

**THE EFFECT OF EXCHANGE RATE VOLATILITY ON PRIVATE
CAPITAL INFLOWS IN ZAMBIA, 1992-2012.**

By

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**A dissertation submitted in partial fulfillment of the
requirements for the degree of Master of Arts in Economics.**

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ABSTRACT

This study investigated the empirical evidence on the effect of exchange volatility on private capital inflows in Zambia. The investigation used monthly time series data for the period 1992-2012 relating to exchange rate, gross domestic product, foreign direct investment and foreign portfolio investment. Exchange rate volatility was estimated using the generalized autoregressive conditional heteroscedasticity (GARCH) model while its effect on private capital inflows to Zambia was captured through the Johansen Maximum Likelihood for Cointegration and Error Correction Model. The findings show that the volatility of the nominal exchange rate exerted significant negative impact on the inflows of both foreign direct investment and foreign portfolio investment in Zambia. In addition, the results show that a stable exchange rate and the size of the market (GDP) are crucial determinants of foreign investment inflows to the country. It is also revealed that while both a stable exchange rate and size of the market (GDP) are likely to attract private capital, foreign investors inclined to long term investments (FDI) do not care much about the size of the market in making a decision to invest in Zambia. The results also suggest that supportive macroeconomic factors are imperative in enhancing the inflow of private capital in the country. This enquiry supports the commitment of policymakers to exchange rate and macroeconomic stability as key to private capital inflows thriving in Zambia.

Keywords: Exchange rate volatility, foreign direct investment, foreign portfolio investment, GARCH, Cointegration, Error Correction Model, Zambia.

With love and affection to the memory of my dad: Mr. Weston Chinyama Funyina; may your soul rest in eternal peace.

To mum Josephine ba Mukanu, thank you for the love, I wish life gave you the opportunity to get educated so that you could read my paper. However, I just pray that God reward you with a good health and long life.

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller
AFDB	African Development Bank
ARDL	Auto-Regressive Distributed Lag
BOZ	Bank of Zambia
CSO	Central Statistical Office
CSPR	Civil Society for Poverty Reduction
EAZ	Economics Association of Zambia
ECM	Error Correction Model
FDI	Foreign Direct Investment
FPI	Foreign Portfolio Investment
GARCH	Generalized Auto Regressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
ICAPM	International Capital Asset Pricing Model
IMF	International Monetary Fund
IRF	Impulse Response Functions
LDCs	Least Developed Countries
MDG	Millennium Development Goals
MDP	Money Demand and Productivity

MFEZ	Multi-Facility Economic Zone
MNCs	Multi-National Corporations
MoFNP	Ministry of Finance and National Planning
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PAM	Portfolio Allocation Model
PCF	Private Capital Flows
PP	Phillips-Perron
PPP	Public Private Partnerships
PSD	Private Sector Development
PSDRP	Private Sector Development Reform Programme
RCM	Return and Creditworthiness Model
SMEs	Small and Medium Enterprises
SSA	Sub-Saharan Africa
UN	United Nations
UNCTAD	United Nations Conference for Trade and Development
UNDP	United Nations Development Programme
US	United States
ZCCM	Zambia Consolidated Copper Mine
ZDA	Zambia Development Agency
ZRA	Zambia Revenue Authority

CHAPTER 1

INTRODUCTION

1.1 Overview

In the last few decades, policy makers, and researchers, especially in developing countries have come to see private capital inflows as an important conduit for economic growth and development. This is mainly because volumes of capital inflows have grown at a phenomenal rate since the early 1990s. Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI) in particular, have grown worldwide. Despite these inflows being largely concentrated in a few developed and emerging economies, significant private capital inflows are moving into developing countries more than ever before. For instance, in Zambia, foreign private capital inflows as a percentage of GDP were estimated at 75 percent in 2007. For many countries in Africa such as Uganda, Cameroon, Tanzania and the Gambia, private capital inflows were estimated at 30 percent of GDP (UNDP, 2011).

It is generally argued that FDI boosts economic growth by providing additional foreign capital and crowding in additional domestic investment. FDI stimulates inflows of foreign currency into the economy, enhances capital formation, technology transfer, increase export earnings, and employment creation. It contributes to increased international trade, and helps to create a more competitive business environment that enhances enterprise development (ZDA, et al, 2012).

FDI helps fill the gap between targeted government tax revenues and locally raised taxes (Todaro, 1996). Given that most developing country governments are unable to generate sufficient revenue locally to meet their expenditure needs, by taxing MNCs profits and participating financially in their local operations; developing countries' governments are better able to mobilize public financial resources for development projects.

As much as FDI is perceived as an important component of private capital inflows in spurring economic growth, FPI has become the most significant and fastest growing component of foreign capital inflows since the 1990s. Proponents argue that FPI can help increase the liquidity of domestic capital markets; and develop market efficiency. As markets become broader and deeper, they become more liquid as a result a wider range of investment can be financed. This is premised on the impression that savers have a greater opportunity to invest with the assurance that they will be able to manage their portfolio, or sell their securities quickly if they need access

to their savings. In this regard, liquid markets can also make long-term investment more attractive (BIS, 2007).

Goldin and Reinert (2007) assert that FPI promotes the development of equity markets and shareholders' voice in corporate governance. This is based on the fact that as firms compete for finances, the market will reward better performance, better prospects for future performance, and better corporate governance. As the liquidity and functionality of markets improve, equity prices will increasingly reflect the underlying values of companies, enhancing the more efficient allocation of capital inflows. FPI helps the domestic capital market by introducing more sophisticated instruments and technology for managing portfolios. For instance, they may bring with them a facility in using futures, options, swaps and other hedging instruments to manage portfolio risk. Increased demand for these instruments would be conducive to developing this role in domestic market, improve market management opportunities for both foreign and domestic investors.

However, we continue to see that inadequate resource mobilization continues to hamper long-term capital development and real growth in Zambia and Africa at large. Consequently, it is becoming increasingly difficult to eradicate poverty and achieve other Millennium Development Goals (MDGs) in Zambia (UNCTAD, 2005). It has become imperative to attract foreign capital inflows to augment the country's resources for rapid socio-economic development. Indeed, among the developing regions of the world, the need for external financing is nowhere more pressing than in Sub-Saharan Africa, particularly in Zambia. Here income levels are too low to generate adequate domestic resources for the attainment of even modest rates of investment and growth (UNCTAD, 2000).

Zambia shares all the characteristics of African countries on the continent with regard to inadequate domestic resource mobilization and minimal capital inflows. Private capital inflows to Zambia have been increasing, while revenue mobilization remains below what is required to execute the country's developmental agenda. For instance, in Zambia, foreign private capital inflows were estimated at 75 percent of GDP in 2007 (UNDP, 2011). It is therefore, not surprising that the economy over the past few years (i.e., 2004 to 2012) grew at an annual average of about 6% in real GDP growth terms. However, this is below the 8% or more required for the attainment of sustainable growth in the economy (Ndulo et al, 2009). The economy remains agrarian, copper dependent and fragile in the face of external and internal macroeconomic shocks. The current account and fiscal balances continue to record negative

values. These and other structural bottlenecks from both supply and demand sides (such as poor and inadequate infrastructure, and high unemployment levels) hamper real economic growth and poverty reduction.

Zambia has abundant natural resources; however, there are inadequate funds to finance long-term investments to take advantage of these resources. This lack of investible funds is a major obstacle to enhanced real economic growth. Due to the importance of foreign private capital in stimulating growth, foreign investment policies aimed at attracting and encouraging increased foreign private capital inflows in developing countries are well-placed.

However, despite the increased foreign capital inflows to developing countries, instability in the exchange rate and inflation has posed serious challenges to their growth. Foreign investors come into the domestic economy with expectations of positive returns; despite the various types of risks that they are exposed to. The risks include the exchange rate, inflation rate, interest rate, political, and legal risks. The re-investment of earnings in the domestic economy depends on the level of risks faced by the investors, the size of returns and future expectations. Expectations of investors play an important role to determine the level of investment and in boosting economic activities of a country (Ahuja, 2008). If foreign investors are optimistic about the future, they will invest their funds. There is, however a debate on the impact of exchange rate volatility on foreign private capital inflows in many countries. With open economies that leave the market to determine the exchange rate, the price level and the interest rate, great fluctuations have been observed in these variables. This has caused a lot of uncertainties in the domestic economies. It is argued that the expectations on the depreciation of a currency tends to discourage foreign investment in assets with given prices and yields denominated in that currency in the domestic economy. This is so because the exchange loss which a potential investor has to expect whenever the proceeds of some of the earnings and of the ultimate liquidation of an asset have to be converted into the investor's currency at a less favorable exchange rate than that at which the asset was originally purchased. These considerations, which concern a particular type of foreign investment (i.e., FPI), are sometimes applied to foreign investment in general. This leads us to expect that exchange rate instability in the domestic economy reduce earnings on foreign investments and thus discourages capital inflows. It is, however, difficult to reconcile the adverse effects of exchange rate volatility with the continued large inflows of private capital into some of the countries whose currencies show very high volatility. For instance, countries like Brazil,

Argentina and Chile despite experiencing high exchange rate volatility and instability in inflation attracted huge private capital inflows between 1951 and 1963 (Moreno et al, 2005).

There is vast literature indicating that exchange rate volatility has a direct and negative effect on private capital inflows (see, for instance, Bénassy-Quéré *et al*, 2001; Kiyota and Urata, 2004; and Ruiz, 2005). Exchange rate volatility generates an air of uncertainty as the variance of expected profits rises and its net present value falls. This could cause investors to hesitate about committing significant resources to foreign investment. This serves as a disincentive for private capital inflows in SSA. It further aggravates the existing political and economic risks. Despite the fact that literature on private capital flows is extensive and the relationship between exchange rate volatility and foreign investment inflows is established, there is very little literature on SSA countries and none on Zambia. This study evaluates the relationship between exchange rate volatility and private capital inflows in Zambia.

The purpose of this study is therefore, to assess the impact of exchange rate volatility on private capital inflows into Zambia. We use time series monthly data for the period 1992 to 2012.

1.2 Private Capital Inflows to Zambia

Private capital inflows to Zambia mainly consist of FDI and FPI.

1.2.1 Foreign Direct Investment

FDI has been significant in the Zambian economy, especially since the 1990s. It has contributed to increased capital inflows and investment in the economy. It has facilitated the rehabilitation of the copper industry. It has also boosted the production and export of non-traditional products and services. FDI inflows have increased steadily over the years. It has averaged US \$133.7 million and US \$674 million per year for the period 1991 to 2000 and 2001 to 2010 respectively. It peaked to US \$1,729.3 million in 2010 (see table 1.0 below). The increase was as a result of the improved investment climate. This was characterized by stability in the macroeconomic environment, arising from prudent economic management by government. The increased FDI inflows were in tandem with Zambia's robust real GDP growth of 7.6 per cent in 2010. The majority of the FDI inflows were directed at the mining sector. However, FDI inflows into other sectors such as the manufacturing, construction, tourism and the financial institutions have also been significant. For instance, the service sector has received the second largest share of FDI inflows. This has been facilitated by the entry of new international banks and the expansion of investment by service providers in such sectors as telecommunications and retail. The tourism

sector has also received significant FDI inflows. This has been facilitated by the active promotion and development of the Victoria Falls region. This has included the opening of the new game parks in the area. Agriculture has likewise been attracting significant amounts of FDI inflows particularly in the production of horticultural and floricultural products, fruits, cotton, maize, tobacco and sugar (BOZ, CSO and ZDA, 2011).

The country has recently attracted significant FDI inflows in large scale projects either through public-private partnership (PPP) or joint ventures from emerging economies such as China and India. For example, one of Zambia’s Multi-Facility Economic Zone (MFEZ) - the Chambishi Multi-Facility Economic Zone located in the Copperbelt region, was developed by Chinese investors. When operational, it is expected to host over 60 companies and generate FDI inflows of US \$ 900 million over a five year period (UNCTAD, 2011; 15).

Overall, Zambia’s FDI inflows have not changed significantly in the last twenty years. It compares poorly with other Sub-Saharan countries such as Angola, Mozambique, Rwanda and Sierra Leon. These countries have made stronger policy efforts to improve their investment climate and implement economic reforms despite their past political turmoil (Chileshe, 2011). Zambia’s FDI performance is strongly based on the performance of its mining industry for which FDI has been a vital source of capital. The challenge has been to attract more FDI inflows into sectors other than mining. This would facilitate the diversification of the economy and encourage broad-based investment and economic growth.

Table 1: Private Capital Flows in Zambia, 1980-2012 (US \$ Millions)

Period	1980	1981-90	1991-00	2001-2010	2011	2012
FDI	61.7	65.8	133.7	674	1,108	1,065.8
FPI	0	0	0.46	21.7	70.7	813

Source: Own calculation using BOP data from BOZ, 2013

1.2.2 Foreign Portfolio Investment

Since 1991, the government has pursued a set of political and economic reforms in order to restructure the financial sector and the economy. More importantly, major reforms were pursued in the financial sector. The government embarked on the liberalization of the money and foreign

exchange markets. Major policy reforms were the introduction of a market-based system of issuing government securities in 1993 and the establishment of the stock exchange in 1994. Participation on both bonds and stock markets was fully open to both local residents and foreigners (Mwenda, 1996).

Despite the lack of restrictions on the government securities market, there was little participation by foreign investors. This was mainly because of the previous severe macroeconomic imbalances. These increased risk. Furthermore, the financial sector is relatively underdeveloped. It was not until 2005 that there was a strong growth in foreign demand for the country's financial assets. This included government securities and equities. This happened in the light of the growth in the economy and the confidence that macroeconomic stability had brought to the economy (Ndulo et al, 2009). Consequently, there has been an increase in portfolio investment inflows into the economy. This has been especially so during the past few years. Inflows increased from a low average of US \$0.46 million to a high of US \$21.7 million per year for the period 1991 to 2000 and 2001 to 2010 respectively. Inflows increased to US \$813 million in 2012 (See table 1.0 below). However, portfolio inflows were characterized by volatility in the wake of the 2008 global financial crisis. The upsurge in the country's portfolio investment in 2012 to US \$813 million was attributed to Zambia's successful securing of the 10 year Eurobond worth US \$750 million. This event reflected high international investor confidence in Zambia and signaled the status of the country as a safe and preferred investment destination. Although, Zambia's share of portfolio inflows compared to emerging economies is small, it still poses serious challenges to policy makers in managing these inflows given the high risk of sudden reversals or stoppages.

It is clear that foreign capital inflows have increasingly become significant sources of investment in developing countries. This indicates the high degree to which developing countries have become integrated into the global economy. This has also exposed them to financial shocks. Undeniably, in some countries, foreign capital is displacing, rather than supporting, domestic capital as the main source of investment. Added to this problem are the low levels of private capital inflows to Zambia compared to other regions in the world. Further, the capital inflows to Zambia are more dominant in the mining sector. Given the volatility associated with capital inflows, it is hardly surprising to find that economic growth may also be highly volatile. Such volatility means that governments can hardly predict how much capital is available to them to plan a sustainable growth strategy. This is ironic, since many LDCs are outbidding themselves in attracting foreign capital.

1.3 Foreign Exchange Evolution in Zambia

Zambia has employed several obtainable exchange rate regimes, ranging from one extreme corner to the other. In 1964, Zambia implemented a fixed exchange rate regime with the British Pound as the nominal anchor (Mungule, 2004). In 1974, the US Dollar replaced the British Pound and served as an anchor until the initial fixed regime was abandoned in 1976. It is worth mentioning that before adopting the Zambian Kwacha as the official legal tender in 1968, the then currency, Zambian Pound, was fully convertible with the British Pound (Mwenda, 1996).

The use of the US Dollar as a nominal anchor was abandoned in favor of the IMF's Special Drawing Rights in 1983. In the same year, Zambia again switched to pegging to a basket of currencies with a monthly crawl of one percent. As economic turmoil continued, the crawl was temporarily raised by 1.5 percentage points until the third quarter of 1985.

A theatrical turn came in the fourth quarter of 1985 when a floating regime via an auction system was adopted. The Government embarked on a weekly auction of foreign currency with the aim that marginal market bids would guide the exchange rate. Noticeably, Zambia was slowly losing grip of its belief in the fixed exchange rate regime and was shifting to a flexible exchange rate system. The alternative explanation could be that authorities were merely embracing a commitment to a more liberal foreign exchange market having futilely experimented with fixity and intermediate regimes (Chikwanka, 2007).

In 1986, there was a slight modification to the auction system with the introduction of the Dutch Auction System. Under this system, successful bidders were permitted to exchange foreign currencies at their bid price as opposed to the marginal rate. However, this system did not last long as shortly after its introduction the economy experienced a critical shortage of hard currency. In response to the shortage, authorities suspended the auction system and introduced the official parity rate, pegged to a basket of currencies. The next step was another U-turn but this time there was a return to the fixed regime. The Kwacha was again pegged to the US Dollar though this peg was characterized by isolated devaluations in 1988 and 1989. Chikwanka (2007) linked this particular reversal in policy to political developments that led to food riots in one of the urban parts of the country, following sky rocketing food prices.

The developments, assuming they were indeed the cause, led to another system. The dual exchange rate system, comprising the official rate set at a lower value, and the managed float set at a higher value, were introduced. This system operated from the first quarter of 1990 until 1992

when it was abolished and the current flexible regime adopted. Since 1992 to date, Zambia has maintained a flexible exchange rate regime. Suffice to say that throughout this period, the broad trend was the depreciation of the Kwacha with an exception of the period between January 2005 and May 2006 when there was a significant, sudden and unexpected appreciation of the Kwacha from K4, 785 per US dollar to K3, 185 per US dollar (Weeks et al, 2007).

With the floatation of the kwacha, Zambia adopted a managed float exchange rate regime. This was aimed at resolving the foreign exchange catastrophe that had hit the country due to suspension of balance of payments support from donors, and the lagged effects of the 1992/93 drought. It was also aimed at improving the country's export competitiveness, and to dampen speculative attacks on the Kwacha. Prior to the floatation, devaluations had become more frequent and very predictable thereby making the whole system very unstable. The government also wanted to restore investor and donor confidence especially the IMF, the donor gatekeeper. Over and above, Fundanga (2006) has argued that the country's foreign reserves had dwindled to such low levels that it was difficult to do business with the rest of the world.

The current regime of exchange rate has exhibited highly volatile short-run dynamics around a slightly downward-sloping long-term trend (see figure 1) below, the risk for the economy is that the continued volatility in the foreign exchange markets and in the price of the Kwacha has begun to negatively affect investment levels in the "real sectors" of the economy. This is basically because exchange rate volatility creates uncertainty for private investors in terms of both the profitability and the cost of investment. Volatile exchange rates are associated with erratic swings in the relative profitability of investment in the traded and no-traded goods sectors (Serven, 2003). The cost of capital goods also becomes uncertain, because of high import content of investment. Exchange rate volatility also makes local banks unwilling to offer credit denominated in foreign currency. On the export side, exports that are invoiced in nonlocal currency are usually negatively affected by exchange rate volatility, since exporters have to absorb currency risk.

Figure 1: Exchange Rate (Kwacha per US dollar, monthly average) Fluctuation



Calculated using data from BOZ data base

1.4 Macroeconomic Trends and Performance

Since the late 1980s, the Zambian economy has been undergoing a reform programme with the support of the IMF, the World Bank and bilateral donors. The reforms were designed to bring about macroeconomic stability so as to boost real growth in the economy which had been declining previously. The reforms consisted of the liberalization of the domestic markets in goods and services, the liberalization of financial markets and the privatization of a dominant sector of state-owned companies. Exchange controls on the capital account were removed, tariffs reduced and quantitative restrictions on exports and imports were removed (Ndulo, 2006; 2).

Table 2 below depicts that the Zambian economy recorded significant positive developments following the implementation of various reforms from the early 1990s. This is reflected in positive real GDP growth since the early 2000s, low and falling inflation, a downward trend in lending interest rates, favorable external sector performance as well as relative stability in the exchange rate of the Kwacha. These developments can be attributed to a sharp increase in mineral export prices; a large recovery in mineral production and exports due to the privatization

of ZCCM and substantial new mining investment; a bumper maize crop harvest in 2005/6 and 2006/11; improved monetary and fiscal policy management and improved economic management, which in turn has enhanced investor confidence (EAZ, 2008).

The Zambian economy has continued to post strong growth in recent years, with real GDP growth averaging about 5.4% annually in the period 2000 to 2010 compared to 0.81% for the period 1990 to 2000. The Zambian economy grew by 7.6 percent in 2010, compared to 6.4 percent in 2009, and exceeded the target of 5 percent. In 2011, real GDP growth slumped to 6.8% but increased to 7.3% in 2012. The key contributors to the sustained increase in economic activity have been increased production in the mining, agricultural, forestry, fisheries and construction sectors and the transport, storage and communication sectors. Transport, storage and communications sector continued with its double digit growth at 13.7 per cent largely explained by growth in road, air and communications sub-sectors. The agricultural sector recorded a historical bumper maize harvest of over 2.8 million metric tonnes during the 2009/10 season and another 3.0 metric tonnes during the 2010/11 harvest season. This was supported by auspicious weather conditions and the Farmer Input Support programme. Performance of the mining sector increased following higher output ascending from increased capacity utilization at various mines and investments into operations at various mines. Metal mining was the main driver of this growth, with copper and cobalt output growing by 17.4% and 49.4% to 819,159.19 metric tonne and 8,781 metric tonne, respectively. Construction output was driven by increased public and commercial infrastructure projects around the country, as well as continued high demand for housing. This was supported by expansion in domestic production of cement (BOZ, CSO and ZDA, 2012).

In tandem with the favorable performance in economic growth, the country has succeeded in lowering inflation. Inflation has declined from an annual average of 46.3 percent in the period 1980-1990, 71.9 percent in 1990-2000 and slowed down to 16.5 percent in 2000-2010. On a year to year basis, inflation is still operating in the single digit threshold, for instance, 7.2 percent in 2011 and 6.6 percent in 2012 (see table 2) below. The decrease in inflation over the years can be attributed to prudent monetary policy and a relatively stable exchange rate. The increase in food supply, arising from the favorable crop harvest, has also been a key element in subduing inflationary pressures in light of high and increasing prices of petroleum products due to high international oil prices.

Table 2: Selected macroeconomic indicators: 1980–2012

Period	1980-90	1990-00	2000-10	2011	2012
Real GDP Growth (end-year %)	1.3	0.81	5.4	6.8	7.3
GDP per capita (end- year US \$)	441.5	368.8	719.5	1,442.50	1,475.50
Annual Inflation end- period (%)	46.3	71.9	16.49	7.2	6.6
Exchange Rate (Annual Average)	7.13	1,104.45	4,200	4,861	5,142

Source: Bank of Zambia and CSO Zambia

Since the liberalization of the foreign exchange market in 1992, the Kwacha lost 92 per cent of its external value with respect to the US dollar in nominal terms. However, the exchange rate has been relatively stable over the past years fluctuating between K1, 104.45 and K4, 200 per US dollar over the period 1990 to 2000 and 2000 to 2010 (see table 2) above. Annual exchange rate average for 2011 and 2012 stood at K4, 861 and K5, 142 per US dollar. The relative stability of exchange rate can be attributed to the rise in international copper prices, as well as capital movements, both private and public over the years. Though relative stable, the exchange rate has been exhibiting highly volatile short-run dynamics around a slightly downward-sloping long-term trend.

1.4.1 Investment Climate in Zambia

Since the inception of economic reforms in the early 1990s, the Zambian economy has embarked on rigorous policy and institutional reforms with the fundamental aim of making the country more attractive to private (both domestic and foreign) investment. Today, the country is one of the most open economies in the Sub-Saharan Africa with appropriate legislation to ensure among others:

“Firstly, investors freely invest in any sector of the economy and are entitled to various incentives as per the ZDA Act of 2006 and non-restricted participation by non-resident on the Lusaka Stock Exchange (Securities Act of 1993). Secondly, the right to private ownership of business enterprises coupled with adequate legal framework for trademark protection. Thirdly, property rights are respected where by no investment of any description can be expropriated

unless Parliament has passed an act relating to the compulsory acquisition of that property. Fourthly, efficient operations and development of capital markets through promoting the establishment of free market financial institutions: and Guarantee protection for foreign investment in cases of war, strife, disaster, other disturbances, or expropriation under an overseas private investment cooperation (OPIC)/Zambia agreement (June 1999) and the Multilateral Investment Guarantee Agency (MIGA)¹.”

Further, the Zambian economy’s macroeconomic fundamentals are strong as reflected in low and single digit inflation, broad-based economic growth averaging 6.4 per cent over the last five years, relatively stable exchange rate and growth supportive fiscal performance. This is supported by vast investment opportunities in most sectors with Government’s pro-private public investment in roads, electricity and other infrastructure. Transparency and good governance and fighting corruption have been one of Government’s top priorities (EAZ, 2008). The recent World Bank Doing Business report shows that Zambia has maintained its position among the top ten countries within Sub-Saharan Africa. However, despite the good enabling environment for foreign investment obtaining in Zambia, foreign investment inflows have remained elusive.

1.5 Problem Statement

The available studies suggest that exchange rate volatility impacts on the performance of private capital inflows in some way as it influences investment decisions. While there are a number of studies that focus on developed countries, there are relatively fewer or no studies on developing countries like Zambia. Most of the studies on developed countries have adopted a common view that exchange rate volatility has a negative effect on foreign private investment. Studies by Alaba (2003), Serven (2003), Biger (1979), Mowatt and Zulu (1999), Udoh and Egwaikhide (2008), and Nucci and Pozzolo (1999) have confirmed this finding. Their studies have found that exchange rate volatility causes uncertainty. This ultimately has a negative effect on foreign investment.

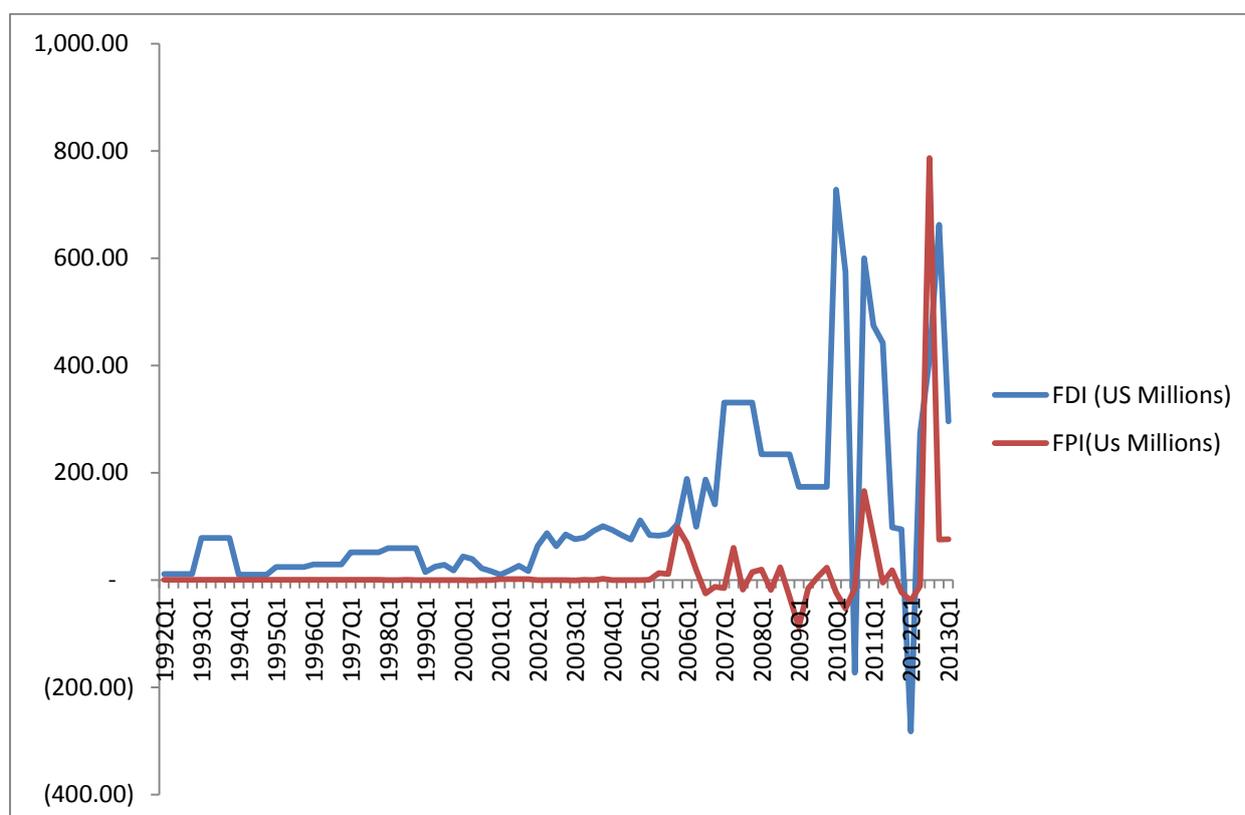
A compelling conclusion on the nature of the relationship between the exchange rate volatility and foreign investment cannot be drawn through a simple cursory overview of the data. Exchange rate volatility in developing countries, including Zambia, is higher than in developed countries. However, the data shows that foreign investment has showed an upward trend (refer to

¹ An extract from: ZDA, BOZ, CSO & PSD (2011). Foreign Private Investment and Investor Perception in Zambia.

table 1.0 above). But this does not clearly indicate if the volatility has hampered foreign investment growth.

Despite the volatility in the Kwacha exchange rate, foreign investment inflows to Zambia continued to reflect an upward trend. For instance private capital inflows to Zambia increased significantly from US \$79.2 million to US \$1,365.7 million between 2001 and 2007. It fell between 2008 and 2009. This drop was attributed to the global economic crunch (UNCTAD, 2011).

Figure 2: FDI and FPI inflows to Zambia, 1992 – 2013 (US\$ Millions)



Source: Own calculation using data from BOZ and IMF Database.

The pattern of private capital inflows in figure 2 above and that of exchange rate volatility in figure 1 does not allow one to make a conclusive judgment about the relationship between private capital inflows and exchange rate volatility in Zambia. Econometric analysis is necessary in order to make an empirical assessment. The puzzling relationship between exchange rate volatility and foreign investment growth is further compounded because there are fewer or no studies that focus on this subject for Zambia. Perhaps this is attributed to the unavailability of

sufficient time series data for analysis, which may be also a major reason for mixed conclusions among various studies regarding the relationship.

The debate on exchange rate volatility and foreign investment is gaining attention in emerging economies because the economies are characterized by high levels of exchange rate volatility compared to developed economies. A lack of clarity on the issue creates policy uncertainty, which creates some tension in society. For example, in Zambia, policymakers are being criticized by various stakeholders for not doing enough to stabilize the country's highly volatile currency. Trade unions and some analyst in Zambia, assert that a volatile currency affects profit margins and ultimately cause job losses (EAZ, 2008).

A lack of consistent empirical evidence on developing countries like Zambia on the topic of exchange rate volatility and foreign investment means the question of the relationship between the two variables remain unanswered. This is the case, particularly for some African countries and has been attributed to the non-availability and unreliability of statistics in the past (Arize, 2003). Therefore, there is still a need for further research using more recent data and econometric techniques to provide more clarity on the issue. With the help of the IMF 'General Data Dissemination System', most emerging economies have improved their data collection and the management of statistics over the past decade (IMF, 2008). This should help to alleviate the problem of insufficient data identified by Arize et al (2003) as a reason for limited research on developing countries.

This study distinguishes itself in several ways. First of all, the study examines the impact of exchange rate volatility on the overall level of private capital inflows to Zambia. Secondly, this study builds on previous studies and endeavors to fill the gap in the literature on the impact of exchange rate volatility on Private Capital Flows (PCF) by considering both foreign direct investment and portfolio investment.

1.6 General Objective

The main objective is to assess the effect of exchange rate volatility on private capital flows (i.e., foreign direct investment and foreign portfolio investment) in Zambia using monthly data for the period 1992 to 2012.

1.6.1 Specific Objectives

1. To evaluate the impact of exchange rate volatility on foreign direct investment

2. To evaluate the impact of exchange volatility on foreign portfolio investment
3. To identify the policy implications for the exchange rate- foreign investment nexus

1.6.2 Hypotheses

1. There is a significant negative effect of exchange rate volatility on foreign direct investment
2. There is a significant negative effect of exchange rate volatility on foreign portfolio investment

1.7 Significance of the Study

Foreign investment has been a very important resource inflow into Zambia and many other developing countries. In Zambia it has increased from 3.8% of GDP in 2000 to 5.6% of GDP in 2007. Further, considerable evidence from the East Asian countries shows that foreign investment can affect growth by complementing and facilitating domestic investment. It also creates new job opportunities (Ajayi, 2007). The country therefore needs substantial inflows of foreign investment in order to facilitate and enhance the growth process and poverty reduction. While this paper is not an attempt to resolve any policy issues surrounding foreign investment, it is a contribution to those seemingly inexhaustive debates, and will certainly be among the few that have looked at private foreign investment in Zambia, especially as it relates to monetary anchor.

Secondly, there are very few studies on private capital flows to Zambia. Most of the studies done focused only on the FDI component of private capital flows. Little or no attention is given to foreign portfolio investment (defined as investment in bonds and stocks used by governments and corporations (Dodd, 2004)) to Zambia perhaps because foreign portfolio flows are recent development in the country's financial history.

The findings of this paper might be useful to government planners and policy makers; in that they will be able to provide and thus create awareness on whether or not foreign private investment should be seen as a panacea for economic growth in Zambia. Further, the study will appeal to government that country competitiveness is not only improved by implementing economic policies that bring forward growth and stability, but also by promoting changes that will strengthen democracy, law and order, and a coherent institutional framework that is in synch

with the dynamism of international trade, markets and practices (Lejour, 2007). By coherent policies and institutional framework, there are many instances in which governments have to work and amplify their efforts. Areas such as political transparency, low corruption, applicability of legislation to business decisions and protection of rights, will create trust in the investor, thereby increasing the chances of attracting foreign private investment. Furthermore, it is also expected that the findings of this paper will motivate further studies into the phenomenon.

Additionally, the findings might help raise international awareness to bilateral and multilateral agencies and make the donor community know real economic situation in Zambia with regards to investment opportunities available. This will enable would be donors and investors to channel their financial resources into rightful developmental projects rather than donating fiscal cash assistance which often stand the risk of being swindled or embezzled into private bank accounts. This will go a long way to drive Zambians out of the doldrums and to improve on their living standards.

Finally, the regulator will find the study useful especially in regulating the transacting of securities, currencies and derivatives. From the Capital Markets point of view, several markets will need a global focus – stock exchange, money market, bonds, derivatives and foreign exchange. What is clear, though, is that countries have to provide policies that facilitate free capital movement. For an investor, the possibilities of equity capital and dividend repatriation are important when deciding on the appropriate jurisdiction to do the investment (Musau, 2009; 6).

1.8 Limitations of the Study

This study specifically centered on private foreign capital and limits itself only to exchange rate volatility and gross domestic product as sole determinants of foreign investment inflows to Zambia. There might be many other factors such as interest rates, infrastructure, the quality of human capital, technology, government expenditure, domestic savings and various socio-economic factors which can influence private capital inflows in the host country. Alfaro (2002) found that the benefit of FDI is sector dependent. This research paper will analyze national data; thus any sector contribution will not be detected. The size of our data set in this study is limited to the period between 1992 and 2012, while a larger number of observations may be desirable, FDI and FPI data before 1992 shows an inconsistent trend or sometimes not available and thus may prove difficult to work with. As for data on portfolio investment, the most reliable ones are from 1995 to 2012 while between 1992 and 1994; the data is not available. I thus extrapolated the missing yearly indices for 1992-1994 using a special formula well elaborated in appendix A.

While monthly data on exchange rate was readily available, I found no monthly data on foreign direct investment, foreign portfolio investment and gross domestic product. Instead, I obtained the monthly average indices by dividing the annual data by twelve months. This was done on the assumption that data on foreign direct investment, portfolio investment and gross domestic product were the same throughout in each month of the individual years, but varies on a year to year basis. The reason attributed to this assumption is that there is lack of monthly data on these variables and that the series do not vary much on monthly basis, instead significant changes are observed on yearly basis. Avery (1979) further argues in favor of monthly data to quarterly and annual data because it reduces impact of feedback from target variables to policy variables and also allows empirical tests of the presence of feedback within a quarter. Since the indices of FDI, FPI and GDP are produced on yearly basis to a larger extent and quarterly to a lesser extent, the extrapolated monthly observations may have an effect on our results.

1.9 Organisation of the Study

The plan of the dissertation is as follows: Chapter 2 presents literature survey of both theory and empirical evidence. Chapter 3 outlines the methodology used, particularly we present the empirical model, describe the dataset, present the econometric estimation and show the stationarity tests conducted. Chapter 4 presents the empirical research findings and analysis. In chapter 5, we present the conclusion and policy implications of empirical findings and suggestions for further research.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter reviews the relevant literature on the impact of exchange rate volatility on foreign investment. Thus, we have reviewed both the theoretical and empirical literature on the effect of exchange rate volatility on foreign investment. Previous research on exchange rate volatility has emphasized its importance as a major determinant of private capital inflows. Although exchange rate volatility and capital inflows have been theoretically and empirically studied by several authors, the nature of the linkages between exchange rate volatility and foreign private investment are uncertain (Coleman et al, 2008).

2.1 Theoretical Literature Review

Several theories and models have been developed to explain the determinants of private capital flows: Among these are the push factor and pull factor theories and neoclassical theory.

2.1.2 The Push Factor and Pull factor Theories

The direction of private capital flows is explained by two classes of theories namely push factor and pull factor theories (Calvo, 1993; Chuhan, 1998; Hernandez and Rudolph, 1994; Taylor and Sarnio, 1997; Montiel and Rudolph, 2001; Haynes, 1988; Ul-Haque, 1997). Primarily, the surge in private capital flows was thought to be a function of domestic developments such as prudent macroeconomic policies and strong economic performance. However, it became clear that cyclical movements in global factors such as exchange rates and interest rates were the driving force behind international capital mobility (Calvo *et al.*1996).

Thus, **push factor theories** attribute direction of capital flows to what happen on the international front such as falling international interest rates, business cycles in industrial countries and the rising trend toward international diversification (Calvo *et al.*, 1996); Calvo and Reinhart, 1998). Indeed, one of the most accepted paradigms in international finance is the relationship between capital movements and interest rate differentials (Haynes, 1988).

Pull factor theories, on the other hand, trace the causes of capital flows to such domestic factors as autonomous increases in the domestic money demand function, increases in the domestic productivity of capital (Ul-Haque *et al.*, 1997) increasing integration of domestic capital markets with global capital markets (Agenor and Montiel, 1999), improvement in external creditor

relations, adoption of sound fiscal and monetary policies and neighborhood externalities (Calvo *et al.*, 1996).

The fundamental postulations on determinants of capital flows are established on the following models which take into account both push and pull factors: Return and Creditworthiness Model (RCM) by Fernandez-Arias and Montiel (1996), International Capital Assets Pricing Model (ICAPM) by Bohn and Tesar (1996), Money Demand and Productivity (MDP) Framework by Ul-Haque *et al.* (1997) and Portfolio Allocation Model (PAM) by Fedderke (2002).

The Return and Creditworthiness Model (RCM) splits factors influencing capital flows into domestic and global factors. Domestic factors are mainly two: a project level expected return which is a function of net flows and creditworthiness of the recipient country which is determined by end-of-period stock of liabilities. The product of these two factors gives total expected returns. From a zero-arbitrage condition where total expected returns are equated to the opportunity costs of asset holdings, the RCM postulates that long- and short-run changes in equilibrium capital flows are due to the initial stocks of liabilities, changes in pull factors such as domestic economic environment and push factors such as external financial conditions (Fernandez-Arias and Montiel, 1996).

The International Capital Asset Pricing Model (ICAPM) by Bohn and Tesar (1996) explains the determinants of capital flows from the perceptions of portfolio rebalancing effect and return-chasing motive. It assumes that an investor purchases market indexes of domestic and foreign equities. Net purchases of an asset are given by the changes in investor's desired portfolio and portfolio rebalancing effect. Thus, according to the ICAPM, capital flows reflect what is required to maintain constant portfolio weights (portfolio rebalancing effect) and the extent to which investors adjust portfolio weights as the portfolio is re-optimized overtime (return-chasing effect).

The Money Demand and Productivity (MDP) framework principally traces the causes of capital flows to changes in money demand function, productivity of domestic capital and external factors such as international interest rates. In this framework, an upward shift of the money demand function and increases in productivity of domestic capital will generate capital inflows, *ceteris paribus* and vice versa. These pull factors usually result in sustained capital flows. Falling international interest rates, other things equal, will discourage inflow of capital while rising rates will cause outflows. Flows associated with this push factor are usually temporary (Ul-Haque *et al.* (1997).

Portfolio Allocation Model (PAM) states that capital flows are compelled by two classes of determinants namely rates of return and risk factors, with positive responses to rates of return and negative responses to risk. The PAM is a dynamic optimization model in which the individual seeks to maximize the present value of his utility derived from expected return on a portfolio of capital assets. Solution to the PAM using calculus of variations approach indicates that equilibrium capital flows are driven by three components namely initial divergence effect, impetus effect and time path effect. The initial divergence effect is given as the ratio of initial divergences between the starting levels of capital stock (foreign and domestic) and the inter-temporal equilibrium holdings of foreign assets and domestic assets respectively. The stronger the divergence between where agents find themselves in their initial asset holdings and where they would wish to be in inter-temporal equilibrium the stronger the flow of funds toward that particular destination-domestic or foreign. Thus, the stronger the divergence is in foreign asset holdings the greater will be capital outflows. Similarly, the wider the divergence is in domestic asset holdings the greater will be capital inflows. The impetus effect depends crucially on the strength of the social rate of time discounting, marginal rate of return, marginal costs of adjustment and expropriation risk factors which are due to harsh domestic macroeconomic and policy environment. It serves to either enhance or dampen the divergence effect. The time path effect characterizes the optimal mix of flows of funds to foreign and domestic assets as they approach their inter-temporal equilibrium values. It also reinforces either positively or negatively the first-two effects (Fedderke, 2002).

While this survey discusses the explanatory power of the prevailing “push and pull” framework, which differentiates between external and domestic factors driving capital flows to emerging markets. The push-pull dichotomy provides a simply and intuitive classification of capital flows drivers, but it certainly has its limitations. Bonizzi (2013), for example argues that contagion effects and other forces that are the product of investor behavior are difficult to classify as being either country-specific or external in nature. In addition, some studies have challenged the push-pull framework by asserting that rather than looking at emerging and advanced economy developments separately, the focus should be on differentials between the two regions variables (such as interest rate differentials and growth differentials; see, for example, Ahmed and Zlate 2013). A comprehensive review of the literature suggests otherwise, however. Most empirical research concludes that emerging and advanced economy effects on capital inflows to emerging economies differ in magnitude and statistical significance, and sometimes even work in the same direction (as in the case of real GDP growth in advanced economies, for which there is some

evidence that faster growth tends to support certain types of capital inflows to emerging economies). Therefore, it would be misleading to focus on differentials between emerging and advanced economy variables.

According to Bonizzi (2013), while the literature are able to account empirically and theoretically for the existing patterns of capital flows, some limitations remain and must be overcome to fully understand them. Firstly, the literature tends to over-aggregate different kinds of investors. In a world where private agents make many decisions of international investments it is vital to understand which sector in the economy is driving capital flows. Moreover it is key to understand the precise nature of the investor driving such flows (e.g. banks, pension fund, and sovereign-wealth funds). Besides, literature is in any case a-historical and does not take into account the evolution of “investors” through historical time and space. Secondly Bonizzi (2013) contends that the process of portfolio choice is restricted within the standard boundaries of a return/risk optimization. While undeniably the risk/return tradeoff plays a major role, different kind of investors may have additional goals and constraint driving their portfolio choice. The role of risk-appetite that some authors have underscored is one of such motives. There are, however, other more structural aspects that refer to the fundamentally asymmetric nature of the global financial system that the literature tends to ignore.

Additionally, it has been argued that push-pull factor theories assume that the determinants of each component of capital flows are the same and fail to distinguish their degree of sensitivity to risk. However, Kim (2013) found that the determinants of each component of capital flows differ depending on the types of capital and economic environment of the domestic and foreign countries. Specifically, his results indicate that a greater number of factors (exchange rate volatility, stock market index and world interest rate) affect portfolio investment than foreign direct investment flows to Korea. Further, according Koepke (2015), available evidence shows that cyclical push factors like global risk aversion and developed economy interest rates are generally most important for portfolio equity and debt flows. Instead, FDI is found to be driven by country-specific factors like real GDP growth, as well as a number of factors that are specific to FDI flows, such as the tax treatment in the home and host country, the degree of trade protection, and the strength of bilateral trade relations. Largely, whether push or pull factors are more important in driving capital flows thus depends not only on the types of capital flows considered, but also on the time period, among other factors. A further caveat is that push and pull factors are interrelated.

Push factors are found to matter most for portfolio flows, somewhat less for banking flows and least for FDI. Specifically, there is evidence that increases in global risk aversion have a strong adverse effect on portfolio and banking flows, but not on FDI. In addition, there is strong evidence that lower interest rates in developed economies push portfolio capital to emerging markets, especially into the bond market. There is also some evidence for such an effect for banking flows, while results for FDI flows are mixed. Pull factors are found to matter for all three components, but most for banking flows. Domestic output growth is the determinant that is most consistently found to show a strong and statistically robust relationship with the four types of capital flows. Greater country risk also appears to reduce all types of capital flows considered, although the evidence is not as robust and there are some exceptions for those country risk measures that indicate increased financing needs, such as a widening current account deficit. Local asset returns seem to attract banking flows the most, followed by portfolio investment, while the evidence is mixed for FDI (Koepke, 2015: p.4-5).

Further, theoretically the push-pull framework is premised under the notions that capital flows move from advanced to emerging economies; capital flows increases the GDP growth of specific countries; capital always flows to the most efficient investment place and that foreign direct investments lead to technological spill-over from which countries might benefit. Reality, however, looks differently: capital flows are largely moving in the opposite direction, the developed countries, especially to the US; most empirical examinations show no clear relationship between capital flows and GDP growth; a surge in capital inflows might lead to economic shocks; a “home bias” exists which leads to less investment in foreign countries and depending on the type of FDI, mostly foreign expertise is used, preventing spill-over effects (Block and Forbes, 2004; Kose et al, 2006 and Moghadam, 2011) .

Furthermore, it has been argued that the push-pull factor theories help explain capital flows as an international diversification of portfolios which is a way of reducing the firm’s risk (Hymer, 1976). As such the push-pull factor theories are portfolio theories that only explain differences in rate of return between countries as a determinant of portfolio investment, but not FDI. Caves (1996) argued that international differences in expected returns are not sufficient to induce FDI. Therefore, FDI flows are driven largely by long-term considerations about the real economy and less subject to short-term financial fluctuations (Addison and Heshmati 2003). Dunning (1988) argues that portfolio theories can only partially explain FDI in that it ignores that “FDI does not involve changes in ownership. It does, however, involve the transmission of factor inputs other

than money capital, viz. entrepreneurship, technology, and management expertise, and is likely to be affected by the relative profitability of the use of these resources in different countries than that of money capital". Furthermore, Multi-National Enterprises are not necessarily profits maximizers. Even if they are, there is no reason why they should forcibly seek higher profits on FDI than on domestic investment (Agrawal, 1980: p. 743). Overall, though there are clearly limitations to the push-pull framework, it still offers a very helpful analytical perspective.

2.1.3 Neoclassical Theory

According to early neoclassical theories, foreign capital flows are influenced by the highest expected return on investment. Cockcroft and Riddell (1991) stressed that future capital flows are directly influenced by incentives such as expected rate of return; security of investment, tax regimes, investment code or guidelines, and the macroeconomic stability especially with regards to exchange rate and inflation. This is because volatility in macroeconomic variables creates uncertainty for private investment in terms of both the profitability and the cost of investment. Cockcroft and Riddell (1991) recommend that addressing problems that pose as danger to foreign capital inflows would help improve the foreign investment climate. Meier (1995) further argues that the major determinant of foreign capital inflows to developing countries is the expectation of higher returns or higher profits by firms. Developed countries will tend to invest in less developed economies that have growth potential with higher rate of return and a stable macroeconomic base. Though, explanations in terms of differences in rates of returns between countries help to explain portfolio investments, they fail to explain foreign direct investment. Neoclassical theory failed to explain the existence of Multi-National Corporations (Hymer, 1976).

Overall, going by the pull-push factor theories and neoclassical discussions above, it can be deduced that for capital flows there is not a unified theoretical explanation, and it seems at this point very unlikely that such a unified theory will emerge.

2.2 Empirical Review

The impact of exchange rate volatility on private foreign capital inflows has been assessed through the crowding-in or crowding-out mechanism. Existing evidence shows mixed findings on the impact of exchange rate on private foreign capital inflows According to prior literatures,

exchange rate risk generates positive, negative, and ambiguous impacts on foreign investment. Some important findings are discussed below.

2.2.1 Exchange Rate and Private Foreign Investment

The mechanisms through which the exchange rate affect foreign capital flows have been examined in several theoretical and empirical studies. The general conclusion of these studies is that devaluation in the recipient country's currency stimulates inflows of foreign capital, and conversely, an appreciation leads to a reduction. Most importantly, the literature identifies two main channels through which exchange rates impact foreign capital flows: wealth effect and relative production costs (Froot and Stein, 1991; Klein and Rosengren, 1994; Blonigen, 1997). Devaluation in the currency of a country receiving foreign capital leads to a reduction in local production costs in terms of foreign currency, raising the profits of export-oriented foreign investors accordingly. This suggests that higher returns naturally attract more foreign capital inflows. The wealth effect, which is the wealth of foreign investors relative to domestic investors, also rises following devaluation because all production inputs become cheaper for the foreign investor whose capital is in a foreign currency, and encourages the acquisition of more domestic assets.

In the study of Biger (1979), it is revealed that from international viewpoint, the overall rate of return from holding foreign financial assets consists of investment return (dividends and capital gains) on the assets plus gains and losses from the movements in exchange rate during the holding period. The fluctuation of exchange rate is additional source of uncertainty that may generate both potential gains and losses to investors across countries. Besides, his work reveals that the movements in exchange rate drastically increase foreign investment risk in holding bonds and stocks; nevertheless, the impact of exchange rate movements on international investment risk for bonds is significantly greater than for stocks due mainly to the reason that stocks are more volatile when compared with bonds. However, Bailey and Tavlas (1991) found no harmful effect of increase in exchange rate variability upon FDI under managed float rate system but Kogut and Chang (1996) observed the movement in exchange rate as a key determinant of foreign direct investment by electronic firms of Japan to U.S. Firoozi (1997) documented the existence of relationship between volatility in exchange rate and FDI. XING (2006) concluded that the real rate of exchange between two currencies is a significant variable to determine FDI of Japan in China and devaluation of Chinese currency positively affects the inward FDI from Japan during the sample period. Jeon and Rhee (2008) documented the

existence of significant relationship between FDI inflow and real rate of exchange as well as expected exchange rate changes in Korea.

Mowatt and Zulu (1999) in a study of the South African investment in the Southern and Eastern African region, identified exchange rate as one of the major barriers to FDI in Zimbabwe, Botswana and Mozambique. Similarly, in a survey of the southern African countries, Jenkins and Thomas (2002) found that about 25 per cent of the total firms surveyed identified exchange rate risk as an important determinant of FDI in the sub-region. However, these studies did not analyze the relationship and the extent to which exchange rate volatility constrains FDI in these countries

Pami and Partha (2004) used quarterly data from India for the period from 1993 to 2004 and the Johansen Maximum Likelihood and Granger causality analysis to test for the link between capital inflow and the real exchange rate. The purpose of their study was to investigate how exchange rate impact foreign capital inflow. The results revealed that capital inflow such as portfolio and foreign direct investment are significant and positively correlated with exchange rate. They also found that increase in either foreign direct investment or equity inflows have a positive effect on the Indian currency exchange rate. However, we feel the use of a less robust measure of volatility (moving standard deviation) adopted by the researchers and focusing only on few observations, forty-four (44), could have posed a compromise on the results.

Omankhanle (2011), using the ordinary least squares estimation technique and time series data, examined the effects of exchange rate and inflation on foreign direct investment in Nigeria for the period 1980-2009. The findings of the study show that whereas inflation rate did not have major effect on the inflow of FDI into the Nigerian economy, exchange rate had great positive effect on the inflow of FDI into the Nigerian economy within the same period of analysis (1980-2009). The negative and non-significant impact of inflation on FDI was in conformity to the economic a priori expectation of negative impact of inflation on FDI. The policy implication from this research suggests that the nation's monetary authorities should develop and implement measures that will ensure that both inflation and exchange rates are sustained at levels that will ensure increasing level of inflow of FDI. However, we feel the results and estimates of the study could be biased as a result of structural breaks from two exchange rate regimes for the period under review. Secondly, the use of Ordinary Least Squares in estimating the effect of exchange rate on FDI suggests that results could have been compromised due to the fact that the OLS

method is too basic, performs badly with outlier data points in the dataset and leads to poor predictions when there is dependence among variables.

2.2.2 Exchange Rate Volatility and Private Foreign Investment

Solnik (1996) studies the link between exchange rate variation and risk as well as return on foreign investment covering the period 1971 to 1994 and concludes that the contribution of exchange rate variation to the aggregate investment risk is rather small whether investment in a single stock market index or investment in an internationally diversified portfolio of stock market indices. In case of the contribution of currency variation to return on investment, his results further show that exchange rate variation is the major source of investment return in short time. For long periods of time, capital gains or investment income is the determinant of return on a diversified portfolio simply because an appreciation of one currency is generally offset by a depreciation of another. The paper of Nucci and Pozzolo (1999) finds out that an increase in exchange rate variation brings about additional source of uncertainty and risk for multinational companies through profitability as well as international trade channel. The risk exposure of international firms' operation might be due to adjustment in revenue, cost of inputs, and competitive positions of firms. This, consequently, implies that exchange rate volatility is one of the most important sources of companies' risk.

The study of Campa and Goldberg (1999) examined the effects of real exchange rate volatility on manufacturing industries in the U. S., Japan, the United Kingdom and Canada from 1970 to 1993. The key goal of their study was to investigate the impact of exchange rate volatility on sectoral investment. Part of their findings suggests that across nations, the effects of exchange rates on investment in low-markup¹ industries in the United States, Japan and the United Kingdom are significant. That is, low-markup industries have higher sensitivity than high-markup industries. Furthermore, in high-markup sectors, exchange rates have weak or insignificant impacts on investment. Another important conclusion from their research is that volatile exchange rates can contribute to the fluctuations of investment by U.S. manufacturing industries.

An attempt was made by Bleaney and Greenaway (2001) to examine the impact of the level and volatility of real effective exchange rate on investment and growth for fourteen SSA countries. The study found that exchange rate volatility has a strong negative effect on investment. However, the focus of the study was on total investment, not FDI.

A study by Alaba (2003) is one of the very few studies that have attempted to bridge the gap on the exchange rate volatility-FDI nexus for SSA countries. The study aimed at determining the magnitude and direction of the effects of exchange rate movement and its volatility on FDI flows to agriculture and manufacturing sectors in Nigeria. Employing the GARCH measure of volatility, the error correction methodology was used for the empirical investigation in testing the effects of both the official and parallel market exchange rates on FDI flows to agriculture and manufacturing. While the results show that the official market exchange rate movement significantly reduces FDI inflows to agriculture, the same is, however, insignificant for the manufacturing FDI. For the volatility coefficients, official market exchange rate volatility was not found to be significant for FDI inflows to both manufacturing and agriculture. Conversely, the estimated parallel market exchange rate coefficients suggest that both systematic movement of the exchange rate and its volatility are significant for flow of FDI to both agriculture and manufacturing in Nigeria with the parallel market rates, yielding both negative and positive signs for exchange rate volatility in the two sectors. The emerging conclusion was that while exchange rate volatility attracted investment in agriculture, it rather deterred FDI in the manufacturing sector, thus suggesting ambiguity on the effects of exchange rate movements and its volatility on FDI inflows.

By using GARCH model of volatility, Serven (2003) found that exchange rate volatility negatively affects investment in developing countries. Serven (2003) further revealed that exchange rate volatility creates uncertain climate for foreign investors by making profit and cost of investment activities harder to predict. Besides, it is summarized that the impact of exchange rate volatility on investment depends on the degree of economy openness and financial system. Higher openness and weaker financial development negatively relates to uncertainty in investment, while stronger financial system and low openness holds the opposite direction. Apart from that, Muller and Verschoor (2009) recently discovers that exchange rate environment plays an increasingly prominent role in changes in relative values of domestic and foreign assets and liabilities, this then results in changes in the level of international portfolio investment flows.

Coleman and Tettey (2008) studied the exchange rate volatility and foreign direct investment link for the sub Saharan African region taking into consideration a small and developing economy of Ghana. This empirical analysis employed Auto Regressive Conditional Heteroscedasticity (ARCH) and GARCH models to find the exchange rate volatility over the time period ranging over 1970 to 2002. Advanced and robust econometric methodologies of

ECM and cointegration were applied to find the outcomes of empirical analysis. Major outcomes and results of the study included that the process of liberalization adopted by Ghana has not been effective to attract the FDI inflow in the country. In addition, it also found a negative impact of volatility of exchange rate on inward flow of FDI (Kyereboah-Coleman and Tettey, 2008). Despite the study using a more robust model in capturing volatility, the GARCH model, we feel the use of the Engel-Granger model to estimate the effect of exchange rate volatility on FDI could have had some shortcomings, thus making the results unreliable. The Engel-Granger model identifies only a single cointegrating relation among what might be many such relations. However, in testing cointegration in a multivariate system, there might exist more than one cointegrating relationship (Muscatelli et al, 1992). Further, the two-step estimation Engel-Granger model is based on the principle that, irrespective of which variable is chosen for normalization, the same results will be attained if variables are interchanged. In practice, it is possible to find that one regression indicates that the variables are cointegrated, whereas reversing the order indicates no cointegration (Ssekuma, 2011). Hence, our study seeks to not only offer more robust estimates using the Johansen's procedure, but by also having a sufficiently large number of observations. This is our major contribution to the empirics of exchange rate volatility on Zambian foreign investment performance.

A research by Ogunleye (2009) examined the relationship between exchange rate volatility and foreign direct investment in Sub-Saharan Africa region with particular focus on Nigeria and South Africa. Using a time series data set, the study applied the GARCH model to capture exchange rate volatility and the two-stage least square (2SLS) to estimate the impact of exchange rate volatility on FDI. This investigation reveals that there was endogeneity between exchange rate volatility and FDI inflows in both countries, hence the use of the two-stage least squares method. The major findings highlighted that exchange rate volatility has detrimental impacts on FDI inflows, with FDI inflows aggravating exchange rate volatility in both countries. The sources of exchange rate volatility were identified as inflation and nominal foreign reserves shocks in both countries. The study recommends that exchange rate and FDI policy coordination, with a view to minimizing the detrimental impact of exchange rate volatility and FDI on each other is, thus a challenge that fiscal and monetary authorities must address. While the two-stage least square method eliminates the problem of endogeneity between the dependent variable and explanatory variables, it is said to be biased in small samples and sometimes inconsistent in large samples when the instrumental variable(s) have a relatively low correlation with the endogenous variable (Wooldridge, 2008). Further, the use of annual data might have resulted in inadequate

capture of volatility in exchange rate as the data frequency has an implication on the robustness of the results obtained (Moono, 2010).

Ellahi (2011) conducted an empirical analysis to find the link between volatility in exchange rate and inflow of foreign direct investment for Pakistan over the time period 1980 to 2010. Using a number of support variables (such as real gross domestic product (GDP), capital account balance, trade openness and real exchange rate) along with the volatility in exchange rate, this study applied modern and robust technique, the ARDL methodology to find the short-run as well as the long-run estimates. The outcomes in general were summarized as the overall estimation results were consistent with theoretical predictions. Major findings of this study included that exchange rate volatility has negative impact on FDI inflow in short run while this impact is positive in the long run. It was also found that an adjustment and liberalization programme has favorable outcomes in the short run for Pakistan. Despite this study applying the most robust technique of ARDL in finding the short run and long run estimates, we feel volatility was not adequately captured with the use of the unconditional moving standard deviation. Hence, the risk of exchange rate volatility on FDI in Pakistan could have been under-estimated. To avoid the risk of under-estimating exchange volatility, our study seeks to use a more robust GARCH model to capture the exchange rate volatility. This has been pronounced to be a superior measure of volatility in the international finance literature (Crowley and Lee, 2003).

The research paper by Wang (2012) using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model and Autoregressive Distributed Lag framework (ARDL) for cointegration and Error Correction Model (ECM) attempted to explore the impact of exchange rate volatility on foreign direct investment in BRICs countries. The sample data was selected over the period of 1994-2012 for both exchange rate volatility and foreign direct investment for all countries. The results indicate a negative long-run relationship between exchange rate volatility and foreign direct investment for India and Russia. The existence of a short-run association was found in China, India, and Russia. However, no evidence of the existence of either long-term or short-term relationship was observed for Brazil. However, with only nineteen (19) observations aggregated at yearly intervals and using unconditional volatility such as moving standard deviation, we feel that this paper has some shortcomings. Hence, our study seeks not only to employ a more robust GARCH model in capturing volatility in exchange rate, but by also having a sufficiently large number of observations, 252, on which to base our estimations.

More recently, Ullah et al (2012) using time series data for a period between 1980 and 2010, analyses the impact of exchange rate volatility on foreign direct investment in Pakistan. The study utilized a robust GARCH model as a measure of exchange rate volatility and the Johansen Cointegration and Granger causality tests to estimate its impact of FDI. While the results reveal that FDI is positively associated with Rupee depreciation and exchange rate, exchange rate volatility is found to deter FDI inflows to Pakistan. Further Granger Causality test reveal that exchange rate volatility granger causes FDI but not vice versa. The study recommends that movements in the exchange rate that leads to the loss of competitiveness should be avoided by proper planning and well regulated foreign exchange market and that economic liberalization with stable exchange rate should be promoted in order to bring fresh FDI by revising the exchange controls and developing modern financial markets. Though the volatility has negative impact on FDI, its effect was found to be small compared to the effect of exchange rate appreciation. With only thirty-one observations aggregated at yearly intervals, we feel that the effect of exchange rate volatility could be underestimated, as the data frequency has a bearing on the robustness of the volatility results obtained (Moono, 2010). Further, we feel that the data set could be constrained by structural breaks as the study does not control for exchange rate regime changes.

Unlike the exchange rate volatility-FDI relationship, the exchange rate volatility-FPI relationship has not enjoyed considerable empirical examination. Nonetheless, in a prominent study conducted by Han and Ray (2006), they developed an equilibrium framework in which exchange rate returns, equity returns and capital flows are jointly determined under incomplete foreign exchange risk trading. They also contend that currency order flows and portfolio flows are closely related within the portfolio rebalancing framework since they both reflect investors' behavior. Their study provides a theoretical framework for analyzing the implications of incomplete foreign exchange risk for the correlation structure of exchange rate fluctuations and equity returns as well as net portfolio flows; even though it does not include statistical tests for the impact of exchange rate uncertainty on portfolio flows internationally. The basic idea is that exchange rate volatility increases transaction costs and reduces potential gains from international diversification by making the acquisition of foreign securities such as bonds and equities more risky, which in turn affects portfolio flows across borders negatively (Caporale *et al.*, 2013). Certainly, Eun and Rasnick (1988) had previously revealed that exchange rate uncertainty is non-diversifiable and pose a lethal impact on the performance of international portfolios. This finding is also consistent with the empirical evidence presented in the study by Carrieri and Basma

(2006) who reports that in foreign investors' viewpoint, currency risk are taken into account as another source of non-diversifiable risk made foreign investment riskier relative to domestic investment. Hence, additional premium in forms of expected return is required in order to compensate for exchange rate risk when investing in international markets.

The literature focusing on Exchange rate volatility and foreign investment have has a serious short coming in using unconditional volatility such as moving standard deviation which is the basis for criticism of researches conducted on the topic in the 1990s rather than the more recent and pertinent conditionally adjusted measure of volatility

In summary, it can be seen that most studies that examined the link between exchange rate volatility and foreign investment found a negative relationship, some show positive and significant relationship, while some other studies documents no relationship. However, the nature of the effect of exchange rate on foreign capital inflows appears to depend on the nature and motive of the investment and the risk behavior of the investor. This brief literature review shows that the existence of a significant linkage between exchange rate volatility and foreign direct investment in both developed and developing countries are well established in the literature. However, there are very few studies that have attempted to interrogate whether there is any relationship between exchange rate and foreign portfolio investment based on SSA countries' experience and Zambia in particular.

Further it is apparently clear from the literature is some kind of general agreement both theoretically and empirically that exchange rate volatility leads to depressed foreign investment inflows. Particularly important to note is that most of the studies in this area have paid attention to FDI flows and little attention to portfolio investment. Further a variety of exchange rate volatility measures have been applied leading to different conclusions. However, the recent advancement in econometric modeling of time series data and studies that apply these techniques still agree with some earlier studies too on the ambiguous effects. Besides the methods, the type of data used also has an implication on what conclusions one arrives at. It's quite certain that using aggregated data may 'over-shadow' foreign investment specific effects. Further, the data frequency is also very important as this has an implication on the robustness of the results obtained.

This study seeks to bring to light the effects of the Kwacha exchange rate volatility on both FDI and FPI in Zambia using high frequency monthly level data. The methodological gap in research

particularly on developing countries needs to be filled, for both research development as well as effective policy advisory.

CHAPTER 3

METHODOLOGY AND THEORETICAL FRAMEWORK

3.0 Introduction

In this chapter, we outline the methodology followed by this study. We begin by considering the theoretical framework adopted and the empirical model used in the analysis of results. We then focus on the data and variables, and the econometric approach that employ the Johansen Maximum Likelihood model. We also analyze the GARCH model widely used to capture volatility in exchange rate.

3.1 Theoretical Framework

This study is inspired by the Return and Creditworthiness model. Thus, analyzing the effects of exchange rate volatility on foreign investment is modeled in the return and creditworthiness model also known as the portfolio balance framework.

3.2 Return and Creditworthiness Model (Portfolio Balance Framework)

The empirical model in this paper draws from the factors suggested by the theoretical model which is based on the fact that foreign investors exploit all the possibilities of arbitrage across the home and the host country. In addition to the factors proposed by the theoretical model, the empirical model will include additional variables that may influence financial flows.

The literature on the theoretical model of capital flows in portfolio balance framework predominantly includes the model developed by Fernandez- Arias and Montiel (1995) and extended by Taylor and Sarno (1997) and Mody, Taylor and Kim (2001). This model analyses the effect of domestic (pull) and global (push) factors on capital flows. Pull factors represent country specific investment risk and returns which attract foreign investment and push factors represent global liquidity and other factors that push investment towards emerging economies. The model splits the domestic factors into those that operate at country level and those that operate at asset or project level. Assuming that capital flows are represented by transactions in different types of assets $k = 1 \dots n$. The expected return by investing in an asset of type i in an emerging economy encompasses two elements. First is the expected return from the project (R_k^e) and the second is an adjustment factor for R_k^e depending on credit worthiness of the country (C_k^A).

The expected return from the project is a function of vector of net capital flows (F) going into each project and the domestic economy environment (D_e). The adjusting credit worthiness factor is a function of stock of capital ($K = K_{-1} + F$) and other factors reflecting credit worthiness of the emerging economy (C_w).

The stock of capital K is the vector of each of period stocks of liabilities which is the sum of initial stocks of liabilities and current net capital inflows. Now the foreign investor will consider the opportunity cost of assets of type K (OP_k). This is the return the foreign investor gets by investing in his own economy. OP_k is a function of the stock of capital ($K = K_{-1} + F$) and the financial and economic opportunities in the source country (OP). Note that D_e and C_w represent pull factors and (OP) represents push factors.

The arbitrage condition is thus given by

$$R_k^e(D_e, F) - C_k^A(C_w, K_{-1} + F) = OP_k(OP, K_{-1} + F) \dots\dots\dots (1)$$

Assume that R_k^e , C_k^A and OP_k are increasing functions of D_e , C_w and OP respectively. The above equation can be solved for equilibrium vector of net capital flows F^* which can be expressed as:

$$F^* = F^*(D_e, C_w, OP, K_{-1}) \dots\dots\dots (2)$$

This entails that foreign investment is a function of economic factors in the host country (D_e) and its creditworthiness (C_w) and also financial and economic opportunities (OP) in the source country. Thus, to capture the effect of economic factors in the host country (D_e) on foreign investment, variables such as exchange rate, domestic interest rate, inflation, domestic output growth, volatility in exchange rate, openness of the economy, domestic market structure and institutions, anticipated structural reform, macroeconomic policies and foreign investment policies are worth considering (Fernandez-Arias and Montiel, 1996). On the other hand, for the source country factors (OP), foreign interest rate, foreign output growth, macroeconomic policies and the well-being of foreign economies are also worth considering (Schadler, et al. 1993).

3.3 The Empirical Model and Estimation Procedure

The return and creditworthiness model categorizes the determinants of foreign investment into factors that affect returns from investment in the host country, factors that affect creditworthiness of the host country and factors that affect returns from investment in the home country.

Considering the objective of our study, an emphasis has been placed on the internal (domestic) determinants of foreign investment in the host country. Our choice of variables is largely informed by both theoretical and empirical literature.

To capture the effect of exchange rate volatility on foreign investment in Zambia, we construct a model for the determination of foreign investment location by a firm. A firm is assumed to maximize its profits given wages, exchange rate and its volatility for a potential host country with respect to the foreign investment source country. Under this framework, depreciation of the currency of the host country is likely to attract private capital inflows at least for the following two reasons. First, the currency depreciation reduces production costs in the host country, thereby making it attractive for foreign investment seeking production efficiency. Second, the currency depreciation lowers the value of assets in the host country in terms of other currencies, including the currency of the source country. Consequently, the cost of undertaking foreign investment declines in terms of foreign currency, making foreign investment in the depreciating country attractive. High volatility in the exchange rate is likely to discourage private capital inflows because it increases uncertainty in the business environment of the host country. In addition to these variables, we consider the size of the market (GDP) in the host country, which is frequently considered as a significant determinant of foreign investment location. The hypothesis which links market size to foreign investment stresses that foreign investment is feasible in those countries where market is large enough to accommodate and benefit through economies of scale. Developed countries attract the largest share of foreign investment as compared to developing countries due to their extensive markets. Theoretically studies have been conducted to find the linkage between market size and inflow of foreign investment. Studies that have used GDP as an indicator of market size, found that it has positive and significant impact on foreign investment inflow (Daniels and Quigley, 1980). Thus, arising from the empirical literature and theoretical framework above, the basic model for analysis is specified as follows:

$$FI = f(VXrate, \ln Xrate, GDP) \dots\dots\dots (3.1)$$

Where;

- FI = Foreign Investment
- VXrate = Volatility in exchange rate
- $\ln Xrate$ = Natural log of exchange rate

Foreign investment in this study takes two compositions, namely Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI). Thus, two models are specified in this study:

$$FDI = f(VXrate, \ln Xrate, GDP) \dots \dots \dots (3.2)$$

$$FPI = f(VXrate, \ln Xrate, GDP) \dots \dots \dots (3.3)$$

Equations (3.2) and (3.3) show that FDI and FPI are dependent on exchange rate volatility, exchange rate and gross domestic Product (size of the market) .The statistical forms of the models are thus:

$$FDI = \alpha_0 + \alpha_1 VXrate + \alpha_2 \ln Xrate + \alpha_3 GDP + e_t \dots \dots \dots (3.4)$$

$$FPI = \beta_0 + \beta_1 VXrate + \beta_2 \ln Xrate + \beta_3 GDP + e_t \dots \dots \dots (3.5)$$

Where:

α_0 = the intercept of the FDI equation

β_0 = the intercept of the FPI equation

α_1 to α_3 = the coefficients of the variables to be estimated in the FDI equation

β_1 to β_3 = the coefficients of the variables to be estimated in the FPI equation

e_t = the random variable or error term.

The a priori expectations are : $\alpha_1 < 0$, $\alpha_2 < 0$, $\alpha_3 > 0$, $\beta_1 < 0$, $\beta_2 < 0$ and $\beta_3 > 0$

3.4 Data and Variable Descriptions

Numerous research studies have used various kinds of data on the topic of exchange rate volatility and foreign investment. It is argued that to some extent, the kind of data that one uses may affect the probable outcomes of an investigation. Notably, the data frequency (that is, daily, monthly, quarterly or yearly) is vital particularly when considering modeling volatility.²

This study employed monthly time series data for the period 1992 to 2012. This period has been selected as it coincides with the introduction of a floating exchange rate regime and reflects the sustained economic reforms in Zambia. Added to this, is the unprecedented growth in the flow of

² Moono, H. (2010), Effects of Exchange Rate Volatility on Zambian Trade Performance. M.A Thesis, University of Sheffield, P. 11.

foreign private capital to Zambia in spite of the volatile exchange rate. The data used in this study was collected from various sources such as Bank of Zambia Annual reports and data base, Central Statistics Office Annual reports and data base, Ministry of Finance and National Planning, Zambia Development Agency, World Bank data base, International Monetary Fund data base and the United Nations Conference for Trade and Development. The data collected covered a wide range of macroeconomic variables that include exchange rate, gross domestic product, foreign portfolio investment and foreign direct investment. Below we explain each of the variables included:

a) Dependent Variables

- i. **Foreign Direct Investment (FDI):** This variable is calculated by taking FDI at current U.S. dollars prices. Foreign direct investment is net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. It includes the actual inward foreign investment which is considered as a key determinant for the developing countries to achieve economic development and growth through technological advancements. The size of this variable is a good indicator of the relative attractiveness of an economy to foreign investment.³
- ii. **Foreign Portfolio Investment (FPI):** This variable is also calculated by taking FPI at current U.S. dollars prices. According to UNCTAD (1999) portfolio investment involves transfer of financial assets by way of investment by resident individuals, enterprises and institutions in one country in securities of another country, either directly in the assets of the companies or indirectly through financial markets. The main aim of the investor is to benefit from capital gains or to reduce the risk of the portfolio that the investor holds by diversifying internationally.⁴

b) Explanatory Variables

- i. **Exchange rate (Xrate):** The nominal exchange rate here is defined as the amount of Zambian Kwacha per unit of United States Dollar. This variable is included in the model

³ International Monetary Fund, Balance of Payments Statistics Year Book and Data files

⁴ UNCTAD, (1999). Comprehensive Study of the Interrelationship between Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI)

to express the strength of a currency in attracting the inward foreign investment. This variable can be calculated by nominal exchange rate times the foreign price divided by the domestic prices. An important question is whether the volatility of the nominal or the real exchange rate is to be used. While real exchange rate has an advantage that it captures the true relative price of goods and services, it also captures variation in the price levels, which perhaps is not desirable. Many studies use both exchange rates and compare the results. The differences they find are usually very small.⁵

- ii. **Exchange rate volatility (VXrate):** This variable is measured as a variance of the nominal exchange rate and defined as a Generalized Autoregressive Conditional Heteroscedastic (GARCH 1, 1) to the nominal exchange rate.
- iii. **Gross Domestic Product (GDP):** This variable is calculated by taking GDP at current U.S. dollars prices. It measures the size of the home economy and it is included in order to control for the supply of foreign investment, as in Blonigen (1997). The assumption is that growth in the host country is likely to generate a greater supply of foreign investment.

3.5 Econometric Approach and Estimation Procedure

To test the effect of exchange rate volatility on private capital flows in Zambia, the study first captured the volatility in exchange rate using the GARCH (1, 1) model and then performed a unit root test to ascertain the stationary levels using the Augmented Dickey Fuller (ADF) test and the Phillip Perron test. For estimating the effect of volatility in exchange rate upon private foreign investment, regression analysis which employs the Johansen Maximum Likelihood framework for cointegration and the Error Correction technique was used. It was used for estimating the long run equations 3.4 and 3.5 specified above and the short run equations specified below in section 3.5.3c. The data was processed using an econometric software package called Stata version 11.2. The size, sign and significance of exchange rate volatility and private capital flows indicate the strength and direction of effects.

3.5.1 Modeling Exchange Rate Volatility

There are several measures of volatility that have been employed in literature. The two common measures of volatility are the standard deviation of a rate of change or a moving standard

⁵ A very profound comparison of the effects real and nominal exchange rate volatility on exports was conducted by Cotter & Bredin (2011) finding that magnitude and direction are not changing, while timing effects can be different.

deviation and different versions of the ARCH and GARCH techniques. The standard deviation measures how the individual values in a series deviate from the mean value and the degree of dispersion from its mean is taken as a measure of volatility. However, this measure is inappropriate in measuring exchange rate volatility (Froot and Stein, 1991) as it is characterized by skewness in distribution. Further, Engle (1982) has criticized different variants of standard deviation as a measure of exchange rate volatility in that they are unconditional measures that ignore the stochastic process generating the exchange rates and do not incorporate the phenomenon of clustering volatility. As such these naive measures capture fluctuations but not uncertainty. Furthermore, Pagan and Ullah (1988) have argued that the standard deviation method is arbitrary in choosing the order of the moving average and is noted for underestimating the effects of volatility on decisions.

To circumvent these apparent deficiencies associated with the standard deviation as a measure of volatility, the ARCH was introduced by Engle (1982) and later modified by Bollerslev (1986) as the Generalized Autoregressive Conditional Heteroscedasticity (GARCH). The GARCH models are deemed as superior measures of volatility mainly because (1) they incorporate the phenomenon of volatility clustering, implying that the time varying variance of the error term in ARCH is conditional on the past values of the series, (2) their appropriateness to capture volatility of the variables with large amounts (thousands) of observations, (3) their ability to distinguish between predictable and unpredictable elements in the exchange rate formation process, and are, therefore, not prone to overstating volatility and (4) their quality results and ability to comprehend the relationship between the exogenous variables and endogenous ones, by taking into account the autocorrelations and interaction effects that may exist within the data⁶ (Engle, 1982). However, the only criticism of the GARCH models is not the failure of the models themselves, but rather methodology error of incorrectly estimating volatility with low frequency data. Since GARCH models are more sensitive to the type of the frequency of the data used than others, and thus would perform poorly with low frequency data (Matei, 2009).

This study employs the Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH) model to capture the exchange rate volatility. The same approach has been used in different studies for measuring exchange rate volatility, for instance, Chipili (2006), Musonda (2008), Chowdhury and Wheeler (2008), Ogunleye (2009) Moono (2010) and Ullah et al (2012). It is

⁶ The quality factor measures preciseness by comparing the forecast with the real (historical) values.

believed that the GARCH model is robust and can be relied upon to generate good estimates of exchange rate volatility. The GARCH model is an extension of the ARCH model in which the variance is given by:

$$\delta_t^2 = \alpha_0 + \beta_1 \delta_{t-1}^2 + \beta_2 \delta_{t-2}^2 + \dots + \beta_k \varepsilon_{t-k}^2 + \alpha_1 \delta_{t-1}^2 + \alpha_2 \delta_{t-2}^2 + \dots + \alpha_m \delta_{t-m}^2 \dots \dots \dots (3.6)$$

Where δ_{t-1}^2 for $j=1, 2 \dots k$ is the GARCH term representing the last period forecast variance. GARCH (1, 1) is the simplest specification in this class, and is the most widely used specification. Thus, the GARCH (1, 1) model is given by:

$$\delta_t^2 = \alpha_0 + \beta_1 \delta_{t-1}^2 + \alpha_1 \varepsilon_{t-1}^2 \dots \dots \dots (3.7)$$

Where $\alpha \geq 0 \beta \geq 0$

The non-negativity restriction on the parameters is to ensure that the variance remains positive for all realizations of the Z_t process. This study employs equation 3.7 as the GARCH process to capture the exchange rate volatility. This involves explaining the exchange rate volatility by positing a structural relationship between volatility and its determinants. Equation 3.7 expresses the variance as a linear function of lagged squared disturbances and lagged variances. That is, volatility today depends upon the volatilities for the previous periods and upon the squared residual for the previous periods (Bollerslev, 1986).

3.5.2 Unit Root Analysis

Most macroeconomics time-series data appear to contain unit roots (that is, they are non-stationary). This implies that the mean and variance is a function of time and they tend to depart from any given value as time progresses (Stock and Watson, 1989). If the movements are predominantly in one direction (up or down), the series are said to exhibit a trend. Non-stationary (trended) time-series data may cause spurious regressions, uninterpretable student-t values and other statistics, goodness of fit measures which are ‘too high’ and, as a rule, make regression results rather difficult to evaluate. Therefore, need arises to make non-stationary time-series data stationary so as to get valid estimates of the regression. Some researchers have suggested a remedy, namely to difference a series successively until stationary is achieved.

I performed the Augmented Dickey Fuller (ADF) test to test the presence of unit roots and determine the order of integration. The ADF deals with serial correlation by requiring that lagged values of the dependent variable in the regression:

$$\Delta \ln X_t = \mu + (\alpha - 1) \ln X_{t-1} + \sum_{i=1}^n \gamma_i \Delta \ln X_{t-i} + \varepsilon_t \dots \dots \dots (3.8)$$

Where n is chosen to ensure that the residuals are white noise. The t-statistic on $(\alpha - 1)$ is used. The null hypothesis is that the series contain a unit root, $(\alpha - 1) = 0$ and the alternative hypothesis that the series does not contain a unit root. The hypothesis is tested using Augmented Dickey Fuller critical values.

3.5.3 Model Specification

This paper uses the Johansen Cointegration Method due to Johansen (1988) and Johansen and Juselius (1990) which examines the question of cointegration in the Vector Error Correction Model (VECM) to investigate the effects of exchange rate volatility upon FDI and FPI. The dependent variables in the model are FDI and FPI, and the independent variable is exchange rate volatility. Different studies have used this methodology, for example, Musonda (2008), Moono (2010) and Mphumuzi (2013). The analysis is based on the following regression equations:

$$\text{FDI} = f(\text{VXrate}, \ln \text{Xrate}, \text{GDP}) \text{ and } \text{FPI} = f(\text{VXrate}, \ln \text{Xrate}, \text{GDP})$$

3.5.3a Cointegration Analysis

Cointegration analysis is commonly used to test the existence of a long run stable relationship amongst variables. Pioneered by Engle and Granger (1987), cointegration in effect attempts to test whether, if variables are integrated of the same order, a linear combination of them will also either be integrated of the same order or lower order. The basic idea behind cointegration is that though macroeconomic variables may tend to move up and down over time, their linear combination may drift together (Dlamin, 2001). Therefore, though individually non-stationary, if they are integrated of the same order, a linear combination of these variables may be stationary. This stationarity attained in a linear combination of these is known as the cointegration equation. This basic cointegration analysis is attributed to Engle and Granger (1987).⁷ However, our study uses the Johansen Cointegration due Johansen (1988) and Johansen and Juselius (1990). The Johansen test is deemed more superior to the Engle-Granger test as it is said to provide better estimates and test statistics (Arize, 1995). Unlike the Engle and Granger, the Johansen and Juselius method permits testing for cointegration in a multivariate system where there might

⁷ Engle, R and Granger, C.W.J, (1987), "Cointegration and Error Correction: representation, estimation and testing", *Econometrica*, Vol 55, 251-276.

exist more than one cointegrating relationship and can be used for VECM accounting for short-run and long-run dynamics (Maddala, 1992).

Further, as the Johansen Maximum Likelihood method is a VAR based technique, less concern is needed over whether the explanatory variables are exogenous or endogenous. Restrictions can be applied to the cointegrating vectors, which is not possible with the Engle-Granger approach. It can also be used for ‘Granger Causality’ testing, where the lags in the error correction model can be jointly tested for significance, thereby determining any short-run causality from the explanatory variables to the dependent variable (Dhliwayo, 1996; Shirvan and Wilbratte 1997).

Furthermore, as Maximum Likelihood estimates (MLE) are invariant to normalization, there is no ambiguity and as such the model does not suffer from misspecification. Additionally, the Johansen methodology offers a unique way to find the number of cointegrating relationships and estimating these relationships. Unlike the Engle-Granger and other methods which tests for stationarity of the residuals to establish cointegration, the Johansen method rely on the relationship between the rank of the matrix and its characteristic roots (Hillier, 1990).

However there is a specific problem associated with this approach, it is believed that critical values for the two test statistics suggested by Johansen and Juselius (1990) might not be universal. The values probably exhibit asymptotic properties. But most economists are more concerned about the finite sample properties. Incidentally, it is in this area that the application of the Johansen cointegration test appears to be more uncertain (Maddala, 1992). It must be noted that both the Johansen Engel-Granger tests are applied on the notion that the variables under investigation are integrated of the same order.

3.5.3b Johansen and Juselius Cointegration Test

This test is employed to determine the number of co-integrating vectors using Johansen’s methodology with two different test statistics namely the trace statistic and the maximum Eigen-value test statistic. The trace statistic tests the null hypothesis that the number of divergent co-integrating relationships is less than or equal to ‘r’ against the alternative hypothesis of more than ‘r’ co-integrating relationships, and is defined as:

$$J_{trace} = -T \sum_{i=r+1}^n \ln (1 - \hat{\lambda}_i) \dots \dots \dots (3.9)$$

The maximum likelihood ratio or the maximum Eigen-value statistics tests the null hypothesis of r co-integrating relations against the alternative hypothesis of ' $r+1$ ' co-integrating vectors, and is defined as:

$$J_{max} = -T \ln (1 - \hat{\lambda}_{r+1}) \dots \dots \dots (3.10)$$

Where $\hat{\lambda}_i$ is the Eigen values, T is the sample size. Johansen argues that, trace and maximum Eigen value statistics have nonstandard distribution under the null hypothesis, and provides approximate critical values for the statistics, generated by Monte Carlo methods. In situations where Trace and Maximum Eigenvalue statistics yield different results, the trace test results should be preferred.

3.5.3c Vector Error Correction Model (VECM)

If a cointegration relationship has been detected between series, we know that there exists a long-term equilibrium relationship between them, so we apply the VECM in order to estimate the short run properties of the cointegrated series. In an event of no cointegration, VECM is no longer useful instead the Granger causality test is used to establish causal links between variables. Thus while cointegration analysis above captures the long run relationship between FDI and FPI and their respective determinants, the VECM captures short run adjustments. We define the VECM for both FDI and FPI respectively as follows:

$$\Delta FDI_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta FDI_{t-1} + \sum_{i=0}^n \beta_{2i} \Delta VEXR_{t-1} + \sum_{i=0}^n \beta_{3i} \Delta \ln(EXR)_{t-1} + \sum_{i=0}^n \beta_{4i} \Delta GDP_{t-1} + \psi ECM_{t-1} + e_t \dots \dots \dots (3.11)$$

$$\Delta FPI_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta FPI_{t-1} + \sum_{i=0}^n \beta_{2i} \Delta VEXR_{t-1} + \sum_{i=0}^n \beta_{3i} \Delta \ln(EXR)_{t-1} + \sum_{i=0}^n \beta_{4i} \Delta GDP_{t-1} + \lambda ECM_{t-1} + e_t \dots \dots \dots (3.12)$$

Where ψ and λ represents the speed of adjustment, and ECM is the Error Correction term derived from long run relationship as given in equations 3.11 and 3.12. In the VECM the cointegration rank shows the number of cointegrating vector. For instance, a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary. A negative and significant coefficient of the ECM (i.e. ψ or λ in the above equations) indicates that any

short-run fluctuations between the independent variables and the dependent variable will give rise to a stable long run relationship between the variables (Fadli, et al; 2011)

CHAPTER 4
RESULTS AND EMPIRICAL ANALYSIS

4.0 Introduction

In this chapter, we analyse the results obtained from our GARCH model, tests for stationarity and for cointegration. We begin our analysis by generating the GARCH (1, 1) series before performing formal unit root tests using the Augmented Dickey-Fuller and Phillip-Perron tests. We conclude by considering results obtained from Johansen’s cointegration tests.

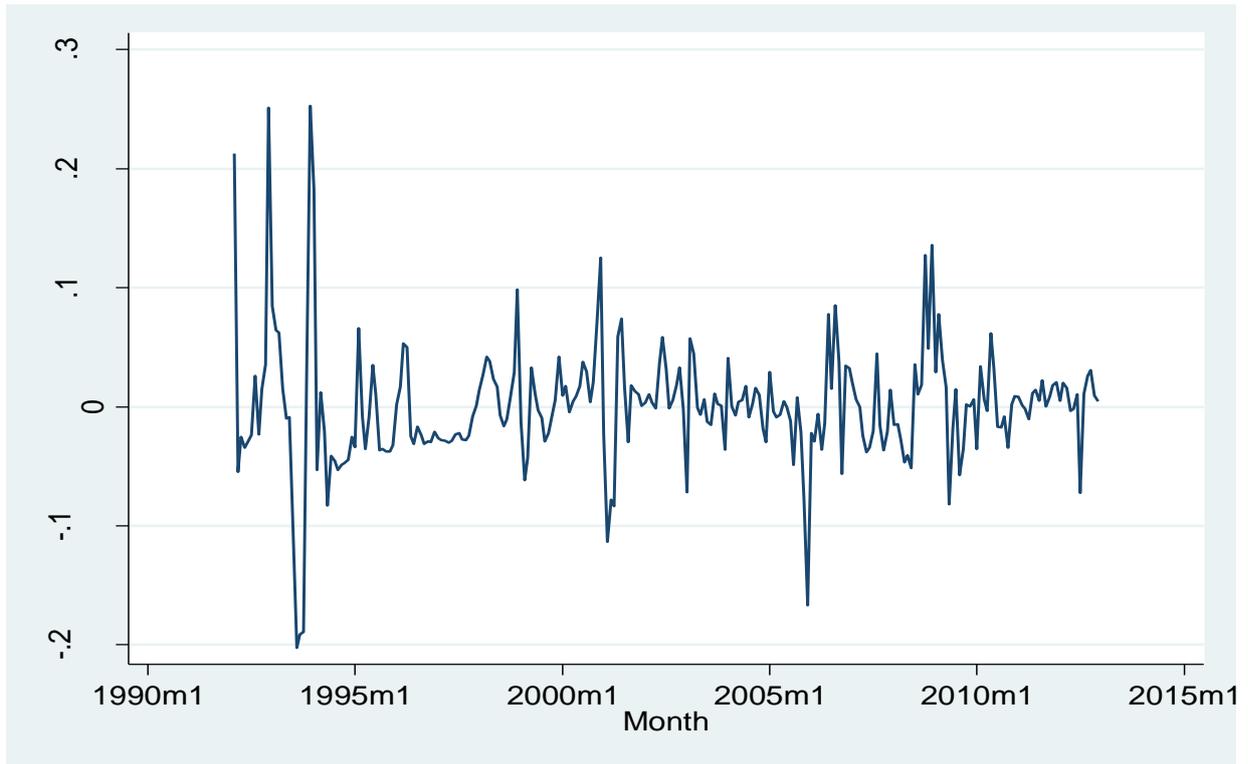
4.1 Generating the GARCH (1, 1) Volatility Series

A precondition to using the GARCH method of estimation for volatility generation is to test for clustering volatility and the presence of ARCH effects in the nominal exchange rate series. To do this the Lagrange Multiplier (LM) ARCH test was employed. The nominal exchange rate was assumed to follow a primitive first-order autoregressive (AR) process, denoted AR (1), and the following equation was run:

$$\ln ex_t = \alpha_0 + \alpha_1 \ln ex_{t-1} + u_t \dots\dots\dots (3.13)$$

After running a regression of the above mean equation of exchange rate, we obtain the residuals or error terms of equation (3.13). Plotting the residual obtained from mean equation of exchange rate, as depicted in figure 3 below, indicates that periods of high volatility are followed by periods of high volatility and periods of low volatility tend to be followed by periods of low volatility for prolonged periods. This behavior is known as **clustering volatility**. This suggests that the residual or error is conditionally heteroscedastic and can be represented by ARCH and GARCH model.

Figure 3: Nominal Exchange Rate Clustering Volatility



Source: Author's own computation

After establishing the presence of clustering volatility in our model, we then ran the ARCH-LM (Lagrange Multiplier test) by regressing the collected residuals from the mean equation of exchange rate series on their lags. The table below presents the results of ARCH-LM test:

Table 3: ARCH-LM Test

LM test for autoregressive conditional heteroscedasticity (ARCH)

lags (p)	chi2	df	Prob > chi2
1	28.703	1	0.0000

H_0 : no ARCH effects vs. H_1 : ARCH (p) disturbance

The Chi-square P-value strongly indicates the presence of ARCH effects in the nominal exchange rate series. Since the Chi-square probability of 0% is less than 5%, we reject the null hypothesis of no ARCH effects and conclude that our model has ARCH effects. Thus, our mean model equation (3.13) has clustering volatility and also ARCH effect. The conclusion above now mandates us to proceed and estimate the GARCH process.

A GARCH model of exchange rate volatility

The GARCH (1, 1) series is a measure of nominal exchange rate volatility. It is assumed that the disturbances derived from the mean equation (3.13) are not correlated. Thus we estimate the mean equation above and then capture the squared residuals and its lag, ε_t^2 and ε_{t-1}^2 respectively. We then estimate the mean equation incorporating the variance through the GARCH (1, 1) process. Therefore, the GARCH process of this equation takes the following form:

$$H_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 H_{t-1}^2 \dots \dots \dots (3.14)$$

Where H_t^2 is the time variant conditional variance of the nominal exchange rate, ε_{t-1}^2 is the squared residuals obtained from Equation 3.13, and α_0 , α_1 and α_2 are the parameters estimated. Equation (3.14) is the regression equation of our interest and gives the conditional variance, which is a function of three terms – the mean (constant); news about the volatility from the previous period measured as a lag of the squared residual from Equation (3.14), ε_{t-1}^2 , also known as the ARCH term; and the last period’s forecast variance, H_{t-1}^2 , the GARCH term.. Thus, using the GARCH (1, 1) result, the following maximum likelihood estimation (MLE) regression results were obtained:

Table 4: GARCH model of nominal exchange rate volatility

Mean equation of the nominal exchange rate process ($\ln(Xrate_t)$)				
Variable	Coefficient.	Std. Err.	Z-statistics	Probability
lnXrateL1	.9881517	.0015081	655.23	0.000
_cons	.0994921	.0115601	8.61	0.000
GARCH equation of the nominal exchange rate volatility H_t^2				
arch (1)	1.03102	.1298041	7.94	0.000
garch (1)	.2059187	.0535334	3.85	0.000
_cons	.0003768	.00007	5.38	0.000

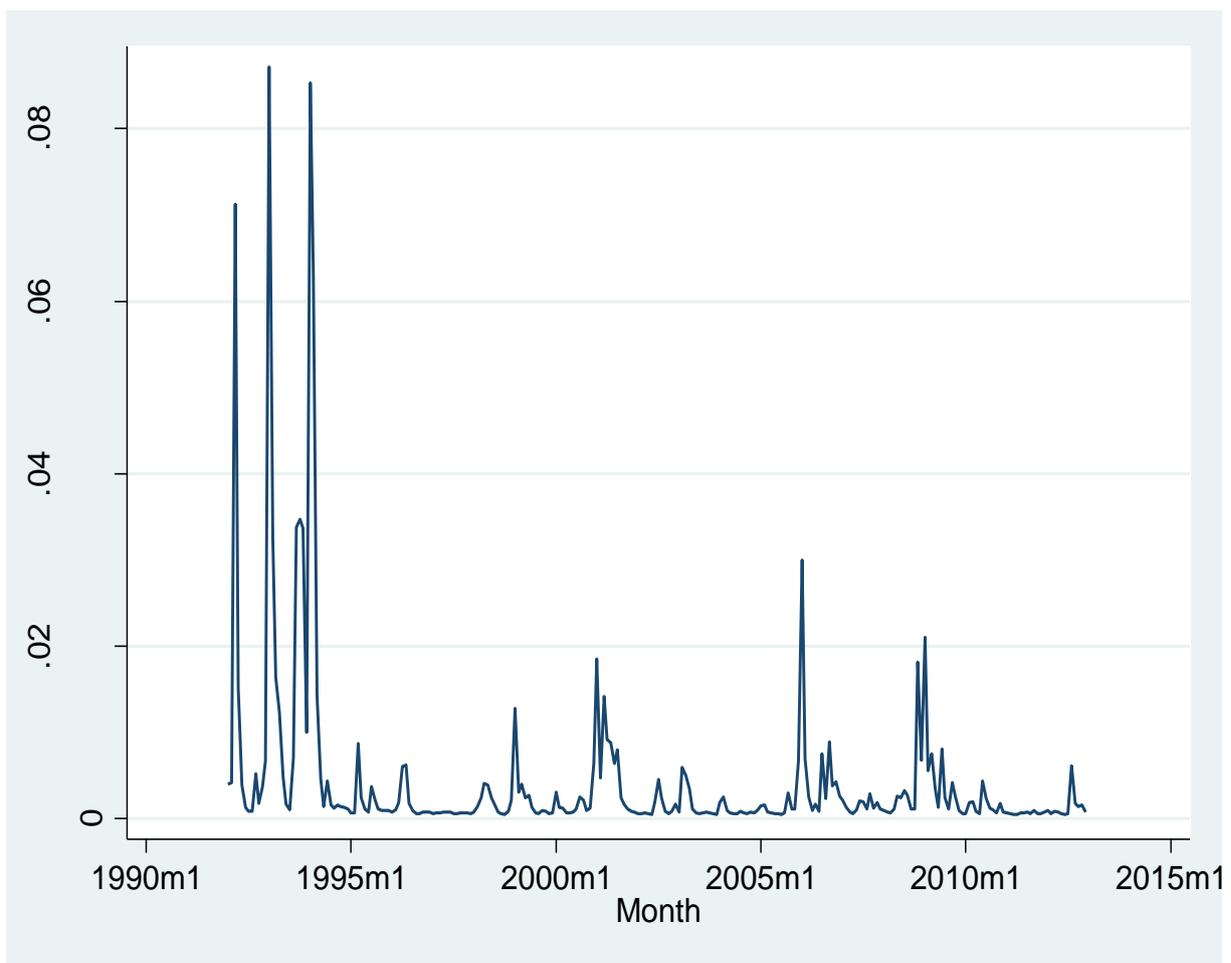
Thus a combination of AR (1) and GARCH (1, 1) models yields equation (3.15)

$$\ln ex_t = 0.0994921 + 0.9881517 \ln ex_{t-1}$$

$$H_t^2 = 0.0003768 + 1.03102 \varepsilon_{t-1}^2 + 0.2059187 H_{t-1}^2 \dots \dots \dots (3.15)$$

From the above table, it can be noted that the GARCH (1) parameter (0.2059187) is about zero while the ARCH (1) parameter (1.03102) is about one and the sum of the two parameters (1.2369387) is greater than one. Thus the non-negativity restriction postulated in equation (3.7) is satisfied. Moreover, table 4 above also shows that the sum of the two estimated ARCH and GARCH coefficients $\alpha_1 + \alpha_2$ is larger than one, suggesting that the conditional variance is an explosive process. The test results show that volatility in the exchange rate was not only significant but also persistent in Zambia over the study period. We therefore use predicted values of variance from the GARCH model as our measure of exchange rate volatility. The volatility in nominal exchange rate is depicted in figure 4 below:

Figure 4: Nominal exchange rate (NER) Volatility



Source: Author's own computation

4.2 Unit Root Tests

Unit root analysis has been done to acquaint ourselves with the nature of data. We present the Augmented Dickey-Fuller unit root tests and further double check the stationarity properties of the series by including the Phillip Perron tests. We came to the same conclusion by using both the Augmented Dickey-Fuller test and the Phillip Perron test. The unit root test results are shown in table 5 below. A test of the time series properties of the data indicates that three of our variables have unit roots while two other variables are stationary in their level form. These findings suggest that the three variables, namely, FDI, FPI and GDP are integrated of order 1(that is, they become stationary only after differencing once) except the exchange rate and exchange rate volatility which are I(0).

Table 5: Unit Root Test Results

(a). Augmented Dickey-Fuller (ADF)

Variable	ADF at level	ADF at first difference	Order of integration
FDI	-1.535	-15.770 ***	I(1)
FPI	-0.070	-15.817 ***	I(1)
GDP	1.835	-16.434***	I(1)
In (Xrate)	-6.840 ***	-9.912***	I(0)
VXrate	-9.526***	-21.611 ***	I(0)

The null hypothesis for all the tests are that there is unit root (i.e., the variable is non-stationary); (***) implies that the variables are significant at 1, 5, and 10 percent respectively. The critical values at 1, 5 and 10 percent are -3.460, -2.880 and -2.570 respectively.

(b). Phillip Perron Unit Root Test Results (PP)

Variable	PP at level	PP at first difference	Order of integration
FDI	-1.560	-15.770 ***	I(1)
FPI	-0.041	-15.818 ***	I(1)
GDP	2.287	-16.505***	I(1)
In (Xrate)	-5.444 ***	-9.981***	I(0)
VXrate	-9.637***	-25.150 ***	I(0)

The null hypothesis for all the tests are that there is unit root (i.e., the variable is non-stationary); (***) implies that the variables are significant at 1, 5, and 10 percent respectively. The critical values at 1, 5 and 10 percent are -3.460, -2.880 and -2.570 respectively.

4.3 Lag Length Selection Test

The requisite for the lags arises because values in the past affect today’s values for a given variable. This implies that the variable in question is persistent. There are numerous methods to determine how many lags to use. The two prominent methods frequently encountered in time series analysis are the Akaike Information Criterion (AIC) and the Schwarz Bayesian Information Criterion (SBIC). These rules choose lag length p to minimize:

$$\log (SSR (p)/n) + (p + 1)C(n)/n \dots \dots \dots (3.16)$$

Where $SSR (p)$ is the sum of squared residuals for the VAR with p lags and n is the number of observations, with $C (n) = 2$ for AIC and $C (n) = \log (n)$ for SBIC. Therefore to determine the number of lags to use in our bivariate model we run the *varsoc* command and the results are shown in table 6 below. Stata results report the final prediction error (FPE), Akaike’s information criterion (AIC), Schwarz’s Bayesian information criterion (SBIC), the Hannan Quinn Information Criterion (HQIC), the log likelihood (LL) and likelihood-ratio (LR)⁸.

⁸ Mphumuzi, S (2013), Cointegration Analysis of Oil Prices and Consumer price Index in South Africa Using Stata. MPRA paper No.49797, September, 2013. University of Cape Town.

Table 6. Test Results for the Lag-Order Selection Criterion**(a). Lag-length selection for the FDI model**

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-2023.28		148.048	16.349	16.3719	16.4057
1	-440.025	3166.5	.00048	3.70988	3.82394	3.99322
2	-383.615	112.82	.000347*	3.38399*	3.5893*	3.894*
3	-369.606	28.018*	.000352	3.40005	3.69661	4.13673
4	-360.287	18.637	.000372	3.45393	3.84174	4.41729

*indicates lag order selected by the criterion

(b). Lag-length selection for the FPI model

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-1870.98		43.3496	15.1208	15.1436	15.1775
1	-217.197	3307.6	.00008	1.91288	2.02694	2.19622
2	-160.885	112.62	.000058*	1.58778*	1.79309*	2.0978*
3	-146.746	28.278*	.000058	1.60279	1.89935	2.33948
4	-137.499	18.495	.000062	1.65725	2.04506	2.62061

*indicates lag order selected by the criterion

The results above show that the FPE, AIC, HQIC and the SBIC tests all chose two lags while the LR chose three lags. However, we have selected optimal lag 2 as suggested by SBIC mainly because of the following two reasons, firstly, SBIC is more accurate than other tests and secondly, when we use the lag length 3 for our cointegration analysis, we have found no cointegrating vector under both trace and maximum eigen statistics while at lag 2 we are getting 1 cointegrating vector under both these statistics. This means our FDI and FPI models are explained by two lags. Now that we have determined the number of lags, our next task is to test for cointegration amongst the variables.

4.4. Cointegration Test and Long Run Estimates

Having established that the variables are integrated of the same order and that the optimal lag length to be used in our models is 2, we proceed to testing for cointegration. Cointegration analysis, as discussed earlier, provides a framework to determine whether or not there exists a

long run stable relationship among a set of economic variables. The Johansen-Juselius maximum likelihood procedure was applied in determining the cointegrating rank of the system and the number of stochastic trends driving the entire system. Below are the results of the test:

Table 7: Johansen Cointegration Test Results:

(a). Johansen Cointegration Test Results: FDI Model

Hypothesis	No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value
None*		.	125.1557	47.21
At most 1		0.32884	25.4705*	29.68
At most 2		0.06290	9.2286	15.41
At most 3		0.03430	0.5034	3.76

*Denotes rejection of the null hypothesis at 5% significance level.

Trace test indicates 1 cointegrating equation(s) at 5% significance level.

(b). Johansen Cointegration Test Results: FPI Model

Hypothesis	No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value
None*		.	121.9016	47.21
At most 1		0.33070	21.5210*	29.68
At most 2		0.05863	6.4167	15.41
At most 3		0.02383	0.3869	3.76

*Denotes rejection of the null hypothesis at 5% significance level.

Trace test indicates 1 cointegrating equation(s) at 5% significance level

Table 7(a) and (b) above reports our cointegration test results based on Johansen maximum likelihood method. Both the FDI and FPI specifications show that there is at least one cointegrating vector among our variables. We can reject the null hypothesis of no cointegrating vector in favor of one cointegrating vector under the trace test statistics at 5 percent level of significance. We also cannot reject the null hypothesis of at most one cointegrating vector

against the alternative hypothesis of two cointegrating vectors, for both the trace and max-eigen test statistics. Therefore, we can conclude that there is only one cointegrating relationship among our variables of interest. This implies that foreign direct investment, foreign portfolio investment, exchange rate volatility, exchange rate and gross domestic product establish a long run relationship in Zambia.

4.5. Vector Error Correction Model (VECM)

The presence of cointegration between variables suggests a long term relationship among our variables of interest. Thus, we applied the Vector Error Correction model and the long run relationship between foreign direct investment, foreign portfolio investment, exchange rate volatility, exchange rate and gross domestic product in Zambia for the period 1992-2012 is presented below in table 8.

As discussed in section 3.5.3c above, the existence of a cointegrated relationship among a set of variables entails that there is an associated short run relationship associated with them too. This short run relationship represents the actual deviated FDI or FPI that are expected to adjust back to their long run stable relationship estimated in the section below. Table 8(a) and (b) below provides the FDI and FPI short-run error correction dynamics. The VECM test result for both FDI and FPI models presented below in table 8(a) and 8(b) shows both the short run and the long run estimates. The short run estimates are read from the ECM component of table 8(a) and 8(b) respectively. The coefficients on ECM_{t-1} make up the long run disequilibrium adjustment matrix ψECM_{t-1} and λECM_{t-1} for our models. The rest of the variables in the tables presents the α_t and β_t parameters of the cointegrating vector.

Table 8: Test Results for Vector Error Correction Model

(a). VECM Test Results for the FDI Model				
Variable	Coefficient	Std. Error	Z-statistic	Probability
Constant	1,696.969	.	.	.
VXrate	-39,337.96	3,677.324	10.70	0.000
ln (Xrate)	-104.9773	48.07514	2.18	0.029
GDP	1.102698	0.4540853	-2.43	0.015
ECM_{t-1}	-0.0008441	0.0017203	-0.49	0.624

$$FDI_t = 1,696.969 - 39,337.96 VEXR_t - \ln 104.98EXR_t + 1.103GDP_t \dots(3.17)$$

(b). VECM Test Results for the FPI Model

Variable	Coefficient	Std. Error	Z-statistic	Probability
Constant	561.08	.	.	.
VXrate	-12,487.96	1,165.357	10.72	0.000
ln (Xrate)	-35.0598	15.26638	2.30	0.022
GDP	0.3104421	0.1445627	-2.15	0.032
ECM_{t-1}	-0.0016043	0.0024444	-0.66	0.512

Results extracted from Stata 11.2 outputs.

$$FPI_t = 561.08 - 12,487.14 VEXR_t - \ln 35.06EXR_t + 0.3104GDP_t \dots \dots (3.18)$$

4.5.1 Analysis of Results from the Short Run Estimation

Our variable of interest is the error correction term (ECM_{t-1}). For both the FDI and FPI model specifications, we note that the error correction term (the adjustment parameters) in general are negative and small, implying a slow correction to equilibrium. However, this confirms that the variables in both the models are cointegrated. The size of the error correction term gives the change in both FDI and FPI per month that is attributable to the difference between the actual and equilibrium level. For the FDI model, the ECM coefficient of -0.0008441 entails that the speed of adjustment to equilibrium is approximately 0.08%. Thus, any disequilibrium in the FDI model can be adjusted at a rate of 0.08%. On the other hand, the ECM coefficient in the FPI model is -0.0016043. This too implies that disequilibrium in the FPI model specification can be adjusted at a rate of 0.16043%. Looking at the volatility coefficient for both model specifications, we note that they are negative, small and insignificant. Therefore, we can say that in the short run, both FDI and FPI are affected negatively but this effect is small and insignificant.

4.5.2 Analysis of Results from the Long Run Estimation

The results of the long run estimates as presented in equation 3.17 and 3.18 yield very interesting results. Firstly, for the FDI model, all the estimated coefficients possess the expected signs. The exchange rate volatility, which is the prime concern of this study, was found to impact negatively on the inflow of FDI. This means that the nominal exchange rate volatility, a measure of risk,

discourages the inflow of FDI. This finding is consistent with our expectation and also with many previous studies. Gerardo and Felipe (2002), Brzozowski (2003), Barrell *et al.* (2003), Kun-Ming-Cheng *et al.* (2006), Dumludag (2007) and Udomkerkgmogkol and Morrisey (2009) have found the same direction of relationship. The study found that a unit increase in nominal exchange rate volatility is associated with a \$39,337.96 monthly decline in FDI inflow at a statistically significant level of 5 per cent, that is $p < 0.05$ as indicated in table 8(a) above. This perhaps signals the depressed FDI performance Zambia has had over the period 1992 to 2012 or so. Thus, without volatility, Zambia's FDI is expected to increase by about \$39,337.96 monthly. This measure is indeed a significant indication of the depressing effect to FDI of having a very volatile exchange rate. With much of the foreign investment to Zambia being envisaged through FDI, the loss in FDI inflow due to exchange rate volatility is huge and significant and thus cannot be ignored by policy makers.

Moving onto the coefficient of exchange rate, equation 3.17 shows that exchange rate has a negative relationship with FDI and it declines by \$104.98 units as a result of a one per cent (1%) increase in exchange rate. This negative relationship is in uniformity with the findings of Ogun and Egwaikhinde (2010) in the cases of Botswana, the Central African Republic, Ghana and South Africa. Whereas, exchange rate is impacting FDI negatively, Froot and Stein (1991), Blonigen (1997) and Tokunbo and Lloyd (2009) found a positive relationship between exchange rate and FDI. The coefficient of exchange rate is statistically significant at 5% level of significance as the p-value is considerably less than 0.05; $p = 0.029$. Our finding implies that an appreciation in the domestic currency (Kwacha) will unambiguously lead to a decline in FDI inflows and that a depreciation of the Kwacha will lead to increased FDI inflows. Contrary to this finding, Ngowani (2012) found that appreciation of the Kwacha encourages FDI inflows to Zambia. Nevertheless, we feel the positive nexus between FDI and the Kwacha appreciation found by Ngowani (2012) could have been compromised due to the fact that he used daily data for the period 2009 to 2011 and a less robust OLS method. Thus, as our result suggests, the appreciation of the Kwacha increases the cost of doing business in the country because wages and operational bills are paid in local currency and further makes the cost of imported inputs expensive thereby leading to higher cost of production.

GDP growth which represents the growth rate of a country has a positive effect on FDI and is statistically significant; $p = 0.015$. This is also in tandem with widely held theories that high GDP growth is a sign of good investment climate in the country and that economic fundamentals in a

host country are strong. The implication is that the size of the market is a vital variable in attracting potential investors into any economy. However, its impact is very low, which suggests that market size in Zambia does not play a crucial role in the determination of the inflow of FDI. Again, it also suggests that most investors attach larger weight to other variables and look elsewhere with regards to marketing their finished products. The fascinating fact about this is that it supports the point that most FDI inflow into Zambia has been in the mining and manufacturing sectors where most of these finished products are exported. The result once again is in synch with studies by Lizondo (1993), who found that market size does not influence foreign investors in most developing countries and established that the influence of market size on FDI is one of an empirical concern. The inflow of FDI into Zambia has mainly found its way into the mining sector of the economy and Tsikata et al. (2000) also pointed out that since mining is basically an export-oriented activity in Sub-Sahara Africa, there is no major consideration for the local market size prior to investing in the sector.

Moving onto the FPI model, we note that all the independent variables have the hypothesized signs and are significant at both 5% and 1% levels. Notably, a unit increase in Zambian exchange rate volatility reduces foreign portfolio investments to Zambia by about \$12,407.14 units on a monthly basis. This negative relationship between volatility in exchange rate and foreign portfolio investment in Zambia concurs with the findings of Nucci and Pozzolo (2001), Serven (2003), Chonnikarn (2010) and Pami and Reetika (2013) who also documents that exchange rate volatility creates uncertain climate for foreign investors by making profit and cost of investment activities harder to predict. The negative long run coefficient on Zambian exchange rate volatility is statistically significant in all the specifications; $p=0.000$. This implies that volatility in exchange rate significantly discourages foreign portfolio investment to Zambia. This is because increased volatility in exchange rate proliferates the uncertainties in the returns that will be received by the foreign investor in terms of his/her own currency. Thus in a way, exchange rate is an additional source of return to foreign investor apart from asset returns. Also, a volatile exchange rate indicates that the overall health of the economy is not good and that there are destabilizing forces that are present in the economy.

With regard to the impact of exchange rate movements on foreign portfolio flows, the results suggest that exchange rate affects foreign portfolio flows negatively in Zambia and the effect is significant with $p=0.022$. A one percentage increase in the exchange rate leads to a \$35.06 unit monthly decline in foreign portfolio investments to Zambia. This finding disagrees with that of

Chonnikarn (2010) who found a significant positive relationship between exchange rate and foreign portfolio investment in the case of Thailand. The implication from our findings is that appreciation of the Zambian Kwacha with respect to other currencies in the basket discourages the inflows of portfolio investment. This result could be described by the reason of momentum investors in the sense that in case that foreign investor allocate their funds to portfolio investment and the Zambian Kwacha subsequently appreciates, the profit gained from international diversification would decrease when they convert their profit from Zambian Kwacha currency into their home country currency. Because momentum investors are likely to invest based on historical performance; therefore, they tend to flow their funds away from Zambia when the Kwacha appreciates.

A close look at the coefficient of GDP reveals that it possesses the expected positive sign and it is also significant; $p=0.032$. This shows that market size is a good factor in determining FPI inflows to Zambia. Similar to this finding, Pami et al (2013) found that increase in domestic output growth attracts FPI in the case of India. Thus, increase in domestic output growth, attracts FPI flows as it indicates an increasingly expanding economic activity in the country which further indicates increasing corporate profits. A higher growth rate is an indicator of better investment opportunities in the country and indicates strong economic fundamentals of Zambia. Thus to a foreign investor better growth performance of the host country is a guard against sovereign risk as well as a signal that demand for investment in the host country will remain high as it is a rapidly expanding economy, and hence the probability that returns from investment will fall in future will be low.

While the available statistics showed that despite exchange rate volatility over the past two decades, foreign investment inflows have risen in Zambia. But what this study brings out is that despite that relationship, there is nonetheless a hidden opportunity cost of exchange rate volatility on such inflows. A unit increase in the Kwacha exchange rate volatility reduces FDI by \$39, 337.96 and FPI by \$12, 487.14 per month respectively. This implies that FDI and FPI inflows could have been greater in the absence of exchange rate volatility for the period 1992 to 2012. While we recommend that Zambia maintains the managed float exchange rate regime, serious and urgent stabilization steps must be taken to minimize the level of Kwacha exchange rate volatility.

4.6. Stability test for the cointegration relationship

We use the stability test to check whether we have correctly specified the number of cointegrating equations. The companion matrix of a VECM with K endogenous variables and r cointegrating equations has $K-r$ unit eigenvalues. Because there is no general distribution theory for the moduli of the eigenvalues, ascertaining whether the moduli are too close to one can be difficult. The results of the stability conditions are shown in Table 10(a) and (b) in appendix B:

Because we specified the graph option, stability test plotted the eigenvalues of the companion matrix. The graph of the eigenvalues shows that none of the remaining eigenvalues appears close to the unit circle in both the FDI and FPI model. Thus, the stability check does not indicate that our model is misspecified.

4.7. Tests for Distribution of Error Terms

The assumption that the errors are independently, identically and normally distributed with zero mean and finite variance allows for the derivation of the likelihood function. If the errors do not come from a normal distribution but are just independently and identically distributed with zero mean and finite variance, the parameter estimates are still consistent, but they are not efficient. We use normality technique to test the null hypothesis that the errors are normally distributed and the results are shown in Table 11 (a) and (b) in appendix C.

The results show that the errors are not normally distributed but show some evidence of skewness and kurtosis. Thus, the results indicate that we can strongly reject the null hypothesis of normally distributed errors. Most of the errors are both skewed and kurtotic.

4.8 Tests for Serial Correlation in the Residuals.

Here we used autocorrelation technique to test for serial correlation in the residuals. The results from table 9(a) and (b) below clearly indicate serial correlation in the residuals at first lag. At lag two, it can be observed that all p-values are above 0.05 and as a result of this the null hypothesis of no serial correlation is not rejected. This shows that there is no correlation in the residuals. The results in Gonzalo (1994) indicate that underspecifying the number of lags in a VECM can significantly increase the finite-sample bias in the parameter estimates and lead to serial correlation. This shows that the above FDI and FPI models were correctly specified.

Table 9: Test Results for Serial Correlation**(a). Results for serial correlation in the FDI model**

Lag	chi2	df	Prob > chi2
1	57.5938	16	0.00000
2	24.6662	16	0.07593

H_0 : no autocorrelation at lag order

(b). Results for serial correlation in the FPI model

Lag	chi2	df	Prob > chi2
1	57.8025	16	0.00000
2	24.4242	16	0.08064

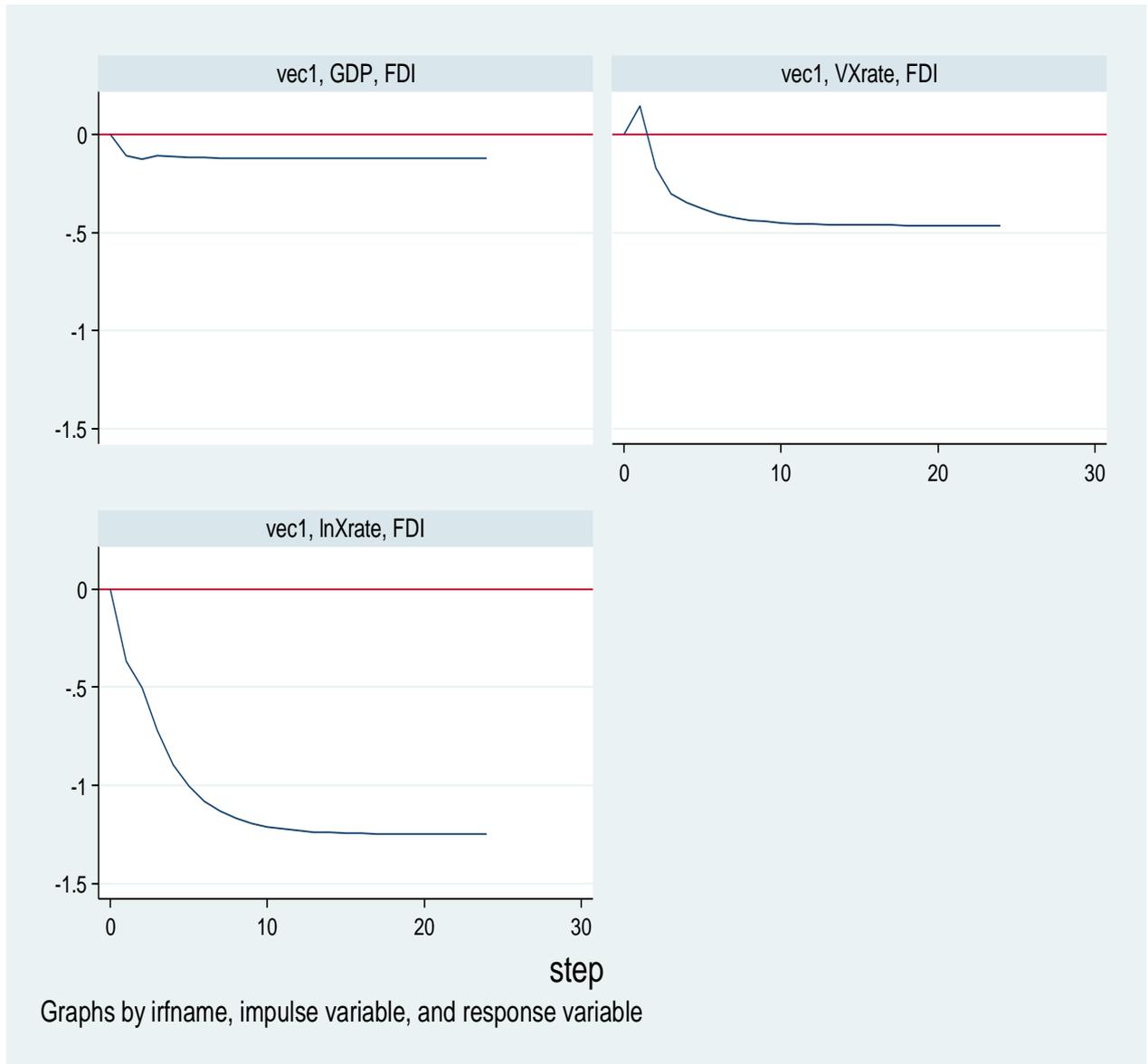
H_0 : no autocorrelation at lag order

4.9. Impulse–response functions for VECMs

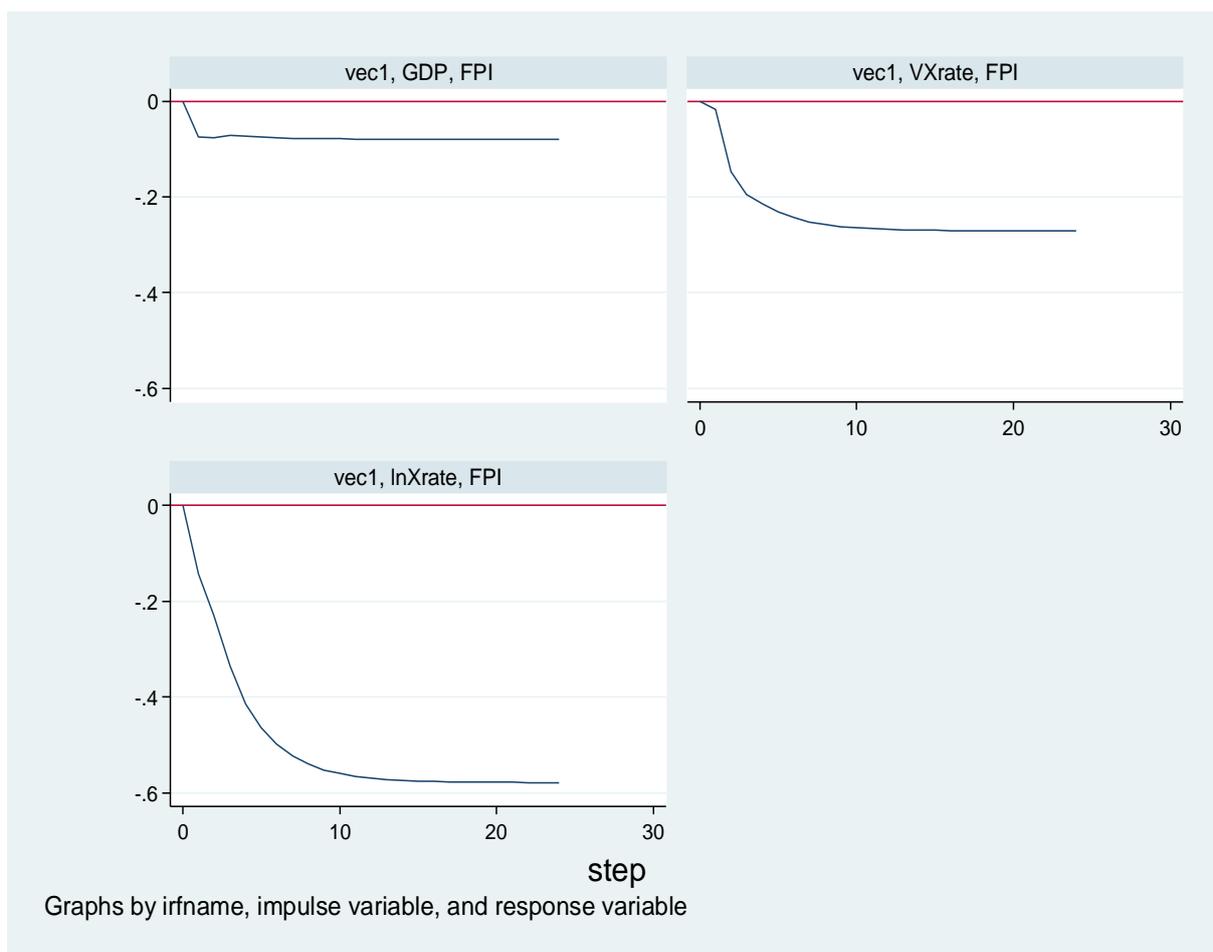
With a model that we now consider acceptably well specified, we used the impulse response function commands to estimate and interpret the IRFs. Whereas IRFs from a stationary VAR die out over time, IRFs from a cointegrating VECM do not always die out. Because each variable in a stationary VAR has a time invariant mean and finite, time-invariant variance, the effect of a shock to any one of these variables must die out so that the variable can revert to its mean. In contrast, the I(1) variables modeled in a cointegrating VECM are not mean reverting, and the unit moduli in the companion matrix imply that the effects of some shocks will not die out over time. These two possibilities gave rise to new terms. When the effect of a shock dies out over time, the shock is said to be transitory. When the effect of a shock does not die out over time, the shock is said to be permanent. Below we use `irf create` to estimate the IRFs and `irf graph` to graph three of the orthogonalized IRFs.

Figure 5: Impulse Response Test Results

(a) FDI model



(b) FPI model



In the initial response of foreign direct investment to a unit shock in gross domestic product is negative, FDI recovers a bit in the third month through up to the seventh month when it drops and dies out as reflected in figure 5 (a). The effect of FDI to a unit shock in exchange rate is negative and dies out. Therefore, the response of FDI to an exchange rate shock is transitory. When the impulse is exchange rate volatility, FDI response is positive in the first two months, thereafter it falls through to the tenth month and dies out.

From figure 5 (b), it can be observed that the response of foreign portfolio investment to a unit shock in GDP is negative and dies out. When the impulse is exchange rate, foreign portfolio investment response is negative for a long time and can be considered as significant. Finally, the initial response of foreign portfolio investment to a shock in exchange rate volatility is negative and can also be considered as significant. Overall, from figure 5(a) and (b) we see that the short-run equilibrium adjustment is quite fast.

CHAPTER 5

CONCLUSIONS AND POLICY RECOMMENDATIONS

After the Bretton Woods System collapsed in 1971, many countries adopted a freely floating exchange rate regime. In analyzing the effects of exchange rate volatility on both FDI and FPI, we pay special attention to the period of floating exchange rate regime which has been associated with high levels of exchange rate volatility. The examination of the effect of exchange rate volatility upon macroeconomic variables, including FDI and FPI has raised significant concerns in the past few decades. Numerous researchers have been directed to this subject and have emphasized different macroeconomic variables and countries. The outcomes vary from study to study with some showing positive association between the volatility in exchange rate and foreign investment and others showing negative association between the variables or none at all. However, others demonstrate inconclusive results or no evidence at all. This study is also aimed at exploring the effect of exchange rate volatility upon foreign investment in Zambia.

This paper has examined the effect of exchange rate volatility on private capital inflows in Zambia from 1992 to 2012 using monthly level data. This period has been selected as it reflects the period in which the Zambian economy has been running a float exchange rate regime in the wake of economic reforms introduced in the early 1990s. Foreign investment was divided into the short term and more liquid part (foreign portfolio investment) and the long term part (foreign direct investment). The effect of exchange rate volatility upon foreign investment is explored by applying the Multi-variate Johansen Cointegration technique and the Kwacha exchange rate volatility is captured through the GARCH (1, 1) model. The GARCH (1, 1) model adequately captured the volatility of the Zambian Kwacha as evidenced from the ARCH-LM test. The result of the Johansen Cointegration test established a long run association among our variables. Infact, based on both trace statistics and max statistics, we find the existence of one cointegrating relationship in both the FDI and FPI models.

From the FDI model, all the estimated long-run coefficients possess the expected signs as predicted by economic theory. The Kwacha exchange rate impact negatively on FDI as hypothesized and is indeed statistically significant. This is in synch with economic theory predictions that in case of exchange rate appreciation due to movements in any of the exchange rate fundamentals, foreign investors will tend to hold back (reduce) their investment in the economy. The logic behind this action is that exchange rate appreciation tends to increase the

cost of production. The size of the market (GDP) was found to be positively related with FDI. However, the size of the market (GDP) appears to play no much active role in determining FDI inflows, perhaps as a result of the fact that most of the investors essentially invest in sectors whose finished products are predominantly exported (i.e. the mining sector). Our main variable of interest, exchange rate volatility shows that FDI inflows to Zambia are adversely affected by the volatility of Zambian Kwacha. The negative and consequently depressing effect of the volatility of Zambian Kwacha is highly statistically significant, signaling serious need for policy intervention in maintaining a stable exchange rate. The short run dynamics as captured by the error correction model (ECM) shows that about 0.08 percent of the variations in Zambia's monthly FDI inflows are adjusted within the first month. Nonetheless, despite the short run coefficient on exchange rate volatility being negative, we find it insignificant and its small absolute value is indicative of a slow speed of adjustment towards equilibrium.

Results from the FPI model suggests that exchange rate has a negative and significant impact on the inflows of foreign portfolio investment while GDP is found to have a positive and significant relationship with foreign portfolio investment. The coefficient of exchange rate volatility is negative and highly statistically significant. With these results, a major point we observe in the study is that exchange rate volatility has a deterrent effect on foreign investment inflows to Zambia.

On the whole, this study provides strong evidence that the Kwacha exchange rate volatility has a negative effect on private capital flows to Zambia particularly by depressing its inflows. With the above findings, we conclude that the adverse impact of exchange rate volatility on private foreign capital calls for serious and sound exchange rate management by the monetary authorities so as to enable Zambia enjoy the benefits of foreign investment. Zambia is a developing country which is in dire need of foreign investment to stimulate domestic economy, seek new technology, modern managerial skills and employment generation for ever increasing population. Foreign investment in this regard can play a decisive role not only to manage difficult economic conditions but it also promotes competition in the economy which brings efficiency leading to the beauty of capitalism. Thus, based on the findings of this study our policy recommendations are as follows:

Firstly, since our theoretical framework identified sound macroeconomic policies and foreign investment policies in the host country as one of the factors that have an influence on foreign investment inflows, thus there is need for policy coordination between monetary and fiscal

authorities to ensure that fiscal policy does not undermine the efforts of monetary authorities at managing exchange rate effectively. This implies policy cohesion and coordination on exchange rate and foreign investment management, especially in developing countries given the endogeneity between them. This is especially true for Zambia where the management of private capital inflows is not as sound as that of developed countries. It implies that foreign investment policies can have very significant effect on the exchange rates. At the same time, exchange rate policies can also stimulate or stifle foreign investment. Hence, in formulating either policy, the other one must be factored in. This will help improve policy performance and its ultimate impact on improving private capital inflows and reducing exchange rate volatility. This calls for concerted efforts and coordination among the different institutions in charge of exchange rate and private capital flows.

Secondly, since the market size (GDP) of the host country has significant impact on private capital flows, there is need for continuous increase and growth of the nation's capital market and Gross Domestic Product. Foreign investors will be motivated and attracted when they are certain that the host country creates the desirable market for their products. This can be achieved if government creates an enabling environment (or incentives) for production activities. This will create jobs for individuals and provide the necessary economic empowerment that can serve as a strong foundation for expanding private capital inflows in Zambia. This also entails that the country's education should be in favor of science and technology which would provide the economy with the required skills that foreign investment require.

Thirdly, government should continue the flexible market-determined exchange rate policy with intermittent interventions by the Central Bank to smooth volatility. This should be done with full regard for the exhaustion of foreign exchange reserves. Such a policy is crucial for the diversification of the economy. The foreign exchange market in Zambia is volatile mainly because it is small and has a single product export base. Therefore, the problem of volatility can be resolved only by structural policies, such as diversification of the economy. One such measure is to make reforms and take actions that enhance the policy of diversification of the economy away from its almost total dependence on copper as the only export commodity.

Fourthly, sound reserve management practices are vital for Zambia because they can increase its overall resilience to exchange rate volatility as well as foreign capital shocks. Suffice to say that through their interaction with financial markets, reserve managers gain access to valuable

information that keeps them and other policy makers abreast with financial market developments and threats.

The unpredictability of the global copper price suggests that serious attention be given to creation of a “copper fund”, for medium term exchange rate management and revenue smoothing (Weeks, 2013). This calls for closer monitoring of foreign exchange flows from copper which requires action by the Central Bank’s partners in relevant institutions and ministries (ZRA, MFNP and Ministry of Mines).

In conclusion, this study can be extended in future by adding more variables such as interest rate unemployment, GDP growth, taxes and other macroeconomic variables, in addition to the volatility of exchange rate, for finding more comprehensive results. Further, our major limitation of the study is its assumption that all the explanatory variables used in the regression are exogenously determined. In reality, however, this may not be the case because it is possible that there is a feedback effect between foreign investment and its determinants. In that case, the vector autoregressive model would have been a more appropriate estimation method. However, this limitation does not compromise on the validity of our findings because it was not our focus. Furthermore, it is suggested that the foreign investment-exchange rate volatility nexus be pursued in sectoral context in sub-Saharan countries. This will improve our understanding of the nature and pattern of influence between these variables across sectors.

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Appendix A

Data Generation

The foreign portfolio investment data was available on an annual basis from 1995 up to 2012. The data for 1992-1994 was not available. I extrapolated the missing yearly indices for 1992-1994 using the formula;

$$\frac{FPI_0}{e^{rt}}$$

where FPI_0 is the last reported index, e is the exponential, r is the GDP rate of growth of the following year. Here it is assumed that the economy grew smoothly at the rate of 6.95 per cent that was recorded in 1996.

Whereas monthly data on exchange rate was readily available, I found no monthly data on foreign direct investment, foreign portfolio investment and gross domestic product. Instead, I divided the available annual data by twelve months to get the monthly average on FDI, FPI and GDP. This was done assuming the monthly indices on FDI, FPI and GDP are constant (the same).

Appendix B

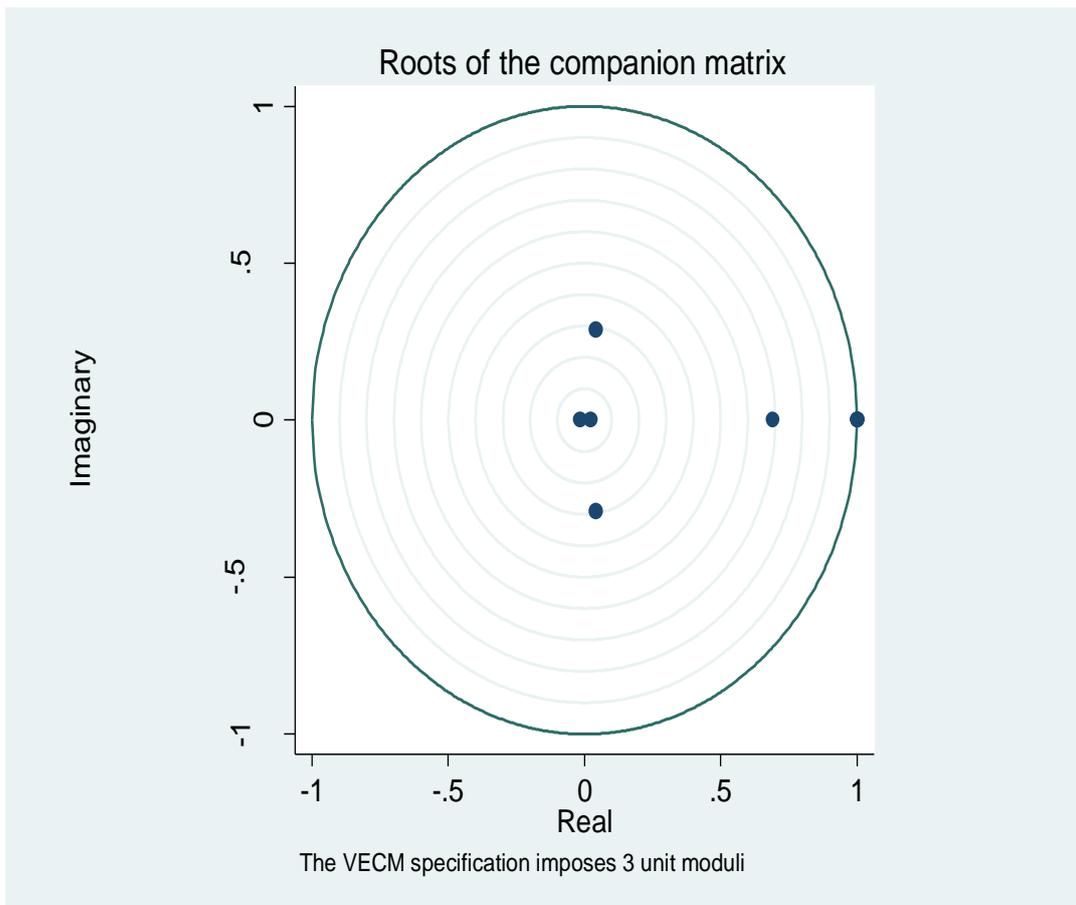
Table 10: Stability Test Results

(a) Stability Test Results in the FDI model

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
.6913861	.691386
.04017928 + .2882149 <i>i</i>	.291002
.04017928 - .2882149 <i>i</i>	.291002
.02210438	.022104
-.01569964	.0157

The VECM specification imposes 3 unit moduli.

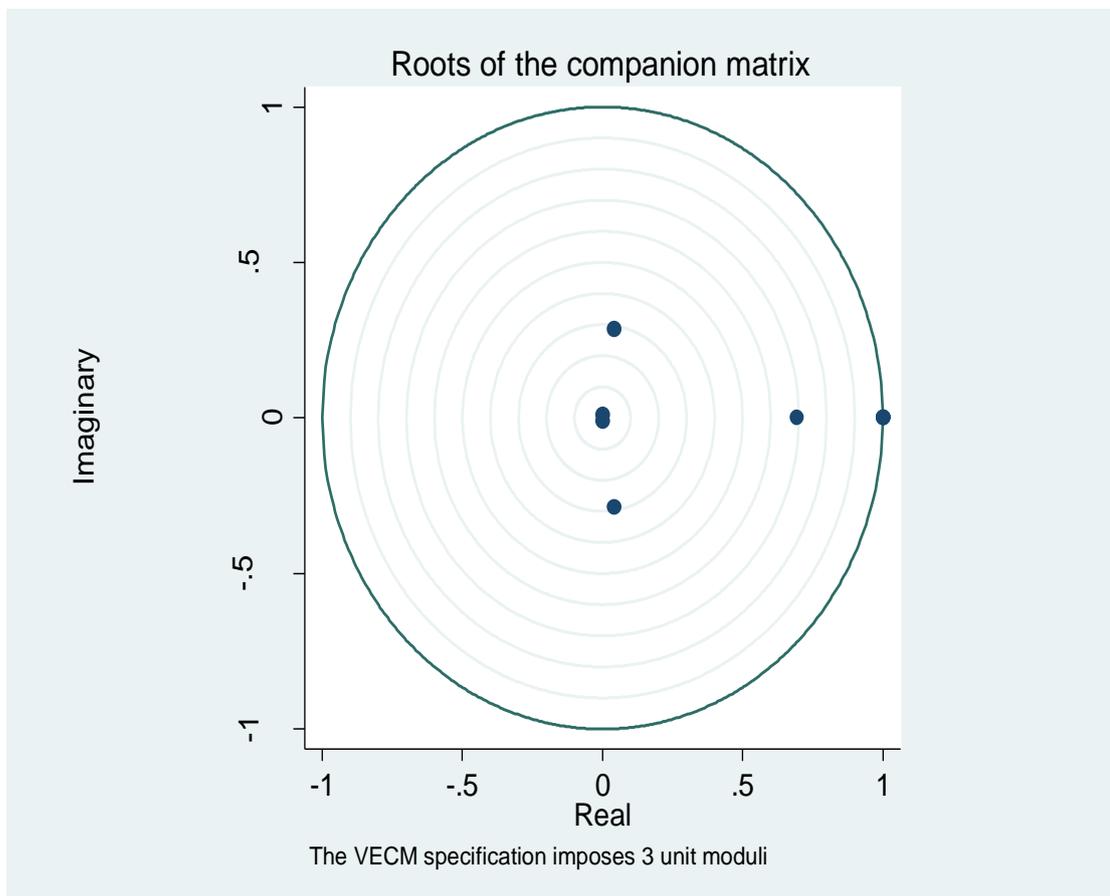


(b) Stability Test Results in the FPI model

Eigenvalue stability condition

Eigenvalue		Modulus
1		1
1		1
1		1
.6939898		.69399
.04086785 + .2865292 <i>i</i>		.289429
.04086785 - .2865292 <i>i</i>		.289429
.00108103 + .01027803 <i>i</i>		.010335
.00108103 - .01027803 <i>i</i>		.010335

The VECM specification imposes 3 unit moduli.



Appendix C

Table 11: Test Results for Distribution of Error Terms

(a). Test Results for the Distribution of Error Terms in the FDI model

Jarque-Bera Test Results				
Equation	chi2	df	Prob > chi2	
D_FDI	3.7e+04	2	0.00000	
D_VXrate	5243.947	2	0.00000	
D_1nXrate	728.432	2	0.00000	
D_GDP	8530.226	2	0.00000	
ALL	5.1e+04	8	0.00000	

Skewness Test Results				
Equation	Skewness	chi2	df	Prob > chi2
D_FDI	1.9868	164.474	1	0.00000
D_VXrate	4.0516	683.969	1	0.00000
D_1nXrate	1.4653	89.459	1	0.00000
D_GDP	4.3512	788.890	1	0.00000
ALL		1726.793	4	0.00000

Kurtosis Test Results				
Equation	kurtosis	chi2	df	Prob > chi2
D_FDI	1.9868	164.474	1	0.00000
D_VXrate	4.0516	683.969	1	0.00000
D_1nXrate	1.4653	89.459	1	0.00000
D_GDP	4.3512	788.890	1	0.00000
ALL		5.0e+04	4	0.00000

(b). Test Results for the Distribution of Error Terms in the FPI model

Jarque-Bera Test Results

Equation	chi2	df	Prob > chi2
D_FPI	4.5e+05	2	0.00000
D_VXrate	5272.220	2	0.00000
D_1nXrate	725.443	2	0.00000
D_GDP	3913.837	2	0.00000
ALL	4.6e+05	8	0.00000

Skewness Test Results

Equation	Skewness	chi2	df	Prob > chi2
D_FDI	13.867	8012.278	1	0.00000
D_VXrate	4.0629	687.795	1	0.00000
D_1nXrate	1.4573	88.493	1	0.00000
D_GDP	3.388	478.272	1	0.00000
ALL		9266.837	4	0.00000

Kurtosis Test Results

Equation	Kurtosis	chi2	df	Prob > chi2
D_FDI	208.1	4.4e+05	1	0.00000
D_VXrate	23.979	4584.425	1	0.00000
D_1nXrate	10.82	636.951	1	0.00000
D_GDP	21.161	3435.565	1	0.00000
ALL		4.5e+05	4	0.00000

Appendix D

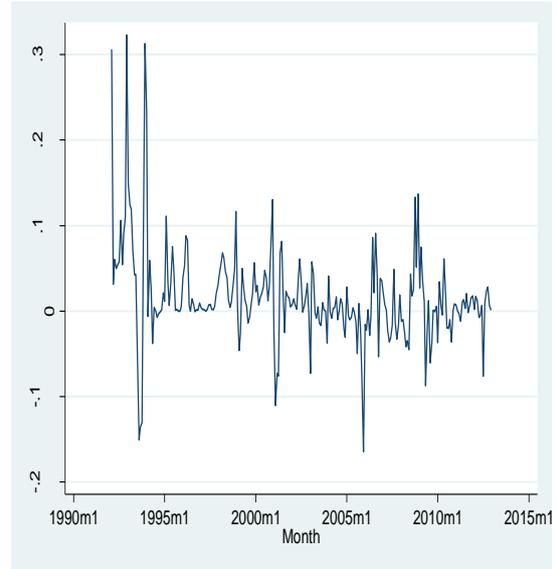
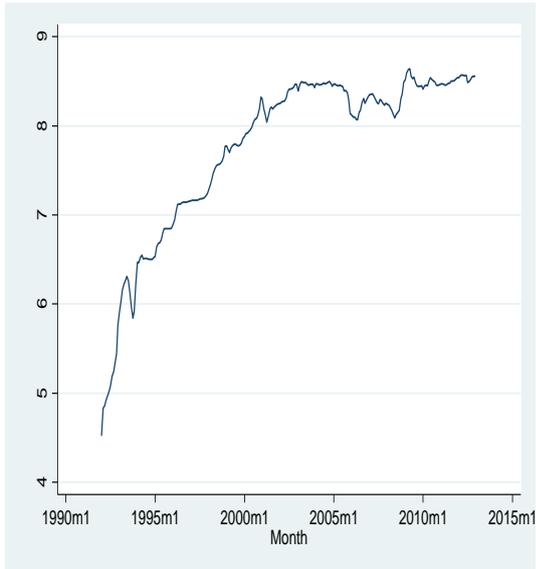
Table 12: Summary Statistics for Variables used

Variable	Observation	Mean	Std. Dev.	Min	Max
lnXrate	252	7.747803	.9381096	4.521789	8.641232
VXrate	252	.0042603	.0107419	.0004819	.0871317
GDP	252	331.2518	89.61224	236.32	539.43
FDI	252	44.40095	45.90122	3.33	165.14
FPI	252	4.184762	14.58689	-6.24	67.75

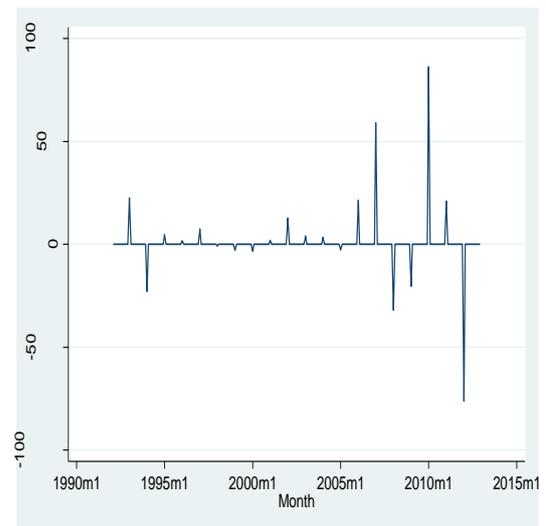
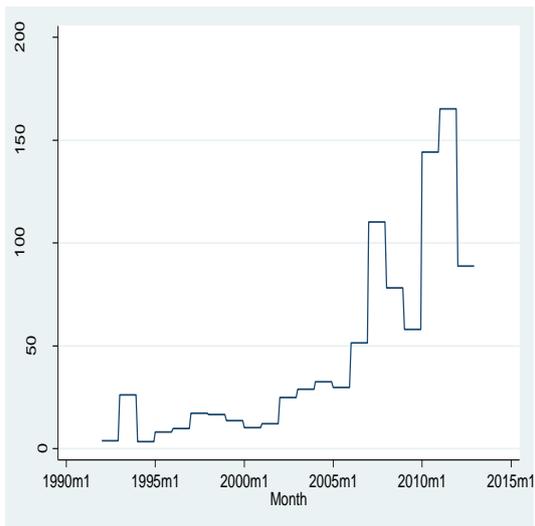
Appendix E

Figure 6: Time plots of levels and first differences

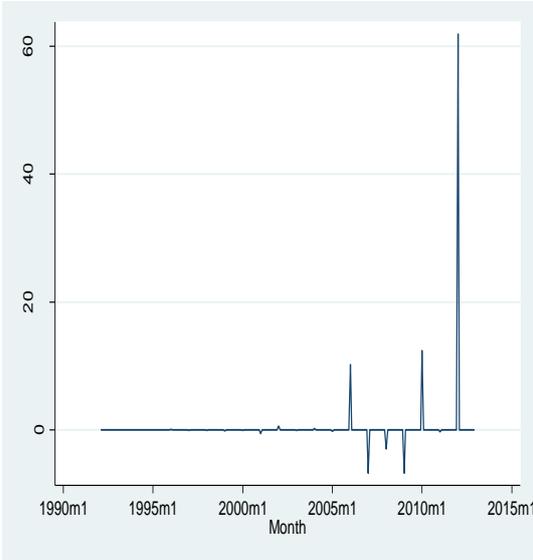
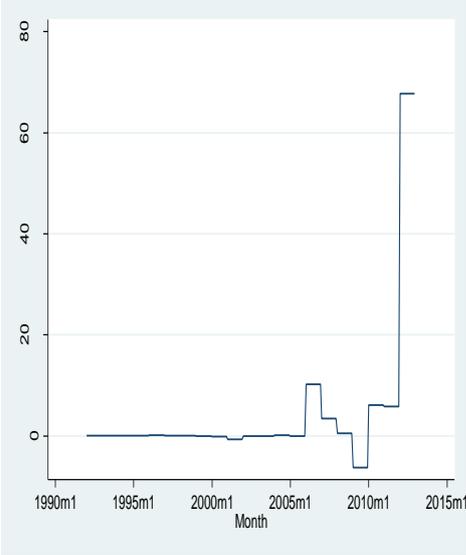
i. Log level and first difference of exchange rate (InXrate)



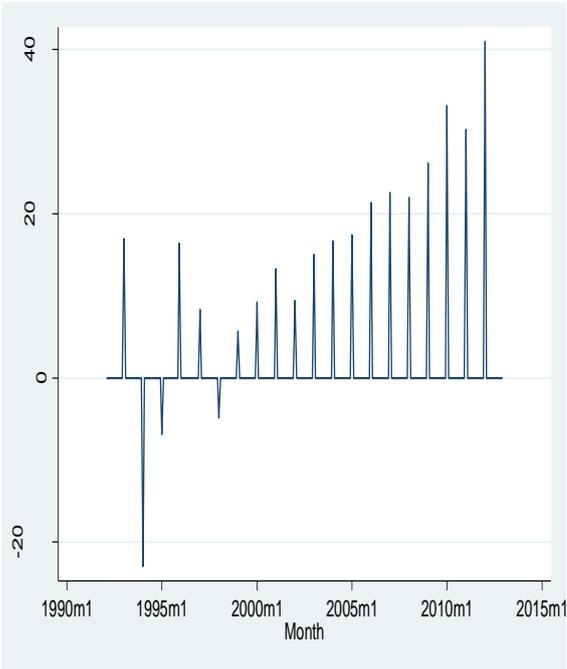
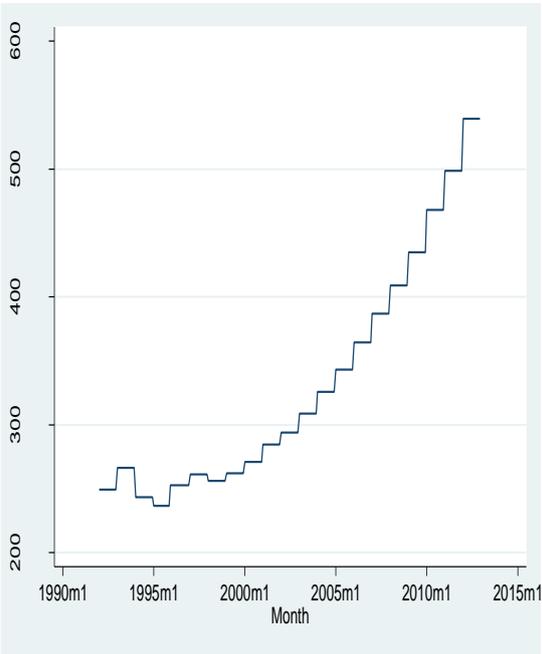
ii. Level and first difference of foreign direct investment (FDI)



iii. Level and first difference of foreign portfolio investment (FPI)



iv. Level and first difference of gross domestic product (GDP)



v. Level and first difference exchange rate volatility (VXrate)

