.

Money supply which was used as a measure of a country's monetary policy positively and significantly affects stock returns. These findings are similar to Aroni (2011) who found a positive relationship between money supply and stock prices. This indicates that a favorable monetary policy will improve the performance of the stock market. This can be due to the fact that if money supply increases, the liquidity of the money market improves as well as the purchasing power of the investors hence increasing stock prices.

The results indicate it is predicted interest rate spread rather than the unpredicted interest rate spread that affects stock returns as shown by the significance of the results. Since predicted interest rate spread is formed by using the lagged model it can be explained by lagged response hypothesis. Where in this case investors form their expectations based on previous interest rate spread.

4.5 Regression Results for Mechanisms of Exchange Rate Exposure

Table 4.8 shows the regression results of the pooled regression, random effects and fixed effects models for equation 16. Exchange rate exposure which is the dependent variable is obtained by equation 15. The study includes dummy variables for August 2010 and July 2011 to cater for structural breaks. Further the test of significance table A3 shows the lagged values for both actual and unexpected values are jointly significant in explaining exchange rate exposure but individually only the first lag of actual openness and financial depth were significant hence they are included in the model. The R^2 shows the pooled and random effects models explain 2%

of the exchange rate exposure and the coefficients are jointly significant as show by the F and Wald statistics. The Ramsey reset test shows the model is correctly specified. To further choose between fixed and random effects model Hausman specification test is used. This is based on the null hypothesis that the differences in coefficients are not systematic. Table A4 shows the Hausman statistic is 54.33 and with a probability of 0.00 which is less than 5% hence, we reject the null hypothesis and choose fixed effects model. Since there was serial correlation and groupwise heteroscedasticity in the fixed effects model we use robust standard errors to correct for this. The reported statistics are based on fixed effects model estimated using robust standard errors.

Table 4.8: Regression Results for Mechanisms of Exchange Rate Exposure

Dependent variable: Exchange rate exposure(β_{lit})

Independent Variables	Pooled	Random	Fixed
Unexpected Market capitalization	0.007 (0.01)	0.007 (0.01)	0.007(0.01)
Unexpected Openness	0.065***(0.05)	0.065***(0.04)	0.067***(0.041)
Unexpected financial depth	-0.001 (0.03)	-0.001 (0.01)	0.010 (0.17)
First lag of actual financial depth	-0.052***(0.03)	-0.052*(0.02)	-0.073* (0.02)
First lag of actual openness	-0.007**(0.041)	-0.007* *(0.00)	0.005** (0.00)
D82010	0.036*(0.008)	0.036(0.03)	0.009** *(0.01)
D72011	0.026 (0.005)	0.026 (0.02)	0.008**(0.00)
Constant	0.150*(0.004)	0.150*(0.02)	0.150* (0.00)
Heteroscedasticity	11.45[0.00]	-	82246 [0.00]
Serial correlation	1783 [0.00]	1783 [0.00]	1783 [0.00]
Cross sectional dependence	-	85.25 [0.00]	5.24 [0.00]
Ramsey test	0.28 [0.0.84]	-	-
F	9.15[0.00]	-	-
Wald chi ²	-	16.93 [0.00]	-
R ²	0.02	0.02	0.01
Hausman	-	54.33[0.00]	-
No. of Observations	192	192	192

Significance- *1%, **5%, ***10%, Standard errors are shown in the parenthesis while probabilities are shown in the square brackets.

The results show openness, the first lag of actual financial depth and the first lag of actual openness are significant across all models. Considering the fixed effects model which was preferred after conducting Hausman specification test, first lag of actual financial depth revealed a significant negative relationship with the exchange rate exposure. On the other hand, the first lag of openness is positively and significantly related to exchange rate exposure. Unexpected market capitalization, unexpected openness and unexpected financial depth increase exposure although only unexpected openness is significant at 10%.

Test for robustness of results for mechanisms of exchange rate exposure as shown by table 4.9 reveals that the first lag of financial depth and openness remains significant even when yearly and monthly effects are included. However, the first lag of actual openness loses significance which shows it is influenced by the time-effects. When financial market depth is measured using another proxy, external debt, the results are still significant.

Table 4.9: Robustness Test for Mechanisms of Exchange Rate Exposure.

Dependent variable: Exchange rate exposure (β_{it})

Independent Variables	Financial depth2	Yearly-effects	Monthly-effects	Monthly and Yearly Effect
Unexpected Market capitalization	0.01 (0.01)	0.00(0.01)	0.01(0.01)	-0.01(0.01)
Unexpected Openness	0.06*** (0.04)	0.05*** (0.03)	0.08*** (0.05)	0.05*** (0.04)
Unexpected financial depth	0.00* (0.00)	0.00 (0.01)	0.01(0.02)	0.00(0.01)
First lag of actual financial depth	0.00*(0.00)	-0.07*(0.01)	-0.08**(0.02)	-0.07*(0.01)
First lag of actual openness	0.00*(0.03)	-0.00 (0.01)	0.01(0.02)	0.01(0.01)
D82010	0.01*** (0.01)	0.01*** (0.01)	0.01(0.01)	0.01*** (0.01)
D72011	0.01** (0.00)	-0.01(0.19)	0.02** (0.01)	0.00(0.01)
Constant	0.15* (0.00)	0.16* (0.01)	0.15* (0.00)	0.16* (0.01)
Yr09	-	0.01** (0.00)	-	0.01*** (0.01)
Yr10	-	-0.01 (0.01)	-	-0.01 (0.01)
Yr11	-	0.02*** (0.01)	-	0.02** (0.01)
Yr12	-	-0.02 (0.02)	-	-0.02 (0.03)
Yr13	-	-0.02 (0.02)	-	-0.02(0.02)
January	-	-	0.01 (0.01)	0.01 (0.01)
February	-	-	0.01 (0.01)	0.00 (0.00)
March	-	-	-0.00 (0.01)	-0.01 (0.00)
April	-	-	-0.01 (0.01)	-0.01 (0.01)
May	-	-	0.01 (0.01)	0.01 (0.01)
June	-	-	0.01 (0.01)	0.01(0.01)
July	-	-	-0.02 (0.01)	-0.02 (0.01)
September	-	-	0.00 (0.00)	0.00 (0.00)
October	-	-	-0.00 (0.00)	-0.00* (0.00)
November	-	-	-0.01** (0.00)	-0.01** (0.00)
December	-	-	-0.01** (0.00)	-0.01*** (0.00)
Ramsey test	0.97[0.04]	0.56[0.644]	2.62[0.05]	1.42[0.24]
F	21.49[0.05]	1.22[0.45]	1.18[0.46]	1.46[0.41]
R ²	0.014	0.08	0.03	0.09

Significance- *1%, **5%, ***10%, Standard errors are shown in the parenthesis while probabilities are shown in the square brackets.

4.5.1 Discussion of Empirical Results

Financial market depth as measured by the level of domestic debt significantly affects exposure only in the lag of actual variable. The lag of actual financial market depth decreases exposure this is similar to the findings of Gatopoulos and Isakov (2010). Hence a deeper financial market protects the stock market from risks such as exchange rate risk this could be due to availability of hedging instruments such as derivatives. Openness as measured by the sum of exports and imports affects exchange rate exposure both in the unexpected and the lag of actual with the same magnitude but only the lag of actual openness is significant. The positive sign shows the more open an economy the higher the exchange rate exposure and this concurs with Friberg and Nydahl (1999). This is because the economy is now more susceptible to macroeconomic shocks from other economies such as exchange rate changes and this is even accelerated by the fact that these countries operates a floating exchange rate regime.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

The chapter summarizes the findings of the study, concludes and gives policy implications. Finally it highlights the limitation of the study and offers suggestions for area of further research.

5.2 Summary

The study aimed to investigate the exchange rate exposure of East African stock markets. It also intended to identify the mechanism through which exchange rate changes affect the stock markets. The adoption of floating exchange regime and liberalization of stock markets means that the markets have a possibility of being exposed to macroeconomic shocks from other economies such as changes in exchange rate. The study aimed to find out how the changes and volatility in US\$ exchange rate affects the stock market returns and whether this effect is due to stock market specific or country specific factors. The study is done in Arbitrage pricing theory setting where various macroeconomic factors such as return on world index, interest rate spread, inflation and money supply were added to improve exchange rate exposure findings.

The study considers three East African stock markets that is Nairobi Securities Exchange (NSE), Dar es Salaam Stock Exchange (DSE) and Uganda Securities Exchange (USE) from January 2009 to April 2014. Unexpected values of independent variables used in this study were obtained by ARIMA and the volatility of exchange rate was obtained by GARCH (1,1) model. The study

used both the pooled Ordinary Least Squares (OLS) and panel regression methods, fixed effects and random effects model. The Hausman specification test chose random effects model as the best model in estimating both exchange rate exposure and fixed effects model for exchange rate exposure mechanisms. The results show that the East African stock markets are significantly exposed to unexpected exchange rate changes and volatility of exchange rates. While exchange rate changes positively affect returns, its volatility negatively affects returns. On the control variables only the return on world index, money supply and interest rate spread had significant explanatory power for returns. The East African stock markets are positively exposed to return on world index and changes in money supply whereas they are negatively exposed to interest rate spread.

On the mechanisms results only the depth of the financial market and openness were significant. The depth of financial markets reduces exposure in the lag of actual values while openness increases exposure in the lag of its actual values. This shows a deep financial market and a less open economy is good as it helps reduce exposure to exchange rate risk.

5.3 Conclusion

The study examined the exchange rate exposure of East African Stock markets and its mechanisms for a period from January 2009 to April 2014. The results show the East African stock markets are positively exposed to US\$ exchange rate changes. This implies that investors benefit from exchange rate changes as returns increases. Further, stock markets are negatively exposed to exchange rate volatility meaning that a change in exchange rate may have persistent

adverse effect. Hence, exchange rate volatility rather than changes create risk in the three stock markets.

Further the results show the extent of exposure in the stock markets is determined by depth of the financial market and openness of the economy. In case of depth of financial markets, the deeper the financial markets the lower the exchange rate exposure. Moreover, the greater the openness of an economy the higher the exchange rate exposure.

5.4 Policy Implications

The US\$ exchange rate changes have a positive impact on the stock market returns hence the policy makers should provide incentives that encourages foreign participation from investors within and outside the region. However, the monetary authority should worry about the volatility of exchange rate changes in exchange rate policy formulation: this is because a shock in the foreign exchange market may have a persistent negative effect on the stock markets.

Further, the government should adopt measures that ensure stability in the macroeconomic variables such as interest rate spread as this has a negative impact on the stock markets. In case of money supply the government should ensure adequacy as this increase the liquidity of the stock market investors.

Finally, the government through the capital market authorities should promote the development of financial markets for instance introduction of derivative markets as this can help in hedging risks. On the other hand, the government should set up incentives to protect investors as it's through the openness of the economy that the exchange rate exposure increases. These measures

can include derivative markets and regional integration at the stock market level or at country level.

5.5 Limitations of the Study

Arbitrage pricing theory was used to estimate both exchange rate exposure and the mechanism. This theory is based on the fact that only the unexpected factors affect returns. The unexpected factors in this study were obtained by ARIMA framework whose model identification is a daunting task hence may not reflect the right representation. Also the study did not consider the asymmetry in exchange rate that is the effect of depreciation and appreciation. Moreover, obtaining the data for the three countries was a bit challenging considering these stock markets are still at their developing stages and their databases are not well buildup.

5.6 Areas for Further Research

The study suggests that future studies should study exchange rate exposure using stock returns at firm level in the three countries. Also some aspects of exchange rate exposure such as asymmetry and pricing in the stock market should be put into consideration. The study only considered US\$ exchange rate thus future studies could consider other exchange rates such as Sterling Pounds, Euro and also a trade weighted exchange rate.

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APPENDIX TABLES AND FIGURES

Figure A1: Exchange Rate Volatility from 2009 to 2014

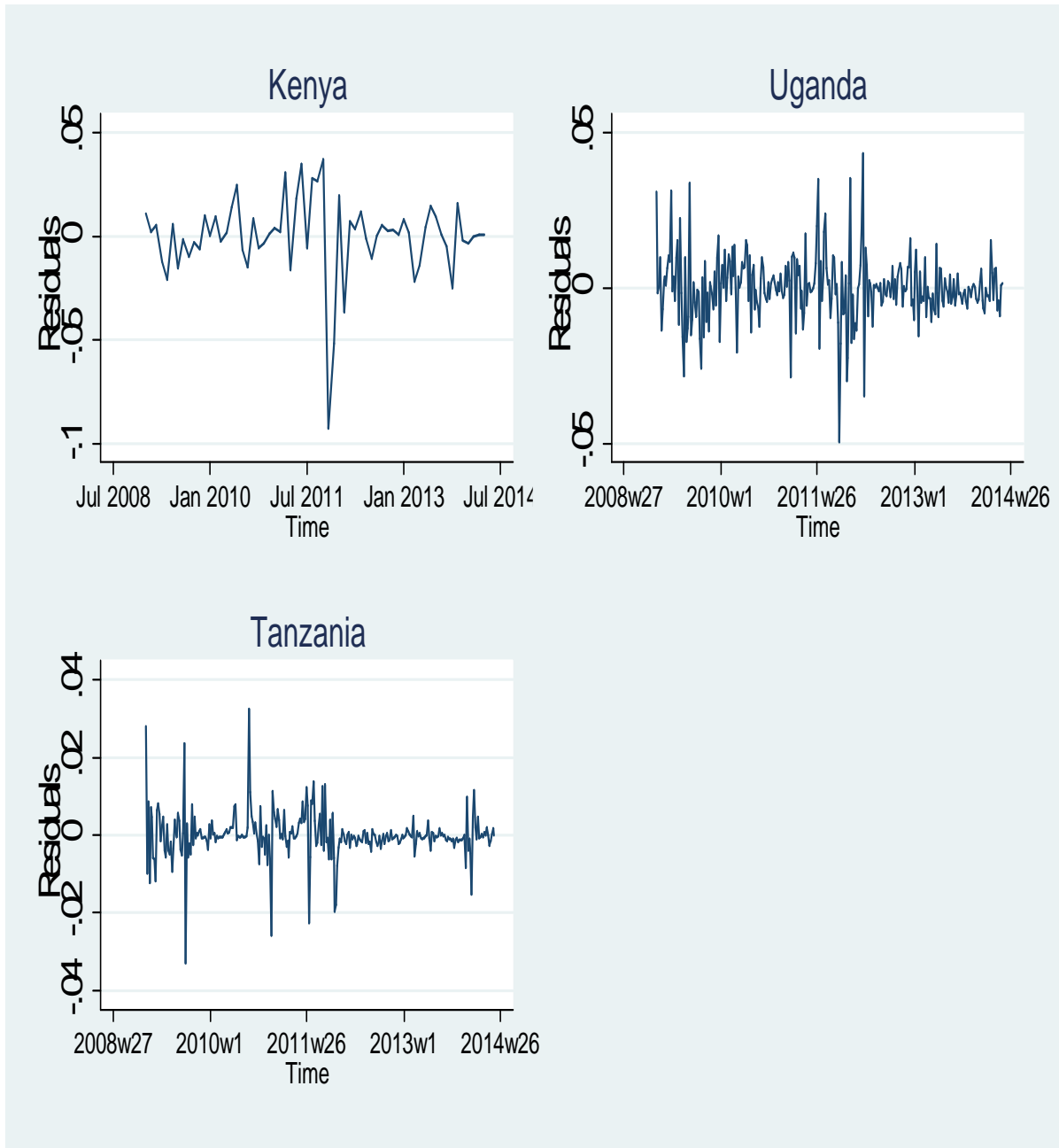


Table A1: Granger Causality Eigen Values Stability Condition

Eigen Value	Modulus
-0.1288504	0.12885
-0.02823075+0.02850317i	0.040117
-0.02823075-0.02850317i	0.040117

Table A2: Exchange Rate Exposure Hausman Specification Test.

	Coefficients			$\sqrt{\text{diag}(V_b - V_B)}$
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	Standard Error
Unexpected exchange rate changes (R^e)	0.207	0.211	-0.004	0.006
Exchange rate volatility (R^e/h_{it})	0.000	0.000	0.000	0.000
Unexpected return on world index (R^w)	0.326	0.355	-0.029	0.018
Unexpected Interest rate spread (IR^{Spread})	-0.226	-0.264	0.038	0.029
Unexpected inflation (INF^U)	0.086	0.082	0.002	0.001
Unexpected money supply (MS)	0.124	0.127	-0.003	0.002
Stock market volatility (RMht)	5.609	4.940	0.669	0.554
Predicted Interest rate spread	0.241	0.111	0.130	0.085
Domestic Treasury Bill rate (DTBR)	-0.011	-0.012	0.000	0.000
<p>b = consistent under H_0 and H_a; obtained from xtreg B= inconsistent under H_a, efficient under H_0; obtained from xtreg. Test H_0: difference in coefficients not systematic $\chi^2(2) = (b-B)'[(V_b - V_B)^{-1}](b-B) = 3.58$ Prob>$\chi^2 = 0.1671$</p>				

Figure A2: Stock Market Returns from January 2009 to April 2014

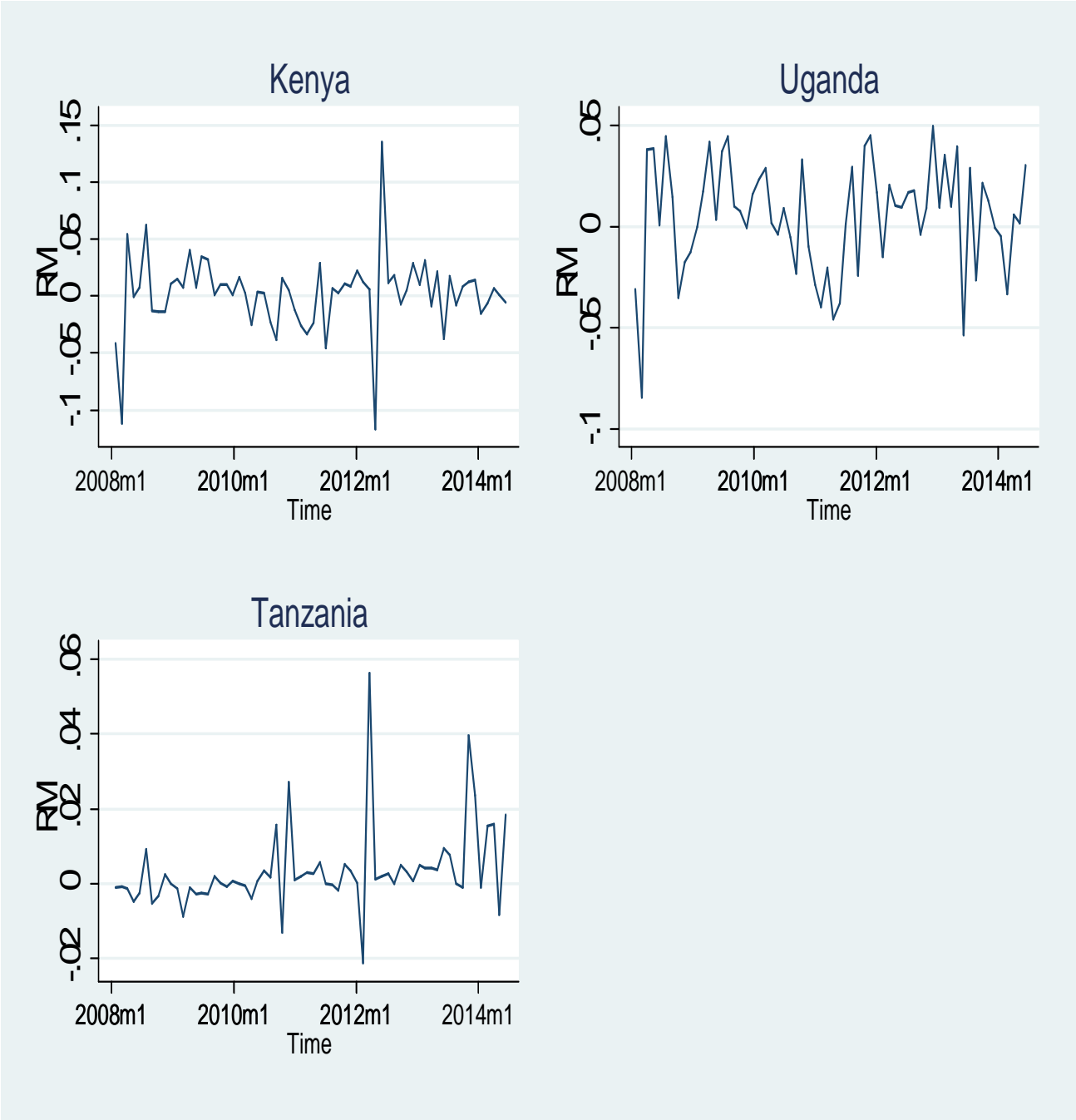


Table A3: Significance Test for Lagged Variables in Mechanisms of Exposure

Dependent variable: Exchange rate exposure			
	All Variables	Unexpected and Actual	Individually
All first lags of the variables	1.30(0.4356)		
Market capitalization		1.18(0.46)	
Actual market capitalization			0.44(0.58)
Unexpected market capitalization			0.22(0.68)
Openness		41.31(0.02)	
Actual openness			17.34(0.05)
Unexpected openness			2.57(0.25)
Financial depth		20.65(0.0462)	
Actual financial depth			23.75(0.04)
Unexpected financial depth			0.25(0.67)

Table A4: Hausman Specification Test for Mechanisms of Exchange Rate Exposure

Variables	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Standard Error
	(b)	(B)		
	Fixed	Random		
Unexpected market capitalization	0.007	0.007	0.000	0.000
Unexpected Openness	0.067	0.065	-0.002	0.001
Unexpected financial depth	0.001	-0.001	0.011	0.001
First lag of actual openness	0.005	-0.007	0.013	0.002
First lag of actual financial depth	-0.073	-0.052	0.021	0.003
D82010	0.009	0.036	-0.026	0.006
D72011	0.008	0.026	-0.018	0.006

b = Consistent under Ho and Ha; obtained from xtreg
 B= inconsistent under Ha, efficient under Ho; obtained from xtreg
 Test: Ho: difference in coefficients not systematic

$\chi^2(2) = (b-B)'[(V_b-V_B)^{-1}](b-B) = 54.33$
 Prob>chi2 = 0.00

Figure A3: Exchange Rate Exposure from January 2009 to April 2014

