The relationship between derivatives, portfolio flows and economic growth: Evidence from South Africa

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ABSTRACT

This study examines the interactions between derivatives trading, portfolio flows and economic growth in South Africa over the period 2000: Q1 to 2018: Q4. As derivatives are widely accepted as effective risk management solutions in developed nations, and can facilitate capital flows to emerging markets, there is a need to investigate the empirical relationships between derivatives, portfolio inflows and economic growth. A vector error correction model was used in addition to conducting Granger causality, impulse response functions and variance decomposition tests to analyse the relationship between the factors of interest. The efficiency of the model was established using standard diagnostics, which confirmed the overall significance of the model. The VECM results find a positive short- and long-run relationship between portfolio flows, derivatives trading and economic growth in South Africa. The Granger causality tests, impulse response analysis and variance decompositions find a short-run relationship only between portfolio flows and derivatives trading. The implications are thus that derivatives trading can lead to an increase in portfolio flows.

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ACCA	Association of Chartered Certified Accountants
ADF	Augmented Dickey Fuller
AFDB	African Development Bank
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
BIS	Bank for International Settlements
ECM	Error Correction Model
EU	European Union
FDI	Foreign Direct Investment
FPI	Foreign Portfolio Investment
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HQC	Hannan-Quinn criterion
ISDA	International Swaps and Derivatives Association
JSE	Johannesburg Stock Exchange
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin
OLS	Ordinary Least Squares
PP	Phillips Perron
SARB	South African Reserve Bank
SIC	Schwarz information criterion
SSA	Sub-Saharan Africa
SDGs	Sustainable Development Goals
UNCTAD	United Nations Conference on Trade and Development
VAR	Vector Autoregression
VECM	Vector Error Correction Model

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1 INTRODUCTION

1.1 Background of the study

The African Development Bank (AFDB) has identified derivatives trading as an important aspect of African development initiatives, noting that it will be instrumental in "improving competitiveness, facilitating trade and integrating Africa with the global economy" (Mezui et al., 2013). Derivatives are financial instruments whose values are the function of the market price of another underlying financial instrument, for example commodities or shares, and which require minimal or no investment (Schwegler, 2010). Currently in the market, options, futures, and credit defaults swaps are some of the derivatives that are commonly traded.

Over the years, the increased liquidity and credit risks introduced into the financial system by derivatives has been the focus of several studies (Dodd, 2008; Colander et al., 2009). Where the derivatives market has been left unregulated, or the risks inadequately unaddressed, the impact has been extremely destabilizing to financial systems (Dodd, 2002). Hence, calls for the trading in derivatives to become more regulated in order to protect market participants from excess risk and volatility have continued to be a theme where derivatives are discussed (Dodd, 2003).

In response to the 2008 global financial crisis, the Basel Committee on Banking Supervision (BIS) developed measures aimed at strengthening the regulation, supervision and risk management of banks when it comes to derivatives trading and other financial products (BIS, 2017). Furthermore, the widely accepted standardized derivatives contract documentation issued by the International Swaps and Derivatives Association (ISDA) and an efficient technological platform have become the standard for fostering a safe and efficient derivatives markets (Arias-Barrera, 2014; Clack & McGonagle, 2019). It is such regulation instituted globally, including in emerging markets such as South Africa, that ensure derivatives can be used as risk management solutions to mitigate the risks associated with a country or company by creating a market for the unbundling and selling of various investment risk components (currency, rate risk, credit risk, and other types of risk) to investors who can bear those risks (Dodd, 2008; Adelegan, 2009).

Moreover, derivatives have also been identified as one of the key factors responsible for the channelling of capital from advanced economies to developing economies and creating price discovery (Dodd, 2002, 2003, 2008). Thus, in addition to being of benefit to investors by assisting them to hedge risks associated with a particular market, instrument or even company, derivatives can also be of benefit to developing countries seeking to attract capital such as portfolio investment flows.

Portfolio flows, subject to much policy and academic scrutiny due to their volatile nature, have been found to have a positive impact on a country's economic growth (de Vita & Kyaw, 2009; Gossel & Biekpe, 2012; Baghebo & Apere, 2014). The transmission channel through which financial flows such as portfolio flows lead to economic growth can be explained through several economic theories (Schumpeter, 1934; Solow, 1956; Romer, 1994; Bailliu, 2000). Bailliu (2000) explains that capital flows promote growth either through an increased domestic investment rate that leads to investments that can create positive economic spill- overs, and/or by developing domestic financial intermediation capacity. Thus, it is predicted that a country with a more developed financial system will have the capacity to yield a relatively higher economic growth rate on the back of a financial sector efficient both at the conversion of foreign funds into productive investments and at their allocation to the most productive and innovative investment projects within the country (Agbloyor, Abor, Adjasi & Yawson, 2014). As such, where a country can demonstrate financial and institutional development, attracting portfolio flows should be a policy objective (Wesso, 2001).

Since derivatives are widely accepted as effective risk management solutions in developed nations, and it can be shown that they can be used as a mechanism to facilitate capital flows to emerging markets, there is a need to investigate and examine their potential impact on economic development in Sub-Saharan Africa (SSA) through facilitating capital flows to SSA countries. The need to finance approximately USD2.5 trillion per year in order to deliver successfully on the Sustainable Development Goals (SGDs) (ACCA, 2017), further reinforces the need to undertake this investigation. Moreover, mobilizing private capital flows such as portfolio flows has been identified as a key action point to this end (UNCTAD, 2014). However, many developing countries in SSA, apart from South Africa (SA), struggle to attract such funding (Ahmed, Arezki & Funke, 2007). Considering that the exchange in South Africa is recognized as one of the deepest and most liquid derivatives market (Marozva, 2014), this study therefore seeks to investigate the effect that derivatives trading has on portfolio inflows to South Africa and South African economic growth.

1.2 Problem definition

Dodd (2003) asserts that foreign investors who purchase securities denominated in local currencies use currency derivatives to hedge their local currency exposure. That investors would seek to hedge exchange rate risk associated with their foreign investment, supports the findings by various studies that exchange rate volatility is one of the significant factors that determine international portfolio flows to countries (Wesso, 2001; Fidora, Fratzscher & Thimann, 2007; Caporale, Menla Ali & Spagnolo, 2013; Garg & Dua, 2014). The explanation for this is that international transaction costs are increased by the exchange rate volatility associated with the acquisition and holding of bonds and equities, and that financial gains that can be derived from pursuing a portfolio diversification strategy are reduced by the same volatility – this all leads to a reduction in portfolio flows to a country (Caporale et al., 2013). In addition to the impact that exchange rate volatility has on the transaction costs of international portfolio flows, it also induces a home bias and causes investors to reduce their financial exposure for the purpose of maximizing their financial returns and to also minimize their exposure to unwanted financial volatility (Fidora et al., 2007; Caporale et al., 2013). As such, there appears to be a case to investigate whether currency derivatives can positively affect portfolio inflows to a country and to also assess the causal relationship between such currency derivatives and economic growth.

1.3 Purpose and significance of the research

The present paper seeks to make the following two contributions to the existing literature:

i. While various studies examine the impact of derivatives on capital markets development and economic growth (Rodrigues, Schwarz & Seeger, 2012; Marozva, 2014; Bekale, 2015; Şendeniz-Yüncü, Akdeniz, & Aydoğan, 2018), the primary focus of this study is to examine the impact of currency derivatives on economic growth and international portfolio flows.

ii. South Africa has a relatively well developed FX derivatives market compared to the rest of SSA, and the most referenced currency in derivatives trade (McCauley & Scatigna, 2011; Upper & Valli, 2016). This study, therefore, seeks to determine whether increased currency derivatives trading referencing a country's local currency can positively impact portfolio flows and economic growth in a SSA context.

1.4 Research Questions and Hypotheses

The main research question that this study seeks to answer is:

What is the empirical relationship between Rand currency derivatives, portfolio inflows and economic growth in South Africa?

In answering the main question, the following sub-questions will also be answered:

i. Are Rand currency derivatives associated with an increase in portfolio inflows to South Africa?

   H0: Rand currency derivatives have no effect on aggregate portfolio inflows to South Africa

   H1: Rand currency derivatives have a significant positive effect on portfolio inflows to South Africa.

ii. Are Rand currency derivatives associated with improved economic growth in South Africa?

   H0: Rand currency derivatives have no effect on economic growth in South Africa

   H1: Rand currency derivatives have a significant positive effect on economic growth in South Africa.

iii. Is the causality between Rand currency derivatives, portfolio inflows and economic growth unidirectional or bi-directional?

   H0: There is no causality between Rand currency derivatives, portfolio inflows and economic growth

   H1: There is significant causality between Rand currency derivatives, portfolio inflows and economic growth.

1.5 Structure of the study

In investigating the research questions stated above, the study is divided into five chapters. The chapter following this chapter is a presentation of the literature review on portfolio flows and economic growth, exchange rate volatility and portfolio flows, derivatives and exchange rate volatility and derivatives and economic growth. In Chapter 3, the data and empirical methodology used are discussed. In Chapter 4, the results obtained from the empirical exercise are reviewed. This is followed by Chapter 5, which will conclude the study and present some recommendations for future research.

2 LITERATURE REVIEW

2.1 Introduction

This literature review is structured in three parts. First, an overview of the literature on the relationship between portfolio flows and economic growth is provided. Second, studies devoted to the association between exchange rate volatility and portfolio flows are presented. Third, studies that explore the relationships between derivatives, exchange rate volatility, and derivatives and economic growth are discussed. The chapter then concludes with a summary of the key themes that arise from the literature review.

According to Sarno, Tsiakas and Ulloa (2016), what drives international portfolio flows to a country continues to be an important debate in international economic policy and research. The need to settle this debate has since the 1990s became increasingly pertinent, particularly within the context of increasingly globalised financial markets, evidenced by a high degree of international capital mobility, particularly to emerging markets (Calvo, Leiderman & Reinert, 1993). It has become increasingly apparent that key to the design of effective macroeconomic policies and to the implementation of structural reforms aimed at economic development of a country, is understanding the key determinants of international portfolio flows to a country (Sarno et al., 2016).

Similarly, and perhaps even more so, research on the theory of how capital flows such as portfolio flows affect a country's economic growth dates back to the early 1900s. Several theories which seek to explain this phenomenon have been developed and are primarily based on the economic growth theory models developed by Schumpeter (1934), Solow (1956) and Romer (1994). A number of similarities can be found between the theories; however, they diverge on the question of whether economic growth is endogenously or exogenously driven.

On the other hand, although research on the impact of derivatives trading remains in its nascent stage, the recently increased interest in derivatives has continued to be driven by the perceived role that the financial instruments played in the recent financial crisis (Dodd, 2002, 2003, 2008; Colander et al., 2009).While these concerns linger, industry practitioners and scholars continue to advocate for the development of derivatives markets, emphasizing that they have the potential to act as development enhancers for developing countries through their economic volatility reducing characteristics (Albulescu, 2007).

2.2 Portfolio flows and economic growth

Portfolio flows are known to have a positive impact on economic growth (de Vita & Kyaw, 2009; Gossel & Biekpe, 2012; Baghebo & Apere, 2014), and considering that, apart from South Africa, many emerging countries struggle to attract such flows (Ahmed et al., 2007), there is a need to understand how the relationship between these two factors materializes in practice. The following section will firstly discuss the various theories that explain economic growth and then proceed to a brief overview of empirical studies that examine the link between economic growth and portfolio investment flows.

There are three main theories which explain how portfolio flows affect a country's economic growth. According to the Schumpeterian view, finance affects the allocation of savings and by financing technological innovations, it improves both productivity and technological growth (Schumpeter, 1934). The neo-classical theory of Solow (1956) predicts that countries with higher savings and lower population growth rates will grow faster and eventually catch up with their more developed and richer counterparts, leading to inevitable convergence in per capita income across countries. This is in contrast to the endogenous growth model promoted by economists such as Romer (1994), which places great importance on technological and knowledge advancement. The theory predicts that a country with a relatively developed financial system (which implies a strong absorptive capacity) is in a position to translate foreign capital inflows that it receives into higher economic growth, because its domestic financial sector is efficient at the conversion of foreign funds into productive investments and the allocation of those funds to the most productive investment projects within the country (Agbloyor et al., 2014). Thus, the model predicts that capital flows can promote growth through the channels of an increased domestic investment rate and greater domestic financial intermediation (Bailliu, 2000).

In essence, all three of the theories seek to provide an explanation for the behaviour of an economy as a whole. Similarities can be ascertained between the Schumpeterian view and the endogenous growth theory in that both advocate that long-run economic growth can be determined by factors found within the economic system, that is, endogenous factors with technological change being the most salient of those factors. However, while the endogenous growth model emphasizes the importance of knowledge advances driven by market incentives and government policies (Romer, 1994), the Schumpeterian view stresses the actions of the entrepreneur which include his willingness to take risks and try new ideas in the hope of increased profits, as the main impetus to technological change (Alcouffe & Kuhn, 2004). In contrast to both the Schumpeterian theory and the endogenous growth theory, the neoclassical growth theory emphasizes that economic growth is the result of external forces (Solow, 1956). While both the endogenous and neoclassical models recognize that economic growth is a function of total factor productivity, the neoclassical theory simply recognizes it as a residual while the endogenous growth model seeks to explain it (Romer, 1994; Agbloyor et al., 2014).

Following the neoclassical framework on economic growth, it can be expected that portfolio investment inflows to a country will lead to economic growth whereas that same effect can be expected under the endogenous model only on condition that there is knowledge advancement.

Empirical studies

Having briefly explored the theoretical studies, the literature review next considers the empirical studies that examine the link between economic growth and portfolio investment flows.

Bailliu (2000) investigates the role of private capital flows in the determination of the economic growth of developing countries using the panel data for 40 countries for the period covering 1975 to 1995. The study's estimation of a growth regression makes use of a dynamic panel data technique that controlled for country-specific effects and took into account the potential explanatory variables being endogenous. The results show that in a country where the banking sector has developed past a minimum threshold, economic growth can be fostered by capital inflows, and this growth is in excess of any effects on the investment rate. Bailliu (2000) concludes the study by emphasizing that the results reveal the significance of the domestic financial sector in the process of transforming international capital flows to economic growth in developing countries.

Similarly, Soto (2000) seeks to understand if capital inflows are associated with faster income growth by analyzing the effects of different private capital inflows on the growth of 44 developing countries for the period 1986 to 1997. The results of the dynamic panel analysis show that foreign direct investment (FDI) and portfolio equity flows have a strong, positive relationship with economic growth, while no significant link can be found between portfolio bond flows and growth. Hence, Soto (2000) suggests that equity flows rather than bond flows are more closely associated with economic development.

Reisen and Soto (2001) explore the growth impact of the various categories of capital flows using the Generalized Methods of Moments (GMM) for 44 countries over the period 1986 to 1997. The results, somewhat consistently with Soto (2000), show that both FDI and portfolio equity investment have a significant impact on growth, but that foreign bank lending contributes to growth only if the banking system is well-capitalized.

De Vita and Kyaw (2009) seek to understand the impact of foreign direct investment (FDI) and portfolio investment flows on the economic growth of 126 low-, lower middle- and upper middle-income countries by employing the GMM over the period 1985 to 2002. In contrast to FDI that is shown to lead to economic growth in lower middle- and upper middle-income countries, portfolio flows evidence a significant and positive effect only on the economic growth of upper middle-income countries. The study concludes with an emphasis on the importance of economic development and financial and institutional absorptive capacity to realise the positive relationship between portfolio flows and economic growth as has been done by the upper middle-income countries included in the empirical analysis of this study (*ibid*).

Ferreira and Laux (2009) examine the importance of portfolio investment flow volumes and volatilities as determinants of economic growth in cross-country data for the period covering 1988 to 2001 using the Ordinary Least Squares (OLS) method. Panel OLS results show that both inflows and outflows of equity flows lead to economic growth and the study suggests that this can be viewed as evidence of the benefits of financial openness (*ibid*). Interestingly, the study finds that volatility in flows does not detract from growth and can in fact precede growth, which is rather counterintuitive. Overall, the evidence is consistent with the notion that financial integration does yield significant benefits and that foreign equity investment enhances domestic economic growth (*ibid*).

Choong, Baharumshah, Yusop, and Habibullah (2010) investigate how private capital flows could promote economic growth in 19 developed and 32 developing countries, taking into account the stock exchanges as a channel through which economic growth can be promoted through foreign capital flows. In performing the analysis, the study makes use of the dynamic panel Generalized Method of Moments for the period covering 1988 to 2002. For the sample countries, the results reveal that economic growth is positively impacted by FDI flows and negatively impacted by foreign debt and portfolio investment. However, based on the findings, the study indicates that once the local stock exchange has developed past a certain minimum threshold, the private capital flows' negative impact on economic growth can be converted into a positive one. This conclusion is in line with the findings of Reisen and Soto (2001) and de Vita and Kyaw (2009), who also emphasize the importance of absorptive capacity in order to realize the benefits of foreign capital.

Somewhat differently, Aizenman, Jinjarak and Park (2013) investigate the relationship between economic growth and four types of capital flows, but examine the relationship before and after the 2008 global financial crisis. The cross-country study consisting of 100 countries for the period between 1990 and 2010 is performed by estimating an OLS regression of the GDP per capita growth rate on the growth rate of each capital flow, other controls, and interaction terms. The study finds that the relationship between growth and lagged equity flows is smaller and unstable in comparison to the relationship between growth and FDI flows (Aizenman et al., 2013). In contrast, the relationship between lagged short-term debt and growth is negative and large during the crisis but reported to be non-existent before the global financial crisis (Aizenman et al., 2013). Although the findings may suggest that non-FDI flows have no distinguishable effect on GDP per capita growth, the study does conclude that the flows do impact growth, albeit not at the same level as FDI.

Similarly, Sawalha, Elian and Suliman (2016) test the impact of both foreign portfolio investment (FPI) and FDI on economic growth in 21 developed and 19 emerging economies using a cross-sectional time series growth regression covering the period from 1980 to 2012. The analysis reveals that while FDI has a positive and significant influence on economic growth, FPI has a negative and significant influence for both developed and emerging economies. Sawalha et al. (2016), however, conclude that countries with advanced equity markets are likely to derive more benefit from FPI capital inflows.

With regards to developing countries, Gruben and McLeod (1998) examine the impact of capital inflows on the economic growth of developing countries to determine whether or not implementation of capital controls will not be at the cost of economic growth. Seven Latin American countries and eleven other developing countries are analyzed for the period covering 1971 to 1994 using the least squares panel regression for the model estimation. The results reveal that the association between changes in the ratio of portfolio equity inflows to GDP and subsequent GDP growth is significant and positive. Moreover, short-term capital inflows are found to have potential positive explanatory power for GDP growth in the sample countries. The study also reveals that in Asia, where domestic savings are significant in the economy, the relationship between capital flows and subsequent growth is weaker than in Latin America. The study concludes that though some portfolio flows can be volatile, where a government uses capital controls to reduce volatility, the price for such action could be lost economic growth.

When it comes to cross-country studies of SSA, Brambila-Macias and Massa (2010) examine the relationship between economic growth and bonds flows, equity flows as well as other capital flows such as cross-border bank lending and FDI for 15 SSA countries over the period 1980 to2008 in order to distinguish between private capital flows that foster growth in SSA and those that do not. The study, which makes use of the GMM, shows that FDI and cross-border bank lending have a significantly positive impact on SSA’s growth, whereas no growth impact can be ascertained from equity and bond portfolio flows on economic growth. The study thus concludes that for SSA growth, portfolio equity flows and portfolio bonds appear to be insignificant, but that this can be attributed to the scarcity of data and to the small and illiquid nature of many stock exchanges in SSA. These findings suggest that, if the efficiency of stock exchanges is enhanced, in terms of access to data relating to stock exchange transactions and the increase of trade flows, economic growth in the SSA region may be fostered by portfolio equity flows (*ibid*).

Similarly, Alley (2015) examines the impact of private capital flows (PCF) shocks on 14 SSA countries’ economic growth using annual data covering the period from 1990 to 2013. The study, performed using the two-stage least square (2SLS) and system GMM methods, finds that private capital flows positively affect economic growth. The effects of PCF shocks are negative, however, and this negative relationship is attributed to the poor response of the region’s economic performance to private inflows. The findings on the negative effect of PCF shocks reinforce the need to maintain capital controls that are capable of mitigating the negative effects of capital flow shocks as a mechanism of securing the full benefits of capital flows (*ibid*).

In the case of country-specific SSA countries, Osinubi and Amaghionyeodiwe (2010) analyze the effect of foreign private investment on economic growth in Nigeria in order to understand whether efforts to attract foreign investors are beneficial to the economy. A Parsimonious Error

Correction Model was estimated for data covering the period 1970 to 2005. The findings reveal that foreign private investments are positively related to economic growth in Nigeria and as such, steps should be taken to attract more of these flows in order to boost the Nigerian economy.

Gossel and Biekpe (2012) investigate the impact of capital flows on GDP and other macroeconomic factors in South Africa using a Vector Error Correction Model (VECM) covering the period between 1988 and 2007. On the one hand, the results reveal that for South Africa, a shock to portfolio inflows marginally increases GDP, while on the other hand, FDI is found to have marginally positive long-run impacts on GDP. On the back of the results, a suggestion is made by Gossel and Biekpe (2012) that in order to control for the boom–bust cycles associated with portfolio inflows, policymakers should rather focus on encouraging FDI flows to the country.

Baghebo and Apere (2014) investigate the impact of foreign portfolio investment (FPI) on economic growth over the period of 1986 to 2011 for Nigeria. The study models the long-run impacts of FPI as well as other determinants of FPI on economic growth, the results show that foreign portfolio investment, market capitalisation and trade openness all have a positive long-run relationship with real GDP. These findings are in line with Osinubi and Amaghionyeodiwe (2010), who similarly found a positive association between foreign portfolio investment and economic growth in Nigeria.

Thus, these studies generally suggest that portfolio inflows can positively influence economic growth in both developing and developed countries. While some studies empirically indicate that portfolio flows can have no distinguishable impact on economic growth, it is apparent that the beneficial absorption of portfolio inflows depends on the level of development, public policies, banking sector level and financial institutions in the host country. Even where the studies find that foreign portfolio investments have a negative and significant influence for both developed and emerging economies, they conclude by asserting that countries with advanced equity markets and banking systems tend to gain more welfare from portfolio capital inflows.

More specifically, the studies uncover three key themes. Firstly, while other components of a country’s absorptive capacity such as the regulatory environment are important, most of the studies emphasize the importance of the domestic financial sector as a key determinant of a country's ability to realize the beneficial impact of portfolio flows. Secondly, most of the results show a positive impact of portfolio flows on economic growth within developed countries and a non-significant, even undistinguishable impact within developing countries. This points to a lack of financial development among the majority of developing countries. Lastly, where studies disaggregate portfolio flows between debt and equity, the results show that portfolio equity flows have a more positive impact on economic growth whereas bond flows can be found to have a detrimental impact on economic growth.

2.3 Exchange rate volatility and portfolio flows

Portfolio flows are known to be highly volatile and easily reversible and by implication expose a country to macroeconomic risks and a deepening financial crisis (Chuhan, Claessens & Mamingi, 1998; Dodd, 2003; Rangasamy, 2014; Garg & Dua, 2014). Hence, identifying the determinants of portfolio and other capital flows is important for formulating effective macroeconomic policy (Wesso, 2001).The literature typically distinguishes between various exogenous (push) and endogenous (pull) factors, and studies have found that exchange rate volatility is a significant pull factor (Agarwal, 1997; Wesso, 2001; Fidora et al., 2007; Caporale, et al., 2013 Garg & Dua, 2014). A selection of the key studies is discussed below on a chronological basis.

Agarwal (1997) examines the determinants of foreign portfolio investment (FPI) and its impact on six developing Asian countries using regression analysis for a period covering 1986 to 1993. The results show that the real exchange rate along with the inflation rate, economic activity and the domestic capital market's share of the global stock market capitalisation are statistically significant determinants of FPI. The results suggest the importance of considering real exchange rate changes on attracting foreign portfolio flows to the domestic market.

Chuhan et al. (1998) investigate the motivation behind equity and bond flows to nine Latin American countries and nine Asian countries for a period covering 1988 to 1992, using a panel data technique. The results show that both country-specific and global factors are important determinants of capital flows, but that global factors such as the United States interest rate are more significant. The results suggest that although push factors have a more significant impact on portfolio flows, pull factors, which are largely within the control of the recipient country, also carry considerable weight.

Fidora et al. (2007) analyze the role of real exchange rate volatility as a driver of home bias using the international capital asset pricing model (CAPM) for the years 1997, 2001, 2002 and 2003 covering 40 industrialized and emerging countries and 120 destination countries. The results show that there is a positive relationship between real exchange rate volatility and home bias for assets with lower local currency return volatility. This provides empirical support for the hypothesis that there is a particularly heightened home bias for instruments with low local currency return volatility, in the presence of real exchange rate volatility for both industrialized and emerging markets (*ibid*).

Kodongo and Ojah (2012) examine the nexus between real foreign exchange rates and international portfolio flows for the period covering 1997 to 2009 for four African countries, with the SSA region being represented by South Africa and Nigeria in the sample. Based on the methodology making use of Granger causality tests and innovation accounting from vector autoregressions, the study finds that there is no indication of a direction of causality between the two factors of interest that can be generalized across all the countries included in the sample, but that the relationship is country-dependent and time-varying. Lastly, bi-directional causality for the full sample period is identified only for South Africa, which is considered to exhibit the highest level of market sophistication relative to other countries investigated.

Caporale et al. (2013) examine the impact of exchange rate uncertainty on the different components of net portfolio flows for the US, Australia, Canada, the EU, Japan, Sweden, and the UK over the period 1988 to 2011, using a bivariate VAR GARCH-BEKK-in mean model. Consistent with Fidora et al. (2007), Caporale et al. (2013) find that exchange rate uncertainty induces a home bias and causes investors to reduce their financial exposure with the expectation that this will lead to maximized returns and minimized exposure to uncertainty. The study concludes with a suggestion that instruments and tools such as exchange rate or credit controls should be put in place for portfolio flow transactions should countries wish to achieve economic and financial stability in the presence of significant uncertainty or volatility.

Garg and Dua (2014) analyze the macroeconomic determinants of portfolio flows to India for the period between 1995 and 2011 using an Autoregressive Distributed Lag (ARDL) approach. The study finds that lower exchange rate volatility and the capacity to diversify risk are key factors in attracting portfolio flows to India. Garg and Dua (2014) thus conclude that higher currency risk discourages portfolio flows to India due to the increased uncertainty it introduces in the returns that a foreign investor can expect to receive in terms of its local currency.

Rashid and Khalid (2017) investigate the effect of exchange rate volatility on foreign portfolio investment in Pakistan for a panel dataset covering the period 2006-2011. They further examine whether foreign portfolio investment can be significantly affected by lagged exchange rate and lagged exchange-rate volatility. In performing the analysis, a robust two-step system-GMM estimator is applied and the results reveal that both exchange rate and exchange-rate volatility have a significantly negative significant impact on foreign portfolio investment in Pakistan. Further, the results suggest that they have long-lasting effects on the investment flows. These findings imply that increased exchange rate volatility is detrimental for foreign portfolio flows to Pakistan, thus strengthening the case for effectively controlling unwanted exchange rate volatility. These findings for Pakistan are in line with the findings for India in Garg and Dua (2014), suggesting certain uniformity between the two Asian countries with respect to their reaction to exchange rate volatility.

Ozimkovska (2018) examines the impact of bilateral real financial market exchange rates volatility on bilateral cross-border equity flows between the US and seven other industrialized countries (Australia, Canada, the euro area (EA), Japan, Sweden, Switzerland, and the UK), as well as six emerging markets (China, Argentina, South Africa, Russia, Mexico and Poland). To perform the analysis, a Granger causality test is performed using data from 2000 to 2014. The study finds that causality goes from exchange rate volatility to purchases and sales of equities. Further, the results for the emerging markets are consistent with the results for the developed countries except that the relationship is found to be weaker in the emerging markets context. The study concludes that the results suggest that real financial market exchange rates volatility can be an important indicator for managing capital flows to a country and can also be used as a warning signal for declining investor activity and financial markets' instability (*ibid*).

While not directly assessing the impact of exchange rate volatility on portfolio flows to a country, Bonga-Bonga and Gnagne (2017)'s analysis on the impact of exchange rate risk on equity returns and bond yields rather than flows, provides useful insights on the impact of exchange rate volatility, particularly within the context of the BRICS economies. A multivariate GARCH-M with BEKK specifications model is applied on data for the period between 1996 and 2016. The study finds that exchange rate volatility has a positive relation to bond yields in all BRICS countries except in South Africa. That an increase in exchange rate volatility leads to an increase in bond yields for BRICS countries, implies that the exchange rate volatility leads to a sell-off of bond assets by foreign investors, i.e. there is a reduction in the demand for the instruments. This is line with the findings above that exchange rate volatility is associated with a reduction in portfolio inflows to a country.

Gossel and Biekpe (2017) examine the effects of various push and pull factors on South Africa's capital inflows over the period of 1986 to 2013 using a vector error correction model (VECM). The results show that both FDI and portfolio inflows are pushed in the short-run, but while portfolio inflows continue to be pushed in the long-run by foreign factors such as the US three-month treasury bill and US GDP, FDI flows are pulled in the long run. The study notes that in the long run, domestic real exchange rate volatility becomes a moderately significant determinant of portfolio flows. The study concludes that the flow of capital to South Africa is vulnerable to short-run foreign business cycle shocks, but in the long-run the vulnerability is to domestic output and investment shocks.

In summary, therefore, the literature on the push-pull factors of capital flows continues to grow in both quantity and quality, with the effect of exchange rate volatility on capital flows being considered in cross-country and country specific studies. The literature reviewed above provides empirical support for the notion that exchange rate volatility has a significant impact on portfolio flows to a country. In particular, the studies show that exchange rate volatility leads to home bias within foreign investors, causing them to rather invest at home rather than in foreign markets. The results from Kodongo and Ojah (2012) and Ozimkovska (2018) provide further insight that causality goes from exchange rate volatility to flows. This is a significant consideration for emerging markets as they seek ways to attract capital flows to stimulate growth.

2.4 Derivatives and Exchange rate volatility

The literature reviewed above indicates that exchange rate volatility discourages portfolio flows to a country. Developing nations with increasing exposure to foreign exchange, interest rate and commodity risk, are often, through external debt exposure, especially vulnerable to volatility that ensues in global financial markets (Claessens, Kreuser & Wets, 2000). Considering this, the section that follows turns to reviewing literature that examines what impact derivatives may have on currency volatility. Hence, this section provides a brief review of the empirical studies that examine the link between derivatives trading and exchange rate volatility on a chronological basis.

Glen and Jorion (1993) examine the benefits from currency hedging in international bond and equity portfolios over the period 1974 to 1990 using the international asset-pricing model (IAPM). The purpose of the study was to investigate the benefits of currency derivatives in international bond and equity portfolios, from a speculative and hedging perspective. The study finds that the use of forward contracts significantly improves the financial performance of global portfolios that include bonds. The results appear to indicate that exchange rates play an important role in optimizing global portfolios (*ibid*).

Similarly, Eun and Resnick (1994) investigate whether the hedging of exchange risk enhances the profitability from pursuing investment portfolio diversification from the Japanese as well as the US perspectives. To perform the analysis, the study makes use of *ex ante* international portfolio strategies, both with and without forward exchange hedging for the period covering 1978 to 1989. The results indicate that hedging exchange risk offers a superior risk-return trade-off for US investors more than it does for Japanese investors. On this basis, Eun and Resnick (1994) conclude that hedging using currency derivatives increases the benefits from an internationally diversified portfolio.

Notwithstanding these positive effects on a portfolio's gains, the direct effect of derivatives on risk has also been investigated. Choi and Elyasiani (1997) examine how derivative transactions have affected the interest rate and exchange rate risk exposures of 59 large US banks for the period 1975 to 1992. The estimation procedure used is a simultaneous method that recognizes cross-equation dependencies and adjusts for serial correlation and heteroskedasticity. The study finds that options are positively related with both interest rate and currency risk. This is in contrast to currency swaps which are found to be useful in reducing exchange rate risk. Regardless of the finding that derivatives do reduce exchange rate risk, Choi and Elyasiani (1997) conclude, however, that monetary and regulatory authorities need to be cognisant of the systematic interest and exchange rate risks that derivatives can introduce for banks.

Allayannis and Ofek (2001) examine whether firms use foreign currency derivatives for hedging or for speculative reasons in order to understand whether intervention in the derivatives market is warranted. Using a cross-sectional regression analysis and a sample of 378 S&P 500 non-financial firms for the year 1993, the study finds not only that the firms in the sample use currency derivatives for hedging, but that the use of such currency derivatives does significantly reduce the exchange rate volatility firms are exposed to. In contrast to the conclusion of Choi and Elyasiani (1997), the study concludes by suggesting that intervening in the derivatives markets may not be warranted.

Similarly, Reichert and Shyu (2003) assess the impact of derivatives trading on not only interest rate risk and currency risk, but also on market risk and equity value-at-risk for international banks found predominantly in the US, EU, and Japan. The study employs a three-factor multi-index model and a modified value-at-risk (VaR) covering the period from 1995 to 1997. Similar to Choi and Elyasiani (1997), the study finds that the use of options increases the interest rate risk for banks while interest rate and currency swaps are found to be effective in reducing risk.

In their study, Yip and Nguyen (2012) consider the relationship of 97 Australian resources firms 'exchange rate risk exposures to their use of foreign currency derivatives, with a special focus on the impact of the global financial crisis, for the period 2006 to 2009. The empirical analysis which was conducted using a cross-sectional regression analysis indicates that while the number of firms significantly exposed to exchange rate risk since the global financial crisis has increased, there is evidence that the use of currency derivatives reduces foreign exchange risk despite the effectiveness of currency derivatives in this regard being relatively lower during the crisis than before.

In a study similar to Allayannis and Ofek (2001) above, Zhou and Wang (2013) assess the effect of derivatives use by 249 large UK non-financial firms as part of the firms' currency risk management for the year 1999. The relationship assessed in the study is the foreign exchange risk exposure of the firms and the use of foreign exchange derivatives to determine whether the latter has an effect on the former. The estimation and analysis makes use of cross-sectional regression and finds that foreign currency hedges implemented by the companies are effective in reducing their risk exposure to a certain extent. The findings are in line with those presented in Allayannis and Ofek (2001).

Ito, Koibuchi, Sato, and Shimizu (2016) performed a similar analysis as above, but for Japanese non-financial firms. Their study investigates the relationship between 227 listed Japanese firms' exposure to exchange rate risk and their risk management practices for the year 2009. Risk management variables were collected from a questionnaire survey with questions that ranged from whether "the firms engage in financial hedges" to "what type of financial instruments are used". The study found that more than 70% of firms use some kind of hedging instrument, with more than 90% of the firms confirming use of forward contracts for hedging purposes. Although this particular study did not make use of quantitative research methods as is the case with the other studies, its findings imply that building more efficient risk management schemes which can reduce exchange rate volatility should be a priority for company risk management. The study concludes with a suggestion that currency derivatives do play a role in reducing a firm's exchange rate exposure.

In summary, therefore, the literature review above indicates that derivatives can be used to reduce exchange rate risk which is characterized by volatility. However, this is only the case with certain derivative instruments because from the studies, it can be noted that options derivatives tend to increase risk rather than reduce it. Hence the conclusion based on the reviewed literature is that derivatives such as swaps and forward contracts can indeed reduce exchange rate volatility. In addition, one of the themes is that firms use financial derivatives for hedging their risk exposure, rather than for speculation on the financial market.

2.5 Derivatives and economic growth

The literature reviewed thus far finds that portfolio flows do lead to economic growth in the presence of a strong absorptive capacity, but that exchange rate volatility discourages such portfolio investment flows. However, notwithstanding the negative impact of exchange rate volatility, it has been found that derivatives can reduce exchange rate volatility. When one synthesises these findings together, it can hence be theorised that derivatives trading can have a positive impact on economic growth through the transmission channels of exchange rate volatility and portfolio flows. With this in mind, this section provides a brief review of the empirical studies that examine the link between the development of derivatives trading and economic growth.

Rodrigues et al. (2012) investigate the relationship between derivatives trading and economic growth using a panel data set comprising 45 countries observed over the period of 1975 to 2009. Fixed effects, GMM and an EGARCH analysis find statistically and economically significant positive effects of domestic derivatives exchange on economic growth.

Bujari, Martínez and Lechuga (2016) assess the impact of the derivatives markets on economic growth in the EU, the US, Japan, China, India, and Brazil for the period g 2002 to 2014 using a dynamic panel data model estimated with the GMM. The results find that derivatives markets have a positive influence on the economic growth of the sample countries. As such, Bujari. et al. (2016) recommend that policy makers should seek to encourage the development of derivative markets, which can then be expected to contribute to economic development, boost economic growth and improve welfare.

More recently, Şendeniz-Yüncü et al. (2018) investigate the relationship between stock index futures markets development and economic growth for 32 developed and developing countries using time-series methods. To perform the analysis, the study makes use of Granger Causality/Block Exogeneity Wald Tests. The results show that there is causality from economic growth to the futures markets for the countries with high real per capita GDP and causality in the reverse direction for middle-income countries. Şendeniz-Yüncü et al. (2018) thereforeus conclude that policies that promote derivative market development may lead to higher economic growth for middle-income countries.

Similar to the study above, Vo, Huynh and Ha (2019) use the Granger-causality test in the framework of a vector error correction model (VECM) to examine the causal and dynamic relation between the derivatives market and economic development in China, India, Japan, and the US for the period covering 1998 to 2017. In the short run, the derivative markets are found to have a positive relationship with economic development in the US, Japan, and India, but have no effect in the long run. For China, the derivatives market is found to have a negative short run effect on economic development but a positive effect from the derivatives market to economic development is identified in the long run. Vo et al. (2019) suggest that strategies to enhance derivatives markets in emerging and developing countries should be encouraged in order to lift economic development. The study, however, cautions that this should be executed within an appropriate risk-based regulatory framework to avoid any unintended consequences that may arise such as growth volatility.

Vo, Van Nguyen, Nguyen, Vo and Nguyen (2019) investigate the dynamic relationship between the derivatives market and economic growth using panel data on 17 countries, for the period 1993 to 2017. The study is conducted using the panel version of VAR (PVAR). Firstly, the study finds that bidirectional Granger causality between derivatives markets and economic growth can be observed internationally. Secondly, economic growth is found to be driven by derivatives markets. Thirdly, the findings reveal that the relationship between the derivatives market and economic growth is more integrated and direct in high-income countries than in upper to middle-income countries. In light of these findings, Vo et al. (2019) conclude that the development of a local derivatives market should be promoted to support domestic economic development in emerging markets.

With regards to India, Chellasamy and Anu (2016) examine the impact of derivative trading on real economic activity of India for the period covering 2000 to 2016 using the Vector Autoregression (VAR) model for purposes of the analysis. The findings from the study reveal that the derivatives markets do not have a significant impact on the level of real economic activity for the Indian economy. The authors conclude the study by asserting that as the derivatives markets does not have any definitive impact on the macro economy, derivatives should not be seen as a threat to systemic stability. This finding of derivatives having no impact on economic growth is contrary to the findings of Vo et al. (2019), who also assessed the impact on the Indian economy and found a positive association between the two variables.

With regards to South Africa, Marozva (2014) investigates the relationship between derivatives trading and capital market development and also between derivatives trading and economic growth for the period from 1994 to 2012. Autoregressive Distributed Lag (ARDL)-bound testing and the Granger causality tests show that there is a significant relationship between capital markets development and derivatives, but there is no significant evidence of direct relationship between derivatives and economic growth. That an association between derivatives and economic growth cannot be identified, falls in line with the findings of Chellasamy and Anu (2016) above for India.

This result also finds support in a more recent study by Bekale (2015). This study seeks to examine whether institutionalisation of derivatives trading could have a developmental effect on SSA countries by investigating the relationship between South Africa’s derivatives exchange and real GDP. GMM and the Granger causality tests covering the period from 1990 to 2012 finds no evidence of a significant relationship between South Africa's derivatives exchange and real GDP growth. However, the results find that there is evidence that derivatives trading can reduce growth volatility.

In summary, the cross-country studies, and the studies focusing specifically on developed nations, all provide support for the notion that derivatives trading can positively influence economic growth. However, the studies performed on South Africa and other developing nations reveal mixed results as to the impact of derivatives trading. Studies conducted on South Africa indicate that derivatives trading does not have a direct influence on growth in the country, but that it can lead to growth stability and capital markets development. The lack of evidence of a positive impact of derivatives on economic growth in India is also detailed above, but the results do indicate that derivatives can have a positive impact on economic growth in China, but only in the long run. Altogether, the majority of the empirical studies do in one way or another point to benefits of derivatives trading, either in the form of stability or capital markets development.

2.6 Conclusion

This chapter has dealt with the potential impact of currency derivatives on portfolio flows and economic growth to a country, as well as how the potential channel through which derivatives can achieve this is through reducing exchange rate risk.

The contribution of derivatives trading to the economies of both developed and developing countries, whether in the form of capital markets development or direct economic growth, has been shown to be positive. The development of a fully functional derivatives market is thus something that should be encouraged in order to support economic development. The economic benefits of using derivatives include more effective risk management and also increase in investment services and products offered.

With regards to the link between portfolio flows and economic growth, the literature review indicates that positively significant impact of portfolio flows on economic growth vary from country to country depending on the level of development, public policies, financial institutions, rule of law and the macroeconomic environment of respective countries. The development of the local capital markets emerged as a key determinant of the extent of the impact that portfolio flows can have on economic growth.

With regards to the impact of derivatives trading on exchange rate volatility, the literature review indicates that derivatives can be used to reduce exchange rate risk which is characterized by volatility. As the literature review also indicates that exchange rate volatility can negatively impact portfolio flows to a country, in the absence of literature that examines the relationship between portfolio flows and currency derivatives, it can be deduced that currency derivatives can have a positive relation to portfolio flows.

3 RESEARCH METHODOLOGY

3.1 Introduction

This study seeks to investigate the empirical relationships between derivatives trading, net portfolio inflows and economic growth in South Africa over the period from 2000 to 2018. This section describes the methodology that was followed to answer the research questions. An overview of the sampling, estimation strategy, data analysis methods, data sources and justification for the choice of factors is provided.

3.2 Research Approach and Strategy

To achieve the objectives of this empirical study, a deductive and quantitative research approach was used to investigate the causal relationship between foreign exchange derivatives, net portfolio inflows and economic growth in South Africa. Quantitative research is an approach that focuses on quantifying data and generalising results from a sample for ease of deductions (Macdonald & Headlam, 2008). Since the objective of the research is to explain a particular phenomenon – the relationship between derivatives trading, portfolio flows and economic growth using historical numerical records – a quantitative research methodology is considered a suitable approach.

The approach taken is to ascertain the dynamic interactions between the different variables using VECM estimation. The VECM is utilised in this study due to the ability of its equations to examine the relationship between various economic models without extensive assumptions being made about the underlying structure of the economy (Kodongo & Ojah, 2012; Gossel and Biekpe, 2017).

3.3 Research Design, Data Collection and Research Instruments

3.3.1 Sampling

The sample period for the study is from the first quarter of 2000 to the last quarter of 2018, from which 76 observations are derived. For a valid statistical inference to be drawn, there needs to be a minimum number of 30 observations. The sample will not be determined using the confidence interval. The data used in the study are from the International Monetary Fund (IMF), the Bank of International Settlements (BIS), Stats South Africa, the Federal Reserve Bank of St. Louis, United States Federal Reserve Bank, United States Bureau of Economic

Analysis (BEA), Bloomberg and the Institute of International Finance (IIF), which are reputable institutions.

3.3.2 Estimation Strategy

The empirical steps used to conduct the analysis consist of the following:

i. Tested for stationarity using the augmented Dickey–Fuller (ADF) test (Dickey & Fuller, 1979; Dickey & Fuller, 1981) and Phillips-Perron (PP) test (Phillips & Perron, 1988) unit root tests, as well as the KPSS stationarity test (Kwiatkowski, Phillips, Schmidt & Shin, 1992).
ii. Tested for co-integration among the I(*d*) variables using the Johansen (1995) trace and max-eigen statistics.
iii. Identified the optimal lag and then conducted the empirical analysis using a vector error correction model (VECM) (Johansen, 1988) as significant cointegration was found to be present.
iv. Conducted stability and specification tests.
v. Conducted impulse response and variance decomposition analysis.
vi. Performed the Granger causality tests (Granger, 1969).

3.3.3 Data Analysis Methods

3.3.3.1 Tests for stationarity

Determining whether the variables are level stationary (I(0)) or stationary in differences, which means they contain a unit root (I(d)), was the first step taken in the analysis. The unit root tests help to understand the degree of stationarity of the variables, which is necessary in order to avoid spurious regression (Okunade & Karakus, 2001). For these purposes, the augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979, 1981), and Phillips-Perron (PP) (Phillips & Perron, 1988) unit root tests were performed on all of the variables. In circumstances where the two aforementioned unit root tests derived conflicting results, the KPSS (Kwiatkowski et al., 1992) stationarity test was used to resolve the conflict.

The ADF test is used to determine whether data series contain unit roots, that is, whether they include a component that is generated by permanent or nearly permanent shocks (Hoffman & Rasche, 2002). The null hypothesis of the ADF test is that the data series is nonstationary ($\alpha j = 0$) while the alternate hypothesis is that the data series is stationary ($\alpha j < 1$) (*ibid*). As such, where the null hypothesis is rejected, Glynn, Perera and Verman (2007) make it clear that this means the time series is stationary. The equation of the ADF is as follows:

$$\Delta yt = \mu + \beta t + \alpha jyt - 1 - \sum_{j=1}^{p} C\Delta yt - j + \varepsilon t \quad (1)$$

where

αj = 0 (null hypothesis)

Y = Time series

T = Trend

Δ = First difference

According to Fedorová (2016), there can be a challenge of the selection of lag *p* in the regression model where the time series is generated by a process with autocorrelated and heteroskedastic non-systematic component. The Phillips-Perron (PP) test addresses this limitation by using the standard Dickey-Fuller test with "non-parametrically modified test statistics instead of describing the autocorrelation structure of the process by the corresponding autocorrelation models" (*ibid*). The PP test is premised on the null hypothesis π = 0 and the alternate hypothesis π <1. The equation for PP tests is as follows:

$$\Delta Yt = \beta + \pi Yt - 1 + \mu t \quad (2)$$

The KPSS (Kwiatkowski et al.,1992) stationarity test is used where the ADF and PP tests produce contradictory results, leading to inconclusive results. The KPSS statistic uses the OLS regression on a trend and random walk (Hashikutuva, 2017) as below:

$$Y_t = \lambda T + (r_t + \alpha) + e_t \quad (3)$$

where $r_t = r_{t-1} + U_t$ is a random walk and $r_0 = \alpha$ is the intercept. All the other variables are as previously defined.

The KPSS (Lagrange Multiplier (LM)) statistic is based on the following equation:

$$LM = \frac{\sum_t S(t)^{\quad 2}}{(T^{\quad 2} f_0)}$$

(4)

where LM is the Lagrange Multiplier statistics, f_0 is the estimator of the residual spectrum at frequency zero and *s(t)* is the cumulative residual function:

$$s(t) = \sum_{p=1}^{t} \hat{e}_p \tag{5}$$

3.3.3.2 Optimal Lag Length Selection

Identifying the optimal lag length of the series was the next step in conducting the empirical analysis. Selecting the correct lag length is important to be able to draw inferences from empirical research based on Vector Auto Regression (VAR) modelling as these model estimations are sensitive to the correct selection of the optimal lag length (Guterez, Souza & Guillèn, 2009). The identification of the optimal lag length was conducted making use of the Akaike Information Criterion (AIC) (Akaike, 1974) (Equation 6) and the Schwarz information criterion (SIC) (Schwarz, 1978) (Equation 7).

$$AIC = -2l/T + 2k/T \tag{6}$$

$$SIC = -2l\ /\ T\ + (k\ \log T)/T \tag{7}$$

where *T* is the sample size, *k* is the number of parameters and *l* is the log likelihood

The difference between the AIC and SIC is that the AIC selects the model that will predict the best values with not much of a concern with having excessive parameters, while the SIC is designed to select the true values of lag lengths (Hashikutuva, 2017). This means that the SIC is not suitable for lag length selection in small samples due to the tendency to identify an underparameterized model, and for this reason, the AIC information criterion is deemed to be more applicable for small sample sizes and is more likely to select the correct lag length for the model (Guterez et al., 2007). Given the small sample size used in this study, AIC was considered appropriate for selecting the lag length.

3.3.3.3 Test for co-integration among the non-stationary variables

Once the stationarity of the data was determined and the optimal lag length was selected, the next step of the analysis was to test for cointegration among the non-stationary variables. The data series considered for this study were all found to be non-stationary at levels and stationary in first differences except for three variables (this is elaborated on further in Chapter 4 of this study). It is generally accepted that cointegration gives an indication of some form of equilibrium in the long run (Hashikutuva, 2017). Where the results of the unit root tests reveal that some variables are non-stationary, it is deemed appropriate to test for cointegration among the first difference variables to determine whether the analysis should be conducted using an unconstrained vector autoregression (VAR) model or a VECM model. If the cointegration test finds no significant evidence of a cointegrating relationship, then the empirical analysis can be conducted using a VAR model as opposed to a VECM model should evidence of a cointegrating relationship be found.

This study uses the Johansen (1995) cointegration procedure as it allows for interaction between the variables and can identify more than one cointegrating equation (Gossel & Biekpe, 2017). The two test statistics used in the Johansen procedure are the trace statistic and the maximum eigenvalue statistic. The maximum eigenvalue statistic tests the null hypothesis that there are exactly r cointegrating vectors (Equation 8) while the trace statistic tests the null hypothesis that the rank of the matrix (Π) is less than or equal to the number of cointegrating vectors (r) (Equation 9).

$$\lambda_{max}(r, r+1) = -T\, ln(1 - \hat{\lambda}_{r+1}) \quad (8)$$

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln(1 - \hat{\lambda}_i) \quad (9)$$

Similar studies that have made use of the Johansen cointegration procedure to test for cointegration between time series include Gossel and Biekpe (2012) and Vo et al. (2019), which are both discussed more elaborately in Chapter 2 above.

3.3.3.4 Model Specification

Section 4.7 below shows that empirical analysis in this study includes one cointegrating equation. Once it was determined that the variables are cointegrated, the Vector Error

Correction Model (VECM) was deemed more suitable for analysing the relationship between the selected variables rather than a VAR.

The VECM was estimated to analyze the interaction between the factors of interest and the control factors. The VECM is an econometric framework that can be used to assess the long-run and short-run dynamics with the following form (Johansen, 1988):

$$\Delta y_t = \prod y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t$$

Where $\Pi = -(I_k - A_1 - \cdots - A_p) and\ \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t$ (10)

Should there have been no evidence of cointegration among the variables, then the analysis would have been conducted using an unconstrained vector auto regression model as proposed by Sims (1980):

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + \mu_t \quad (11)$$

where y_t is a vector of *k* potentially endogenous variables, *p* is the number of lags, A_i is a ($k \times k$) matrix of parameters, and μ_t is an unobservable error term.

The VECM is thus an extension of a basic VAR where each equation is an autoregression plus distributed lag, with p lags of each variable included in the model (Namoloh, 2018). It is a restricted VAR model which includes an error correction specification to the general VAR model (Namoloh, 2018). According to Keating (1992), this makes the model appropriate for capturing the short run and long dynamics in a system of equations and it is useful in showing the causal relationship between variables. The error correction model that is included as part of the VECM is estimated for the purpose of accounting for short-run dynamics which are influenced by the long-run equilibrium and its estimation is useful for estimating the speed of convergence to equilibrium after an exposure to an exogenous shock (Keating, 1992).

3.3.3.5 Conduct stability and specification tests

Following this, the relevant stability and specification tests were performed. The stability and specification tests conducted include the Breusch-Godfrey test for serial correlation, the Jarque-

Bera tests for normality of the residuals, and the White VEC Residual test for heteroskedasticity.

Breusch-Godfrey LM Test

According to Breusch and Pagan (1979), the Breusch-Godfrey Serial Correlation LM Test entails testing residuals for serial correlation. The null hypothesis of the Breusch-Godfrey Serial Correlation LM Test is that there is no serial correlation and the hypothesis is rejected for any p-value less than 0.05.

Jarque–Bera (JB) Test (1980)

The JB test is used to test the null hypothesis that the data follows the normal distribution as it can identify the difference in the distribution of the study's time series to that of a normal distribution. The test statistic of the JB test is expressed as follows:

$$JB = \frac{n-k+1}{6}\left(s^2 + \frac{1}{4}(C-3)^2\right) \tag{12}$$

where n is the number of observations (or degrees of freedom in general); S is the sample skewness; and C is the sample kurtosis.

White VEC Residual Heteroskedasticity Tests

The null hypothesis of the White test (White, 1980) is that the residuals are homoskedastic. The test is performed by firstly regressing the squared residuals from the original regression model onto a set of variables that contain the original regression along with their squares and cross-products (Yu, 2017). Second to this step is the need to inspect the R^2. The Lagrange multiplier (LM) test statistic follows a chi-squared distribution, with degrees of freedom equal to $P - 1$, where P is the number of estimated parameters in the auxiliary regression (Yu, 2017). It is expressed by the formula below:

$$LM = nR^2 \tag{13}$$

3.3.3.6 Conduct impulse response and variance decomposition analysis

Following the stability and specification tests, the causal linkages were also examined using impulse response functions. Impulse response functions are conducted to trace the effects on a variable of a one standard deviation shock to another variable in the system (Stock & Watson, 2001). The impulse response functions provide additional information as to whether the causal relationship identified under the Granger causality test is positive or negative. Based on an assessment of the graphical output, the impulse response functions also provide an indication of the magnitude of the relationship (Namoloh, 2018).Ordering of variables in a VECM is an important consideration when it comes to impulse response specification. The technique to be used to compute the impulse response functions is the generalised impulse response function (GIRF). The technique is preferred due to its insensitivity to the ordering of variables in the VECM and because it does not require orthogonalization of shocks (Mousa, 2010). As such, in this study, the GIRF approach is used to avoid ordering restrictions.

Over and above impulse response functions, the relationship between the variables will also be assessed using variance decomposition analysis. According to Brooks (2008), variance decompositions are useful in econometric analysis as they provide a measure of the contribution of a shock to each of the independent variables to the forecast error variance of the dependent variable.

3.3.3.7 Perform the Granger causality tests (Granger, 1969)

If the time series had been found to be stationary at their levels, the Granger causality tests would have been based on the following bivariate vector autoregressive (VAR) equation (Granger, 1969):

$$X_t = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} X_{t-i} + \sum_{i=1}^{k} \gamma_{x,i} Y_{t-i} + \varepsilon_{x,t} \qquad (14)$$

where α_x is the intercept term, $\varepsilon_{x,t}$ is the stochastic error terms assumed to be serially uncorrelated with zero mean and finite covariance matrix. k is the lag length, $\beta_{x,i}$ is the parameter of the past value of *X*, which indicates how much past value of *X* explains the current value of *X*, and $\gamma_{x,i}$ is the parameter of the past value of *Y*, which shows how much past value of *Y* explains the current value of *X*.

However, since the time series are found to be I(1) and cointegrated, the causality test was estimated within a vector error correction model (VECM). The causality test was applied using the following form:

$$\Delta X_t = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} \Delta X_{t-i} + \sum_{i=1}^{k} \gamma_{x,i} \Delta Y_{t-i} + \varphi_x ECT_{x,t-i} + \varepsilon_{x,t} \quad (15)$$

where φ_x is the parameter of the ECT, gauging the error correction mechanism that drives the Xt back to its long-run equilibrium relationship.

VEC Granger causality/Block exogeneity Wald test were conducted to determine whether lagged values of independent variables jointly affect a particular dependent variable (Ahmed, 2011). Further, the test allows the assessment of whether the inclusion of lagged values of a variable is important for explaining the dynamics of the other variables in the system of equations over and above the explanatory power of the lags of those other variables (*ibid*).

3.3.4 Empirical Model

The factors included in the model below have been selected on the basis of the domestic push–pull literature (Wesso, 2001; Fedderke & Liu, 2002; Ahmed et al., 2007; Gossel & Biekpe, 2017). In order to highlight the impact of derivatives trading on economic growth and net portfolio flow, the study runs four VECM models. The first two models examine SA_NETPIF. The first VECM includes SA_XTD as a variable within the structure while the second VECM excludes SA_XTD as a variable (16 and 17). The remaining two models examine SA_GDP Growth Rate. The third VECM includes SA_XTD as a variable within the structure while the fourth VECM excludes SA_XTD as variable (18 and 19). The models can be summarized as follows:

$$SA_{NETPIF} = f(u_t^{SA_{XTD}}, u_t^{USA_{GDPG}}, u_t^{USA_{TBill}}, u_t^{SA_{Tbill}}, u_t^{SA_{REER}}, u_t^{SA_{SPI}}, u_t^{SA_{GDPG}}, u_t^{y}) \quad (16)$$

$$SA_{NETPIF} = f(u_t^{USA_{GDPG}}, u_t^{USA_{TBill}}, u_t^{SA_{Tbill}}, u_t^{SA_{REER}}, u_t^{SA_{SPI}}, u_t^{SA_{GDPG}}, u_t^{y}) \quad (17)$$

$$SA_{GDPG} = f(u_t^{SA_{XTD}}, u_t^{USA_{GDPG}}, u_t^{USA_{TBill}}, u_t^{SA_{Tbill}}, u_t^{SA_{REER}}, u_t^{SA_{SPI}}, u_t^{SA_{NETPIF}}, u_t^{y}) \quad (18)$$

$$SA_{GDPG} = f(u_t^{USA_{GDPG}}, u_t^{USA_{TBill}}, u_t^{SA_{Tbill}}, u_t^{SA_{REER}}, u_t^{SA_{SPI}}, u_t^{SA_{NETPIF}}, u_t^{y}) \quad (19)$$

where SA_NETPIF is South Africa’s portfolio flows and SA_GDPG is South Africa’s real GDP growth rate, *SA_XTD* is the turnover of FX exchange traded derivatives (referencing the South African rand), *USA_RGDP* is the US real GDP growth rate, *USA_TBill* is the three-month US Treasury bill, *SA_Tbill* is the three-month Treasury bill rate, *SA_REER* is the real effective exchange rate, and *SA_SPI* is the domestic share price performance.

In addition to the above endogenous variables, the VECM models also include a set of 0/1 binary dummy variables to account for specific structural breaks and upsets associated with the variables.[1] SA_XTD is excluded as a variable in equations 17 and 19 in order to isolate its specific impact on the dependent variables of SA_NETPIF and SA_GDPG.

3.3.4.1 Data

This study seeks to understand the relationship between derivatives, portfolio inflows and economic growth in South Africa over the period of 2000 to 2018. The analysis makes use of three factors of interest and a set of control factors.

3.3.4.2 Factors of Interest

This study makes use of three factors of interest: portfolio inflows, exchange traded foreign exchange derivatives, and economic growth. As a measure of portfolio flows, this study uses the sum of the net non-resident purchases of SA stocks (portfolio equity flows) and bonds (portfolio debt flows) as published by the IIF normalised to SA real GDP. The natural logarithm of turnover of exchange traded foreign exchange derivatives (referencing the South African Rand) as published by the BIS will act as a measure of the development of the foreign exchange derivatives market in South Africa. Turnover is a measure of the number of purchases/sales of a particular contract during a given period of time which gives a good indication of the liquidity in a particular contract (Jeanneau & Micu, 2003). It is, therefore, considered a more appropriate measure of activity on the derivatives exchange than open interest. The SA real GDP growth rate as published by Statistics South Africa will be used as a proxy for South Africa's economic growth.

3.3.4.3 Control Factors

The following five control factors have been selected based on the literature that focuses on understanding the determinants of capital flows from a South African perspective (Wesso, 2001; Fedderke & Liu, 2002; Ahmed et al., 2007; Gossel & Biekpe, 2017):

i. Foreign economic growth proxied by the US real GDP growth rate published by the US Bureau of Economic Analysis. Foreign economic growth is expected to be significantly and negatively related to portfolio inflows given the logic that a larger foreign economy

[1] The dummy dates are listed in Appendix A.

will attract capital away from the domestic market due to its capacity to offer more investment opportunities and economic benefits in comparison to the local economy. Gossel and Biekpe (2017) found that the US GDP was one of the two most significant factors for portfolio inflows to South Africa.

ii. Foreign interest rates proxied by the three-month Treasury bill as published by the United States Federal Reserve Bank. Foreign interest rates are expected to be significantly and negatively related to portfolio inflows given the logic that higher foreign interest rates will attract capital way from the domestic market due to the ability to offer higher returns in the foreign markets. This is confirmed by Wesso (2001) and Ahmed et al. (2007), who find that portfolio investors chase high yield- bearing securities.

iii. Domestic interest rates proxied by the three-month Treasury bill rate published by the Federal Reserve Bank of St. Louis. Domestic interest rates are expected to be significantly and positively related to portfolio inflows given the logic that higher domestic interest rates will attract capital way from the foreign market due to the ability to offer higher returns locally. Fedderke & Liu (2002) highlighted that a more positive interest rate differential was important for attracting foreign capital.

iv. Exchange rate volatility using the 12-month standard deviation of the real effective exchange rate using data sourced from the IMF. Exchange rate volatility is expected to be significantly and negatively related to portfolio inflows. This is based on the expectation that exchange rate volatility will induce a home bias among foreign investors (Fidora et al., 2007; Caporale et al., 2013).

v. Domestic share price performance will be measured by the natural logarithm of the JSE All Share price index (ALSI) using data sourced from Bloomberg. Domestic share price performance is expected to be positively yet insignificantly related to portfolio inflows, particularly in the long run. This is based on the findings of Ahmed et al. (2007) and Gossel and Biekpe (2017).

3.4 Limitations

As a proxy for derivatives trading, the study makes use of exchange traded foreign exchange derivatives and does not include over-the-counter data in the measurement. This is due to the fact that the Bank of International Settlements only publishes the overthe-counter statistics on a triennial basis. As over-the-counter instruments constitute a significant portion of the total derivatives market, this is considered to be a limitation of the study.

3.5 Conclusion

This chapter outlined the data used in the study, including the time period, frequency and source of the data on all variables. The chapter also outlined the econometric method that was applied, with justifications provided for the choice of approaches followed. This study employs the VECM model as an analytical framework after testing for stationarity and cointegration. The results of the model are analysed and discussed in the following chapter.

4 RESEARCH DATA FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

The previous chapter presented the methodology used in this study to examine the relationship between the three selected factors of interest and the selected control factors. This chapter follows on from that by proceeding to present the empirical analysis and findings. Firstly, each of the series is tested for stationarity using the selected unit root tests. This is followed by a determination of the appropriate lag length, and thereafter the cointegration tests which assess the existence of a long-run relationship between the variables are presented. Considering these findings, the results of the econometric model is presented. The results from the model are discussed next, including the impulse response functions, the variance decompositions, and the Granger causality tests. The inferences drawn from these tests are compared to the results from previous studies throughout this chapter.

4.2 Graphical Analysis

Prior to presenting the formal unit root tests below, a graphical analysis of the three factors of interest, namely South Africa's real GDP growth rate, net portfolio flows to South Africa and the turnover of exchange traded derivatives referencing the Rand are presented and discussed. The preliminary graphical inspection was conducted on the three factors of interest series to identify any trend, pattern or relationship that may be of interest for the purposes of this study. In addition, the graphical inspection was done to gain greater insight on the data (including the control factors) such as whether they are stationary or not.

As depicted in Figure 4.1(a) below, South African real GDP growth rate has displayed an inconsistent pattern since the early 2000s. South African income is somewhat reliant on commodity prices (Rangasamy, 2009) and the volatility in income may reflect how South Africa's economic performance is greatly tied to global economic conditions (Baxter, 2009). From 2000 to 2001, the SA GDP growth rate series showed a sharp decrease, which can be attributed to the reconsideration by international investors of emerging markets as a strong investment opportunity and fears that instability in other parts of SSA might affect South Africa (SARB, 2000). Such an inconsistent pattern in growth, depicted in Figure 4.1 (a), is not favourable given South Africa's context of a high unemployment and inequality rate. At the advent of democracy in 1994, it was expected that tax reforms, fiscal discipline and the gradual liberalisation of exchange control would be the primary factors that lead to sustainable economic growth (Wesso, 2001), but since then it has been observed that other external factors such as negative perceptions about emerging markets in general can affect the country's growth through the impact these have on foreign investment (SARB, 2000).

This observed link between foreign investment to South Africa and its economic growth is a theme that continues to this day, and the country continues to rely significantly on foreign capital flows for the funding of its current account deficit (Gossel & Biekpe, 2012). As can be seen in the figures below, similar to the growth rate, the SA net PIF series depicted in Figure 4.1(b) also shows a decrease in early 2000 and 2001 and in 2008-2009. The similar trends between economic growth and portfolio flows in Figures 4.1(a) and 4.1(b) suggest that there is a positive relation between the two series. The pattern observed in the figures provides support for the notion that South Africa is highly dependent on foreign investment to support its growth (Wesso, 2001). In fact, Brambila-Macias and Massa (2010) observe that in 2006, South Africa accounted for about 88% of the portfolio equity flows to SSA. In recognizing that South Africa's growth prospects are influenced by foreign investment, significant research work has been performed on this area (de Vita & Kyaw, 2009; Gossel & Biekpe, 2012; Baghebo & Apere, 2014). Also worth nothing is that Figure 4.1(b) shows that, although there is notable volatility in the net portfolio flow series, it has followed a downward trend since 2004. Such a decrease suggests a gradual loss of attractiveness of South African assets in the global markets.

In contrast, the derivatives turnover (SA XTD) series depicted in Figure 4.1(c) below shows consistent growth since 2000, with no identifiable sense of volatility in the series. Given this preliminary observation of a delink between the trend in foreign investment and derivatives trading, it would appear that derivatives trading in South Africa may be of a speculative nature rather than for the purposes of hedging risk. The delink in the trend of foreign investment and that of derivatives trading is inconsistent with the expectation that derivatives should not only result in adequate price discovery but should also provide for adequate risk hedging which would then translate into increased foreign investment flows (Şendeniz-Yüncü, Akdeniz, & Aydoğan, 2007).

In all cases there appears to be evidence of non-stationarity, and as such, the series are tested for the presence of a unit root using statistical methods, the results of which are presented in the next section.

Figure 4.1(a) SA GDP Growth Rate

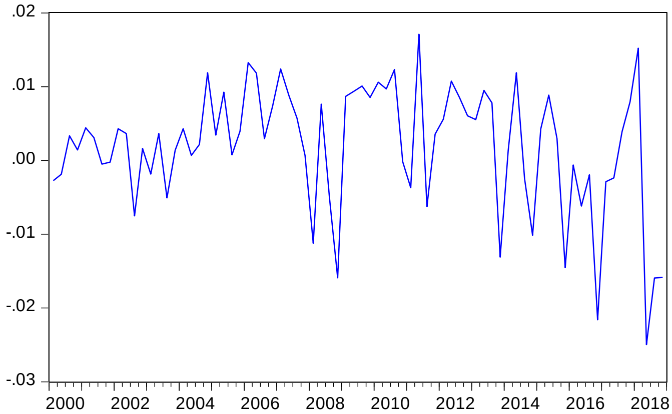


Figure 4.1(b) Normalised Net PIF

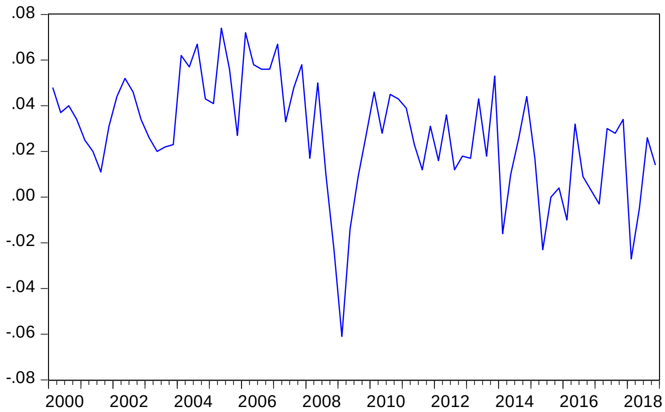
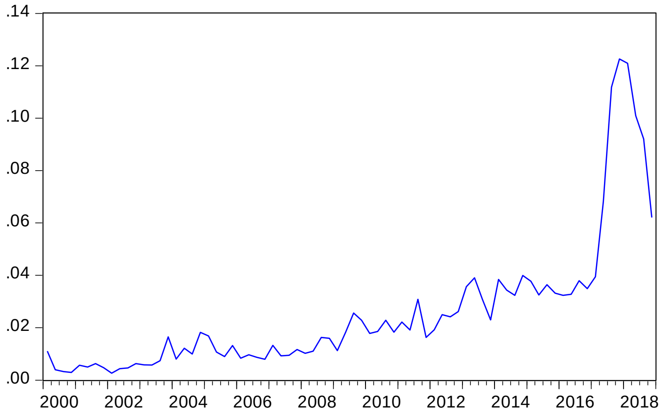


Figure 4.1(c) Natural log of SA XTD series



4.3 Descriptive Statistics

The descriptive statistics for the factors of interest net portfolio flows, derivatives trading and SA GDP growth rate are presented in Table 4.1 below. Derivatives Trading (SA_XTD) has a mean of 0.025 and a low standard deviation of 0.026. The kurtosis is 8.127 indicating a relatively peaked distribution and a positive skewness of 2.288, which indicates a distribution with an asymmetric tail leaning toward more positive values. A positively skewed SA_XTD implies increased use of derivatives trading. Net Portfolio Flows to South Africa (SA_NETPIF) has a mean of 0.002 and a standard deviation of 0.009. The kurtosis is -3.789 indicating a peaked distribution, but relatively flat to that of the SA_XTD, and a negative skewness of -0.947 which indicates a distribution with an asymmetric tail leaning toward more negative values. A negatively skewed distribution implies a diminishing in relative net portfolio flows to South Africa. This statistic adds weight to the observation under section 4.2. of a downward trend in the portfolio inflows to South Africa. South Africa GDP growth shows a mean of 0.027 and a standard deviation of0.025. The kurtosis is relatively peaked at 3.973 with a negative skewness of 0.713. A negatively skewed distribution implies a deceleration in economic growth in the country which is not preferred in a country beset with inequality and unemployment.

Table 4.1. Descriptive Statistics

	SA_XTD	SA_NETPIF	SA_GDP_G
Mean	0.025	0.002	0.027
Median	0.018	0.003	0.028
Maximum	0.123	0.017	0.074
Minimum	0.003	-0.025	-0.061
Std. Dev.	0.026	0.009	0.025
Skewness	2.288	-0.947	-0.713
Kurtosis	8.127	3.789	3.973
Sum	1.935	0.139	2.076
Sum Sq. Dev.	0.052	0.006	0.047
Observations	76	76	76

4.4 Multicollinearity

When running econometric models, approximate linear relationships between two or more independent variables within the model could possibly exist (Lin, 2008). This is referred to as multicollinearity and when regression techniques are being utilised, it can lead to the inaccurate specification and estimation of a structural relationship (Farrar & Glauber, 1967). It is thus necessary to test for multicollinearity using a correlation matrix so as to avoid validation, interpretation, and analytical errors.

As can be seen from Table 4.2 below, there is evidence of multicollinearity between share price index (*SA_SPI*), derivatives turnover (*SA_XTD*) and domestic interest rate (*SA_TBill*). Hence, the inclusion of these three highly correlated factors in the same empirical model may result in multicollinearity difficulties, and thus the share price index (SA_SPI) has been excluded.

Table 4.2 Correlation

	SA_SPI	SA_TBILL	SA_XTD
SA_SPI	1.000	- 0.615	0.668
SA_TBILL	-0.615	1.000	-0.357
SA_XTD	0.668	- 0.357	1.000

4.5 Tests for stationarity

Leading on from the graphical analysis performed above, it is necessary to employ formal testing mechanisms for stationarity. As indicated in the preceding chapter, the ADF (Dickey & Fuller, 1979; Dickey & Fuller, 1981) and PP (Phillips & Perron, 1988) tests were used to formally test for stationarity, and the KPSS (Kwiatkowski et al., 1992) test is employed where the ADF and PP methods yield conflicting results. False regression attributable to means and variances which are not constant over time may result from non-stationary data (Mulumba, 2018). If such unstable behaviour is identified, it may mean that the model and subsequent analysis may produce spurious results.

For both the ADF and the PP tests, the null hypothesis is that the series has a unit root which is rejected if the absolute value of the test statistic is higher than the critical value. For the KPSS test, the null hypothesis is that the series does not have a unit root which is rejected if the absolute value of the test statistic is higher than the critical value.

The results from the ADF and PP unit root tests are presented in Table 4.3 and show that the three-month SA Treasury bill (*SA_3MTBILL*) and SA exchange traded derivatives turnover (*SA_XTD*) are first-difference stationary (*I(1)*) while the SA net portfolio flows (*SA_NETPIF*), SA GDP growth rate (*SA_GDPG*), and the US GDP growth rate (*US_GDP*) are level stationary

(*I(0)*). In the case of the SA real effective exchange rate volatility (*SA_REER*) and the three-month US treasury bill rate (*US_3MTBILL*), the ADF and PP unit root tests provide conflicting results and thus the variables were tested using the KPSS stationarity test. The KPSS test results presented in Table 4.4 then show that SA_REER is level stationary while the US_3MTBILL is first-difference stationary.

Table 4.3 Unit Root Test Results

Variable in levels	Test	I(0)	I(1)
SA_3MTBILL	ADF	-2.159	-5.123***
	PP	-1.968	-3.991***
SA_GDPG	ADF	-4.681***	-7.071***
	PP	-4.681***	-25.467***
SA_NETPIF	ADF	-6.419***	-8.336***
	PP	-6.413***	-25.370***
SA_REER	ADF	-2.713*	-6.455***
	PP	-3.006**	-6.300***
SA_XTD	ADF	-2.242	-5.308***
	PP	-1.436	-5.504***
US_3MTBILL	ADF	-4.095***	-3.662***
	PP	-2.336	-4.079***
US_GDPG	ADF	-6.142***	-8.568***
	PP	-6.234***	-19.045***

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table 4.4 KPSS Unit Root Test Results

Variable in levels	I(0)	I(1)
SA_REER	0.208***	0.050***
US_3MTBILL	0.569	0.186***

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

4.6 Lag Length Selection

The next step of the estimation process is to test for the existence of a long-run relationship using the Johansen cointegration test (Johansen, 1988). However, before carrying out this test, the correct lag specification of the VAR needs to be determined. The optimal lag length test results are shown in Table 4.5. As stated in Chapter 3, the optimal lag length is selected using the AIC information criterion. The results show that the AIC selects an optimal lag length of five. The AIC is the information criterion which was deemed most appropriate for this study based on the relatively sample size. This lag length was confirmed by one other information criteria, namely, the log-likelihood ratio test (LR). However, in running the analysis, it was noted that the lag length of five selected by the lag selection criteria led to over-identification and an unstable model. For this reason, the lag length of four was applied in the cointegration test and VAR analysis in the next section.

Table 4.5 Appropriate Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1367.749	NA	5.32E-26	-38.331	-38.108	-38.242
1	1723.220	630.835	9.54E-30	-46.964	-45.179*	-46.254
2	1795.625	114.216	5.13e-30*	-47.623	-44.277	-46.293*
3	1843.608	66.230	5.84E-30	-47.595	-42.687	-45.643
4	1895.024	60.829	6.71E-30	-47.663	-41.193	-45.090
5	1966.580	70.549*	5.15E-30	-48.298*	-40.267	-45.104

* indicates 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
HQ: Hannan-Quinn information
criterion

4.7 Cointegration Tests

As the unit root tests above show that the series examined in this study are nonstationary, the Johansen cointegration test was used to test for the existence of a long-run relationship. The results of both the trace and maximum eigenvalue tests are used to ensure that the inferences drawn about the existence of a long-run relationship are robust. The results presented in Table 4.6 show that for both the trace and maximum-eigenvalue tests, the first test has a null hypothesis that there are no cointegrating relationships, with the alternative hypothesis for the trace test being that there are more than zero relationships while that for the maximum-eigenvalue test is that there is at least one cointegrating equation (Namoloh, 2018).

To interpret the results of the test, the test statistics are compared with the critical values and if the test statistics are greater than the test critical values, the null hypothesis is rejected. For the first test, Table 4.6 shows that the null hypothesis that there is no cointegration is rejected by the trace test which indicates one cointegrating equation at the 0.05 level. Similarly, the null hypothesis that there is no cointegration is rejected by the maximum-eigenvalue test.

The trace test tends to have power performance more superior than that of the maximum eigenvalue (Lüutkepohl, Saikkonen & Trenkler, 2001) and as such, the empirical analysis in this study includes one cointegrating equations in the VECM. As the series have been shown to be cointegrated, the VECM is deemed more suitable for analyzing the relationship between the selected variables rather than a VAR.

Table 4.6 Cointegration Test Results

Trace test					Max-Eigen			
Cointegrating equations	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.306	36.607	29.797	0.007	0.306	25.986	21.132	0.010
At most 1	0.096	10.621	15.495	0.236	0.096	7.156	14.265	0.471
At most 2	0.048	3.465	3.841	0.063	0.048	3.465	3.841	0.063
* denotes rejection of the hypothesis at the 0.05 level								

4.8 Diagnostic tests

Stability of the models specified in equations 16 to 19 of Chapter 3 has been established using standard diagnostic tests. The diagnostic tests presented in Table 4.7below show that the models perform well for normality, with no serial correlation and no heteroskedasticity.

Table 4.7 Diagnostic Test Results

	Target: SA_NETPIF; SA_XTD incl		Target: SA_NETPIF; SA_XTD excl		Target: SA_GDPG; SA_XTD incl		Target: SA_GDPG; SA_XTD excl	
Residual serial correlation tests (LM-Stats)								
Lag	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
1	44.411	0.660	39.776	0.306	44.411	0.660	39.776	0.306
2	43.965	0.677	29.885	0.754	43.965	0.677	29.885	0.754
3	55.043	0.257	35.556	0.490	55.043	0.257	35.556	0.490
4	39.852	0.821	35.417	0.496	39.852	0.821	35.417	0.496
Normality test								
Jarque-Bera	10.070	0.757	18.069	0.114	11.966	0.609	18.047	0.114
Heteroskedasticity tests								
Chi-sq	1407.672	0.814	974.603	0.417	1407.672	0.814	974.603	0.417

4.9 Econometric Model

4.9.1 Long run Analysis

The coefficients of the cointegrating equation represent the long run relationship in the VECMs. The coefficients for equations 16 to 19 specified in Chapter 3 are summarised in Table 4.8as VECM 1, VECM 2, VECM 3 and VECM 4 respectively.

The first VECM estimation of the long run relationship between net portfolio (SA_NETPIF) (as the target variable) and the other variables shows that there is a long run positive relationship between net portfolio flows and derivatives turnover. The results imply that for a 1% increase in derivatives turnover, net portfolio flows increase by 0.83% and a 1% increase in the real effective exchange rate volatility is associated with a 4.05% decrease in net portfolio flows. When it comes to the relationship between net portfolio flows and economic growth, the results show that a 1% increase in economic growth is associated with a 1.295% increase in net portfolio flow. These results thus indicate that portfolio flows are sensitive to the level of volatility in the local exchange rate. Furthermore, these results reveal that the quantum of the increase in net portfolio flows as a result of a rise in derivatives turnover is lower than the negative impact of exchange rate volatility, which suggests that some form of exchange rate volatility mitigation can be obtained through the use of exchange rate derivatives but that this can only be expected to be partial.

In addition, the results show that there is a significant long run relationship between net portfolio flows and the remaining control factors. More specifically, a 1% increase in SA 3-month Treasury bill rate is associated with a 2.88% increase in net portfolio (SA_NETPIF), a 1% increase in foreign interest rate (US 3MTBILL) is associated with a 1.51% decrease in net portfolio (SA_NETPIF) and a 1% increase in foreign GDP (US GDP) is associated with a 1.87% decrease in net portfolio (SA_NETPIF).

Table 4.8 also presents the VECM estimation of the long run relationship between net portfolio flows (SA_NETPIF) and the other variables excluding derivatives turnover. The direction of the relationship between net portfolio flows and the other variables reflected in VECM 2 is as the same direction of the same relationships examined in VECM 1. The only difference is in the size of the coefficients for all the remaining variables once derivatives turnover is excluded from the model. This suggests that derivatives trading has a significant impact on the model estimation. The results show that a 1% increase in SA 3-month Treasury bill rate is associated with a 6.81% increase in net portfolio (SA_NETPIF), a 1% increase in exchange rate volatility is associated with a 10% decrease in net portfolio (SA_NETPIF), a 1% increase in economic growth is associated with a 1.91% increase in net portfolio (SA_NETPIF), a 1% increase in foreign interest rate (US 3MTBILL) is associated with a 3.36% decrease in net portfolio (SA_NETPIF) and a 1% increase in foreign GDP (US GDP) is associated with a 4.44% decrease in net portfolio (SA_NETPIF).

Table 4.8 provides the estimation of the long run relationship between the SA GDP growth rate and the other model variables (VECM 3), which shows a long-run positive relationship between SA GDP growth rate, net portfolio flows and derivatives turnover. In particular, for every 1% increase in the derivatives turnover (SA XTD), SA GDP growth increases by 0.64% and for every 1% increase in net portfolio flows, SA GDP growth increases by 0.77%. The results also show that there is a negative relationship between SA GDP growth rate and real exchange rate volatility, with a 1% increase in exchange rate volatility leading to SA GDP growth rate decreasing by 3.13%. The results therefore suggest that derivative trading and SA GDP growth affect each other in the long-run.

The results further reveal a long run relationship between the SA GDP growth rate and the remaining control factors with a 1% increase in SA 3-month Treasury bill rate associated with a 2.23% increase in SA GDP growth and a 1.17% decrease in SA GDP growth while a 1% increase in US GDP growth is associated with a 1.44% decrease in SA GDP growth.

The estimation of the long run relationship between SA GDP growth and the other variables excluding derivatives turnover is summarised under VECM 4. The direction of the relationship between economic growth and the other variables reflected in VECM 4 is the same direction of the same relationships estimated in VECM 3. The only difference is in the size of the coefficients for all the remaining variables once derivatives turnover is excluded from the model. This suggests that derivatives trading has a significant impact on the model estimation. The results show that a 1% increase in SA 3-month Treasury bill rate is associated with a 3.57% increase in economic growth, a 1% increase in exchange rate volatility is associated with a 5.23% decrease in economic growth, a 1% increase in net portfolio flows is associated with a 0.52% increase in economic growth, a 1% increase in foreign interest rate (US 3MTBILL) is associated with a 1.76% decrease in economic growth and a 1% increase in foreign GDP (US GDP) is associated with a 2.3% decrease in economic growth. As there is a notable difference in all coefficient sizes for all the remaining variables once derivatives turnover is excluded from the model, the test infers that derivatives trading does have a significant impact on the model estimation.

Thus, in summary, the VECM analysis shows that there is a positive long run relationship between derivatives turnover and portfolio inflows to South Africa, and that there is a positive long run relationship between derivatives turnover and economic growth.

Table 4.8 Estimation of long run relationship

	Dependentvariable: SA_NETPIF (VECM 1)			**Dependent variable: SA_NETPIF (VECM 2)**			**Dependent variable: SA_GDPG (VECM 3)**			**Dependent variable: SA_GDPG (VECM 4)**		
Variable	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**
SA_GDP_GROWTH_RATE	1.293	-0.267	4.841***	1.910	-0.616	3.099***	1.000	n/a	n/a	n/a	n/a	n/a
SA_NETPIF	n/a	n/a	n/a	n/a	n/a	n/a	0.773	-0.711	1.087	0.524	-1.150	0.455
SA_REER	-4.049	-0.497	-8.145***	-9.991	-1.271	-7.863***	-3.130	-0.381	-8.220***	-5.231	-0.679	-7.710***
SA_3MTBILL	2.879	-0.305	9.430***	6.813	-0.776	8.785***	2.226	-0.275	8.104***	3.567	-0.493	7.231***
US_GDP_GROWTH_RATE	-1.869	-0.289	-6.460***	-4.400	-0.736	-5.983***	-1.445	-0.179	-8.076***	-2.304	-0.306	-7.532***
US_3MTBILL	-1.510	-0.292	-5.174***	-3.356	-0.773	-4.339***	-1.168	-0.215	-5.440***	-1.757	-0.376	-4.668***
SA_XTD	0.830	-0.215	3.852***	n/a	n/a	n/a	0.642	-0.148	4.324***			
c	-0.095			-0.130			-0.073			-0.068		

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

4.9.2 Short Run Adjustments

The error correction components in the VECM represent the speed of adjustment to the equilibrium (Namoloh, 2018). The error correction term should lie between zero and one and should be negative in value (*ibid*). The error correction terms for VECM 1 to 4 are included in Table 4.9 and show that the error correction terms for all models except for VECM 2 have negative signs and are significant at the 5% level. This thus confirms that excluding VECM 2, the systems are stable and converge to their long run equilibrium. The error correction term for VECM 2 is positive, implying that the system is unable to converge to its long run equilibrium. This result is, however, statistically insignificant with the model already having been found to have no autocorrelation through the diagnostic tests.

Table 4.9 Summary of short run error correction terms

Model	Variable	ECT
Dependent variable: SA_NETPIF (VECM 1)	Coefficients	-0.098
	Standard error	-0.052
	t-statistic	-1.866*
Dependent variable: SA_NETPIF (VECM 2)	Coefficients	0.007
	Standard error	-0.025
	t-statistic	0.279
Dependent variable: SA_GDPG (VECM 3)	Coefficients	-0.481
	Standard error	-0.155
	t-statistic	-3.099 ***
Dependent variable: SA_GDPG (VECM 4)	Coefficients	-0.254
	Standard error	-0.098
	t-statistic	-2.599 ***

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table 4.10 shows the estimation of the short run relationship between the factors of interest along with the control factors. VECM 1 and VECM 2 show a positive relationship between net portfolio flows and SA GDP growth whereby VECM1 shows that a 1% increase in SA GDP growth is associated with a 0.12% increase in net portfolio flows. The short run relationships estimated by VECM 1 shows that a statistically significant positive relationship exists between net portfolio flows and derivatives turnover whereby a 1% increase in derivatives turnover is associated with an increase of 0.50% in net portfolio flows. The results also show that 10% of the disequilibrium in the long run relationship between the variables is adjusted within one year.

VECM 3 in Table 4.10 shows the short run relationships between SA's GDP growth rate and the other factors of interest. The results indicate that an increase of 1% in derivatives turnover is associated with an increase in SA's GDP growth of 0.69%. The VECM analysis shows that 48% of the disequilibrium in the long run relationship between the variables is adjusted within one year. This short run positive effect of derivatives turnover on economic growth is in line with the findings of Rodrigues et al. (2012), Bujari et al. (2016) and Vo et al. (2019).

These results thus show that there is a positive short run relationship between derivatives turnover and portfolio inflows to South Africa, and that there is a positive short run relationship between derivatives turnover and economic growth.

Table 4.10 Estimation of short-run relationship between factors of interest

	Dependent variable: SA_NETPIF (VECM 1)			**Dependent variable: SA_NETPIF (VECM 2)**			**Dependent variable: SA_GDPG (VECM 3)**			**Dependent variable: SA_GDPG (VECM 4)**		
Variable	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**	**Coefficients**	**Standard error**	**t-statistic**
SA_GDP_GROWTH_RATE	0.1198	-0.0669	-1.792*	0.0840	-0.0695	-1.209	n/a	n/a	n/a	n/a	n/a	n/a
SA_NETPIF	n/a	n/a	n/a	n/a	n/a	n/a	-0.1685	-0.3189	-0.529	-0.2134	-0.3052	-0.670
SA_REER	-0.2367	-0.2029	-1.166	-0.1274	-0.2329	-0.547	-0.6109	-0.4658	-1.311	-0.6201	-0.4854	-1.277
SA_3MTBILL	-0.0026	-0.2260	-0.011	-0.1272	-0.2556	-0.498	1.7613	-0.5189	-3.394***	1.5606	-0.5327	-2.930***
US_GDP_GROWTH_RATE	-0.2093	-0.1016	-2.059**	-0.0425	-0.1152	-0.369	-0.1527	-0.2333	-0.654	-0.0971	-0.2401	-0.404
US_3MTBILL	-0.4921	-0.4111	-1.197	-0.2171	-0.5189	-0.418	-1.4283	-0.9438	-1.513	-1.5745	-1.0815	-1.456
SA_XTD	0.4980	-0.1813	-2.748***	n/a	n/a	n/a	0.6860	-0.4161	-1.649*	n/a	n/a	n/a
c	-0.0019	-0.0011	-1.632	-0.0008	-0.0012	-0.629	-0.0028	-0.0026	-1.071	-0.0023	-0.0025	-0.909

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

4.10 Granger Causality Tests

The null hypothesis of the Granger causality test is that there is no Granger causality and this hypothesis is rejected should the calculated p-value be less than 5% (Namoloh, 2018). Table 4.11 below shows the calculated p-values for the F-test of Granger causality. According to the Granger causality test outputs, SA's GDP growth rate is only Granger-caused by the domestic 3-month Treasury bill rate. The finding that net portfolio flows do not Granger-cause SA GDP growth contrasts with Reisen and Soto (2001) and de Vita and Kyaw (2009) but accords with Brambila-Macias and Massa (2010) and Aizenman et al. (2013). There is no evidence of causality between SA GDP growth and derivatives turnover, which is a departure from the findings of Şendeniz-Yüncü et al. (2018) and Vo et al. (2019). However, the finding of no causality between derivatives turnover and economic growth in South Africa accords with Marozva (2014) and Bekale (2015), and possibly supports the notion that there is no need to focus on the development of a derivatives market if it cannot be positively linked to economic growth benefits.

With regards to net portfolio flows, the Granger causality tests reveal that derivatives trading significantly runs unidirectionally from derivatives trading to net portfolio flows. This finding appears to support the notion that foreign investors do use currency derivatives to hedge exchange rate risks associated with holding securities in a country's local currency (Dodd, 2002; Dodd, 2003; Dodd, 2008). This would then seem to support the notion that in order to further the increase of portfolio flows to a country, there needs to be a focus on increasing the turnover of derivatives referencing the country's local currency. It is of interest to note that the results find no significant causality between real exchange rate volatility and net portfolio flows, which contrasts with Fidora et al. (2007), Kodongo and Ojah (2012) and Caporale et al. (2013). The results further show that net portfolio flows do not Granger-cause derivatives trading, which does not accord with Ehlers and Packer's (2013)observation that there is a bidirectional relationship between these two factors. This is possibly as a result of South Africa's highly developed equities market but relatively undeveloped derivatives market.

Thus, in summary, the Granger causality tests indicate that, while there is a unidirectional causal relationship between derivatives turnover and net portfolio, there is no causal relationship between economic growth and either of the other two factors of interest, namely portfolio flows and derivatives turnover.

Table 4.11: Granger Causality Tests

	Dependent variable						
Independent variable	SA_NETPIF	SA_GDPG	SA_REER	SA_3MTBILL	SA_XTD	US_GPDG	US_3MTBILL
SA_NETPIF	n/a	0.492	0.182	0.642	0.949	0.344	0.895
SA_GDPG	0.117	n/a	0.018**	0.175	0.184	0.618	0.263
SA_REER	0.534	0.246	n/a	0.052**	0.561	0.884	0.525
SA_3MTBILL	0.804	0.002***	0.040**	n/a	0.657	0.921	0.947
SA_XTD	0.000***	0.334	0.529	0.691	n/a	0.817	0.459
US_GPDG	0.122	0.562	0.125	0.182	0.078*	n/a	0.215
US_3MTBILL	0.419	0.134	0.085	0.715	0.658	0.917	n/a

***, **, * represent significance at the 1%, 5%, 10% levels respectively.

4.11 Impulse Response Functions

Figure 4.2(a) depicts the relationship between the SA GDP growth rate and SA net portfolio flows over a 24-quarter period. Figure 4.2(a) shows that in the short run, a shock to net portfolio flows leads to a marginal 0.2% positive effect on domestic GDP. After this initial positive effect, the results show that the response of SA GDP growth to a one standard deviation shock to net portfolio flows is relatively volatile but smoothes out after 10 periods, remaining positive in the long run. This short run effect eventually wears off, suggesting that the introduction of foreign portfolio flows into the country does not induce lasting economic growth benefits, which accords with Reisen and Soto (2001) and de Vita and Kyaw (2009).

Figure 4.2(b) shows the response of SA GDP growth to a one standard deviation shock in derivatives turnover (*SA XTD*). While there is a small 0.1% response in GDP to the shock in derivatives turnover, soon after (approximately after two periods), there is a decrease in GDP growth that appears to offset the initial increase. The first notable sustained increase on the South African economy occurs six periods after the shock and results in an increase in the GDP growth rate that is sustained for two periods thereafter. In both the long and shortrun, however, the effect of derivatives turnover (SA XTD) on GDP growth rate remains negative. As already indicated, a one-standard deviation in derivative turnover (SA XTD) induces both an upward and downward response within the first year, implying that overall, derivatives turnover (SA XTD) does not impact SA GDP growth within the first year. These results are consistent with findings of the Granger causality tests in section 4.9.

Figure 4.2(c) captures the impact of net portfolio flows to a one-standard deviation shock in SA GDP growth. The impulse responses show that there is a 0.2% increase in net portfolio flows within one year, which then stabilises after 12 quarters. In the long run, the impulse response functions reflect that economic growth has no impact on portfolio flows, which mirrors the results of the Granger causality tests but contrasts with Gossel and Biekpe (2017).

Figure 4.2(d) shows the response of net portfolio flows to a one standard deviation shock in derivatives turnover (*SA XTD*). The results show that there is an immediate 0.2% impact on portfolio flows as a result of a shock to derivatives trading but this diminishes after one year. Over the long term, however, an overall positive effect close to approximately 0.1% on portfolio flows as a result of a shock to derivatives trading is observed. The result of a positive relationship between the two in the short run also mirrors the finding observed in the Granger causality tests with the impulse response function test aiding to establish the direction of that test. Furthermore, this result provides support for Gossel and Biekpe (2017), who report that of all the push–pull shocks examined in their study, in the short run, exchange rate volatility shocks have the least significant effect on portfolio inflows, which implies that in the short term, portfolio investors tend to hedge their foreign currency positions.

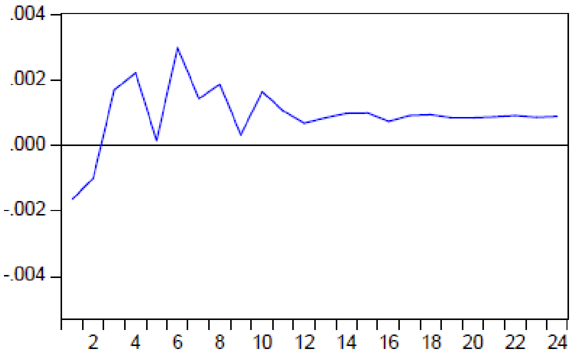
Figure 4.2(e) shows the response of derivatives turnover (SA XTD) to a one-standard deviation shock in SA net portfolio flows. Initially, there appears to be no response in derivatives turnover (SA XTD) to the shock in net portfolio flows but after two periods, a small 0.1% negative impact on derivatives turnover (SA XTD) is noted. After just two quarters, however, this reverses, and thereafter the relationship between derivatives turnover (SA XTD) and portfolio flows remains stable in the positive range over the long run. This result suggests that increased foreign investment in a country encourages greater use of derivatives to hedge the currency risk associated with such investment.

Lastly, Figure 4.2(f) depicts the relationship between derivatives turnover (SA XTD) and changes to SA GDP growth in South Africa. The results show that there is an immediate positive response of SA XTD to a one standard deviation shock to the growth rate of GDP. This short run positive impact of the economic growth rate on derivatives turnover accords with Vo et al. (2019) and Şendeniz-Yüncü et al. (2018). The figure, however, also shows that the response of derivatives turnover (SA XTD) to SA GDP growth remains below zero in the long run, at a negative 0.0006.

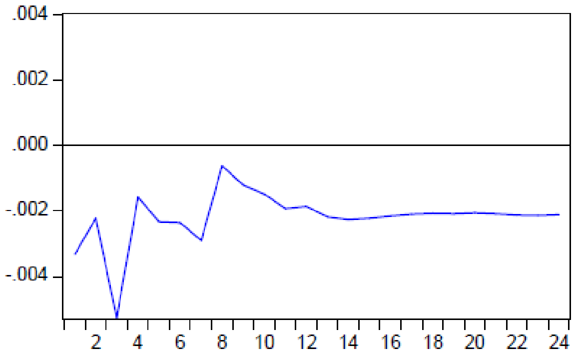
Thus, in summary, the impulse responses results show that in the shortrun, SA GDP growth is positively affected by net portfolio flows to South Africa but negatively affected by derivatives turnover. On the other hand, net portfolio flows to South Africa are positively affected by both derivatives turnover and SA GDP growth, while net portfolio flows positively affect derivatives turnover as opposed to the negative affect that SA GDP growth has on derivatives turnover. Over the long run, the impacts are similar to the short run effects with the exception of SA GDP growth, which has an insignificant impact on net portfolio flows.

Figure 4.2: Impulse Responses

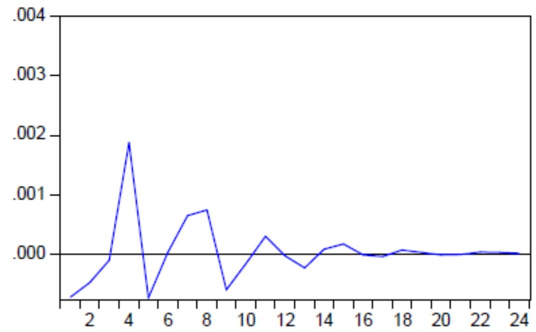
(a) SA GDP Growth Rate to SA_NETPIF



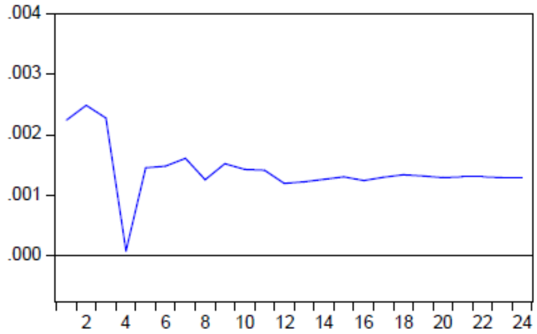
(b) SA GDP Growth Rate to SA XTD



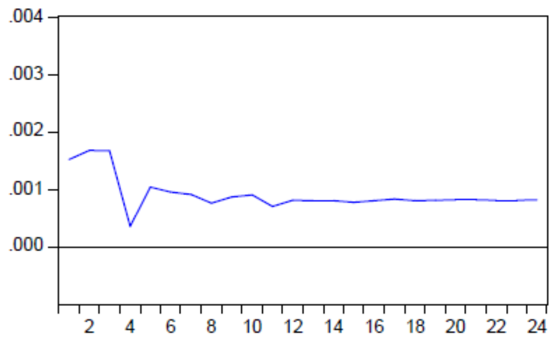
(c) SA_NETPIF to SA GDP Growth Rate



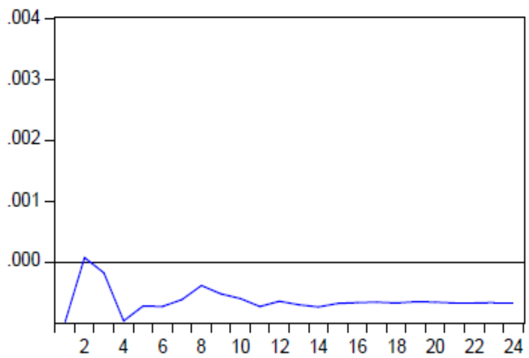
(d) SA_NETPIF to SA_XTD



(e) SA_XTD to SA Net_PIF



(f) SA_XTD to SA GDP Growth Rate



4.12 Variance decomposition

The variance decompositions are presented in Table 4.12and are reported for 24 quarters. According to the results, a significant portion of the variance for the three factors of interest is explained by each of the factors themselves, but this is only in the short run. However, in the long run, this significance decreases except for SA GDP growth rate where the rate of decrease is insignificant, with close to 65% of SA GDP growth rate still being explained by itself after 24 periods. It is of interest to note that derivatives turnover (SA XTD) explains more of the variance in SA GDP growth than net portfolio flows, which suggests, in accordance with the Granger causality test results, that portfolio flows do not have a significant impact on economic output in SA. This may be because portfolio flows to South Africa have been found to be unstable, with around half of the portfolio inflows to the country being reversed after a year (Rangasamy, 2014).

Other than economic growth itself, the two most significant contributors to GDP growth are the domestic interest rate and US real GDP growth. In the long run, US GDP growth explains 10.93% of the variance in SA GDP growth compared to the 9.11% explained by the three-month Treasury bill rate. Considering the globalized nature of much of the world's economic activity, the finding that the US GDP growth rate significantly contributes to the SA's GDP growth rate suggests that the South African economy is highly linked to the global economy. The implication of this may then be that South Africa's macroeconomic policy cannot be expected to yield significant impact for the economy but rather that the state of the country's economy is leveraged to factors external to it (Gossel and Biekpe, 2017). As can be seen in Table 4.12, the contribution of the domestic interest rate increases steadily over time, which implies that over the long term, the investment return that can be offered to investors has a growing influence over the country's economic growth.

Regarding net portfolio flows, the variance decomposition results show that in the short run, the most significant factor impacting net portfolio flows is net portfolio flows itself and that the next most significant factor is the domestic interest rate followed by derivative turnover. While the contribution of the domestic interest rate increases steadily over time, the contribution of derivatives turnover decreases over time. By quarter 4, 17% and 7.18% % of the variance in net portfolio flows is explained by domestic interest rate and derivatives turnover respectively. A total of 3.8% is explained by the push factors comprising the USD GDP growth rate and the

US three-month Treasury bill rate, which suggest that in the short run, net portfolio flows are impacted more by domestic factors than external factors. This result contrasts with Gossel and Biekpe (2017), who found that in the short run, the two most significant factors impacting net portfolio flows to South Africa are US GDP and Treasury bill rates. However, considering that derivatives referencing the local currency can be traded on any derivatives exchange around the world, it cannot be ascertained whether the result relating to the impact of derivatives trading is a reflection of domestic or international conditions. It may, however, be that in the short run, where the purchase of portfolio flows may be for short-term trading rather than for holding the instrument to maturity, investors and traders will wish to use currency derivatives to hedge potential short run exchange rate volatility. In the long run, the contribution of the three-month Treasury bill rate predominates, followed by currency derivatives turnover.

Lastly, similar to the results for GDP growth, the variance decompositions of the currency derivatives turnover show that in the short-run and in the long-run, the most significant factor is currency derivatives turnover itself, followed by net portfolio flows. The contribution of net portfolio flows to the variance in derivatives turnover implies that as investors take up South Africa's portfolio securities, they opt to hedge currency risk with currency derivatives.

Thus, in summary, the variance decompositions show that SA GDP growth is affected by the two push factors of foreign interest and foreign economic growth rather than by the two factors of interest being net portfolio flows and currency derivatives, which is in line with the Granger causality tests. The variance decomposition results show, however, that derivatives turnover and net portfolio flows have a significant impact on one another.

Table 4.12 Variance Decomposition output

Variance Decomposition of SA_GDP_GROWTH_RATE:							
Period	SA_NETPIF	SA_GDPG	SA_REER	SA_TBILL	SA_XTD	US_GDPG	US_TBILL
1	0.85	99.15	-	-	-	-	-
4	1.39	60.43	0.36	5.31	2.75	28.21	1.55
8	1.57	62.74	0.93	11.74	2.12	19.87	1.03
12	1.31	63.75	1.49	14.00	1.76	16.68	1.00
16	1.13	64.66	1.69	14.67	1.72	15.08	1.05
20	1.02	65.38	1.81	15.04	1.67	14.03	1.05
24	0.94	65.83	1.90	15.26	1.64	13.38	1.06
Variance Decomposition of SA_XTD:							
Period	SA_NETPIF	SA_GDPG	SA_REER	SA_TBILL	SA_XTD	US_GDPG	US_TBILL
1	8.31	2.56	0.78	1.17	87.19	-	-
4	6.29	1.29	1.20	5.63	83.11	0.99	1.51
8	5.18	1.29	1.63	8.09	79.66	0.79	3.37
12	4.50	1.30	1.62	8.01	79.79	0.66	4.10
16	4.11	1.40	1.63	7.75	79.86	0.55	4.70

20	3.89	1.42	1.61	7.65	79.98	0.48	4.97
24	3.73	1.44	1.60	7.58	80.05	0.44	5.16
Variance Decomposition of SA_NETPIF							
Period	SA_NETPIF	SA_GDPG	SA_REER	SA_TBILL	SA_XTD	US_GDPG	US_TBILL
1	100.00	-	-	-	-	-	-
4	67.20	4.46	0.28	17.04	7.18	2.70	1.14
8	60.57	4.01	0.66	22.68	5.64	5.10	1.35
12	57.37	3.39	0.82	24.01	5.18	6.26	2.97
16	55.90	2.95	0.81	24.98	4.71	6.84	3.81
20	54.82	2.61	0.81	25.68	4.44	7.32	4.32
24	54.08	2.35	0.82	26.22	4.22	7.60	4.71

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study examined the impact of currency derivatives on economic growth and international portfolio flows to South Africa over the period of 2000 to 2018, to determine whether Rand currency derivatives are associated with an increase in portfolio inflows to South Africa, and an improvement in economic growth, and whether there are significant causal relationships between currency derivatives, portfolio inflows and economic growth.

Johansen cointegration tests reveal that there is one significant long-run relationship between foreign interest rates and domestic interest rates. The results of the VECM analysis then reveal that there are positive long-run and short-run relationships between derivatives turnover and portfolio inflows, and between derivatives turnover and economic growth. The impulse response analysis shows that in the short run, GDP growth is positively affected by net portfolio flows to South Africa, but negatively affected by derivatives turnover. On the other hand, net portfolio flows to South Africa are positively affected by both derivative turnover and GDP growth, while net portfolio flows positively affect derivative turnover. The long-run impacts are similar to the short-run effects, with the exception of GDP growth, which has an insignificant impact on net portfolio flows.

The variance decompositions further show that South African GDP growth is affected by the two push factors of foreign economic growth and foreign interest rates rather than by the two factors of interest, namely, derivatives turnover and net portfolio flows. The variance decomposition results show, howeve, that derivatives turnover and net portfolio flows have a significant impact on one another.

The Granger causality test finally indicates that while there is a unidirectional causal relationship between derivatives turnover and net portfolio, there is no causal relationship between economic growth and portfolio flows, nor derivatives turnover.

In summary, therefore, the results answer the research questions as follows:

5.1.1 Are Rand currency derivatives associated with an increase in portfolio inflows to South Africa?

The results of the study show that there is a short-run and long-run relationship between derivatives turnover and net portfolio flows. The study concludes that, based on the VECM analysis, impulse response analysis and variance decompositions, there is a short-run relationship between derivatives turnover and net portfolio flows.

5.1.2 Are Rand currency derivatives associated with improved economic growth in South Africa?

The results of the study show that there is only a short-run relationship between derivatives turnover and economic growth, which accords with the results of Rodrigues et al. (2012), Bujari et al. (2016) and Vo et al. (2019).

5.1.3 Is the causality between currency derivatives, portfolio inflows and economic growth unidirectional or bi-directional?

The Granger causality tests indicate that while there is a unidirectional causal relationship between derivatives turnover and net portfolio, there is no causal relationship between economic growth and either of the other two factors of interest, namely portfolio flows and derivatives turnover. The relationship between derivatives turnover and net portfolio flows is unidirectional from derivatives turnover to net portfolio flows. The finding of no causality between derivatives turnover and economic growth in South Africa accords with Marozva (2014) and Bekale (2015).

5.2 Policy Implications

The results presented in this study have the following three policy implications:

i. Sub-Saharan governments with economic and regulatory conditions similar to those of South Africa should focus their efforts on establishing derivatives exchanges in these countries in a bid to increase the flow of portfolio flows. The establishment of these exchanges will further entail engaging with the relevant stakeholders to ensure that the appropriate legal and governance frameworks are established for the facilitation of trading. The legislation that is developed must be in line with international regulation to ensure cross-border trades can take place and also to provide foreign investors with confidence in the newly set-up derivatives exchanges. An important step to ensure that this objective is achieved would be to ensure that the derivatives exchanges accede to the International Swaps and Derivatives Association (ISDA) requirements, which are considered global best standards. The establishment of a derivative exchange can be expected to lead to direct job creation by the exchanges themselves, innovation and improved foreign investor confidence in a country's capital markets' transparency and efficiency (Mezui et al., 2013).

ii. In establishing the derivatives exchanges, SSA states must ensure that the right technological trading platforms are installed to ensure ease of use by foreign investors and connection with other derivatives exchanges. However, while the development of a derivative trading exchange will lead to financial development and global financial integration, the increase of portfolio flows to a country can also lead to capital flows instability and increase the risk of procyclical boom–bust cycles (Gossel & Biekpe 2017).

iii. The finding that there is no significant long-run relationship between the two financial factors and economic growth implies that a financial flow-led growth strategy is not effective for South Africa. As de Vita and Kyaw (2009), Gossel and Biekpe (2012) and Gossel and Biekpe (2017) have found, that FDI is more likely to stimulate economic growth in South Africa, FDI or a trade-led growth strategy is likely to be more effective.

5.3 Recommendations for future research

Given the findings of the study, the following were identified in the course of the research as potential areas for future research:

i. The effects of over-the-counter (OTC) derivatives turnover on portfolio flows to South Africa because OTC instruments constitute a significant portion of the total derivatives market:this would shed significant light on the overall strength of the relationship identified between exchange traded derivatives and net portfolio flows in this study.

ii. The study could be further expanded to include the interlinkages between FDI, other capital flows, derivatives and economic growth. FDI has been identified as having a positive impact on South Africa's macroeconomy (Gossel & Biekpe, 2012), and thus such a study would provide an understanding of whether derivatives can encourage further FDI flows to South Africa and also shed light on the overall strength of the relationship between economic growth and FDI.

iii. Moreover, it is noted that although the control factors noted in this study are appropriate for the foreign portfolio investment model, they are less so for the economic growth model. It is recommended that for future research, more appropriate control factors should be determined for the economic growth model.

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APPENDIX A: Dummy Variables

APPENDIX A: DUMMY VARIABLES
VECM model 1 - 4
2001:Q1
2001:Q4
2003:Q1
2011:Q4
2014:Q1
2017:Q2
2017:Q3
2018:Q4