CAPITAL FLIGHT AND THE ROLE OF EXCHANGE RATES IN NIGERIA, SOUTH AFRICA AND ZAMBIA

SAMSON MBEWE
(Student Number: MBWSAM002)

A dissertation submitted in partial fulfilment for the degree of
Master of Commerce in Applied Economics

In the

School of Economics
FACULTY OF COMMERCE

At the

UNIVERSITY OF CAPE TOWN

Supervisor: Adjunct Professor Mark Ellyne

May 2015

University of Cape Town

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ABSTRACT

The problem of capital flight presents an interesting paradox towards capital accumulation in Sub-Saharan Africa. Though Africa has been labelled as "*the rising continent*" by various researchers, we continue to see capital flight and its adverse effects extend beyond the lack of domestic investment capital, to sluggish economic growth and disquieting poverty rates. This paradox highlights the importance of understanding the drivers of capital flight from Africa. Among the many postulated determinants, this study investigates the effect of the exchange rate on capital flight using 3 case studies from Nigeria, South Africa and Zambia for the period 1970 to 2010. By employing Granger's (1969) causality test, we investigate the causal relation between capital flight and the exchange rate. We further use the Johansen (1988) Method of Cointegration to determine the existence of a long run relationship and estimate a Vector Error Correction Model (VECM) to determine the short run dynamics.

Our granger causality test results suggest that the direction of causality between capital flight and the real exchange rate only holds in the period under analysis and therefore, it should not be assumed to hold in different time periods. Our main findings suggest that capital flight from Nigeria, South Africa and Zambia is habitually motivated by portfolio considerations. We find that capital flight from Nigeria and South Africa is driven by expected currency depreciation while capital flight from Zambia is driven by expected currency appreciation in the long run. Our other findings suggest that other macroeconomic policy errors in the form of inflation unpredictability and foreign direct investment also increase capital flight from Nigeria, South Africa and Zambia. We also find that political factors have a significant role in determining capital flight from Nigeria, South Africa and Zambia. We however find inconclusive evidence of the short run effects in all three countries. It is recommended that the imposition of efficient exchange controls can curb capital flight when implemented concurrently with effective macroeconomic management practices by the fiscal authorities.

Keywords: Capital Flight; Exchange Rates; VECM; Cointegration

ACKNOWLEDGMENTS

I cannot attribute the completion of this dissertation to be entirely of my own effort. In the absence of the following persons during the conceptualization and writing phase, this dissertation would not only have been impossible to complete, but would have been a boulevard of a broken dream. In light of this, I owe my sincere gratitude and lasting appreciation to the following persons:

- Adjunct Professor Mark Ellyne, who notwithstanding his demanding schedule, accepted to assume the role of supervisor during this phase. His commitment towards this dissertation, backed by his experience in both academia and the corporate world enriched me with the wisdom and acumen to stay fixated, motivated and sustain the drive to complete this dissertation.

- Professor Leonce Ndikumana, whose invaluable input helped map a clear trajectory at a time when I was bounded by so much ambiguity regarding the course of this dissertation.

- My lasting appreciation goes to my family for their support both financially, spiritually and morally. Justice Irene Mambilima and Mrs. Mikala Mukongolwa, my two mothers, to whom I remain indebted for I would not have been studying towards this masters' degree if not for them. My aunties, uncles, brothers, sisters, nieces and nephews for their love and support.

- Farai Mazhandu, my sister, who has been a strong support structure towards my study in UCT and during the course of writing this dissertation.
- Special thanks to my friends Josefine Westerback, Gibson Nyirenda, Francis Anguyo, Rabson Kanyinji, Nyasha Kurasha, Dale Mudenda, Peter Wamalwa, Evelyn Bengal, Natasha Nkhoma and others for their continued support, guidance and source of laughter throughout this process.

- The School of Economics staff for their enduring support academically and administratively.

This dissertation is dedicated to my late grandmother, Vesta Nthani Mbewe, to whom I remain indebted to for raising me during my early childhood. "May your soul rest in eternal peace."

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SECTION ONE

INTRODUCTION

The relationship between the exchange rate and capital flight is complex and highly dependent on a multitude of conditions. We have chosen to examine this linkage through 3 case studies, which highlight the importance of varying conditions to this relationship.

1.1 Background

The subsequent end to the debt crisis of the 1980s saw the augmentation of yet another imminent problem in developing countries: the rising levels of capital flight. In various works, capital flight is defined in its most primitive form as the process of accumulating unrecorded assets in foreign institutions by the private sector (Ajayi, 1992; Forfack & Ndikumana, 2010; Yalta & Yalta, 2012). The amount of capital flight from Sub-Saharan (SSA) Africa presents a case worthy of concern, more especially for a continent highly in need of direct resources and investment capital. According to Ndikumana and Boyce (2012), capital flight from Sub-Saharan Africa between the period 1970 and 2010 was estimated to be $ 814 Billion (Constant 2012 US$), which exceeded the amount of foreign direct investment of $306 Billion (Constant 2012 US$) received during this period. These figures are large—capital flight from Sub-Saharan Africa has been larger than its total public debt stock, making Africa a net creditor to the rest of the world (Ndikumana & Boyce, 2002). This situation presents an interesting paradox and thus, a motivation for this study.

The effects of capital flight extend far beyond eroding the fiscal tax base needed for government expenditure to raising the debt services and dampening economic growth (International Finance Corporation, 2005) and slowing poverty alleviation. Although many African countries implemented capital account liberalization (CAL) policies in the 1990s, the goal of increasing foreign investment inflows and reducing the debt stocks has also been undermined by immense capital flight. Various empirical studies (Harrigan et al., 2002; Ndikumana et al., 2013) have sought to investigate the determinants of capital flight based on the proposition that capital flight is categorically driven by portfolio considerations, macroeconomic policy errors and the political turmoil. The studies of Ajayi (2005) and Ayadi (2008) postulate that exchange rate misalignment, weak institutions, corruption, financial repression, risk of expropriation, tax evasion and banking secrecy laws are significant determinants of capital flight.

After the 1980s, several African countries experienced overwhelming currency instability and changes in exchange rate regimes. It was at the same time that significant levels of capital flight from Sub-Saharan Africa began developing. Applied economic theory explains that exchange rate misalignment highlights the errors in macroeconomic policy, which presents a case for capital flight. Uncertainty arising from expected real currency depreciation and appreciation offers an interesting paradox for asset losses by economic agents. When agents anticipate a real depreciation, they tend to engage in capital flight to avoid the risk of loss of purchasing power. Even a real appreciation may trigger expectations of future depreciation. We will discuss the differences between a real exchange rate appreciation resulting from a nominal appreciation, which may represent an improvement in the terms of trade and an increase in purchasing power, versus a real appreciation resulting from the inflation differential and a loss of competitiveness.

The studies of Harrigan et al. (2002), Ayadi (2008), Ndikumana and Boyce (2012), Brada et al. (2013) and Ndikumana et al. (2013) have been at the forefront of the investigation of the impact of the exchange rate on capital flight. Recent studies by Brada et al. (2013) and Ndikumana et al. (2013) focus on exploring this linkage by using panel regressions and find no significant relationship. However, earlier studies by Harrigan et al. (2002) and Ayadi (2008) make use of the single equation Error Correction Model (ECM) for the countries concerned to explore this linkage and find that currency depreciation explains capital flight. The lack of significant results for the panel data approach would indicate that the relationship between capital flight and the exchange rate is not invariant across time and space (countries). The relationship between capital flight and the exchange rate is thus intricate and there are many *a priori* conditions that may affect the direction of causality.

This study adds to the existing literature by offering empirical results towards the contending hypothesis regarding the direction of causality between capital flight and the exchange rate. Further, this study provides a country-by-country comparative analysis using applied time series econometric models while making use of the most recent estimates of capital flight from Nigeria, South Africa and Zambia. This study estimates single country equations which aim to outline that the determinants of capital flight are in certain cases country specific and cannot be generalized as predominantly performed in cross-country panel studies. To the best of our knowledge, no other study exists that investigates the determinants of capital flight for Zambia.

This study provides 3 country case studies on the effect of exchange rates on capital flight from Nigeria, South Africa and Zambia between the period 1970 and 2010. These countries are selected based on the availability of data, their importance in the African economy and whether they have a flexible exchange rate regime. We make use of the Johansen Cointegration and Vector Error Correction Model (VECM) to assess the short run and long run relationships. Our findings suggest that real currency depreciation affects capital flight from Nigeria and South Africa while real currency appreciation explains capital flight from Zambia. We also find significant effects of inflation unpredictability, foreign direct investment and regime durability index on capital flight.

1.2 Goal and Objectives of the Study

The goal of the study is to investigate reasons for capital flight and in particular the impact of the exchange rate. We do this by using 3 large African countries between 1970 and 2010: Nigeria, South Africa and Zambia.

To realize this goal, the following objectives are disaggregated:

- To determine the direction of causality between capital flight and the exchange rate in Nigeria, South Africa and Zambia.
- To econometrically investigate the short run and long run relationship between capital flight, the exchange rate and other economic variables in Nigeria, South Africa and Zambia between 1970 and 2010.
- To develop case studies for Nigeria, South Africa and Zambia on the link between capital flight and macroeconomic variables to identify similarities and differences in relationships across countries.
- To outline the policy recommendations based on the findings of the 3 case studies.

To attain these objectives, Section Two describes the various definitions and measurements of capital flight and provides the theoretical framework and empirical literature on the link between capital flight and the exchange rate. Section Three presents the methodology and applied time series econometric techniques employed in the study. Section Four presents the empirical results for the 3 countries used in the study (Nigeria, South Africa and Zambia). Finally, Section Five sums up the conclusions and policy recommendations.

SECTION TWO

LITERATURE REVIEW

The definition and measurement of capital flight is particularly difficult and complex because it is an "unobserved" variable. Yet, considerable work has been done on this topic because of its importance. Similarly, exchange rate misalignment is not easily defined or measured when the exchange rate is flexible and markets appear to clear. The fact that capital flight and exchange rate misalignment are not easily measured makes this a challenging topic even before identifying any relationship. This section discusses the theoretical relationship between capital flight and the exchange rate, and concludes with a review of the econometric studies on the determinants of capital flight.

2.1 Definitions of Capital Flight

Although most authors agree that capital flight has been a contentious problem, there is a range of definitions over the issue being analysed, including definitions by Bhagwati et al. (1974), the World Bank (1985), Dooley (1986) and Cuddington (1987). The paradoxical assertion of distinguishing between legitimate outflows of capital from 'capital flight' (Harrigan et al., 2002) has produced mixed definitions with dissimilar estimates of capital flight in each case. In its simplest form, capital flight can be defined as the process of accumulating unrecorded assets in foreign institutions by the private sector (Ajayi, 1992; Makochekanwa, 2007; Ndikumana & Boyce, 2010; Yalta & Yalta, 2012).

It is important to note that capital flows that end up as capital flight can be 'licit' or 'illicit'. Licit capital defines the capital legally acquired, transferred or utilized, while illicit capital describes capital flows illegally acquired, transferred or utilized by domestic economic agents (Kar & LeBlanc, 2012). Whether licit or illicit, capital flows become capital flight when they are in contravention of capital control regulations; whether they are fleeing the country due to tax evasion, or to avoid the risk of loss as a result of expropriation, or due to risk from bad macroeconomic management. Even though 'illicit capital flows' and 'capital flight' are used interchangeably in the literature, Ndikumana et al. (2013) contend that they are two different concepts. Illicit capital flows may be classified as capital flight if they accumulate abroad, but this may not hold true if part of the illicit capital is utilized to finance imports, which eventually return to the resident's home country.

Views of capital flight have changed overtime and an earlier study by Khan and Haque (1985) defines capital flight in relation to the reaction of domestic and foreign investors' to an asymmetric risk of expropriation. They suggest that investors will avoid the risk of expropriation by investing abroad while financing domestic investment through foreign funds. They however assume non-existence of costs related to foreign investment.

Deppler and Williamson (1987) ascribe to the view that capital flight is driven by uncertainties faced by domestic economic agents against potential capital losses emanating from risk of currency depreciation, expropriation or debt repudiation. They also suggest that uncertainties can emanate from market distortions such as financial repression or stringent exchange control regulations. This would perpetuate capital flight if market distortions decrease the value of an asset as compared with its value if invested abroad. However, they acknowledge that general capital outflows (non-capital flight) are commonly driven by maximizing the returns on international portfolio management and diversification, as opposed to the notion of avoiding large financial losses. In light of this, their definition only qualifies an outflow of capital as capital flight if the transfer of capital in response to losses and risks is considered to be 'large' in relation to the capital deployed.

Ashman, Fine and Newman (2011) describe the phenomenon of capital flight as that of a rational market wherein the balance of risk and reward determines the portfolio choices economic agents make. More importantly, they redefine capital flight in the South African context as capital not entirely subject to the market mechanism and which has been influenced by the peculiar history of the apartheid era.

Thus, the empirical literature on the definition of capital flight attests to the existence of diverse views among researchers and policy makers. This study accords to the definition that capital flight refers to *unrecorded* private capital outflows fleeing the domestic economy to circumvent any risk or loss due to changes in macroeconomic policy errors, political turmoil as well as asset diversification.

2.2 Measurements of Capital Flight

Owing to the different definitions of capital flight, as well as its "unrecorded" nature, the measurement of capital flight is particularly difficult and poses a huge challenge in deriving a concise method of measurement. Notwithstanding these problems, there are four methods that have received the most attention, comprising (i) the Dooley Method; (ii) Trade Misinvoicing Method; (iii) Hot Money Method; and (iv) Residual Method.

2.2.1 Dooley Method

The Dooley Method (Dooley, 1986) views capital flight from an entirely behavioural perspective. This method suggests that capital flight can be viewed as all outflows of capital held in foreign countries, but not within the reach of the domestic monetary and fiscal authorities. He captures this relationship by focusing on the stock of foreign assets owned by private individuals that do not yield any income for domestic residents. To achieve this, he starts by calculating capital flight with a focus on the total capital outflows:

$$TCO_t = FB_t + NFI_t - NEO_t - WBIMF_t - CA_t - OFR_t \tag{1}$$

where TCO denotes the total outflows of capital at time period t; FB refers to foreign borrowing as presented in the balance of payments (BoP); NFI means net investment flows; NEO is net errors and omissions (treated as a debit entry); $WBIMF$ is the difference between the World Bank's report on the change in stock of external debt and the IMF balance of payment statistics on foreign borrowing; CA is the current account deficit; and OFR is official foreign reserves.

Capital flight is given by:

$$CF = TCO_t - EA_t \tag{2}$$

where CF[1] is capital flight at time period ; TCO is the result of Equation 1; and EA refers to external assets derived as a ratio of reported interest earning to the United States deposit rate.

(b) Hot Money Method

The hot money method, adopted by Cuddington (1986), determines the magnitude of capital flight by considering the speculative capital flows (also referred to as *hot money*) of a short nature that adjust to intermittent interest rate differentials, financial or political uncertainty, contractionary fiscal policy and restrictive capital or exchange controls.

Cuddington measures hot money by using the balance of payment. He treats the 'errors and omissions' entry as an indication of private capital flows or *hot money*. The 'errors and

[1] See Dooley (1986 & 1988) for a detailed discussion on this method.

omission' is the discrepancy item that emanates when the debit and credit side of the capital and current account of the balance of payment do not balance. This could happen when a surplus on the combined current and capital account is not matched by increase in reserves assets. In this case, the net errors and omissions would be negative, indicative of positive capital flight. The Hot Money Method can thus be summarized as follows:

$$Cf = SKF + EO \tag{3}$$

where SKF signifies the recorded short term capital flows; and EO are the errors and omissions. This method uses both 'recorded' and unrecorded flows to measure capital flight.

(c) Residual Method

The residual method, proposed by the World Bank (1985), has been used extensively in modern day economic literature. This method measures capital flight by determining the difference between the sources of capital flows and the respective uses of these capital flows. On the one hand, the sources of capital flows could be from inflows of net foreign investment or the net increase in external debt. On the other hand, the uses of capital flows could be to finance the current account deficit or make additions to reserves. Capital flight, under the residual method can be estimated as follows:

$$CF_t = ED_t + NFI_t + CAB_t - \Delta R_t \tag{4}$$

where CF refers to capital flight at time period t; NFI_t is the net foreign investment flows; ED refers to the change in stock of gross external debt; CAB is the current account balance (deficit is negative); and ΔR_t is the change in the stock of foreign reserves.

Based on the residual method algorithm presented in Equation 4, Ndikumana et al. (2013) make three key extensions. They adapt the first extension (Boyce and Ndikumana, 2001) by calculating the change in external debt ED by adjusting the end-of-year debt stock to account for exchange rate fluctuations in the course of the year. They further extend[2] the algorithm by adjusting the change in debt to incorporate debt write-offs, considering that despite not having matching entries in the BoP, they are reported as a reduction in the debt stock. They make the third extension by accounting for unrecorded remittances.

[2] See Ndikumana and Boyce (2010) for a detailed adjustment to the algorithm.

This study makes use of data generated through the residual method algorithm as extended by Ndikumana et al. (2013). This method appears superior to the other two methods. For example, in a study by Schneider (2003), it is argued that the Dooley method is highly subject to issues such as the structure and level of the rate of interest and the consistency of the capturing of outstanding external claims, which may bias the estimation of capital flight due to huge measurement errors.

The hot money method proposed by Cuddington (1986) suffers a significant drawback in that it only incorporates short-term capital flows when measuring capital flight, whereas a study done by Hernes and Lensink (1990) argue that capital flight can also be composed of long term capital flows. This approach depends on 'recorded' short-term flows, which we prefer not to directly call capital flight. Furthermore, the high reliance on 'errors and omissions' from the balance of payments may simply reflect other measurement errors and does not necessarily confirm the existence of capital flight as we defined it.

2.3 The Exchange Rate and Misalignment

The exchange rate is defined as the rate at which a country's (domestic) currency can be exchanged for a unit of foreign currency (MacDonald, 2007:2) and it is commonly quoted in either nominal or real terms. An increase in the nominal exchange rate measured in local per foreign currency would indicate a depreciation. The real exchange rate is defined as the nominal exchange rate adjusted by the price level in the domestic country relative to the foreign country's price level (Overseas Development Institute, 1985), or equivalently as the foreign price level (expressed in local currency) relative to the domestic price level.

$$RER = NER\left(\frac{p^f}{p^d}\right) \tag{5}$$

where RER is the real exchange rate; NER is the nominal exchange rate; and $\left(\frac{p^f}{p^d}\right)$ is the ratio of foreign prices (USA) to domestic prices.

An increase in the real exchange rate depicts a rise in the foreign price level compared to the domestic price level (all measured in domestic prices) similarly indicates a real depreciation. Black (1976) depicts this as the amount of goods and services in the domestic country that can be exchanged for the goods and services in a foreign country, which is rather like a terms of trade effect.

The nominal and real exchange rates can also be measured as bilateral or effective exchange rates. A bilateral exchange rate is the rate of exchange between two currencies (for instance Rand/US$), whereas the effective exchange rate (or multilateral exchange rate) measures the rate of exchange between the home currency and a basket of partner currencies (MacDonald, 2007:28). The real effective exchange rate (REER) can be viewed as a weighted average of the real bilateral exchange rates, where weights represent normalised partner trade shares.[3]

Economic theory suggests that it the real exchange that is ultimately responsible for changes in the current account balance through the Marshall-Lerner conditions (MacDonald, 2007:28).[4] However, we emphasise that the real exchange rate may move owing to either movements in the nominal exchange rate or in relative prices. This source of a real appreciation can be important in our latter analysis and lead to differing conclusions. Generally speaking, an appreciation in the nominal exchange rate may represent a shift in the terms of trade, a significant improvement in the current account (possibly due to a discovery and export of a new mineral), or perhaps due to a major productivity shift. All else being equal (i.e. no change in relative prices), this creates a real appreciation that improves the countries international purchasing power without necessarily leading to a big change in the current account. However, if domestic inflation is far higher than partner/competitor countries' inflation, then, all other things being equal (like the nominal exchange rate remaining stable), the real exchange rate appreciates and the country experiences a loss of competitiveness that is most likely to lead to a deterioration of the current account. Thus, the cause of a real appreciation (or depreciation) may have different impacts on the balance of payments.

Due to frictions, price rigidities and other economic factors, the real exchange rate may be misaligned. This could measure the deviation of the actual real exchange rate from some "equilibrium real exchange rate" that would prevail at a simultaneous full employment internal and external balance[5] (Razin & Collins, 1997:1). Thus, the actual real exchange rate

[3] The same is true for the nominal effective exchange rate (NEER). The two are related through the relative price index of the home country to the weighted basket of prices of its trading partners.
[4] The Marshall-Lerner conditions state that the trade balance will improve for a real depreciation if the quantity adjustment of imports and exports is greater than the price adjustment or the sum of the import and export price elasticities are greater than one.
[5] According to Razin and Collins (1997:1), this refers to "the RER that would have prevailed if the economy was in a simultaneous internal and external balance. An internal balance refers to an economy operating at full employment and at full capacity while the external balance refers to a country maintaining a sustainable current account position considering the countries capital position"

that clears the market for an economy in disequilibrium is likely to be in disequilibrium as well. There is also the case of a disequilibrium real exchange rate that is being prevented from adjusting by institutional constraints, such as foreign exchange rationing. In such a case, the nominal exchange rate may not move, but the queue for foreign exchange lengthens. Deviations in the real exchange rate from some underlying equilibrium result in either an "overvalued currency" or "undervalued currency". According to Saheed and Ayodeji (2012), an overvalued currency implies that the real exchange rate persistently depreciates from its current equilibrium while an undervaluation implies that the real rate persistently appreciates from its current equilibrium.

Conventionally speaking, when a country's currency is overvalued, exports become more expensive and imports become cheaper. We would therefore expect the volume of exports to decrease while the volume of imports increases and the current account to worsen. This might be the result of real exchange rate appreciation due to higher domestic inflation without any offsetting nominal depreciation, as noted above. If there is an expectation of a corrective nominal depreciation, to bring the real rate back towards equilibrium, there would be a strong incentive for capital flight to increase, as economic agents would prefer to hold foreign currency asset resources abroad to avoid the risk of loss of the domestic currency value. Similarly, there may be cases when the local currency is undervalued and expected to appreciate that may make capital inflows (and reverse capital flight) attractive. Again, we should distinguish whether the source of the real appreciation is due to relative prices or the nominal rates.

2.4 Theoretical Relationship between Capital Flight and the Exchange Rate

Various empirical analyses (Cuddington, 1986; Lessard & Williamson, 1987; Pastor, 1990; Ajayi, 1992) argue that real exchange rate misalignment is among the primary determinants of capital flight. Currency uncertainty remains an important source of currency depreciation. In times when the fiscal authorities indorse exchange rate policies promoting short-run real currency appreciation of the domestic currency (Ajayi, 1992; Harrigan et al., 2002), economic agents tend to convert their assets into foreign assets claims while they try to avoid assets losses related the correction of the overvalued real exchange rate. Part of these foreign claims would however be in the class of capital flight. In the real world, it is however, problematic to accurately measure real exchange rate expectations.

We outline our basic model built on the portfolio choice approach, and make use of the interest rate parity in Equation 6 below to best understand how capital flight is driven by higher expected returns or the fear of asset loss arising from expected currency depreciation. When all else is equal,[6] the standard interest rate parity equation should hold:

$$i^d = i^f + \frac{E(NER)-(NER)}{NER} \tag{6}$$

where i^d is the domestic interest rate; i^f is the foreign interest rate; $(i^d - i^f)$ is the interest differential; $E(NER)$ is the expected nominal exchange rate; and NER is the current level of the nominal exchange measured in local/foreign currency.[7] Thus, the return to a foreign investor (an American) of investing in a foreign country (South Africa) is equal to the domestic (South African) interest rate (or rate of return) less the expected percentage change in the exchange rate, *ceteris paribus*.

Given the linkage between the nominal and real interest rate, we note this in Equation (7) below:

$$i^d = \pi^d + r^d \tag{7}$$

where π is the inflation rate, we can turn this into the equivalent real Equation (8) as shown below:

$$r^d - r^f = \frac{E(RER)-(RER)}{RER} \tag{8}$$

[6] Forgetting political risk premia, productivity differentials, etc.
[7] So an increase represents a depreciation.

where r^d is the domestic interest rate; r^f is the foreign interest rate; $(r^d - r^f)$ is the interest differential; $E(RER)$ is the expected real exchange rate; and RER is the current level of the real exchange measured as the foreign/domestic price level (in domestic currency).[8]

Now imagine that there is an expectation of a depreciation shock and the effects of which can be shown using Figure 1 below which represents the foreign exchange market in Panel (a); the loanable funds market in Panel (b); and the net capital outflow in Panel (c). Noted by a movement from RER_0 to RER_1[9], an expected depreciation shock effectively reduces the expected return to an American investor who invests in South African government securities. Therefore, an expected decline in this yield will motivate the American investor to withdraw his portfolio investments from South Africa (shown by an increase in foreign loanable funds from LF_0 to LF_1) and create a capital outflow. The capital outflow reduces liquidity (the market for loanable funds) in the South African financial market, which then causes South African interest rates to rise (as shown by a movement from r_0 to r_1). The process eventually returns the market to interest rate parity at an interest rate and new expected exchange rate equilibrium.

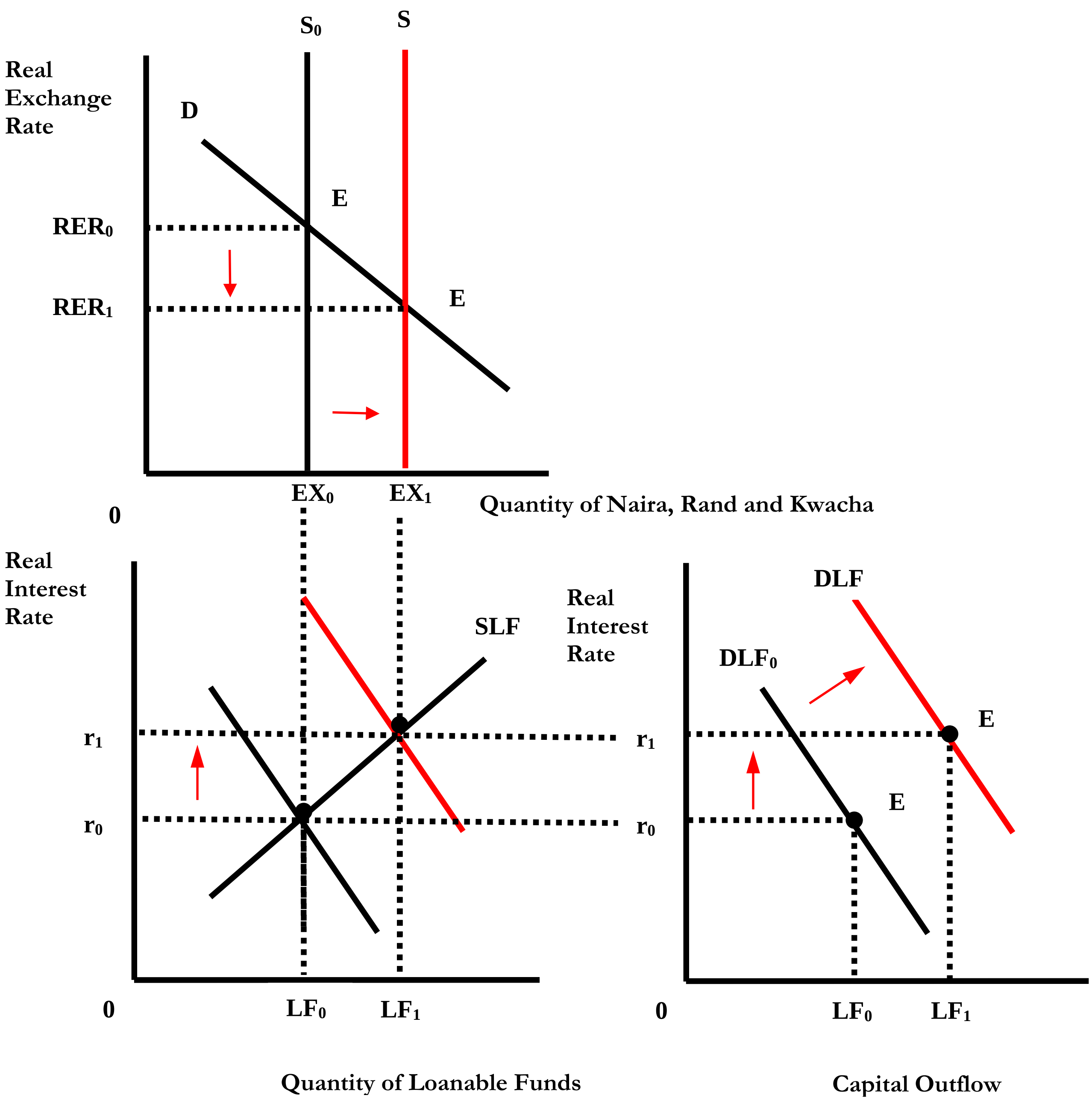
2.5 Empirical Literature

Several important empirical works have emerged that examine key determinants that influence capital flight. A study by Ng'eno (2000) investigates the determinants of capital flight in Kenya from a macroeconomic perspective and finds that capital flight appears to be prevalent in periods when the balance of payment is in crisis, which he attributes to an unfavourable outlook for the expected return on local currency. He further finds that a real currency appreciation prompts capital flight. Interestingly, he suggests that capital flight will increase with economic growth if institutional quality remains poor.

[8] In this case an increase represents a depreciation.

[9] The exchange rate is measured in foreign currency per unit of local currency so that a decline is a depreciation. It is shown as the inverse to the way it has been described above to have a correctly sloping demand curves.

(a) Foreign Exchange Market in Nigeria, South Africa and Zambia



(b) Loanable Funds Market

(c) Net Capital Outflows

Figure 1: A Model for Capital Flight and the Role of Exchange Rates

Source: Author's own presentation.

Nyoni (2000) investigates the determinants of capital flight in Tanzania from a macroeconomic perspective and introduces a dummy variable in his econometric model for a political shock. He finds that capital flight exhibits habit formation characteristics i.e. the lagged value of capital flight determines the current level of capital flight. His findings further suggest that the interest rate differential[11] and exchange rate fluctuations[12] have a positive effect on capital flight while the rate of real GDP growth has a negative effect on capital flight. The political shock dummy, however, has no significant influence on capital flight.

A study by Ndikumana and Boyce (2003) examines the determinants of capital flight from 30 Sub-Saharan African countries between the period 1970 and 1996. They explore the effects of inflation, exchange rate appreciation, the role of the political environment and governance indicators, fiscal policy indicators, financial development, the interest rate differential and past capital flight on capital flight. They find that past capital flight has a statistically significant relationship with the current level of capital flight while the growth rate differential, budget surplus, the volume of domestic credit to the private sector and the political-governance index have a negative effect on capital flight. On the other hand, the effect of inflation, the interest rate differentials and real exchange rate appreciation have a statistically insignificant effect on capital flight.

Harrigan et al. (2002) analyses the impact of macroeconomic fundamentals on capital flight from the Malaysian economy during the period 1976 to 1990. We review this international study with ample focus on the methodology employed and the determinants of capital flight being investigated. Harrigan et al. apply a cointegration analysis using a single-equation and the general-to-specific procedure. They estimate four unique models by using four measures of capital flight data as defined by: Dooley, World Bank, Private Claims, and the Balance of Payments measures. The explanatory variables used in the study include the exchange rate, external debt, domestic GDP growth, inflation, interest rate differentials, uncertainty and foreign direct investment. They find the existence of a long run relationship between capital flight (for all measures of capital flight) and real GDP growth, exchange rate fluctuations, foreign direct investment and the changes in external debt. The results of the short dynamics are mostly consistent with the results of the long run relationship.

[11] He calculates the interest rate differential by taking the difference between the foreign interest rate (USA) and the domestic interest rate (Tanzania) and therefore, a rising differential leads to more capital flight.

[12] Nyoni (2000) considers exchange fluctuations as real exchange rate movements.

Ayadi (2008) investigates the determinants of capital flight in Nigeria between 1970 and 2008 by making use of the error correction model (ECM). He uses the capital flight data estimated by the residual method. Ayadi's model explains capital flight as a function of the: lag of the total debt stock, exchange rate, interest rate differentials, the real GDP and trade balance. The econometric results suggest there is cointegration between capital flight and all of the explanatory variables. The results further suggest that in the short run and long run, changes in currency depreciation, lagged debt stock and the trade balance have a positive effect on capital flight while changes in the real GDP growth and the interest rate differential have a negative effect on capital flight. This study, however, does not find any significant effect of inflation on capital flight.

A recent study by Brada, Kutan and Vuksic (2013) investigates capital flight in the presence of domestic borrowing in 10 Central and Eastern European countries by making use of panel regressions for the period 1996 to 2009. They postulate that the determinants of capital flight include the real interest rate differential, current account balance, fiscal deficit, real GDP growth, real exchange rate, private credit, foreign direct investment, polity score, lagged capital flight, chin-ito index, trade liberalization index, current account openness, and index of economic freedom. Their findings indicate that the lagged capital flight, real GDP growth, foreign direct investment, index of economic freedom and financial liberalization have statistically significant and positive effect on capital flight. The results further suggest that the real interest rate differential, fiscal deficit and private credit have a statistically significant but negative effect on capital flight. The real exchange rate, current account balance and polity score have statistically insignificant positive effects on capital flight. In their earlier study, Brada et al. (2012) found similar results except for a non-significant coefficient on the regime durability index.

Ndikumana et al. (2013) provide updated estimates on capital flight for 39 African countries from the period 1970 to 2010. They present a comprehensive econometric investigation of the various domestic and external factors driving capital flight by making use of the General Method of Moments (GMM) estimation techniques and Panel Fixed-Effects Regressions. Among many factors, they limit their focus to the macroeconomic environment, investment risk and returns, governance, capital account openness and structural factors. The findings suggest that the macroeconomic environment, proxied by the GDP growth, has a negative and significant relationship with capital flight. The net credit to the private sector as a ratio to

GDP, used as a proxy for financial development, is insignificant and thus exhibits no effect on capital flight. They find no significant relationship between the exchange rate and capital flight. Their results indicate that few variables are consistently significant for all 39 countries, which may be indicative of differing relationships or conditions across countries.

A recent study by Onodugo et al. (2014) presents an econometric investigation of capital flight from Nigeria for the period 1970 to 2010. They use the two-step Engle-Granger Approach to determine the effect of changes in the exchange rate, trade balance, real GDP growth, interest rate differential, index of political climate and the manufacturing output on capital flight. Their findings suggest that the one period lagged capital flight and the other explanatory variables—except the exchange rate and the domestic political environment index—have a significant and positive effect on capital flight. Although the coefficient on the exchange rate is statistically insignificant, the sign conforms to *a priori* expectation. On the other hand, our study finds a statistically significant effect of the exchange rate on capital flight in Nigeria using the Johansen cointegration—highlighting the importance of using the Johansen method of cointegration to obtain significant and efficient parameters through imposing exogeneity restrictions due to the many variables in the model.

In the studies surveyed above, we note the similarity of independent variables used to explain capital flight, with fairly consistent results. Table 1 below further provides a summary of the literature on the determinants of capital flight which are highly relevant to the determinants of capital flight in this study. We note that the four variables of interest each have a significant relationship with capital flight and some with varied expected signs. This study contributes to the existing literature by providing empirical results towards the contending hypothesis concerning the direction of causality between capital flight and the exchange rate. Through a country-by-country econometric comparative analysis using the most recent estimates of capital flight from Nigeria, South Africa and Zambia, this study adds to the existing literature and fills the gap between cross-country panel studies and single country studies. This study estimates single country equations which aim to outline that the determinants of capital flight are in certain cases country specific and cannot be generalized as predominantly performed in cross-country panel studies. Further, to the best of our knowledge, no other study exists that investigates the determinants of capital flight for Zambia.

Table 1: Summary Results of Empirical Literature

Author (s)	*Number of Countries*	*Single Equation or Panel Regression*	*Real Currency Depreciation*	*Foreign Direct Investment*	*Inflation*	*Regime Durability*	*Interest Rate Differentials*	*GDP Growth*
Vos (1992)	1	Single	+	n.s.e	Insig.	n.s.e	n.s.e	-
Gibson and Tsakalotos (1993)	1	Single	+	n.s.e	n.s.e	-	-	n.s.e
Ayadi (2008)	1	Panel	+	n.s.e	n.s.e	n.s.e	-	-
Harrigan et al. (2002)	1	Single	+	-	+	n.s.e	+	-
Brada et al. (2013)	10	Panel	Insig.	+	+	n.s.e	-	+
Ndikumana et al. (2013)	39	Panel	n.s.e	n.s.e	Insig.	+	-	-
Onodugo et al. (2014)	1	Single	Insig.	n.s.e	n.s.e	+	+	+

Notes : n.s.e = not studied in the estimation; Insig. = statistically insignificant link; (-) negative or (+) relationship.
: Gibson and Tsakalotos (1993), Ayadi (2008) and Brada et al. (2013) calculate the interest rate differential by subtracting the domestic from the foreign interest rates.
: Harrigan et al. (2002) calculate interest rate differential by taking the difference between the foreign and the domestic interest rate.
: Ndikumana et al. (2013) calculates the interest rate differential by subtracting the African country's deposit rate from the 3-month USA Treasury bill.

Source : Author's presentation

SECTION THREE

METHODOLOGY

This study provides country case studies for Nigeria, South Africa and Zambia for the period 1970 and 2010 to study the relationship between capital flight and the exchange rate. The sample selection is largely motivated by the availability of data not only on capital flight, but also on our other variables of interest in this study. The data limitations restrict our sample selection for South Africa and Zambia to 1973-2010 and 1972-2010, respectively. This study exclusively makes use of secondary data in the form of annualized time series. The three countries are selected based on condition that they belong to Sub-Saharan Africa (SSA) with readily available data and have a flexible exchange rate regime.

This research design follows the work of Ayadi (2008) in his analysis of the linear determinant of capital flight in Nigeria. We examine all three countries independently by employing a step by step approach. Our study begins with a Granger causality test. We then look for long-term relationships using Johansen Cointegration and then apply a Vector Error Correction Model (VECM) to carry out the short-term analysis. We confirm the robustness of our estimates by testing for normality of residuals, autocorrelation, heteroskedasticity and weak exogeneity. All variables are tested for the presence of unit roots in the data.

The relationship between capital flight and the exchange rate is complex and there are many a priori arguments regarding the direction of causality. Moreover, we try to show that it is the misalignment which is the factor of interest and not the level.

3.1 Model Specification

We have employed a basic, simple model using four explanatory variables that represent key demand, supply and risk factors, explained in detail below. The real exchange rate (RER) is a price variable linked to expected domestic asset returns through interest rate parity (Equations 6 and 8). Our premise is that money flows out of the country if real returns are expected to decline or if there is expected real currency depreciation. Foreign direct investment is used as a proxy for the supply side or source of foreign exchange that funds capital flight. Inflation is used as a proxy measure for macroeconomic uncertainty, which is linked to investor confidence and business conditions as well as the interest rate. We use the regime durability index to capture the importance of political risk, as it may be linked to the potential for corruption.

We specify our model by identifying a long run capital flight relationship as specified in the general model below:

$$
\begin{aligned}
Cf = \beta_0 &+ \beta_1(\text{Portfolio Approach}) \\
&+ \beta_2(\text{Supply of Forex}) \\
&+ \beta_3(\text{Uncertainty}) \\
&+ \beta_4(\text{Politics}) \\
&+ \varepsilon \qquad (9)
\end{aligned}
$$

where the dependent variable is:

CF – Capital flight/nominal GDP ratio (%).

Portfolio Approach variable is:

RER – Real exchange Rate is foreign/domestic price (all in domestic currency).

Uncertainty variable is:

INF – Inflation Unpredictability (%).

Supply of Forex Variable is:

FDI – Foreign Direct Investment/nominal GDP (%).

Politics variable is:

RDUR – Regime Durability Index scale of 1 to 20.

3.2 Data

This sub-section presents the variables used in the study and the various sources used to collect these data, including the sources of the empirical and theoretical literature. The graphs of all the variables are shown below and Appendix 1 gives additional details on the summary statistics of the data, including the data utilized in the econometric analysis.

3.2.1 Data Sources

The time series data on capital flight for the period 1970 to 2010 was constructed by Ndikumana and Boyce (2012) and collected from the Political Economy Research Institute

(PERI)[13]. The macroeconomic time series data are collected from the World Bank's *World Development Indicators* (WDI)[14] and include: the consumer price index; the nominal exchange rate, the inflation (%); the nominal GDP (US$ Dollars) and foreign direct investment. The Exchange Control Restrictive Index (ECRI) obtained from Ellyne's (2014) workshop on the validation of the creation of ECRI for the Southern African Development Community (SADC). Finally, the time series data on governance are collected from the Polity IV database[15] and these include the regime durability index.

3.2.2 Variable Explanations

Our choice of explanatory variables is informed by the results of selected determinants of capital flight from the empirical literature in Sub-Section 2.5 and reported in Table 1 above. We base the model on the portfolio choice approach theory of capital flight described in Sub-Section 2.4 and Figure 1.

(a) Capital Flight

The share of Capital flight/GDP is our dependent variable. Capital flight is defined as unrecorded private capital outflows leaving the domestic economy,[16] which is normalized as a share of nominal GDP (in US dollars) to allow for cross country comparisons. We hypothesize that the size of capital flight is due to higher expected returns overseas or to circumvent any risk or loss as a result of changes in macroeconomic policy errors, political turmoil as well as asset diversification. Capital Flight is estimated using the residual method incorporating the extensions from Ndikumana et al. (2013)[17]. The charts of capital flight to GDP presented in Figure 2 below do not appear to show any overt trends or consistency across countries.

(b) Portfolio Choice Approach - Exchange Rate

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[13] Available: http://www.peri.umass.edu/300/#c2324 [2014, March, 20].
[14] Available: http://data.worldbank.org/data-catalog/world-development-indicators [2014, June, 15].
[15] Available: http://www.systemicpeace.org/polity/polity4.htm [2014, June 15]
[16] Capital flight may also be negative or inward.
[17] They adapt the first extension from Boyce and Ndikumana (2001) by adjusting the end-of-year debt stock to account for exchange rate fluctuations in the course of the year. They further adjust the change in debt to incorporate debt write-offs, considering that despite not having matching entries in the BoP, they are reported as a reduction in the debt stock.

We calculate the bilateral real exchange rate versus the US dollar for each domestic country currency—Nigeria (Naira), South Africa (Rand) and Zambia (Kwacha)—as follows. [18]

$$RER = NER\left(\frac{US\ Price\ level}{Domestic\ Price\ level}\right) \tag{10}$$

where NER is the nominal exchange rate; the US price level and the Domestic Price level are proxied using the US and domestic consumer price indices (CPI). The real exchange rate may be influenced by both the nominal exchange rate and the relative price level, as explained in Sub-Section 2.3. Our basic premise is that domestic economic agents will try to maximise their return on assets and will therefore convert their assets into foreign claims when they expect real exchange rate depreciation, perhaps correcting for a real exchange rate overvaluation. It is however difficult to accurately measure currency expectations (Harrigan et al., 2002) and similarly, it remains a daunting task identifying a highly suitable proxy to further depict it. In the context of this study, the availability of data inevitably skews us towards using the real exchange rate as a proxy for currency expectations. Therefore, *a priori* expectation is that currency depreciation has a direct and positive relationship with capital flight. The charts of the real exchange rate presented in Figure 3 below show an early period of relative stable real exchange rates followed by trended depreciations for all countries, starting at different times and to much different degrees.

(c) Sources of Forex - Foreign Direct Investment

Foreign direct investment, which is the long term investment by a non-resident in the reporting country, is scaled by nominal GDP to identify its relative size. In the empirical literature, Brada et al. (2013) argue that inward foreign direct investment tends to create liquid assets for domestic owners during mergers & acquisition and part of these assets wind up as capital flight. It is important however to note that foreign direct investment does not encourage capital flight, but rather, provides the largest source of private capital flows. We scale the foreign direct investment by nominal GDP (US$) in order to account for differences in economic size among countries. A *priori* expectation is that foreign direct investment has a positive relationship with capital flight. The charts of foreign direct investment to GDP presented in Figure 4 below show varying size and trends among the 3 countries being studied.

[18] In this study, we create a real exchange rate against the dollar by using CPI from the United State of America (USA).

(d) Uncertainty and the Real Interest Rate - Inflation

The macroeconomic effects of uncertain inflation extend beyond falling business confidence, volatile interest rates and varied consumption patterns. Therefore, rising inflation uncertainty serves as a signal for imprudent macroeconomic policy. Rising inflation would erode the real interest rate, so economic agents would be expected to guard against a falling real return by increasing their demand for foreign claims. Part of these claims would be in the form of capital flight. Inflation uncertainty is estimated following Ndikumana and Boyce (2011b), who created a simple trended, auto-regressive inflation predictor and then took the absolute value of the difference between predicted inflation and the actual inflation in Equation (11). If inflation was readily predictable with this constant forward—and backward—looking expectations, the absolute value of the residual would be zero.

$$(Inf_t = \beta_0 + \beta_1 Trend + \beta_2 Inf_{t-1} + \varepsilon) \qquad (11)$$

Following Ndikumana and Boyce, we calculate the predicted inflation by using the absolute value of the error term as the measure of predictability. A *priori* expectation is that unpredictability has a positive relationship with capital flight. The charts of inflation unpredictability presented in Figure 4 below differ across countries and vary considerably in magnitude and timing.

(e) Politics - Regime Durability Index

The regime durability index is defined as the number of years since the last substantive change in authority characteristics (Marshall & Jagger, 2002). Following Ndikumana et al. (2013), the index is used to capture the effects of political risk on capital flight. It ranges from a score of 1 (short regime change) to a score of 20 (long regime change). Short regimes would be a sign of unstable government, which would promote capital flight if new governments were continually changing fiscal and monetary policy. However, long regimes could be a sign of a stable government and stable policies or autocratic government that susceptible to cronyism. We cannot assign an *a priori* expectation on the assumed relationship between capital flight and the regime durability index, although we might hope it to be negative. The charts for regime durability presented in Figure 6 below are particularly choppy, but clearly demonstrate the regime stability of South Africa versus the other countries.

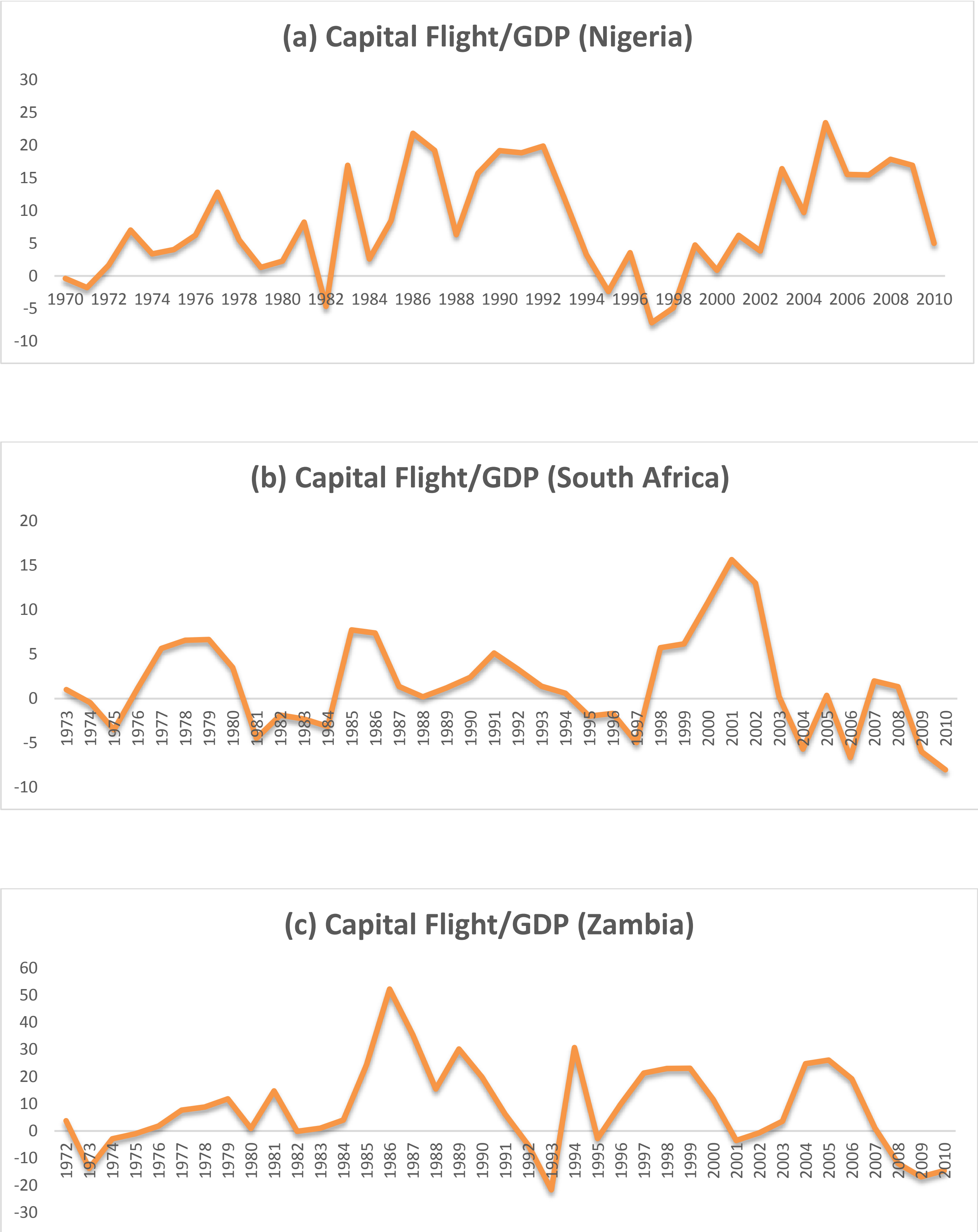
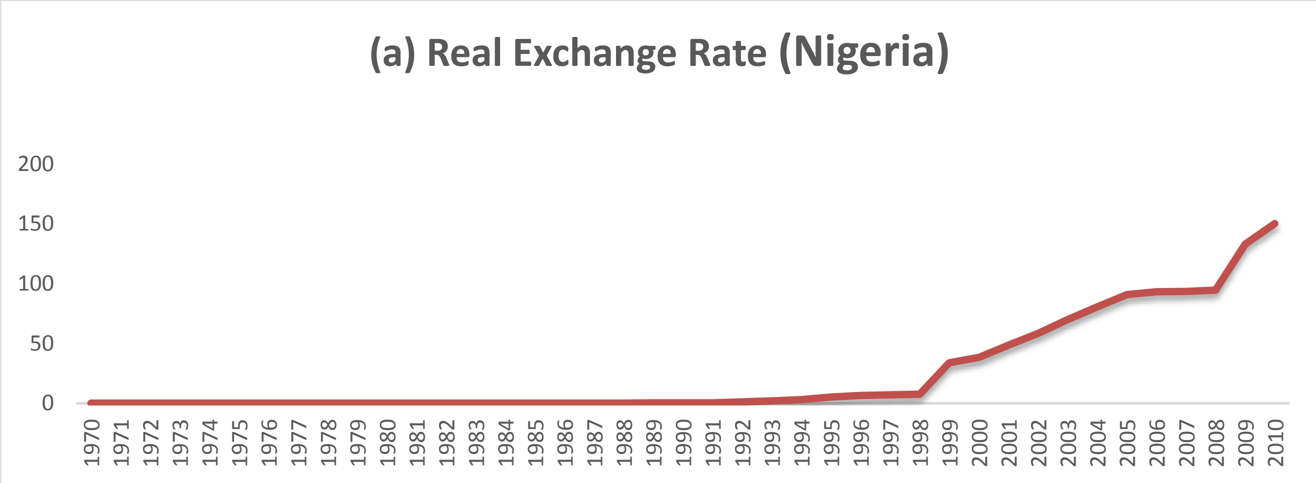
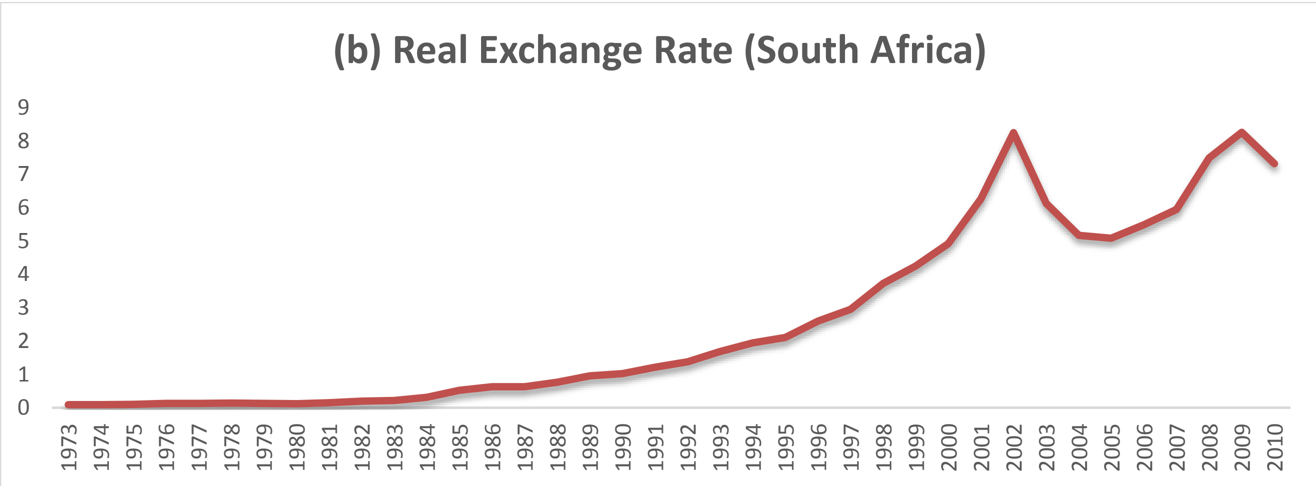


Figure 2: Capital Flight/GDP in Levels - Nigeria, South Africa and Zambia

Source: Author's own calculations





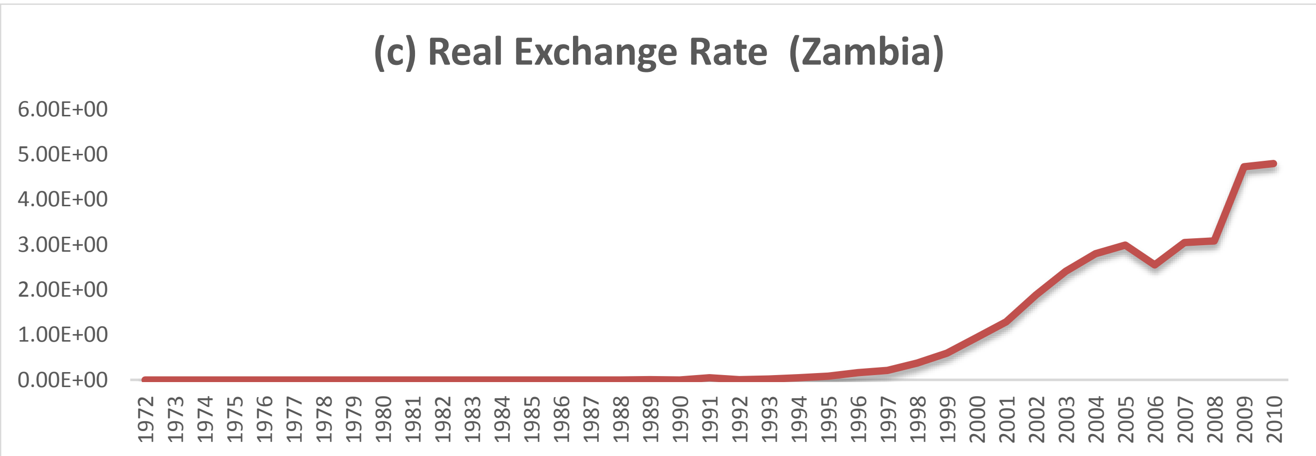


Figure 3: Real Exchange Rate in Levels - Nigeria, South Africa and Zambia

Source: Author's own calculations

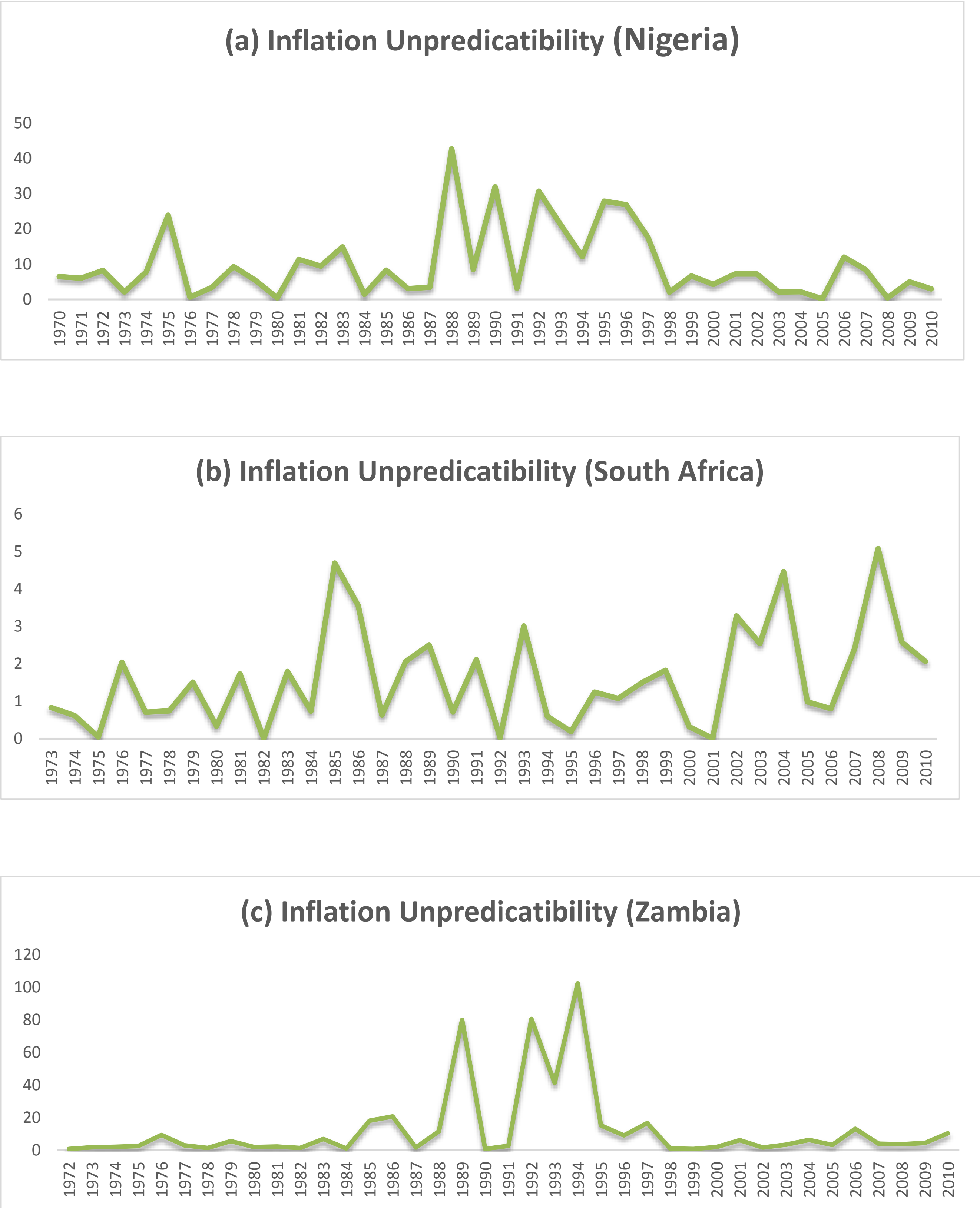


Figure 4: Inflation Unpredictability in Levels - Nigeria, South Africa and Zambia

Source: Author's own calculations

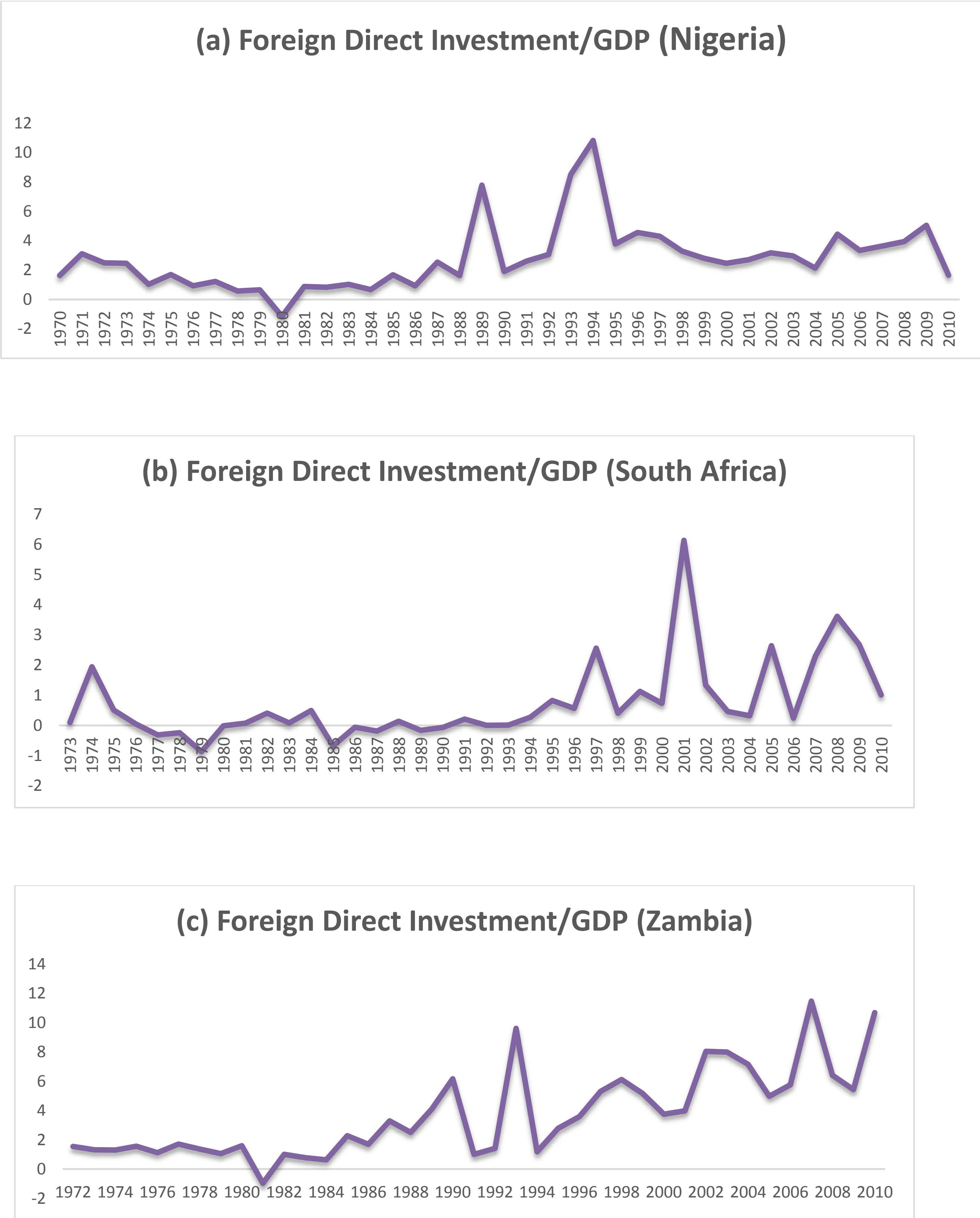
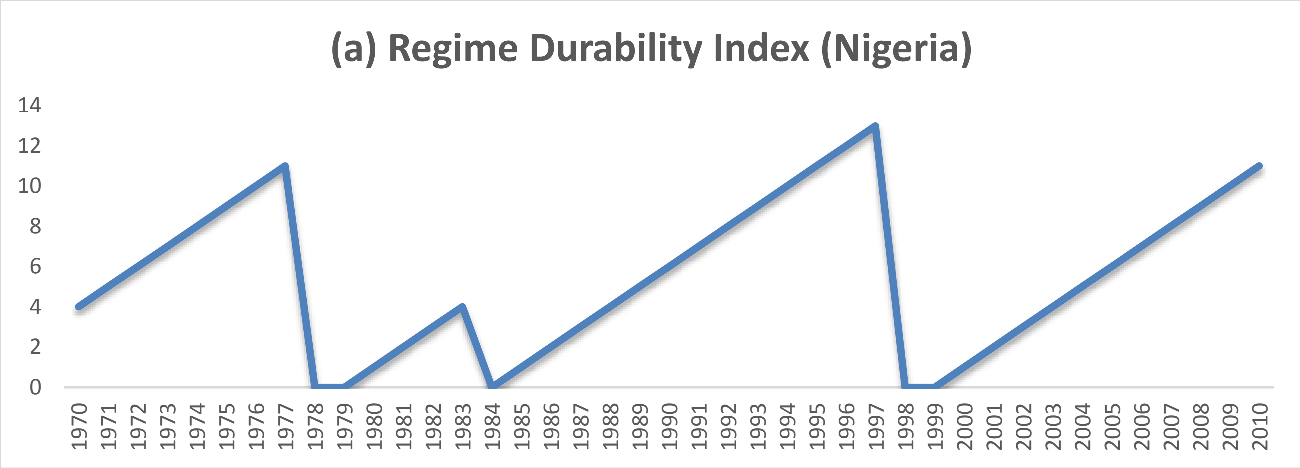
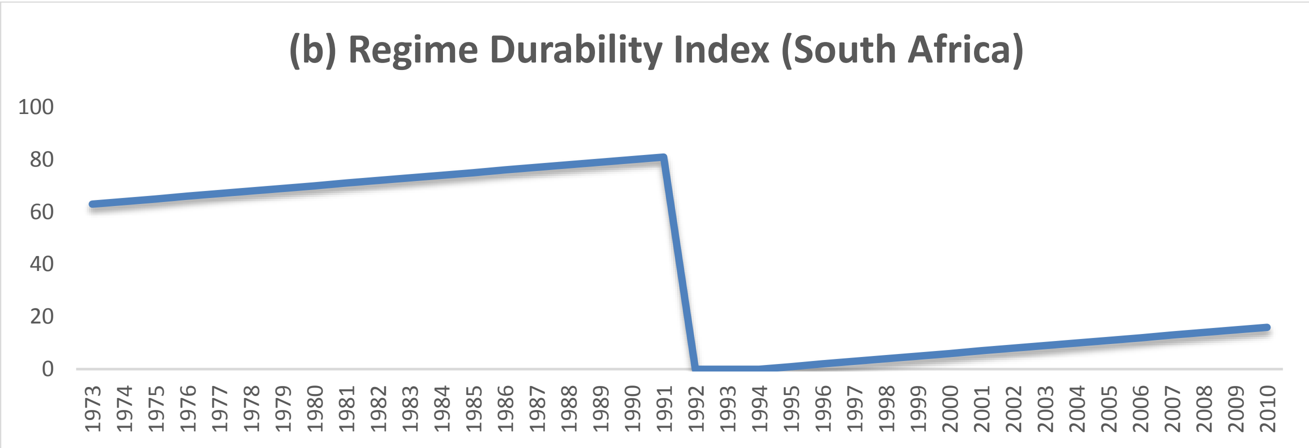


Figure 5: Foreign Direct Investment in Levels - Nigeria, South Africa and Zambia

Source: Author's own calculations





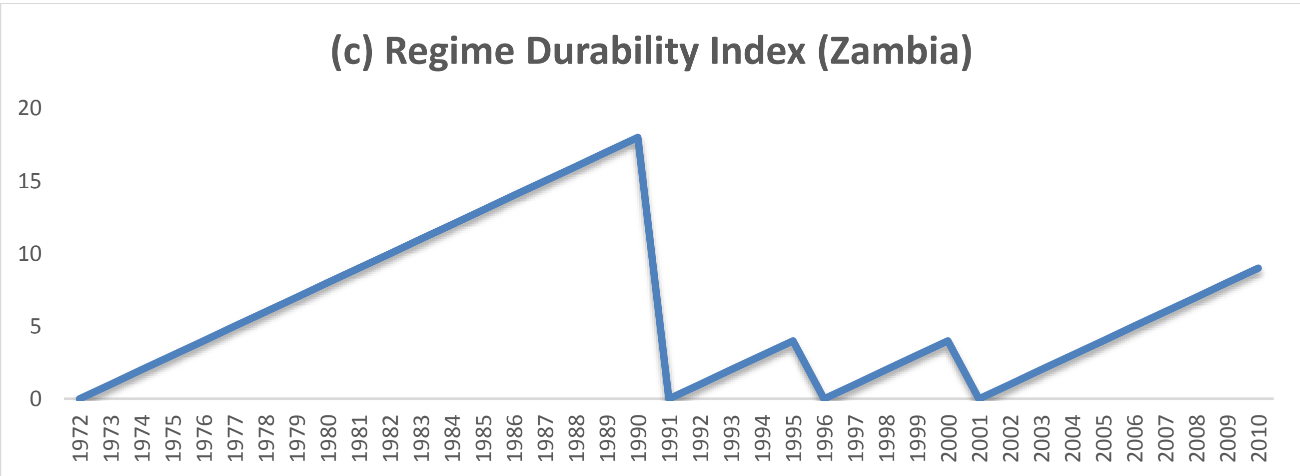


Figure 6: Regime Durability Index - Nigeria, South Africa and Zambia

Source: Author's own calculations

3.3 Data Analysis

We begin our analysis by examining the statistical properties of the data through testing for unit roots using the ADF and PP tests. If the variables are non-stationary (which is frequently the case with macroeconomic time series data), we may introduce the concept of cointegration analysis which allows for the estimation of models with non-stationary variables. We carry out the cointegration analysis through performing the Johansen Cointegration technique. The presence of a cointegration relationship allows us to estimate a long run relationship of capital flight and the real exchange rate (including other explanatory variables). This further permits us to determine the short run dynamics through estimating a Vector Error Correction Model (VECM). We finally check for the robustness of our models by testing for autocorrelation, heteroskedasticity and the normality of residuals.

3.3.1 Method of Estimation

(a) Unit Root Test

The study uses the traditional Augmented Dickey-Fuller (ADF) test for unit roots, and the Phillips-Perron (PP) (non-parametric) test to identify any basic structural breaks. We examine the data to determine if the variables are non-stationary and to which order they are integrated (Asteriou & Hall, 2011: 338). If variables are stationary, they are expected to have a constant variance and some elements of autocorrelation over time.[19] However, if a series is not stationary, it may become stationary after differencing (Asteriou & Hall, 2011: 339). Empirical literature suggests that models estimated using trended or non-stationary macroeconomic time series due to the presence of a unit root in the data may result in a "spurious regression". In applied work, researchers tend to resolve this problem by differencing the series until it becomes stationary or using cointegration methods (See (a) in Appendix 2 for detailed explanation).

(b) Granger Causality Test

Although we cannot determine true causality, the granger causality test is used to approximate whether a pseudo-causality exists between capital flight and the real exchange rate. Granger (1969) suggests that X_t causes Y_t if Y_t can be predicted with greater accuracy

[19] See Noula (2012) for further discussion.

by using past values of X_t in addition to the lags of Y_{t-1}, that is the lags on X are systematically different from Zero. It is possible that granger causality may work in both directions or in neither direction. Using a more mathematical approach, we can express the Granger causality test in the form of a system as follows:

$$Y_t = \omega_1 + \psi_1(L)X_{t-i} + \phi_1(L)Y_{t-i} + \varepsilon_{1t} \tag{11}$$

$$X_t = \omega_2 + \psi_2(L)Y_{t-1} + \phi_2(L)X_{t-i} + \varepsilon_{2t} \tag{12}$$

If $\psi_2(L)$ is statistically not equal to zero, it can be implied that Y_t granger causes X_t. It is also true that when $\psi_1(L)_{t-i}$ is statistically not equal to zero, it can be inferred that X_t granger causes Y_t. If $\psi_1(L)$ and $\psi_2(L)$ are both statistically equal to zero, it implies that there is no causality between the variables.

However, if $\psi_1(L)$ and $\psi_2(L)$ are both statistically not equal to zero, it implies that there is bilateral or feedback causality between the variables. It is however imperative to also note that, to perform a Granger Causality test, it is a requirement that the series should be stationary (Gujarati & Porter, 2009:784). If the series is non-stationary in levels, it would be required to difference it until it becomes stationary.

(c) Long Run Relationship

Developments in applied time series econometric literature suggest that non-stationary macroeconomic variables can become stationary through the combination of two or more non-stationary variables with a common stochastic trend. This effectively outlines the concept of cointegration. The variables X_t and Y_t are held to be cointegrated if they follow a common stochastic trend and the linear combination of which yields a stationary process (Engle & Granger, 1987). Testing for cointegrated series requires the use of either the Johansen (1988) or Engle and Granger (1987) cointegration techniques (See (b) in Appendix 2 for detailed explanation). We also test for weakly exogenous variables (See (c) in Appendix 2 for basic explanation). Although using OLS on stationary series may appear ideal, it may change the nature of the underlying relationship being studied if it employs differenced series. Using cointegration methods on non-stationary level data preserves more of the original information in the data, which can be particularly beneficial for establishing long-run relationships.

(d) Vector Error Correction Model

When a model has a long run (cointegrated) relationship, then the short run divergences can be understood by specifying an error correction model (ECM), Equation (13). The ECM relates the short run deviations from the long run relationship to the long run relationship with an error correction term (γ_1) that must have a negative value less than 1 to be stable. If a long-run cointegration exists, then the ECM will exist, as proven by Engle and Granger (1987), the "Granger Representation Theorem"[20]

$$\Delta Y_t = \gamma_1(Y_{t-1} - \beta' X_{t-1}) + \sum_{j=2}^{p} \mu_j \Delta Y_{t-1} + \sum_{j=2}^{p} \gamma_j \Delta \beta' + U_t \qquad (13)$$

where $(Y_{t-1} - \beta' X_{t-1})$ is an interaction term with short run dynamics (speed of adjustment); U_t is a white noise process; and the coefficient γ_1 signifies the reap force towards equilibrium (Engle & Granger, 1987)), also known as the speed of adjustment towards equilibrium. If the speed of adjustment coefficient is significant and negative, the short run dynamics will converge towards the long run relationship.

The VECM is a two-step procedure, the first step involves estimating the long run relationship: either by Johansen methods or by OLS; and the second step involves estimating the short-run equation by means of OLS (See (d) in Appendix 2 for VECM Diagnostic Test Procedures).

3.4 Limitations to the Methodology

A limiting factor in this methodology is the frequency in the data. We make use of annual time series data for the period 1970 to 2010. While it is a requirement in time series analysis to have at least 30 data points, the dynamics of a VECM only permit us to incorporate few variables in the models due to the loss of degrees freedom arising from the lag structures of the VAR. We are further limited by the availability of data. For instance, the capital flight data in South Africa and Zambia only starts at 1973 and 1972, respectively.

[20] The Granger representation theorem states that, if Y and X are two variables and they are cointegrated, the relationship the two hold can be expressed as an ECM (Gujarati & Porter, 2009:764). When expressed matrix notation, the ECM can be presented in the form of a vector. It therefore develops into a vector error correction model (VECM) as specified below:

SECTION FOUR

EMPIRICAL RESULTS AND DISCUSSION

We examine the statistical properties of each variable followed by an examination of the approximated causality between capital flight and the exchange rate using the granger causality test. We then test for the long run cointegration equation and use it to further test for the short run VECM.

1.1 Unit Root Tests

We need to statistically test the variables for unit roots[21] because stationarity cannot always be visually[22] determined: see Table 2 for Nigeria, Table 3 for South Africa and Table 4 for Zambia. The results of both the ADF tests and PP tests indicate that all variables are non-stationary in their original specification but become stationary after taking the first difference. Thus, the variables are integrated of order *I* (1).

However, in the results for Nigeria and South Africa, the FDI/GDP variable appears to be stationary in levels at a 10% significance level in the PP test. The ADF test conversely suggests that the variable is non-stationary. As such, we take the first difference and the variable becomes clearly stationary. In both South Africa and Zambia, the CF/GDP variable appears to be stationary in levels at a 10% significance level in the ADF test. The PP test suggests that the variable is non-stationary; however, after taking the first difference the variable becomes absolutely stationary.

The granger causality test must be performed using stationary variables, which we chose to use the first difference of the variables stationary (as the variables are *I* (1)). However, we can use the non-stationary levels to test for the existence of any cointegrating relationships[23] among the variables and more importantly, between capital flight and the exchange rate (including other explanatory variables).

[21] ADF and PP tests are performed in EViews and their t–statistics presented in Tables 2, 3 and 4 below are compared against the MacKinnon (1990) critical values.
[22] See Figures 2, 3, 4, 5 and 6 in Sub-Section 3.2.2 for visual inspection of all variables.
[23] Cointegration Testing is less cumbersome if all the variables are integrated of the same and which in this case, they are all *I* (1).

Table 2: Unit Root Test Using the ADF and PP Test for Nigeria

Variable	ADF Test		Phillips-Perron Test		Order of Integration
	Levels	First Difference	Levels	First Difference	
CF_GDP	-1.323	9.806***	-2.150	-8.053***	*I* (1)
RER	4.913	-4.449***	1.872	-5.438***	*I* (1)
FDI	-0.671	-6.033***	1.725*	10.368***	*I* (1)
RDUR	-2.358	-6.117***	-0.957	-6.914***	*I* (1)
INF_PRED	-2.771	-4.895***	5.553	-17.118***	*I* (1)

Notes : * [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.
Source : Author's own calculations.

Table 3: Unit Root Test Using the ADF and PP Test for South Africa

Variable	ADF Test		Phillips-Perron Test		Order of Integration
	Levels	First Difference	Levels	First Difference	
CF_GDP	-2.818*	-5.925***	-2.964	-6.515***	*I* (1)
RER	2.704	-4.592***	-2.032	-4.391***	*I* (1)
FDI	-0.179	-7.485***	-3.544**	16.045***	*I* (1)
RDUR	-2.111	-6.273***	-0.980	-6.358***	*I* (1)
INF_PRED	-2.516	-6.8802***	6.153	-16.802***	*I* (1)

Notes : * [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.
Source : Author's own calculations.

Table 4: Unit Root Test Using the ADF and PP Test for Zambia

Variable	ADF Test		Phillips-Perron Test		Order of Integration
	Levels	First Difference	Levels	First Difference	
CF_GDP	-2.832*	-4.215***	-2.446	-6.935***	*I* (1)
RER	2.286	-3.600***	1.709	-7.100***	*I* (1)
FDI	-0.021	-6.526***	-0.387	11.574***	*I* (1)
RDUR	-2.111	-6.273***	-0.980	-6.358***	*I* (1)
INF_PRED	-2.612	-15.602***	5.553*	-18.491***	*I* (1)

Notes : ***** [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.
Source : Author's own calculations.

1.2 Granger Causality Test

We use the granger causality test to help understand the direction of causality between capital flight and the exchange rate. Based on the results of the unit root tests above, we performed this test on the first difference of capital flight and the exchange rate.[24] In all three tables (5-7), the first null hypothesis is that the real exchange rate does not granger cause capital flight while the second null hypothesis is that capital flight does not granger cause the real exchange rate. A high f-statistic causes us to reject the null hypothesis and establish some sort of causality. A *priori*, we expect a change in the real exchange rate to cause a change in capital flight. The results are notable because they differ for each country. For Nigeria, Table 5 shows that the real exchange rate movements granger cause capital flight and not vice versa. For South Africa, Table 6, we find a bi-directional causal relation between capital flight and the real exchange rate. For Zambia, Table 7, we find that capital flight, interestingly, causes real exchange rate movements, but not vice versa. We attribute this to rising domestic inflation which causes a real appreciation that inevitably drives capital flight due to the fear of asset losses by economic agents as they expect a real currency depreciation to follow.

[24] It is a requirement that variables should be stationary when performing the granger causality test (Asteriou & Hall, 2011: 400).

Table 5: Pairwise Granger Causality Tests - Nigeria

Sample: 1970 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusions
D(RER) does not Granger Cause D(CF_GDP)	39	17.6882	0.0000	Reject
D(CF_GDP) does not Granger Cause D(RER)		0.32980	0.7213	Accept

Notes : D ( ) implies that the variable is in first difference; Obs means number of observations
: Prob. means probability value.

Source : Author's own calculations.

Table 6: Pairwise Granger Causality Tests - South Africa

Sample: 1973 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
D(RER) does not Granger Cause D(CF_GDP)	36	0.12070	0.0795	Reject
D(CF_GDP) does not Granger Cause D(RER)		3.76891	0.0375	Reject

Notes : D ( ) implies that the variable is in first difference; Obs means number of observations
: Prob. means probability value.

Source : Author's own calculations

Table 7: Pairwise Granger Causality Tests - Zambia

Sample: 1972 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
D(RER) does not Granger Cause D(CF_GDP)	37	0.12070	0.8867	Accept
D(CF_GDP) does not Granger Cause D(RER)		3.76891	0.0343	Reject

Notes : D ( ) implies that the variable is in first difference; Obs means number of observations
: Prob. means probability value.

Source : Author's own calculations.

1.3 Cointegration Tests

We present the summarized results of the Johansen cointegration Tests in Tables A8, A9 and 10A in Appendix 4. To obtain these results, we used the VAR Johansen Cointegration Tests and the Hannan-Quinn (HQ) and Schwarz (SC) information criterion (See Appendix 3 and 4). We determined an optimal lag length of 1 for Nigeria (Table A5) and of 3 for South Africa (Table A6) and Zambia (Table A7) (See Appendix 3 for Lag Length Selection Tables). The cointegration tests yielded one cointegrating vector present based on the Maximum Eigen Vector (Max-Eigen) values following the recommendations of Cheung and Lai (1993). We found that a long run cointegrating equation with an intercept but no trend worked well for South Africa and Zambia, and we needed to include a trend term for Nigeria. In summary, we find that there is one cointegrating relationship between capital flight, the real exchange rate and other explanatory variables for Nigeria, South Africa and Zambia.

1.4 The Long Run Relationship

We present the results of the normalized long run cointegration relationship for Nigeria (Tables 8), South Africa (Tables 9) and Zambia (Tables 10). We present a summary of all the long run relationships from our models in Table 11. We estimate five long run cointegrating equations using capital flight, real exchange rate, foreign direct investment, inflation unpredictability and regime durability index as dependent variables. The t-statistics indicate that all the estimated coefficients are statistically significant at the 5% level in all tables. It is important to also note that virtually all the estimated coefficients conform to our *a priori* expectations except for the real exchange rate and regime durability index for Zambia.

We further tested for the condition of weak exogeneity of the parameters and the system based on the null hypothesis that all explanatory variables are weakly exogenous. We eliminated any endogeneity by imposing restrictions on all coefficients (individually and jointly) on the error correction terms[25] to zero, allowing the cointegrating relation only to enter the capital flight equation in the dynamic system. We report the results in Appendix 5 for: Nigeria (Table A11), South Africa (Table A12) and Zambia (Table A13). The results suggest that we reject the null hypothesis in all models of weakly exogenous explanatory variables both individually and jointly based on a 1% level of significance.

[25] See Tables A14, A15 and 16A in Appendix 6 for ECT parameters in the dynamic equations.

The coefficients on the real exchange rate for Nigeria and South Africa, our main variable of interest, suggest that real exchange rate depreciation significantly increases capital flight. This finding is strongly supported with evidence from previous studies by Ajayi (1992), Harrigan et al. (2002), Ayadi (2008) and Olubanjo (2010). These findings make sense and conform to the theoretical underpinning that currency depreciation brings about the fear of loss of asset value by economic agents.[26] In the midst of expected currency depreciation, we would anticipate economic agents to safeguard their assets by demanding higher valued currencies and thus, engaging in capital flight. These results are also in line with the findings of the granger causality tests which suggest that real exchange rate depreciation causes capital flight.

Consistent with the findings of Ng'eno (2000) but contrary to our *a priori* expectation, the results suggest that a currency appreciation (rather than a depreciation) in Zambia increases capital flight and this is also consistent with our findings of the granger causality test in section 4.2. This presents a different case as compared to Nigeria and South Africa; the findings that a real currency appreciation increases capital flight present an interesting paradox which can largely be explained by the rising domestic inflation in 1985 to 1993. In the period under analysis, Zambia experienced a substantial rise in inflation arising from large government borrowing and the printing of substantive amounts of money. It is important to note that rising domestic inflation can lead to a real currency appreciation which certainly makes exports expensive and thus, serves as a driver for capital flight by domestic economic agents due to the associated risk of loss with an anticipated devaluation of the currency to correct for an overvaluation.

Table 8: Estimation of the Long Run Relationship - Nigeria

Variable	Coefficients	Standard Error	t-statistic
C	-28.1037	-	-
TREND	3.6242	0.57496	6.30342
RER	1.3430	0.1979	6.7864
FDI	7.8765	2.10835	3.7359
RDUR	-7.2434	1.09366	-6.6231
INF_PRED	4.2463	0.63465	6.6907

Notes : t-statistics are evaluated on a 1% (∓ 2.58), 5% (∓ 1.96) and 10 % (∓ 1.65) critical values.

Source : Author's own calculations.

[26] In this case, our expectations of the future are proxied by what is happening now.

Table 9: Estimation of the Long Run Relationship – South Africa

Variable	Coefficients	Standard Error	t-statistic
C	-1.095042	-	-
RER	3.58181	1.0689	3.35095
INF_PRED	3.701475	1.27638	2.89999
FDI	6.293216	2.55649	2.46166
RDUR	-0.061507	0.03679	-1.67174

Notes : t-statistics are evaluated on a 1% (∓ 2.58), 5% (∓ 1.96) and 10 % (∓ 1.65) critical values.

Source : Author's own calculations.

Table 10: Estimation of the Long Run Relationship - Zambia

Variable	Coefficients	Standard Error	t-statistic
C	23.31594	-	-
RER	-17.25865	0.91377	-18.8872
INF_PRED	0.169971	0.04125	4.12033
FDI	8.964813	0.54217	16.5351
RDUR	2.494666	0.10412	23.9603

Notes : t-statistics are evaluated on a 1% (∓ 2.58), 5% (∓ 1.96) and 10 % (∓ 1.65) critical values.

Source : Author's own calculations.

Table 11: Summary of Long Run Relationships

Variable	Nigeria	South Africa	Zambia
C	-	-	+
TREND	+	N.S	N.S
RER	+	+	-
FDI	+	+	+
INF_PRED	+	+	+
RDUR	-	-	+

Notes : N.S means not studied; (+) means positive relationship; (-) means negative relationship.
Source : Author's own calculations.

We also identify a statistically significant and positive effect of foreign direct investment on capital flight in Nigeria, South Africa and Zambia. Highly consistent with the studies of Harrigan et al. (2002) and Brada et al. (2013), we find that an increase in foreign direct investment increases capital flight in Nigeria, South Africa and Zambia. We interpret this as a supply side factor that foreign exchange inflows, proxied by foreign direct investment inflows, provided more resources for those engaging in capital flight. In other words, capital flight is likely to be "supply constrained." Some might argue that such results also present an intriguing paradox for Capital Account Liberalization (CAL). Should CAL decrease capital flight? It also makes capital outflows legal and easier, and could lead to more depreciation of the exchange rate.

The long-run effects of inflation unpredictability on capital flight reported in all tables are positive, statistically significant and consistent with a previous study by Ndikumana and Boyce (2011a). Of importance, Zambia experienced rapid capital flight between 1985 and 1995: a period when the unpredictability in inflation was at its highest. The rising unpredictability in inflation was due to large amounts of government borrowing and money being printed during this period. This was a policy response to stabilize the drastic fall in GDP during this period as a result of falling copper prices on the global commodities market. As such, the rising unpredictability in inflation can be viewed as a signal for poor macroeconomic policy which would not only decrease investor confidence, but create greater uncertainty in expected business profitability.

The coefficients on the regime durability index reported for Nigeria, South Africa and Zambia are statistically significant, but contrary to the results found by Brada et al. (2012), who found a statistically insignificant relationship. In the case of Nigeria and South Africa, the coefficients are negative, suggesting that a decrease in the index (or regime duration) results in an increase in capital flight, which is consistent with the findings of Gibson and Tsakalotos (1993). In other words, this implies that greater regime stability would reduce capital flight, or regime stability might be associated with less corruption. In Zambia, the estimated coefficient is rather positive and suggests that an increase in regime duration is associated with an increase capital flight. This result implies that longer regimes can lead to entrenched interests and corruption that may facilitate capital flight. Under the period of analysis, Zambia's first republican president served 27 years (since 1964 to 1991), which was also a period associated with substantive macroeconomic and political instabilities owing to rising inflation and the hope of transitioning to a new government. It was also within this period that the country also experienced the highest levels of capital flight (in 1986 with an extraordinary peak of 52%), possibly due to unaccounted flows from the nationalised copper mine.

The fundamental difference in the long run equations is between Zambia and the other two countries. The negative coefficient on the RER indicates that more capital flight occurs during periods of appreciation than depreciation. If these appreciations were due to the inflation differential being greater than the nominal depreciation, then this means that the currency was overvalued and agents expected a nominal depreciation adjustment. Also recall that the Granger causality test indicated that capital flight was driving the real exchange rate rather than vice versa. There is some evidence to suggest that as capital flight occurred in the past, the government borrowed more money domestically, creating inflation and a real depreciation of the exchange rate.

1.5 Short Run Dynamics

The results of the full short run dynamics from the VECM are shown in Appendix 6 for Nigeria (Table A14), South Africa (Table A15) and Zambia (Table A16).[27] The summary results for the coefficients on the error correction terms (ECT) presented in Table 11 below all have negative signs less than 1, which confirms that the system is stable and converges back to the long-run equilibrium. The rate of convergence is fastest for Zambia and South Africa. South Africa's coefficient on the error correction term has a magnitude of -0.72, which means that 72% of the disequilibrium in capital flight caused by changes in the independent variables is corrected each year. In other words, this implies that the disequilibrium will be corrected in approximately 2 years. On the other hand, the coefficient on the ECT reported for Nigeria is -0.10, which suggests that it would take 10 years to return to equilibrium. The coefficients on the error correction terms suggest that the disequilibria in capital flight caused by the changes in our postulated determinants are corrected rapidly in

[27] We tested for the joint significance of the lags (3) of the coefficients in South Africa and Zambia (see Table A17 in Appendix 6) using the Wald Test results shown in Tables A18 and A19 in Appendix 7.

South Africa and Zambia each year as compared to Nigeria. [28] This suggests that the effects of capital flight in Nigeria are highly persistent as compared to South Africa and Zambia.

Table 12: Summary of Short Run Error Correction Terms

	Nigeria	**South Africa**	**Zambia**
ECT	-0.10	-0.72	-0.78
t-statistics	-2.02	-2.34	-1.85

Notes : ECT means error correction term.
Sources : Author's own computations

1.6 Robustness Checks

We performed certain diagnostic tests to ensure that our models are parsimonious and yield robust estimates. These results are presented in Tables A20, A21 and A22 in Appendix 8. We tested for the normality of residuals by using the Jarque-Berrer test and the *p*-values on the test suggest that all our models have normally distributed residuals at the 5% significance level. We further tested for heteroskedasticity and autocorrelation by using the Breusch-Pagan-Godfrey Lagrange Multiplier (LM) and the Breusch-Godfrey LM test, respectively. The results of the Breusch-Pagan-Godfrey LM test suggest that all our models are homoscedastic at the 5% level. On the other hand, the results of the Breusch-Godfrey LM test suggest that the models are free from autocorrelation. Based on the diagnostic tests, we can conclude that the modelling and results of all our models, including the VECM are robust and as such, we can make inference with greater certainty.

1.7 Does Capital Account Liberalization Decrease Capital Flight?

Our findings from the long run relationship above suggesting that foreign direct investment provides funds for capital flight presents another case for analysis as it implies that countries with liberalized capital accounts are expected to have greater capital flight.

[28] Disequilibria are corrected in approximately ten years in Nigeria $\left(\frac{100\%}{10\%}\right)$, two years both in South Africa $\left(\frac{100\%}{72\%}\right)$ and Zambia $\left(\frac{100\%}{78\%}\right)$.

To add on to this these findings, we examined the effect of the newly re-weighted Exchange Control Restrictiveness Index (ECRI) by Ellyne (2014) on capital flight for 11 countries[29] from the Southern African Development Community (SADC). We started by testing for the correlation between ECRI and capital flight using cross-sectional data[30] and the results in Table 13 below suggest that capital flight and the ECRI have a negatively strong correlation (0.7). This implies that as the exchange controls become more restrictive (ECRI), capital flight tends to decrease.

Table 13: Cross-Sectional Correlation Analysis between ECRI and Capital Flight in 2005

	CF_GDP	*ECRI*
CF_GDP	1	-0.68
ECRI	-0.68	1

Source : Author's own computations

We further performed a cross-section regression analysis of the effect of ECRI on capital flight using the same dataset used to perform the correlation analysis. The results presented in Table 14 below further reinforce the findings of the correlation analysis of a negative relationship between ECRI and capital flight. The coefficient on the ECRI is statistically significant at the 5% level and suggests that a 1 point increase in ECRI reduces capital flight by 0.6%. It is also important to note that this is a cross-sectional regression and thus, we are unable to isolate the effects emanating from the other countries used in the regression.

Table 14: Cross-Section Regression of ECRI and Capital Flight

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	18.94477	7.997639	2.368795	0.042
ECRI	-0.585007	0.208513	-2.80562	0.0205

Notes : Prob. means probability value; Std. Error means standard error.

Source : Author's own computations.

[29] Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.
[30] See (ECRI and Capital Flight Data) and (Cross-Section Regression Diagnostic Tests) in Appendix 9.

SECTION FIVE

CONCLUSIONS AND RECOMMENDATIONS

This study's goal is to add to our understanding of the complex area of capital flight and its determinants, particularly in Sub-Saharan Africa. We have chosen to examine 3 important countries as case studies to demonstrate that the cause of capital flight may not be uniform, but rather country-specific.

5.1 Conclusions

This study focused on the effect of the exchange rate on capital flight from Nigeria, South Africa and Zambia for the period 1970 to 2010. After transforming our variables into stationary series, we used Granger's causality test to investigate the causal relation between capital flight and the exchange rate. Next, we used the Johansen Method of Cointegration to identify a long-run relationship between capital flight and our set of economic variables. We tested the equations to ensure that they met standard requirements, which we found acceptable. We then estimated the Vector Error Correction Model (VECM) to determine the short-run dynamics, and our diagnostic tests strongly suggested that our models are parsimonious and yield robust estimates.

The problem of capital flight presents an interesting paradox towards capital accumulation in Sub-Saharan Africa. Although Africa appears to be an attractive investment destination, the outflow of substantial private capital that could have been used for domestic development warranties an investigation into this problem. The underlying economic model of capital flight is that it is driven by portfolio choice considerations and a desire to avoid losses due to exchange rate depreciation, which links capital flight to macroeconomic policy errors and the political turmoil. Applied economic literature postulates that exchange rate misalignment (overvaluation) is a typical condition that presents a strong case for capital flight from Sub-Saharan Africa. Based on this hypothesis, we examined various models to explain the determinants of capital flight since the 1970s. A better understanding of the reasons for capital flight can help governments learn to manage economic policy to minimize capital flight in the future. For the basis of policy formulation, it is therefore important to understand the role of exchange rates in determining capital flight from Sub-Saharan Africa.

The granger causality test results provided mixed findings but seemed to suggest that causality generally runs from the real exchange rate to capital flight (as was observed in Nigeria and South Africa), but may run in the opposite direction (as was found in Zambia). This allows us to conclude that this relationship needs to be examined on a case-by-case basis; it should not be assumed to be the same for all countries for all time periods.

Our basic model for capital flight is based on portfolio considerations of maximizing returns on investment. If domestic economic agents expect currency depreciation, they tend to convert their domestic assets into foreign claims to protect against erosion of capital. In addition, we try to control for the effects of economic and political uncertainty as well as the supply of foreign exchange.

We found one cointegrating vector in our capital flight equations for Nigeria, South Africa and Zambia, which corroborates the presence of a long run relationship with explanatory variables for: the real exchange rate, inflation unpredictability, foreign direct investment, and regime durability. The findings revealed that real currency depreciation tends to increase capital flight in Nigeria and South Africa while in Zambia, we also observed that real currency appreciation led to an increase in capital flight. We draw the conclusion that the presence of high inflation and previously rigid domestic market appreciated the real exchange rate, creating an 'over-valued' real exchange that was expected to correct or depreciate.

Our other findings suggest that other macroeconomic policy errors and uncertainty, proxied by the variable for inflation unpredictability, generally increased capital flight from Nigeria, South Africa and Zambia. On the other hand, foreign direct investment also has a positive effect on capital flight. It is important to note that foreign direct investment does not encourage capital flight, but provides the sources of funds for capital flight. In other words, capital flight is likely to be "supply constrained." Some might argue that such results also present an intriguing paradox for Capital Account Liberalization (CAL) which makes capital outflows legal and easier, and could lead to more depreciation of the exchange rate. Even so, a continent starved with direct resources would expect to attract more foreign direct investment inflows with CAL. Our results from the effect of the restrictiveness of exchange controls on capital flight suggest that capital flight decreases with more restrictive controls. We can thus conclude that countries with greater capital account liberalization would be expected to experience more capital flight due to the increased source of funds.

The role of political factors in determining capital flight from Nigeria, South Africa and Zambia is also suggested to be significant in our other findings. In Nigeria and South Africa, we note that capital flight increases with short regimes. For capital flight, this means that political office bearers may all have different political agendas and given the short terms of office, they may enact unsound policies that may induce political and macroeconomic uncertainty which in turn, would provide motives for capital flight. In the case of South Africa, we also draw the conclusion that other than the length of the regime, the historical events (for instance, the Apartheid era) in any one regime have a role to play. Our conclusion for Zambia however, based on the result that long regimes are associated rising in capital flight, entails that longer regimes perpetuate an autocratic society.

Though contrary to *a priori* expectation, the fact that a real exchange rate appreciation (rather than a depreciation) causes capital flight traces back to understanding the macroeconomic and political fundamentals within the country. In the period under analysis, the real currency appreciation would have been due to the inflation differential being greater than the nominal depreciation. Zambia had experienced a substantive rise in inflation due large government borrowing and printing of money to stabilize the economy at a time when global commodity prices were falling. We also note a fundamental difference between the coefficient of the regime durability index in Zambia and the other two countries. At one point, Zambia was characterised by a long regime more than half of the sample period and within this period, Zambia also witnessed the effects high inflation, rising government debt and falling GDP. There is some evidence to suggest that as capital flight occurred in the past, the government borrowed more money domestically, creating inflation, a real appreciation of the exchange rate and consequently, a long unstable regime.

The short run dynamics validate our estimated models and suggest that we can draw inference from our findings. However, we find inconclusive evidence on the short run determinants of capital flight from Nigeria, South Africa and Zambia. We however note that the disequilibria in capital flight caused by the various determinants of capital flight are corrected much quicker in South Africa and Zambia, as compared to Nigeria.

5.1.1 Limitations of the Study

We experienced challenges in finding adequate data for several Sub-Saharan countries including Angola and Mozambique which would have presented an interesting case study due to their high absolute amounts of capital flight. We also had troubles finding adequate data for the countries used. In the study, for instance, we had difficulties obtaining capital flight data for South Africa and only managed to obtain these data starting from 1973, as opposed to 1970. Similarly, we had troubles finding adequate macroeconomic data from Zambia which starts from 1970 and thus, we only managed to find data starting from 1972. We also experienced challenges in obtaining data on ECRI which would serve as basis for understanding capital flight and the role of foreign direct investment and exchange control regulations.

5.2 Policy Recommendations

The main findings of this study provide us with a platform to propose and tailor certain policy guidelines in Nigeria, South Africa and Zambia. It is important to note that these countries have witnessed the fleeing of substantive capital during the period under analysis As such, designing policy to curb the problem of capital flight would require not only a focus on policies aimed at reducing capital flight, but also a strong emphasis on policy aimed at stimulating the repatriation of previously fled capital.

5.2.1 Inhibiting Capital Flight

This sub-section outlines how a corroborative effort between prudent macroeconomic management and imposition of efficient exchange controls can impede capital flight.

(a) Political and Macroeconomic Stability

The evidence from our findings proposes that pursuing prudent macroeconomic policy and promoting better governance are a path-way to reducing capital flight. Acknowledging that real exchange rate depreciation and appreciation can cause an increase in capital flight, there is a strong need by the fiscal authorities to pursue policy that creates less exchange rate uncertainty. The fiscal authorities should ensure that real exchange rate movements are stable and this can also be complemented by closely observing the general rise in the price level.

While macroeconomic variables are interlinked in the economy and macroeconomic variables, the fiscal authorities should implement policies promoting macroeconomic stability by also considering the necessary fiscal adjustments. Though hampered by a lack of capital in Nigeria, South Africa and Zambia, government should focus on channelling foreign direct investment into human development platforms which would rather encourage domestic investment as opposed to capital flight.

(b) Imposition of Efficient Controls

There is need to legally retain capital domestically and this can be achieved by imposing more advanced and more efficient capital controls. This policy guideline has been argued in applied work by some researchers to be a driver of capital flight rather than an inhibitor. Cuddington (1986) and Fischer (1998) argue that capital controls are less effective at reducing capital flight because economic agents largely find ways to avoid them. They also argue that restricted capital mobility is one of the primary reasons capital flight occurs. On the other hand, Pastor (1990) outlines that there is evidence suggesting that capital flight is low in countries that have functioning exchange controls. Ndikumana and Boyce (2002) however argue that exchange controls are quite limited in addressing macroeconomic management, but would be essential in dampening the effects of capital flight, including the retention of domestic legal private capital.

To add on to this contentious literature, the results of our empirical analysis for the correlation between the ECRI and capital flight suggests that exchange controls have a negatively strong correlation which implies that as the exchange controls become more restrictive, capital flight tends to decrease. The reported results of the cross-section regression analysis[31] further attests to the existence of a negative relationship between capital flight and exchange control. It is however recommended that the imposition of exchange controls can only work efficiently in an economy with effective macroeconomic management practices and therefore, this calls for a corroborative effort among the fiscal authorities.

(c) Bringing Capital back "HOME"

The bitter effects of capital haemorrhage from African countries have instigated interesting responses to focus on repatriating the previously fled capital. This has been seen through higher domestic interest rates above world interest rates and while in other instances, they promote tax amnesty.

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[31] Note that this cross-section incorporates the effects ECRI on capital flight countries other than South Africa and Zambia which are used in the regression as we cannot isolate their impact.

High domestic interest rates set above the world interest rate would be expected to attract capital inflows and part of which can be previously fled capital. However, high domestic interest rates may have harmful effects on the domestic economy. For instance, countries with initially low levels of capital accumulation and poor economic growth would result in high costs of borrowing. Therefore, the cost of high domestic interest rates would outweigh the benefits and thus create social and economic distortions.

In principal, tax amnesties incorporate writing off preceding liabilities on capital that had fled the domestic economy owing to either tax evasion or other factors such as corruption, political turmoil, risk of expropriation, risk-adjusted returns. In certain instances, this may include tax exemptions on the capital repatriated and any attributed impending earnings. Critics such as Ndikumana and Boyce (2003) argue that capital held abroad is homogenous and is composed of legally acquired and transferred capital, as well legally acquired, but illegally transferred capital. Donbusch (1987) argues that conceding tax amnesties would promote illicit financial flows and moreover, serve as a signal for government inefficiency among economic agents.

5.2.2 Directions for Further Research

- This study largely focused on Nigeria, South Africa and Zambia. It would be enriching for future research to include more countries and analyse them on a country-by-country basis while also acknowledging the limitations in data availability.

- Part of this study investigated the causality between capital flight and the real exchange rate. Based on the results, our findings are quite mixed and lead us to the conclusion that causality between capital flight and the real exchange rate only holds in the period under analysis. Therefore, there is need for further research around the causal relation between capital flight and the exchange rate with a different or extended period of analysis.

- Macroeconomic theory suggests that capital outflows (including capital flight) can be stimulated by exchange rate overvaluation. It is also hypothesized that a highly volatile currency can promote capital flight. To the best of our knowledge, no study has investigated the effect of real exchange rate volatility on capital flight in Africa. This would require capital flight data with a higher frequency (monthly or quarterly) to allow for a greater sample period and parsimonious volatility modelling.

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APPENDICES

Appendix 1: Descriptive Statistics and Data

Table A1: Variable Definitions and Summary Statistics

Variable	Definition	Descriptive statistics				
		Obs	Mean	Std Dev	Min	Max
Nigeria						
1. CF_GDP	Capital Flight/GDP	41	8.17	8.12	-7.14	23.49
2. RER	Real Exchange Rate	41	24.88	41.71	0.00	150.30
3. FDI	Foreign Direct Investment/GDP	41	2.77	2.24	-1.15	10.83
4. RDUR	Regime Durability Index	41	5.54	3.84	0.00	13.00
5. INF_PRED	Inflation Unpredictability	41	10.00	10.07	0.19	42.65
South Africa						
1. CF_GDP	Capital Flight/GDP	38	1.57	5.37	-8.03	15.64
2. RER	Real Exchange Rate	38	2.59	2.73	0.09	8.26
3. FDI	Foreign Direct Investment/GDP	38	0.76	1.35	-0.87	6.14
4. RDUR	Regime Durability Index	38	39.58	33.30	0.00	81.00
5. INF_PRED	Inflation Unpredictability	38	1.61	1.34	0.00	5.08
Zambia						
1. CF_GDP	Capital Flight/GDP	39	8.64	15.80	-21.69	52.21
2. RER	Real Exchange Rate	39	0.82	1.39	0.00	4.80
3. FDI	Foreign Direct Investment/GDP	39	3.74	3.03	-0.96	11.47
4. RDUR	Regime Durability Index	39	6.05	5.20	0.00	18.00
5. INF_PRED	Inflation Unpredictability	39	12.84	23.34	0.80	102.27

Notes : Obs means observations; Std Dev means Standard Deviation

Sources : Author's own calculations

Table A2: Nigerian Data Used in the Time Series Econometric Analysis

Year	CF_GDP	RER	INF_PRED	FDI	RDUR
1970	-0.371621	0.004014	6.52061	1.634007	4
1971	-1.784188	0.004458	6.059115	3.114868	5
1972	1.641802	0.00412	8.24605	2.484843	6
1973	7.028858	0.004088	2.158574	2.459956	7
1974	3.392239	0.003975	7.872013	1.034345	8
1975	4.054277	0.004765	23.91989	1.692362	9
1976	6.255924	0.005702	0.6802	0.933656	10
1977	12.80431	0.006341	3.422466	1.222448	11
1978	5.532836	0.007064	9.356246	0.577459	0
1979	1.315005	0.006743	5.435469	0.655098	0
1980	2.269615	0.005914	0.471138	-1.150856	1
1981	8.264965	0.007317	11.35765	0.887948	2
1982	-4.658603	0.008093	9.467253	0.837806	3
1983	16.93643	0.010392	14.90357	1.027979	4
1984	2.606834	0.01242	1.430367	0.663717	0
1985	8.480414	0.015023	8.300155	1.681726	1
1986	21.83808	0.030608	3.049899	0.932437	2
1987	19.24356	0.07516	3.498213	2.534126	3
1988	6.326287	0.126137	42.65182	1.627125	4
1989	15.71919	0.293901	8.505288	7.776141	5
1990	19.18683	0.326765	32.0133	1.911375	6
1991	18.84877	0.436733	3.222733	2.600578	7
1992	19.8793	1.069909	30.68934	3.060113	8
1993	11.7158	2.083412	21.21245	8.520921	9
1994	3.239377	3.178452	12.16871	10.83256	10
1995	-2.366738	5.31911	27.8516	3.780688	11
1996	3.558668	6.676809	26.85781	4.554308	12
1997	-7.144804	7.081331	17.68123	4.297446	13
1998	-4.890797	7.670128	2.086622	3.284921	0
1999	4.735309	33.76364	6.691927	2.80149	0
2000	0.89201	38.46515	4.254308	2.457935	1
2001	6.216146	48.63698	7.255046	2.697521	2
2002	3.826233	58.5839	7.212421	3.170063	3
2003	16.43064	70.00427	2.123316	2.964105	4
2004	9.740012	80.62858	2.169166	2.133331	5
2005	23.48838	90.79715	0.185207	4.438849	6
2006	15.54541	93.30498	12.00397	3.337979	7
2007	15.4719	93.4867	8.419176	3.62567	8
2008	17.86282	94.65547	0.460816	3.93945	9
2009	16.93327	133.0844	4.998927	5.047661	10
2010	5.0004	150.298	3.001798	1.638899	11

Source : PERI; *World Development Indicators*

Table A3: South African Data Used in the Time Series Econometric Analysis

Year	CF_GDP	RER	INF_PRED	FDI	RDUR
1973	0.997079	0.092934	0.834572	0.09623	63
1974	-0.45213	0.091489	0.616573	1.948346	64
1975	-3.511745	0.102666	0.043113	0.508729	65
1976	1.13117	0.126754	2.043007	0.051867	66
1977	5.650858	0.132308	0.705464	-0.30939	67
1978	6.561746	0.136595	0.741193	-0.241019	68
1979	6.648138	0.134679	1.508372	-0.866242	69
1980	3.4999	0.124737	0.335983	-0.012788	70
1981	-4.481861	0.146845	1.734344	0.074859	71
1982	-1.870571	0.196199	0.003122	0.41168	72
1983	-2.305891	0.219041	1.79212	0.082429	73
1984	-3.148978	0.310097	0.738008	0.492537	74
1985	7.72732	0.526055	4.691452	-0.67492	75
1986	7.380161	0.628296	3.55622	-0.063504	76
1987	1.369453	0.626853	0.629062	-0.184257	77
1988	0.203409	0.758978	2.060409	0.138215	78
1989	1.189718	0.95828	2.505528	-0.161085	79
1990	2.375129	1.025396	0.711662	-0.067601	80
1991	5.117915	1.210888	2.11208	0.211381	81
1992	3.306269	1.382319	0.028932	0.002573	0
1993	1.376373	1.6879	3.012055	0.008658	0
1994	0.600491	1.947277	0.594281	0.275752	0
1995	-1.991349	2.102784	0.189062	0.826153	1
1996	-1.68162	2.599629	1.242536	0.567994	2
1997	-4.967371	2.956669	1.074929	2.560606	3
1998	5.720034	3.733304	1.495594	0.409797	4
1999	6.145451	4.246653	1.827697	1.128767	5
2000	10.81107	4.915375	0.31689	0.729115	6
2001	15.63947	6.268287	0.007248	6.1364	7
2002	12.98852	8.247152	3.276489	1.331947	8
2003	0.229111	6.126412	2.545459	0.465545	9
2004	-5.683934	5.165647	4.461422	0.320148	10
2005	0.364409	5.085711	0.986385	2.639974	11
2006	-6.631061	5.489642	0.797798	0.238803	12
2007	1.977119	5.947398	2.402277	2.301691	13
2008	1.321991	7.490723	5.077296	3.619	14
2009	-6.001322	8.260553	2.577839	2.68295	15
2010	-8.02582	7.321222	2.061958	1.011278	16

Source : PERI; *World Development Indicators*

Table A4: Zambian Data Used in the Time Series Econometric Analysis

Year	CF_GDP	RER	INF_PRED	FDI	RDUR
1972	3.70701	8.15E-06	0.800	1.5488	0
1973	-13.754	7.46E-06	1.86409	1.31457	1
1974	-2.937	7.16E-06	2.13119	1.3054	2
1975	-0.9996	7.22E-06	2.61489	1.55567	3
1976	1.82551	8.85E-06	9.392519	1.13021	4
1977	7.60736	1.12E-05	2.9736449	1.70795	5
1978	8.77291	1.23E-05	1.446649	1.37316	6
1979	11.8141	1.20E-05	5.525069	1.04967	7
1980	0.90694	1.17E-05	1.92162	1.58835	8
1981	14.7325	1.34E-05	2.27430	-0.9581	9
1982	-0.1417	1.51E-05	1.30990	1.00746	10
1983	0.99615	2.38E-05	6.93740	0.77385	11
1984	3.97304	3.94E-05	1.08660	0.63247	12
1985	24.3133	9.06E-05	18.02820	2.2864	13
1986	52.2076	0.00034	20.73320	1.7003	14
1987	35.4362	0.000583	1.66980	3.28882	15
1988	15.4583	6.84E-06	11.60460	2.50209	16
1989	30.1485	0.002744	79.83070	4.09796	17
1990	19.772	0.000108	0.80100	6.16413	18
1991	6.17252	0.0475	2.71250	1.01576	0
1992	-5.2053	0.003044	80.39110	1.41385	1
1993	-21.686	0.022058	41.20800	9.60438	2
1994	30.7136	0.049122	102.26549	1.19525	3
1995	-2.8459	0.08321	15.179300	2.78924	4
1996	9.89822	0.161671	9.127644	3.58071	0
1997	21.3043	0.213786	16.57447	5.30382	1
1998	22.9722	0.371399	1.030633	6.11639	2
1999	23.0744	0.591012	0.87096	5.1735	3
2000	11.6717	0.938706	1.95778	3.74053	4
2001	-3.4917	1.286367	6.175325	3.96845	0
2002	-0.7254	1.885367	1.67703	8.04007	1
2003	3.59188	2.408363	3.39313	7.992	2
2004	24.7509	2.793637	6.34080134	7.15255	3
2005	26.0709	2.986073	3.32638	4.97231	4
2006	19.1436	2.545668	13.12727	5.75386	5
2007	1.12185	3.042546	3.948756	11.4709	6
2008	-11.892	3.083274	3.726196	6.41086	7
2009	-16.875	4.72699	4.456876	5.42599	8
2010	-14.573	4.797137	10.33864	10.6812	9

Source: PERI; *World Development Indicators*

Appendix 2: Explanation of Tests

(a) Unit Root Tests

We use the following three models as a basis for formulating these tests:

$Z_t = \rho X_{t-1} + K_t + L + \vartheta_t$ (1) Autoregressive model with an intercept and trend.

$Z_t = \rho X_{t-1} + K_t + \vartheta_t$ (2) Autoregressive model with only an intercept.

$Z_t = \rho X_{t-1} + \vartheta_t$ (3) Autoregressive model with no intercept or trend.

The ADF test rests on the key rule that if the null hypothesis ($H_o: \rho = 1)$ is accepted in any one of the three autoregressive equations above, it entails that the variable is stationary. It is performed in stages and in a specific sequence. The first stage involves estimating the first equation (1). However, prior to this, the maximum number of lags is estimated by using the Schwarz Information Criteria (SIC).Upon determining the approximate number of maximum lags that can be used, the parameters ρ, K and L of the first equation are estimated. The parameter K, in equation (1) is tested for significance using the t-statistics ($H_o: K = 0;\ H_1 = 0)$. If K appears to be significantly different from zero, we test for ρ in the same model, that is $H_o: \rho = 1\ ; \rho < 1$; if $\rho = 1$, the series is not stationary with trend; in the case $\rho < 1$, the series is stationary. H_1 is only accepted if critical values are greater than the ADF-statistic. On the other hand, if K is significantly equal to zero, we proceed straight to equation (2) and repeat the same test, observing the procedure outlined beforehand in equation (1). If Z_t appears not to be stationary at level form, we difference the variables and re-apply the procedure used in level form.

(b) Cointegration Tests

Augmented Engle-Granger (EG) Approach

To avoid the estimation problems associated with using differenced series in regression analysis, Engle and Granger (1987) propose an estimation method known as the "Method of Cointegration". This method concurrently models non-stationary series and eliminates the problem of spurious regression. Given that macroeconomists are concerned with long run relationships (Asteriou & Hall, 2011:358), Engle and Granger state that a long run relationship can be derived if two series are cointegrated. A long run relationship can be held to exist between capital flight and the explanatory variables (for instance, the real exchange rate) if the stochastic trend present in capital flight is related to the stochastic trend present in the real exchange rate. Although the series may present diverging evolutions, cointegration translates the fact that the linear combination does not deviate for a long period from its mean value (Noula, 2012). In a bivariate setting, the time series X_t and Y_t are cointegrated of order d, b for $d \geq b \geq 0$ on condition that:

- X_t and Y_t are integrated of order d
- the vector $\{\theta,\sigma\}$ is held to be the cointegrating vector if the process $H_t = \theta X_t + \sigma X_t$ is integrated of order$(d - b)$

Engle and Granger determine the order of integration for various combinations of cointegrating variables by estimating the long run relationship. In order to determine the long run relationship, they make use of the ordinary least squares (OLS) estimation method on variables in their levels. The residual error (e_t) estimates are obtained as follows:

$$e_t = Y_t - \theta - \sigma X_t \tag{14}$$

The null hypothesis (H_0: e_t No cointegration) is tested against the alternative hypothesis (H_0: e_t No cointegration) (H_1: e_t Cointegration exists) using the Augmented Dickey-Fuller test. In the event that the errors hold the properties of Gaussian white noise, an error correction model can be applied. However, the critical values for the Augmented Engle-Granger are not the same as the standard ADF critical values. Therefore, to determine the critical values applicable to the ADF test, we use the Mackinnon (1991) tables[32]. The Mackinnon formula is presented below:

$$\boldsymbol{C(p)} = \phi_{\infty} + \phi_1 \mathrm{T}^{-1} + \phi_2 \mathrm{T}^{-2} \tag{15}$$

Though the EG approach appears to be an ideal model for estimating regressions with non-stationary time series, it has certain limitations. For instance, the EG approach assumes the existence of one cointegrating vector in a bivariate analysis. This may however, not be the case when there are more than two variables given that, the EG approach is unable to identify the existence of more than one cointegrating vector. Further, while the EG approach is two-step, errors introduced in the first step when generating the residual series are feed into to the second step when determining the if the series is stationary or not (Asteriou &

[32] See MacKinnon. 2010. Critical values for cointegration tests. Working Paper No. 1127

Hall, 2011:366). This may bring about unreliable results in the case of any estimation problems. To counteract the aforementioned problems, Johansen (1988) developed another method of cointegration.

Johansen Cointegration

The Johansen test of cointegration allows for the determination of multiple cointegrating vectors in cases where the model has more than two variables. This is subject to the idea that variables may have multiple equilibria links in a multivariate analysis (Asteriou & Hall, 2011:368). Assuming the following model:

$$Z_{t=}\alpha_1 Z_{t-1} + \alpha_2 Z_{t-2} + \cdots + \alpha_k Z_{t-k} + \varphi_t \qquad (16)$$

Given that Z is a process with multi facets, we can thus express the model as follows:

$$Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \cdots + \Gamma_{k-1} \Delta Z_{t-k} + \alpha Z_{t-k} + \mu + \varphi_t \qquad (17)$$

Johansen builds his test of cointegration based on the matrix order of α and presents this in 3 cases:

- Case 1 assumes that Z is stationary on condition that the ordering of the α matrix is zero. This further implies that regardless of the presence of a unit root, an estimation of the system can be carried out.
- Case 2 assumes that Z will be non-stationary, regardless of the linear combinations emulated. This case is only applicable on condition that the complete order (p) represents the ordering of the α matrix.
- Case 3 assumes that g represents the order of the α matrix, given that $p > g > 0$. If (p*g) α and σ are matrices, provided that $\alpha = \theta\sigma$, the cointegrating vector becomes σ while the adjustment matrix becomes θ.

We determine the cointegrating vector by solving the system presented above equations using Maximum Likelihood Estimation (MLE) to estimate the cointegrating vector σ which further provide the associated vectors. The results of the MLE allow us to construct the trace test and a test of proper value. The main use of the test of proper value is to test the null hypothesis of the presence of g vectors of cointegration against the alternative hypothesis in the presence of $g + 1$ vectors. Therefore, the test of proper value is given by the following test statistic:

$$TPV_{max} = -Tlog(1 - \lambda_{n+1}) \quad (18)$$

Johansen further states that the test of trace with the null hypothesis $(q \geq r)$ is tested against the alternative hypothesis $(q < r)$. Therefore, the test of trace is given by the following test statistic:

$$Trace = -T \sum log(1 - \lambda_i) \quad (19)$$

We determine if the series are cointegrated by analysing the trace test based on the following three cases:

- Case 1: On condition that $r = 0$, it can be inferred that a cointegration relationship is not present and thus, variables are not cointegrated although Z_t will be stationary.
- Case 2: On condition that $r = n$, Z_t will be non-stationary and thus, it can be inferred that the variables will not exhibit a cointegration relationship.
- Case 3: On condition that $n > r > 0$, it can be inferred that Z_t will be conitegrated of the order r with r cointegration relations.

In summary, if Case 3 applies, this confirms that the series are cointegrated and allow us to estimate a long run relationship, as well as the short run dynamics using the VECM. We therefore choose the ideal lag length meant to estimate a parsimonious and robust VAR model by using the Hannan-Quinn information criterion (HQ) and the Schwarz information criterion (SC) which circumvents the shortcomings of (AIC)[33]. Finally, the various drawbacks of the Engle-Granger approach lead us to the use of the Johansen Method in this study.

(c) Testing for Weak Exogeneity

In estimating a model in the form of an error correction, we further test for exogeneity due to the presence of expected endogenous and exogenous variables in the model. In the most basic definition, variable Z is said to be exogenous if changes in the data generating process of Z ensure that $\rho(Y|Z)$ remains invariant (Leamer, 1985). In an alternative definition, Engle et al. (1983) also suggest that exogeneity is a concept that seeks to extract structural invariance of certain interactions under policy intervention. Understanding exogeneity not

[33]Due to the small sample size, an inherent problem the Akaike information criterion (AIC) would pose is by over estimating the lag length due to outliers in our real exchange rate data.

only provides us with an understanding of causality, but further helps with identification and interpretation problems (Pearl, 2009) in time series econometrics analysis when making use of error correction models. In this study, we test for weak exogeneity by making use of a Cointegrated VAR as outlined by Johansen (1992).

(d) Diagnostic Tests

The VECM is likely to yield inefficient estimates if the equations are wrongly specified, or whether the data has outliers and with large variation. We therefore ensure that our estimates are robust by observing that our parameters are BLUE (Best Linear Unbiased Estimator). As such, we test for heteroskedasticity, serial correlation and the normality of residuals.

Testing for Normality of Residuals

We test the assumption of normality of residuals of the VECM by employing the Jarque Berra residual tests by testing whether the residuals of the VECM are normally distributed through estimating a chi-square statistic which is eventually compared to the Jarque Berra tabulated statistic. This test is performed against a null of not normally distributed residuals.

Test for Autocorrelation

The VECM is a dynamic model with various lag structures which can cause autocorrelation through omitted variables, misspecification of the model or measurement error. We imply that a model has autocorrelation when the errors in period *t* are correlated with the errors in the preceding period (Asteriou & Hall, 2011:368). The presence of autocorrelation in a VECM may undermine the ability of our estimators being BLUE. We test therefore test for autocorrelation by making use of the Breusch-Pagan LM test based on the null hypothesis of presence of autocorrelation.

Test for Homoskedasticity

Homoskedasticity relates to when the errors in the model have a constant variance. When errors are heteroskedastic (non-homoskedastic or without a constant error variance), our parameters become inefficient and we this using the Breusch-Godfrey LM Test which regresses the squared OLS residuals on the model's explanatory variables (Wooldridge, 2009). We perform this test based on the null hypothesis of the presence of heteroskedasticity (non-constant error variance).

Appendix 3: Lag Length Selection

Table A5: VAR Lag Order Selection Criteria – Nigeria

Endogenous variables: CF_GDP RER FDI RDUR INF_PRED
Sample: 1970 2010

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-527.63	179.8355*	8600457.*	30.14227*	31.44842*	30.60275*
2	-509.75	25.1274	13664944	30.5272	32.92179	31.3714
3	-485	28.0986	17117996	30.5405	34.02357	31.7685
4	-460.84	20.8967	28346633	30.5858	35.15733	32.1975

Notes: * is lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion
Source: Author's own calculations

Table A6: VAR Lag Order Selection Criteria – South Africa

Endogenous variables: CF_GDP RER INF_PRED FDI RDUR
Sample: 1973 2010

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-350.0782	NA	2656.538	22.06342	23.18575	22.44617
2	-315.6175	48.65044*	1647.521*	21.50691	23.75156	22.27240
3	-292.5336	25.79958	2334.101	21.61963*	24.9866	22.76786*
4	-267.7894	20.37759	4074.759	21.63467	26.12397	23.16565

Notes: * is lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion
Source: Author's own calculations

Table A7: VAR Lag Order Selection Criteria – Zambia

Endogenous variables: CF_GDP RER INF_PRED FDI RDUR
Sample: 1972 2010

LogL	LR	FPE	AIC	SC	HQ
-645.6527	NA	3.06E+10	38.32301	39.43397	38.70652
-610.9442	49.58364	1.89E+10	37.76824	39.99016	38.53525
-543.0938	77.54326*	2.02E+09	35.31965	38.65254*	36.47016*
-478.0812	55.72513	3.34E+08	33.03321	37.47706	34.56723

Notes: * is lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion
Source: Author's own calculations

Appendix 4: Johansen Tests

Table A8: Summary of VAR Johansen Cointegration Test - Nigeria

Data trend	None	None	Linear	Linear
Test type	No intercept	Intercept	Intercept	Intercept
	No trend	No trend	No trend	Trend
Trace	3	4	5	3
Max-Eig	0	0	0	1

Notes : Critical values are based on MacKinnon-Haug-Michelis (1999). The series are ordered in the following way: *CF_GDP, RER, FDI, RDUR* and *INF_PRED*. For each model, the number of cointegrating vectors is based on a 95% confidence.

Source : Author's own calculations.

Table A9: Summary of VAR Johansen Cointegration Test – South Africa

Data trend	None	None	Linear	Linear
Test type	No intercept	Intercept	Intercept	Intercept
	No trend	No trend	No trend	Trend
Trace	3	3	2	1
Max-Eig	1	1	1	1

Notes : Critical values are based on MacKinnon-Haug-Michelis (1999). The series are ordered in the following way: *CF_GDP, RER, INF_PRED, FDI* and *RDUR*. For each model, the number of cointegrating vectors is based on a 95% confidence.

Source : Author's own calculations.

Table A10: Summary of VAR Johansen Cointegration Test - Zambia

Data trend	None	None	Linear	Linear
Test type	No intercept	Intercept	Intercept	Intercept
	No trend	No trend	No trend	Trend
Trace	2	2	3	2
Max-Eig	1	1	1	1

Notes : Critical values are based on MacKinnon-Haug-Michelis (1999). The series are ordered in the following way: *CF_GDP, RER, INF_PRED, FDI* and *RDUR*. For each model, the number of cointegrating vectors is based on a 95% confidence.

Source : Author's own calculations.

Appendix 5: Exogeneity Tests

Table A11: Testing for Weak Exogeneity in the Nigeria Cointegrating Equation

Restriction	$\chi^2_{0.05}$	**d.f**	***p*-value**
H_0: $ECT_{RER} = 0$	43.2444	5	0.0000
H_0: $ECT_{FDI} = 0$	31.3074	5	0.0000
H_0: $ECT_{RDUR} = 0$	31.0780	5	0.0000
H_0: $ECT_{INF\_PRED} = 0$	32.2478	5	0.0000
H_0: $ECT_{RER} = ECT_{FDI} = ECT_{RDUR} = ECT_{INF\_PRED} = 0$	45.6917	8	0.0000

Notes : $\chi^2_{0.05}$ means Chi-Square test; d.f means degrees of freedom; *p*-value means probability value.
Source : Author's own calculations.

Table A12: Testing for Weak Exogeneity in the South Africa Cointegrating Equation

Restriction	$\chi^2_{0.05}$	**d.f**	***p*-value**
H_0: $ECT_{RER} = 0$	35.8944	5	0.0000
H_0: $ECT_{FDI} = 0$	32.3733	5	0.0000
H_0: $ECT_{RDUR} = 0$	31.1451	5	0.0000
H_0: $ECT_{INF\_PRED} = 0$	32.2589	5	0.0000
H_0: $ECT_{RER} = ECT_{FDI} = ECT_{RDUR} = ECT_{INF\_PRED} = 0$	36.7988	8	0.0000

Notes : $\chi^2_{0.05}$ means Chi-Square test; d.f means degrees of freedom; *p*-value means probability value.
Source : Author's own calculations.

Table A13: Testing for Weak Exogeneity in the Zambia Cointegrating Equation

Restriction	$\chi^2_{0.05}$	**d.f**	***p*-value**
H_0: $ECT_{RER} = 0$	56.8556	4	0.0000
H_0: $ECT_{FDI} = 0$	56.5907	4	0.0000
H_0: $ECT_{RDUR} = 0$	58.5821	4	0.0000
H_0: $ECT_{INF\_PRED} = 0$	59.6417	4	0.0000
H_0: $ECT_{RER} = ECT_{FDI} = ECT_{RDUR} = ECT_{INF\_PRED} = 0$	59.5934	7	0.0000

Notes : $\chi^2_{0.05}$ means Chi-Square test; d.f means degrees of freedom; *p*-value means probability value.
Source : Author's own calculations.

Appendix 6: ECM Results Full

Table A14: Estimated Vector Error Correction Model - Nigeria

Error Corection	D(CF_GDP)	D(RER)	D(FDI)	D(RDUR)	D(INF_PRED)
ECT1	-0.1000	0.0300	0.0204	-0.0573	0.2121
	(0.0495)	(0.054)	(0.01394)	(0.02062)	(0.07334)
	[-2.02071]	[0.55463]	[1.46328]	[-2.78081]	[2.89175]
D(CF_GDP(-1))	-0.343673	0.011938	-0.045327	0.043646	-0.246267
	(0.15221)	(0.16606)	(0.04287)	(0.06341)	(0.22551)
	[-2.25792]	[0.07189]	[-1.05737]	[0.68834]	[-1.09202]
D(RER(-1))	-0.162364	0.424354	-0.048103	0.017959	0.139741
	(0.14969)	(0.16332)	(0.04216)	(0.06236)	(0.22178)
	[-1.08467]	[2.59836]	[-1.14099]	[0.28799]	[0.63008]
D(FDI(-1))	-1.889485	-0.128483	-0.029326	-0.281677	1.50303
	(0.64614)	(0.70495)	(0.18198)	(0.26917)	(0.95733)
	[-2.92429]	[-0.18226]	[-0.16115]	[-1.04646]	[1.57003]
D(RDUR(-1))	0.257643	-0.78359	-0.037022	0.063293	-0.078539
	(0.39978)	(0.43617)	(0.11259)	(0.16654)	(0.59232)
	[0.64447]	[-1.79654]	[-0.32881]	[0.38004]	[-0.13260]
D(INF_PRED(-1))	-0.396171	-0.036315	0.119948	-0.11605	-0.153471
	(0.14523)	(0.15845)	(0.0409)	(0.0605)	(0.21518)
	[-2.72784]	[-0.22918]	[2.93246]	[-1.91812]	[-0.71322]
C	0.990785	2.530736	0.159351	0.083588	-0.571427
	(1.22044)	(1.33153)	(0.34372)	(0.50842)	(1.80822)
	[0.81183]	[1.90063]	[0.46360]	[0.16441]	[-0.31602]

Notes: The parentheses represent standard errors ( ) and t-statistics [ ]

Source: Author's own calculations

Table A15: Estimated Vector Error Correction Model – South Africa

Error Correction:	D(CF_GDP)	D(RER)	D(INF_PRED)	D(FDI)	D(RDUR)
ECT	-0.724412	-0.06868	-0.105947	-0.16898	0.607963
	(0.30921)	(0.01929)	(0.08561)	(0.05984)	(1.04306)
	[-2.34280]	[-3.55959]	[-1.23756]	[-2.82370]	[0.58287]
D(CF_GDP(-1))	0.577463	0.09458	0.182617	0.137424	-1.469329
	(0.41132)	(0.02567)	(0.11388)	(0.07961)	(1.3875)
	[1.40394]	[3.68506]	[1.60359]	[1.72632]	[-1.05898]
D(CF_GDP(-2))	0.56358	0.047465	0.100136	0.051169	-1.572413
	(0.43247)	(0.02699)	(0.11974)	(0.0837)	(1.45886)
	[1.30317]	[1.75890]	[0.83630]	[0.61135]	[-1.07784]
D(CF_GDP(-3))	0.170064	0.010335	0.107193	0.075086	-0.808364
	(0.31703)	(0.01978)	(0.08777)	(0.06136)	(1.06943)
	[0.53644]	[0.52242]	[1.22124]	[1.22377]	[-0.75588]
D(RER(-1))	-1.424748	-0.087372	-2.109855	-0.041793	25.6214
	(5.9436)	(0.37088)	(1.64558)	(1.15031)	(20.0496)
	[-0.23971]	[-0.23558]	[-1.28213]	[-0.03633]	[1.27790]
D(RER(-2))	-4.658119	0.299638	-0.291929	1.146185	3.012939
	(4.74769)	(0.29625)	(1.31448)	(0.91886)	(16.0155)
	[-0.98113]	[1.01143]	[-0.22209]	[1.24740]	[0.18813]
D(RER(-3))	3.792691	0.18042	0.977581	0.05503	-5.787105
	(3.18427)	(0.1987)	(0.88162)	(0.61628)	(10.7416)
	[1.19107]	[0.90802]	[1.10885]	[0.08929]	[-0.53876]
D(INF_PRED(-1))	1.059416	0.092412	-0.27901	0.245146	-2.728386
	(1.28781)	(0.08036)	(0.35655)	(0.24924)	(4.34418)
	[0.82265]	[1.15001]	[-0.78253]	[0.98357]	[-0.62805]
D(INF_PRED(-2))	0.151348	-0.088947	-0.295258	-0.16732	0.712531
	(1.07252)	(0.06692)	(0.29694)	(0.20757)	(3.61794)
	[0.14111]	[-1.32908]	[-0.99432]	[-0.80608]	[0.19694]

D(INF_PRED(-3))	0.222462	-0.028553	-0.251958	-0.23338	1.405312
	(0.87243)	(0.05444)	(0.24155)	(0.16885)	(2.94299)
	[0.25499]	[-0.52450]	[-1.04310]	[-1.38218]	[0.47751]
D(FDI(-1))	3.071019	0.551788	1.109161	-0.149155	-7.815446
	(2.32148)	(0.14486)	(0.64274)	(0.44929)	(7.8311)
	[1.32287]	[3.80915]	[1.72567]	[-0.33198]	[-0.99800]
D(FDI(-2))	1.477745	0.01477	1.371734	-0.69684	-11.4899
	(3.2881)	(0.20517)	(0.91036)	(0.63637)	(11.0918)
	[0.44942]	[0.07199]	[1.50680]	[-1.09502]	[-1.03589]
D(FDI(-3))	1.447032	-0.14528	0.862328	-1.039312	-3.035003
	(2.09233)	(0.13056)	(0.5793)	(0.40495)	(7.0581)
	[0.69159]	[-1.11275]	[1.48858]	[-2.56655]	[-0.43000]
D(RDUR(-1))	0.013753	-0.004867	-0.022777	-0.001083	-0.037936
	(0.0753)	(0.0047)	(0.02085)	(0.01457)	(0.25402)
	[0.18263]	[-1.03585]	[-1.09247]	[-0.07432]	[-0.14934]
D(RDUR(-2))	-0.026012	-0.004074	0.00935	-0.008079	0.025699
	(0.0795)	(0.00496)	(0.02201)	(0.01539)	(0.26816)
	[-0.32722]	[-0.82134]	[0.42481]	[-0.52512]	[0.09583]
D(RDUR(-3))	0.002076	-0.001756	0.006266	-0.006224	0.090955
	(0.075)	(0.00468)	(0.02077)	(0.01452)	(0.253)
	[0.02768]	[-0.37515]	[0.30175]	[-0.42882]	[0.35951]
C	-0.045772	0.10422	0.273407	-0.112435	-5.857465
	(1.52113)	(0.09492)	(0.42115)	(0.2944)	(5.13127)
	[-0.03009]	[1.09801]	[0.64919]	[-0.38192]	[-1.14152]

Notes: The parentheses represent standard errors ( ) and t-statistics [ ]

Source: Author's own calculations

Table A16: Estimated Vector Error Correction Model – Zambia

Error Correction:	D(CF_GDP)	D(RER)	D(INF_PRED2)	D(FDI)	D(RDUR)
CointEq1	-0.780874	0.024484	-0.653795	0.069156	0.276898
	(0.42136)	(0.0058)	(0.76959)	-0.06291)	(0.06283)
	[-1.85323]	[4.21926]	[-0.84954]	[1.09922]	[4.40708]
D(CF_GDP(-1))	0.52069	-0.017649	-0.502865	-0.01668	-0.151248
	(0.30238)	(0.00416)	(0.55228)	(0.04515)	(0.04509)
	[1.72196]	[-4.23818]	[-0.91052]	[-0.36946]	[-3.35441]
D(CF_GDP(-2))	0.226549	-0.024716	0.269575	-0.06175	-0.115144
	(0.37423)	(0.00515)	(0.6835)	(0.05588)	(0.0558)
	[0.60538]	[-4.79566]	[0.39440]	[-1.10512]	[-2.06343]
D(CF_GDP(-3))	-0.098053	-0.003029	0.353266	-0.001138	-0.014664
	(0.24025)	(0.00331)	(0.4388)	(0.03587)	(0.03582)
	[-0.40813]	[-0.91563]	[0.80507]	[-0.03174]	[-0.40932]
D(RER(-1))	0.734963	-0.082015	0.608547	-0.416821	-0.440582
	(11.7936)	(0.16242)	(21.5403)	(1.76091)	(1.75859)
	[0.06232]	[-0.50497]	[0.02825]	[-0.23671]	[-0.25053]
D(RER(-2))	24.08464	1.20586	-13.20711	1.250304	1.191756
	(14.9259)	(0.20556)	(27.2613)	(2.2286)	(2.22566)
	[1.61361]	[5.86635]	[-0.48446]	[0.56103]	[0.53546]
D(RER(-3))	2.008609	-1.513253	46.7031	-1.826871	-10.2763
	(22.1774)	(0.30542)	(40.5057)	(3.31133)	(3.30696)
	[0.09057]	[-4.95465]	[1.15300]	[-0.55170]	[-3.10748]
D(INF_PRED2(-1))	-0.015147	-0.006854	-0.313457	0.009499	0.017827
	(0.17704)	(0.00244)	(0.32334)	(0.02643)	(0.0264)
	[-0.08556]	[-2.81124]	[-0.96942]	[0.35937]	[0.67532]
D(INF_PRED2(-2))	-0.424408	0.002465	-0.463695	-0.001757	-0.064319
	(0.18954)	(0.00261)	(0.34618)	(0.0283)	(0.02826)
	[-2.23916]	[0.94432]	[-1.33946]	[-0.06209]	[-2.27574]

D(INF_PRED2(-3))	-0.146308	0.002401	-0.322663	-0.006183	0.011022
	(0.15223)	(0.0021)	(0.27804)	(0.02273)	(0.0227)
	[-0.96110]	[1.14546]	[-1.16049]	[-0.27203]	[0.48557]
D(FDI(-1))	-3.359984	0.223647	-5.575462	-0.057724	2.385039
	(3.55256)	(0.04892)	(6.48854)	(0.53044)	(0.52974)
	[-0.94579]	[4.57124]	[-0.85928]	[-0.10882]	[4.50232]
D(FDI(-2))	-5.334407	0.130001	-0.522066	-0.495966	0.868883
	(2.17546)	(0.02996)	(3.97334)	(0.32482)	(0.32439)
	[-2.45208]	[4.33920]	[-0.13139]	[-1.52690]	[2.67851]
D(FDI(-3))	-1.860775	0.114448	-1.496753	-0.0102	1.013972
	(2.1747)	(0.02995)	(3.97195)	(0.32471)	(0.32428)
	[-0.85565]	[3.82140]	[-0.37683]	[-0.03141]	[3.12687]
D(RDUR(-1))	0.490364	0.019353	-1.98827	0.045103	0.294281
	(1.09275)	(0.01505)	(1.99585)	(0.16316)	(0.16294)
	[0.44874]	[1.28597]	[-0.99620]	[0.27643]	[1.80602]
D(RDUR(-2))	1.435458	0.005995	0.817365	-0.100296	0.332291
	(0.95233)	(0.01312)	(1.73937)	(0.14219)	(0.14201)
	[1.50731]	[0.45711]	[0.46992]	[-0.70535]	[2.33999]
D(RDUR(-3))	-2.778942	0.016156	-3.305989	0.104369	-0.559484
	(0.91979)	(0.01267)	(1.67994)	(0.13733)	(0.13715)
	[-3.02127]	[1.27547]	[-1.96792]	[0.75996]	[-4.07925]
C	-0.712505	0.082808	-0.947721	0.435739	0.259058
	(2.60473)	(0.03587)	(4.75737)	(0.38891)	(0.3884)
	[-0.27354]	[2.30845]	[-0.19921]	[1.12040]	[0.66699]

Notes: The parentheses represent standard errors ( ) and t-statistics [ ]

Source: Author's own calculations

Table A17: Joint Significance of Lagged Variables

	South Africa		Zambia	
Variable	**Coefficient**	***p*-value**	**Coefficient**	***p*-value**
CF-GDP	1.311107	0.5468	0.649186	0.2573
RER	-2.290176	0.6396	26.828212	0.3523
IN-VAR	1.433226	0.7582	-0.585863	0.1517
FDI	5.995796	0.2262	-10.555166	0.0811
RDUR	-0.010183	0.9883	-0.85312	0.0289

Notes : *p*-value means probability value.

Sources : Author's own calculations.

In the model for South Africa and Zambia with both an optimal lag length of 3, we further tested for the joint significance of the lags of each variable using the Wald Test[34] by imposing restriction on all the coefficients to zero. The results, as presented in Table 16 above, strongly suggest that the joint significance of the lags of each variable for South Africa do not have a statistically significant effect on capital flight. In the case of Zambia, we also find a statistically insignificant effect of all variables on capital flight from Zambia except for FDI and RDUR which appear to be significant at the 10% and 5% level, respectively. In fact, a 1% increase in FDI results in an 11% decrease in capital flight while a 1 point increase in RDUR results in a 0.8% decrease in capital flight.

[34] See Tables 32A and 33A in Appendix 7 for Wald Test results below on the joint significance of the lags of the short run dynamics for South Africa and Zambia.

Appendix 7: Wald Tests

Table A18: Imposing Restrictions on Lagged Short Run Coefficients for South Africa

Wald Test: CF_GDP

Null Hypothesis: CF_GDP(-1)=CF_GDP(-2)=CF_GDP(-3)=0

Test Statistic	Value	df	Probability
F-statistic	0.732509	(3, 17)	0.5468
Chi-square	2.197526	3	0.5324

Wald Test: RER

Null Hypothesis: RER(-1)= RER(-2)= RER(-3)=0

Test Statistic	Value	df	Probability
F-statistic	0.574299	(3, 17)	0.6396
Chi-square	1.722896	3	0.6319

Wald Test: INF_PRED

Null Hypothesis: INF_PRED (-1)= INF_PRED (-2)= INF_PRED (-3)=0

Test Statistic	Value	df	Probability
F-statistic	0.39501	(3, 17)	0.7582
Chi-square	1.185031	3	0.7566

Wald Test: FDI

Null Hypothesis: FDI (-1)= FDI (-2)= FDI(-3)=0

Test Statistic	Value	df	Probability
F-statistic	1.600791	(3, 17)	0.2262
Chi-square	4.802372	3	0.1869

Wald Test: RDUR

Null Hypothesis: RDUR (-1)= RDUR (-2)= RDUR (-3)=0

Test Statistic	Value	df	Probability
F-statistic	0.041513	(3, 17)	0.9883
Chi-square	0.124539	3	0.9887

Source: Author's own calculations.

Table A19: Imposing Restrictions on Lagged Short Run Coefficients for Zambia

Wald Test: CF_GDP

Null Hypothesis: CF_GDP(-1)=CF_GDP(-2)=CF_GDP(-3)=0			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	1.465586	(3, 18)	0.2573
Chi-square	4.396758	3	0.2217

Wald Test: RER

Null Hypothesis: RER(-1)= RER(-2)= RER(-3)=0			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	1.159985	(3, 18)	0.3523
Chi-square	3.479956	3	0.3234

Wald Test: INF_PRED

Null Hypothesis: INF_PRED(-1)= INF_PRED (-2)= INF_PRED (-3)=0			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	1.989184	(3, 18)	0.1517
Chi-square	5.967552	3	0.1132

Wald Test: FDI

Null Hypothesis: FDI (-1)= FDI (-2)= FDI(-3)=0			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	2.636253	(3, 18)	0.0811
Chi-square	7.90876	3	0.0479

Wald Test: RDUR

Null Hypothesis: RDUR (-1)= RDUR (-2)= RDUR (-3)=0			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	3.782043	(3, 18)	0.0289
Chi-square	11.34613	3	0.01

Source: Author's own computations

Appendix 8: Diagnostic Tests for VECM

Table A20: Diagnostic Tests - Nigeria

Test	Null Hypothesis (Ho)	Statistic	*P*-Value
Normality			
Jarque Berrer	Normally distributed residuals	5.8546	0.0535*
Heteroskedasticity			
Breusch-Pagan-Godfrey	No Heteroskedasticity	4.9539	0.8942
Autocorrelation			
Breusch-Godfrey	No Autocorrelation	0.3809	0.8266

Notes : * [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.

Source : Author's own calculations.

Table A21: Diagnostic Tests – South Africa

Test	Null Hypothesis (Ho)	Statistic	*P*-Value
Normality			
Jarque Berrer	Normally distributed residuals	5.8546	4.0417
Heteroskedasticity			
Breusch-Pagan-Godfrey	No Heteroskedasticity	20.3827	0.4342
Autocorrelation			
Breusch-Godfrey	No Autocorrelation	5.4576	0.0653*

Notes : * [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.

Source : Author's own calculations.

Table A22: Diagnostic Tests - Zambia

Test	Null Hypothesis (Ho)	Statistic	*P*-Value
Normality			
Jarque Berrer	Normally distributed residuals	5.8546	3.0641
Heteroskedasticity			
Breusch-Pagan-Godfrey	No Heteroskedasticity	14.2538	0.1617
Autocorrelation			
Breusch-Godfrey	No Autocorrelation	9.7829	0.075

Notes : * [**] (***) indicate rejection of the null hypothesis at 10% [5%] (1%) level of significance.

Source : Author's own calculations.

Appendix 9: Cross-Section Data for ECRI and Diagnostic Tests

Table A23: Cross Sectional Data of ECRI and Capital Flight in 2005

Country	CF_GDP	ECRI
Botswana	8.644476	11.84159
DRC	-1.101284	22.50444
Lesotho	-7.342707	38.46194
Malawi	-35.44018	54.70993
Mozambique	-0.010085	43.40487
Seychelles	-5.158307	21.39475
South Africa	0.547514	44.59544
Swaziland	-8.72162	48.73436
Tanzania	2.55714	27.52022
Zambia	32.984	0
Zimbabwe	3.124506	60.00564

Notes : DRC means Democratic Republic of Congo; ECRI means Exchange Control Restrictive Index; CF_GDP means the normalized capital flight data on GDP.

Sources : PERI (2010); Ellyne (2014)

Table A24: Residual Test for Cross-Section Regression

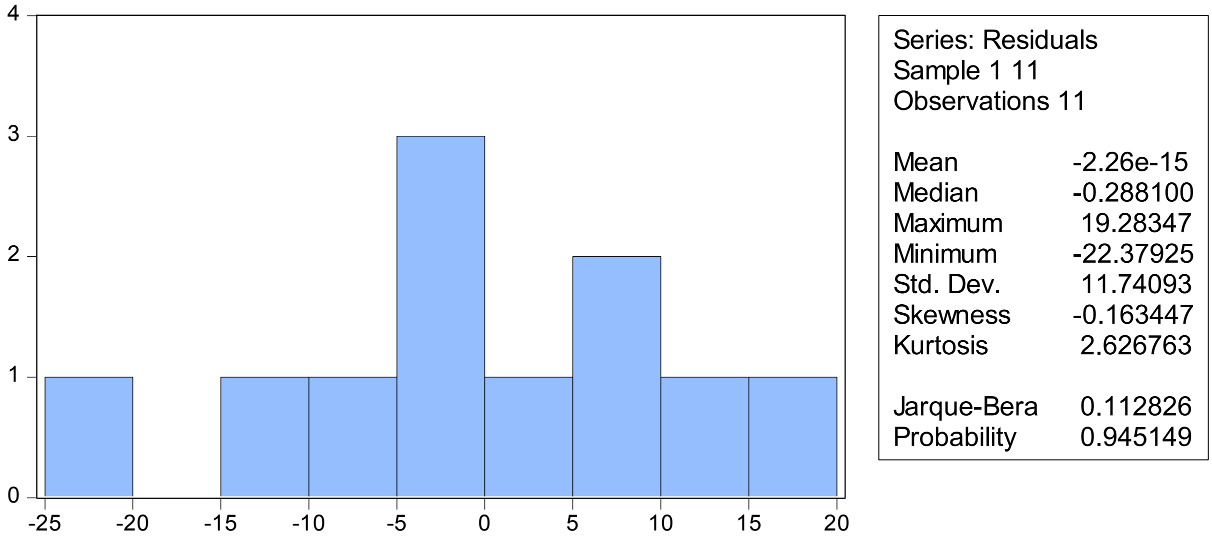

Table A25: Heteroskedasticity Test for Cross-Section Regression

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.545801	Prob. F(1,9)	0.2452
Obs*R-squared	1.612377	Prob. Chi-Square(1)	0.2042
Scaled explained SS	0.877931	Prob. Chi-Square(1)	0.3488

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1 11
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.312711	105.4901	0.088280	0.9316
ECRI2005	3.419472	2.750315	1.243302	0.2452

R-squared	0.146580	Mean dependent var	125.3177
Adjusted R-squared	0.051755	S.D. dependent var	167.6375
S.E. of regression	163.2418	Akaike info criterion	13.19131
Sum squared resid	239830.9	Schwarz criterion	13.26365
Log likelihood	-70.55219	Hannan-Quinn criter.	13.14570
F-statistic	1.545801	Durbin-Watson stat	2.162394
Prob(F-statistic)	0.245168		

Table 26A: Serial Correlation Test for Cross-Section Regression

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.181069	Prob. F(2,7)	0.3614
Obs*R-squared	2.775383	Prob. Chi-Square(2)	0.2497

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 1 11
Included observations: 11
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECRI2005	0.021137	0.204912	0.103153	0.9207
C	1.941617	7.955886	0.244048	0.8142
RESID(-1)	0.272241	0.404968	0.672253	0.5230
RESID(-2)	0.720106	0.475498	1.514424	0.1737

R-squared	0.252308	Mean dependent var	-2.26E-15
Adjusted R-squared	-0.068132	S.D. dependent var	11.74093
S.E. of regression	12.13431	Akaike info criterion	8.105239
Sum squared resid	1030.691	Schwarz criterion	8.249928
Log likelihood	-40.57881	Hannan-Quinn criter.	8.014033
F-statistic	0.787379	Durbin-Watson stat	2.019936
Prob(F-statistic)	0.538045		