The Effects of Exchange Rate Volatility on South African Investments

Magdeline M. Maepa

ERSA working paper 609

May 2016

Economic Research Southern Africa (ERSA) is a research programme funded by the National Treasury of South Africa.

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May 23, 2016

Abstract

This paper analysed the short- and long-run interactions between the exchange rate and different types of investments in South Africa from 1970 to 2014. The Vector Autoregressive model (VAR), a multivariate Johansen co-integration approach and Granger causality test were conducted to analyse the interactions between the exchange rate and different types of investments. The short-run analysis found that there was a short-run relationship between the exchange rate and different types of investments in South Africa. However, this short-run interaction were found to be small, thus, not significant enough to cause disruptions to the exchange rate and to the inflow of investments into the country. The long-run analysis found that a there was a long-run relationship between the exchange rate and different types of investments in South Africa. This long-run relationship was also found to be negative. This paper concluded that investments have a negative, long-run effect on the exchange rate, suggesting that a fall in the investments would cause an increase in the exchange rate in the long-run.

Keywords: Exchange rate, domestic credit extension to the private sector, private domestic investment, foreign direct investment, foreign portfolio investment, South Africa

1 Introduction

During the last two decades, South Africa has made significant economic head waves. The country came out of the economically, physically, emotionally and mentally crippling apartheid era, and has emerged as a fast emerging country, one to be reckoned with across the world (Mwakikagile, 2008:15). Investment has played a rather significant role in the growth of the South African economy, with trade inflows increasing tremendously into the country over the past 20 years, contributing about 2.7% of the total Gross Domestic Product (GDP),

[*]School of Economic Sciences, North-West University, Vanderbijlpark, 19; email: magdelinemaepa@gmail.com

and with this increased investment came the improved transfer of technology and knowledge with other participating countries globally (Parajuli, 2012:1).

Previous studies (Crowley & Lee, 2003; Dooley *et al.*, 2003; Parajuli, 2012; Rodrik, 2008) have been conducted on exchange rate volatility and investments have found that there exists a relationship between foreign direct investment (FDI), exports, the exchange rate and economic growth. A study (Diallo, 2008) conducted on the relationship between exchange rate uncertainty and domestic investment, and found that exchange rate volatility, both a depreciation and appreciation of the currency, had a strong negative effect on investment more especially in low income and middle income countries.A study by Aizenman (1992) conducted on the relationship that exists between exchange rate volatility and its effects on domestic and foreign direct investment within developing countries, found that a fixed exchange rate yields more positive investment results, and is more suitable to domestic and foreign direct investment, as opposed to a flexible exchange rate.

This paper contributes to the existing literature by conducting an analysis of the effects of exchange rate volatility on South African investments for the period 1970 to 2014.

The next section of the paper considers the existing literature on the interactions between the South African exchange rate and different types of investments in the country. The third section of the paper focuses on the methodology employed in the analysis of the interaction between exchange rate and investments in South Africa. The fourth section presents the results of the analysis, while the fifth section presents the discussion of the results obtained in the analysis of the interaction between exchange rate and investments in South Africa. The sixth section provides the conclusions.

2 Literature review

2.1 Theoretical literature on the link between exchange rates and investments

The interaction between the exchange rate and investments is explained by different approaches, including the modern portfolio theory, the portfolio balance and monetary approaches to the determination of exchange rates.The modern portfolio theory is based on the assumption that investors, who have a strong dislike for risk, have the choice of constructing investment portfolios which are concentrated on maximising their expected return, given a certain level of risk (Markowitz, 1952:76). Investment portfolios are an investment management strategy of integrating a myriad of different investments that are held by an investor into a single diversified portfolio, with the aim of gaining higher returns, while also seeking to minimise the risks of the investments (Fin24, 2014). These investments may range from safe to risky (Dash, 2009:11). In the world of investment, there exist a number of reasons for making investments, with the most prominent of the reasons being the maximisation investment returns.

According to the modern portfolio theory, investors need to establish a composition of asset classes which will yield the highest level of returns, given a certain level of risk (Markowitz, 1952:76). However, for this composition to be established, investors need to make use of the Markowitz efficient frontier. The efficient frontier is essentially a graphical illustration that represents portfolios that are diversified efficiently for an investor, making it difficult for any other combination of asset classes to yield a higher expected return, given a certain level of risk (Reilly & Brown, 2011).

The portfolio balance approach to the determination of the exchange rate is a theory that focuses on the notion that the exchange rate is not simply determined by the market forces of supply and demand, but this theory also takes into consideration the supply and demand for financial assets in each individual country (Van der Merwe&Mollentze, 2012:133).

According to the portfolio balance approach to the determination of exchange rates the opportunity cost of holding money is the direct yield lost on holding other financial assets, including domestic and foreign assets (Van der Merwe&Mollentze, 2012:133). Furthermore, the theory assumes that financial assets, which are made up of domestic and foreign assets, are imperfect substitutes due to investors' perception that foreign exchange rate risk is directly linked to foreign assets, but the holding of foreign assets has the advantage of spreading expected risk amongst different financial markets (Husted & Melvin, 2007:455; Van der Merwe&Mollentze, 2012:133).

The portfolio balance approach to the determination of exchange rates states that the exchange rate can be explained making use of the following equation:

$$E = \frac{(W - M - B)}{B^*} \tag{1}$$

Where:

E is the domestic currency's exchange value; W denotes wealth, M denotes money, B denotes domestic assets, and B^* denotes foreign assets.

The role that the exchange rate plays in the portfolio balance approach is one of which provides a balancing act between the demand of assets and the supply of assets. This balancing act means that a decrease in the supply of domestic money, with all other variables held constant, results from an increase in domestic interest rates (Van der Merwe&Mollentze, 2012:134). This increase in domestic interest rates will lead to an increase in holdings of domestic assets, thus leading to a decline of households' holdings of foreign assets. The added increase in domestic assets' holdings will ultimately lead to the appreciation of the domestic currency (Van der Merwe&Mollentze, 2012:134).

The monetary approach to exchange rate determination is another approach which can be used to explain the link between exchange rate and investments. According to this theory, the exchange rate is said to be determined by the demand and supply of money between two countries. This theory differs from that of the portfolio balance approach to exchange rates in the sense that the monetary approach to exchange rates states that domestic bonds and foreign bonds are perfectly substitutable to each other, whereas the portfolio balance approach to exchange rates assumes these two variables to be imperfect substitutes (Husted & Melvin, 2007). Furthermore, this exchange rate theory assumes that there is a linkage between the demand for money and the level of national income. This relationship is assumed to be positive and stable in the long-run, and also that the conditions of the absolute purchasing power parity hold in the long run.

2.2 Empirical literature on the link between exchange rates and investments

A number of studies have been conducted with the focus being on the impact that exchange rates fluctuations have on investments (Darby *et al.*, 1999; Giovannini, 1988; Goldberg, 1993; Hooper &Kohlhagen, 1978). Since investors, corporations and governments in many countries do not have any control over the performance, or changes in exchange rates, the empirical literature of this study will look at the effects of such exchange rate movements on investments. Exchange rate movements can have an indirect effect on investments in that exchange rates influence the international price of goods and services, which in turn has an effect on the international trade of such goods and services across all global borders (Campa& Goldberg, 1999). Fluctuations in exchange rates have two opposing effects on the economy and the overall future prospects of investment. When a currency appreciates, imports become relatively cheaper as opposed to exported goods and services, and the marginal profit of investing one additional unit of capital is more likely to decrease due to the lower revenue generated by domestic firms operating both locally and in foreign lands (Harchaoui*et al.*, 2005:1). Darby *et al.* (1999) found evidence that uncertainty regarding exchange rates can, in the long-run, have a significantly negative effect on investment. This means that when there exists uncertainty from investors regarding the performance and the ability of a country's currency to appreciate in the long-run, then investors tend to move their investment from the country to markets which are perceived to be more stable, and have an open and healthy investment environment (Destiny Connect, 2015).

Studies conducted by Giovannini (1988) and Hooper and Kohlhagen (1978) have found that exchange rate fluctuations affects investment indirectly as they have an influence on the domestic and international trade of goods and services, as well as having an influence on the prices of such goods and services. It was also found in these studies that there exists a relationship between exchange rates and domestic and international trade, because exchange rates affect the cost of production, capital and the location in which investment is directed towards. They concluded that the exchange rate risk that exists for all firms operating domestically and internationally has a positive effect on the prices if exporters are willing to bear the risk, and a negative effect on prices on importers if they are willing to bear the exchange rate risk.

Finally, perhaps the most important argument set forth by Goldberg is the argument associated with the effect that exchange rate variations have on investment is its influence on the portfolio and the wealth of domestic and international investors. Goldberg (1993) argues that changes in exchange rates affects international investors' wealth and can provide incentives for investments in domestic or foreign countries. This, however, depends heavily on the relationship towards investors' perceived preferences and perceptions for domestic or foreign investment and financial assets, as well as their personal perception of the domestic or foreign risk- return relationship that may be in existence (Gomez, 2000:6).

3 Methodology

The relationship between the exchange rate and investments was analysed making use of the multivariate model, which is a statistical model used in determining, or rather analysing the possible associated relationship or patterns between more than one variable (Jekel, 2007:175). The exchange rate is the independent variable, with the different types of investments being the dependent variables. This model aims to explore the strength of the relationship between the two studied variables. A multivariate analysis was conducted by taking each dependent variable, the different types of investments, and testing it against the independent variable, being the exchange rate, with the study period being from 1970 to 2014. The variables were obtained from the South African Reserve Bank (SARB).

3.1 Model specifications

In examining the possible relationship between exchange rates and different types of investments in South Africa, a multivariate approach was used. The appropriate model for a multivariate analysis is the Vector Autoregressive Model (VAR). The Vector Autoregressive Model (VAR) provides the basis for the analysis of causal relationship between the studies variables. According to Brooks (2002), VAR is the beginning point for different analysis, including the co-integration test.

The vector autoregressive model is a model which treats a set of variables equal simultaneously (Sims, 1980). The VAR model has been used and found to be useful especially for describing the dynamic behaviour of economic and financial time series, as well as for forecasting. It is useful in providing forecasts for multivariate time series models and for theory-focussed equation models (Brooks, 2014). If the time series is not stationary, then the VAR model needs to be modified in order to allow for consistency amongst the estimation of the relationships that are being tested for among the series (Dolado*et al.*, 1999).

Thus, the VAR used in this study is as follows:

$$LRER_t = \Sigma_{i-1}^{n} \beta_{1i} LRER_{t-i} + \Sigma_{i-1}^{n} \gamma_{1i} LINVEST_{t-i} + e_{1t} \qquad (2)$$

$$LINVEST_t = \Sigma_{i-1}^{n} \beta_{2i} LRER_{t-i} + \Sigma_{i-1}^{n} \gamma_{2i} LINVEST_{t-i} + e_{2t} \qquad (3)$$

Where:

$LRER_t$ is the log of the real exchange rate at period $tLINVEST_t$is the log of the real private domestic investment at period $t.\beta_{1i}$, β_{2i}, γ_{1i} and γ_{2i} are the coefficients to be estimated; e_{1t} and e_{2t} are the error terms known as shocks in a VAR model; and n is the number of lags in the VAR model. Four different models were estimated for this study as the effective exchange rate was tested against four different types of investments. Logs were used in the estimation of the four models, so as capture the appropriate growth in the variables.

3.2 Johansen co-integration

In the event that two series move together simultaneously then it can be assumed that an equilibrium relationship exists between the two series. This, thus, suggests that the variables are co-integrated but are not stationary in the short-term, however, they will move together over time, thus their differences will eventually be stationary (Sibanda, 2012:54). This study used the Johansen's multivariate co-integrating VAR approach to identify whether there was a long run relationship between the variables. The Johansen's (1988 and 1991) multivariate co-integrating is derived from a VAR model as follows:

Considering unrestricted VAR model:

$$Z_t = \sum_{i=1}^{k} A_1 Z_{t-i} + e_t \tag{4}$$

Where:

$$Z_t = \begin{bmatrix} X_{1t} \\ X_{2t} \\ . \\ . \\ X_{nt} \end{bmatrix}$$ is column vector of varables X_{1t} to X_{nt}; and

e_t = a column vector of random errors which are usually assumed to be contemporaneously correlated but not auto-correlated. Assuming that all variables are co-integrated in the same order, the VAR model in Equation 4 can be presented as follows:

$$\Delta Z_t = \ Z_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + e_t \quad , \text{ for } k \geq 2 \tag{5}$$

Where: $\Pi = -(I - A_1 - A_2 - \ldots .A_k)$; and, Γ_i = - $(A_{i+1} + A_{i+2} + \ldots + A_k)$, $i = 1, \ldots, k-1$

According to Johansen & Juselius (1990), the matrix Ï can be expressed as a product of two matrices:

$$\Pi = \alpha\beta' \tag{6}$$

Where:

α and β' are both the same since Π is a square matrix.

The matrix β' gives the co-integrating vectors (a matrix of long run coefficients), while α stand for the adjustment of parameters that shows the level of speed with which the system responds to last period's deviations from the equilibrium (Brooks, 2014). Therefore, Johansen co-integration is based on the examination of the Π matrix. The test for co-integration is conducted by looking at the rank (r) of the Π matrix with the use of the *trace test* and the *maximum eigenvalue* test.

The trace test tests the hypothesis that there are at most r co-integrating vectors and is as follows:

$$\lambda_{trace}(r) = -T\Sigma_{i=r+1}^{n} In(1 - \hat{\lambda}_i) \tag{7}$$

λ_{trace} is a joint test where:
H_0: the number of co-integrating vectors $\leq r$ and
H_a: the number of co-integrating vectors $> r$.

The maximum eigenvalue test tests the hypothesis that there are r+1 co-integrating vectors against the hypothesis that there are r co-integrating vectors and is a follows:

$$\lambda_{\max}(r, r+1) = -TIn(1 - \hat{\lambda}_i) \tag{8}$$

Where:

r is the number of co-integrating vectors under the null hypothesis, $\hat{\lambda}_i$ is the estimated value for i^{th} ordered eigenvalue from the Π matrix and T is the number of usable observations. λ_{max} conducts a separate test on each eigenvalue in sequence as follows:
H_0: r = 0 versus H_1: 0 < r ≤ n
H_0: r = 1 versus H_1: 1 < r ≤ n
H_0: r = 2 versus H_1: 2 < r ≤ n
... ...
H_0: r = n-1 versus H_1: r = n

The first test involves a H_0 of non-co-integrating vectors (corresponding to Π having zero rank). If the H_0 is not rejected, it would indicate that there are no co-integrating vectors and the cointegration test would be completed. Contrary, if the H_0 for $r = 0$ is rejected; the H_0 for $r = 1$ will be tested and so on. Hence, the value of r is repeatedly increased until the H_0 is no longer rejected. Since there are only two variables in each country's equation, the results are expected to have at most one co-integrating equation. If the co-integration is not present then the first difference of the VAR model in Equation 4.1 and 4.2 is used (Abdalla&Murinde, 1997). However, if variables are found to be co-integrated then the following vector error correction model (VECM) is used to capture the error correction.

3.3 Vector error correction model (VECM)

The Vector Error Correction Model (VECM) is a statistical model used with the sole intend of being used with time series that is non-stationary, but are recognised to be co-integrated. The vector error correction model (VECM) is interrelated with co-integration because it provides a restriction for the long-run behaviour and trends of the endogenous variables to converge to their co-integrating relationships, whilst making room and availing itself for short-run adjustment dynamics (Brooks, 2002). Co-integration is also known and phrased as the correction error since the long-run equilibrium is corrected gradually through a series of short-run adjustments over time; this, thus, forms the foundation and the basis for the presence of the vector error correction model. The VECM model shows which of the variables that are being used in the study responds more to any shocks that may be in the system (Brooks, 2008). If it is found that the variables are co-integrated, then the Vector error correction model (VECM) will be estimated. If the variables are found to not be co-integrated then the VAR model needs to be estimated at the 1^{st} difference (Abdalla&Murinde, 1997). The VECM model for this study is as follows:

$$\Delta LRER_t = \Sigma_{i=1}^{n}\beta_{1i}\Delta LRER_{t-i} + \Sigma_{i=1}^{n}\gamma_{1i}\Delta LINVEST_{t-i} + \alpha_1 u_{1t-1} + e_{1t} \quad (9)$$

$$\Delta LINVEST_t = \Sigma_{i=1}^{n}\beta_{2i}\Delta LRER_{t-i} + \Sigma_{i=1}^{n}\gamma_{2i}\Delta LINVEST_{t-i} + \alpha_2 u_{2t-1} + e_{2t} \quad (10)$$

Where:

$LRER_t$ is the log of the real exchange rate at period $t.LINVEST_t$ is the log of the real private domestic investment at period t.

u_{1t-1} And $u_{2t-1}$are the error correction terms; and $\alpha_1$and α_2 are error correction coefficients which are anticipated to capture the adjustments, or shocks, of change in the real effective exchange rate ($\Delta LRER_t$) and change in the real gross private domestic investment ($\Delta LINVEST_t$) towards long-run equilibrium, while the coefficients on $\Delta LRER_t - i$ and $\Delta LINVEST_{t-i}$ are expected to capture the short-run dynamics of the Vector Error Correction Model (VECM) model (Abdalla & Murinde, 1997).

The choice of lags in the VAR Model is of crucial importance (Li & Liu, 2012). Thus, the optimum numbers of lags were selected, based on the criterion of the Schwartz Information Criterion and the Aiaike Information Criterion (AIC) (Ivanov&Kilian, 2005). Other diagnostic tests were conducted include autocorrelation and heteroscedasticity. The Granger causality model was also conducted.

4 Results

Table 1 illustrates the results of the Augmented Dickey Fuller unit root tests conducted for the real effective exchange rate and domestic credit extension to the private sector. At level, the p-values of the real effective exchange rate (RER) is 0.152, which greater than the 0.05; meaning that the null hypothesis that RER has a unit root is accepted at the 5 percent level of significance. This means that RER is not stationarity at level. However, at 1^{st} difference, the p-value of the real effective exchange rate is 0 (< 0.05); meaning that the null hypothesis for unit in RER is rejected at the 5 percent level of significance. Therefore the real effective exchange rate is stationarity at 1^{st} difference, implying that it is I (1).

The results of the unit root test for the domestic credit extension to the private sector variable show that at level the p-value is greater than 0.05, meaning that, at the 5 percent level of significance, the null hypothesis that domestic credit extension to the private sector has a unit root is accepted. At 1^{st} difference, however, the domestic credit extension to the private sector becomes stationary as the null hypothesis is rejected at the 5 percent level of significance (p-value < 0.05). This means that the domestic credit Extension to the private sector is stationarity at 1^{st} difference, implying that it also is I(1). These results show that both the two variables have a unit root at level but become stationary at 1^{st} difference. Thus both variables are I (1). This means that there is a possibility that the two variables may be integrated; thus, the co-integration test should be conducted next.

Table 2 illustrates the results of the Johansen co-integration test for the real effective exchange rate and domestic credit extension to the private sector. The p-values of the Trace statistic and the Maximum Eigen Value of no co-integrating equation are less than 0.05; meaning that at the 5 percent level of significance the null hypothesis for no co-integrating equation is rejected. However, the p-values of the Trace statistic and the Maximum Eigen Value of at most 1 co-integrating equation are more than 0.05; meaning that at the 5 percent level of significance, the null hypothesis for of at most 1 co-integrating equation is accepted. This means that there exists 1 co-integrating equation between the two variables; implying that there is a long-run relationship between the real effective exchange rate and the domestic credit extension to the private sector. The equation that describes this long-run relationship is shown by equation 11.

$$Exchange\_Rate = 95.9700 - 0.0000568 Credit\_Extension \tag{11}$$

Equation 11 above shows the co-integrating equation, shows that the domestic credit extension to the private sector has a long-run negative effect on the real effective exchange rate. This means when the domestic credit extension to the private sector falls by 1% then the real effective exchange rate increases by 0.00568%. The existence of the 1 co-integrating equation means that the Vector Error Correction (VECM) can be estimated to capture the speed of adjustment to long-run equilibrium. Thus, VECM is estimated next.

Table 3 above represents the results of the Vector Error Correction Model (VECM) for the study. The VECM is used as a mode of determining the short-run properties of the variables that have been co-integrated, being the exchange rate and the domestic credit extension to the private sector. The results show that when exchange rate is the dependent variable, the error correction term has a significant (t-value > 1.96) negative coefficient. This means that there exists a long-run relationship between the two variables emerging from the exchange rate equation or when exchange is set as dependant variable. The value of the error correction coefficient of -0.04705 means that approximately 4.71% of deviation from equilibrium is eliminated in every month of the year. Thus, the model takes about 21.23 months to adjust to the full equilibrium, suggesting the slow adjustment to the equilibrium.

The exchange rate lags are significant meaning that past changes in the exchange rate have effect on the current changes in the exchange rate. The lags of domestic credit extension to the private sector are not significant (t-values < 1.96) meaning that the previous changes in the domestic credit extension to the private sector have no effect on current changes in the real exchange rate. Thus, short-term changes in the domestic credit extension to the private sector have not effect on the real exchange rate.

In the domestic credit extension to the private sector equation (second equation), the two lags of the exchange rate are not significant (the t-values < 1.96), meaning that previous changes in the real exchange rate have no effect on current change in domestic credit extension to the private sector. Thus, the short-run changes in the real exchange rate have not effect on domestic credit extension to private investors in the country.

The first graph from Figure 1 shows that a shock in the real exchange rate has a positive but declining effect on the exchange rate from 1994 to 2014. This means that the real exchange rate react to its own shock, especially in the first 4 months. A change in the domestic credit extension has an increasing, then negative and declining effect on the real effective exchange rate but it dies away after the second month. This suggests that real exchange rate do not react to shocks from the domestic credit extension. From the third graph, it can be seen that changes in the real effective exchange rate has a small decline effect on domestic credit extension to the domestic private sector, and falls to zero at the 5^{th} period and follows into the negative values. This means that the domestic credit extension to the private sector reacts negatively to shocks in the real effective exchange rate; but the reaction seems to be very small. The last graph shows that reaction of the domestic credit extension to the private sector to its own shocks is only visible the first and the second and become stable after period 3. Thus, the domestic credit extension to the private sector is affected by its own shocks.

Overall, the impulse response analysis has shown that movements in the real effective exchange rate has a small but negative effect on the domestic credit extension to the private sector, and any changes in the domestic credit extension to the private sector has a negative and declining effect on the real effective exchange rate. However, these effects are small, suggesting that the variables may not affect each other in the short-run. These results are similar to the VECM short-run result which suggests that there is no significant short-run relationship between the two variables.

Table 4 illustrates the results of the Granger causality test for the real effective exchange rate and the domestic credit extension to the private sector variables for the study period. The results show that the null hypothesis that real effective exchange rate does not Granger cause domestic credit extension to the private sector is accepted at the 5 percent level of significance (p-value > 0.05). Similarly, the null hypothesis that domestic credit extension to the private sector does not Granger cause real effective exchange rate is accepted at the 5 percent level of significance (p-value > 0.05). This implies that there is no causal relationship between the two variables. In other words, the real effective exchange rate does not Granger cause domestic credit extension to the private sector, and the domestic credit extension to the private sector does not Granger cause the real effective exchange rate.

The results found from the Granger causality test are confirmed by the results found by the impulse response analysis and the VECM, which showed that the real effective exchange rate and the domestic credit extension to the private sector do not have an effect on each other in the short-run. Thus, these two variables are not interlinked together in the short-run, but there is a negative relationship between the two variables in the long-run.

Table 5 represents the Augmented Dickey-Fuller unit root test results for the real effective exchange rate and private domestic investment for the period of the study. The results show that the p-values of both the real effective exchange rate and private domestic investment, at level, are greater than the 0.05 significant level of these two variables ,therefore the null hypothesis that RER and PDI has a unit root is accepted. This means that there is no stationarity at level for both of these variables. However, the p-values of the real effective exchange rate and private domestic investment, at 1^{st} difference, become less than the 0.05 significance level , thus there exists stationarity for the two variables at 1^{st} difference. These results show that the exchange rate and private domestic investment may be integrated, thus the co-integration test should be conducted.

Table 6 depicts the results of the Johansen co-integration which were conducted for the real effective exchange rate and private domestic investment for the study period. The results from the table show that the p-values of the Trace statistic and the Maximum Eigen Value of no co-integrating equation are less than 0.05; meaning that at the 5 percent level of significance the null hypothesis for no co-integrating equation is rejected. However, the p-values of the Trace statistic and the Maximum Eigen Value of at most 1 co-integrating equation are more than 0.05; meaning that at the 5 percent level of significance, the null hypothesis for of at most 1 co-integrating equation is accepted. This means that there exists 1 co-integrating equation between the two variables; implying that there is a long-run relationship between the real effective exchange rate and private domestic investment in South Africa. Equation 12 below explains this long-run relationship.

$$Exchange\_Rate = 5.4030 - 0.070440 \Pr ivate\_Domestic \quad (12)$$

Equation 12 shows the co-integrating equation, which shows that private domestic investment has a long-run negative effect on the real effective exchange rate. The equation above shows that, in the long-run, private domestic investment is negatively correlated to the exchange rate. This means that when the private domestic investment falls by 1% then the real effective exchange rate increases by approximately 7.044%. The existence of the 1 co-integrating equation means that the Vector Error Correction (VECM) can be estimated to capture the speed of adjustment to long-run equilibrium, which is the nest test to be conducted for the real effective exchange rate and private domestic investment for the duration of this study.

Table 7 represents the results of the Vector Error Correction which were conducted for the real effective exchange rate and private domestic investment for the period of the study. The results show that when the exchange rate is the dependent variable, then 1 co-integrating equation exists. The value of the error correction term has a significant negative coefficient (t-value ? 1.96).This means that there exists a long-run relationship between the two variable which emerges from the exchange rate being the dependent variable. The error correction coefficient of 0.1614 means that approximately 16.14% of deviation from equilibrium is eliminated in every month of the year, and that the current growth in the real effective exchange rate is because of a result of the previous quarter's growth in both the real effective exchange rate and in the private domestic investment. Therefore, it takes the model approximately 6.19 quarters to adjust to the full equilibrium, which suggests a short but slow adjustment to the equilibrium.

The exchange rate lags are not significant (t-values ? 1.96) which implies that previous changes in the exchange rate have no effect on the current change in the exchange rate.

The exchange rate lags, in the private domestic investment equation, are also not significant (t-values ? 1.96), meaning that past changes in the exchange rate has no effect on the current change in the private domestic investment. Therefore, short-run changes in the exchange rate have no effect on private domestic investment, and short-run changes in private domestic investment have no effect on the exchange rate.

Figure 2 shows the results of the impulse response analysis that was conducted for the real effective exchange rate and private domestic investment from 1990 to 2014. The figure illustrates that the first graph shows that a shock in the exchange rate has a downward falling effect on the exchange rate in the first three periods, then increases sharply in the 4^{th} period. This increase then declines in the 5^{th} period throughout the period of the study. The second graph, which is the top right graph, shows that when there are changes in the private domestic investment then the exchange rate tends to be negative and declining during in the first three periods. The exchange rate increases slightly in the 4^{th} period, and continues to increase throughout the period; however, this increase remains below the 0% point.

The bottom left graph shows the effect that shocks in the exchange rate has on private domestic investment. The graph shows that when there are shocks in the exchange rate, the private domestic investment tends to have a negative and falling effect during the 1^{st}, 2^{nd} and 3^{rd} periods. Private domestic investment increases slightly during the 4^{th} period to shocks in the exchange rate, and continues to increase until the 10^{th} period. The last graph (bottom right) shows that changes in the private domestic investment tends to have a positive and increasing effect on private domestic investment.

The overall findings from the impulse response analysis shows that movements in the real effective exchange rate has a positive but declining effect on the exchange rate, while shocks in private domestic investment have a negative but slightly increasing effect on the exchange rate. Changes in the real effective exchange rate has a negative but increasing effect on private domestic investment, while shocks in the private domestic investment have a positive and increasing effect on private domestic investment. These findings show that the exchange rate and private domestic investment have an effect on each other, but not significantly. Thus, these results are similar to the findings obtained by the short-run VECM test for the exchange rate and private domestic investment.

Table 8 represents the results obtained from the Granger causality test that was conducted for the real effective exchange rate and private domestic investment for the period of the study. The table shows that the null hypothesis that the private domestic investment does not Granger cause the real effective exchange rate is accepted at the 5 percent significance level (p ? 0.05). Similarly, the null hypothesis that the real effective exchange rate does not Granger cause private domestic investment is accepted at the 5 percent level of significance (p ? 0.05). These results imply that there is no causal relationship between the real effective exchange rate and private domestic investment between theperiod of $1990 - 2014$.

The results found from the Granger causality test are confirmed by the results found by the impulse response analysis and the VECM, which showed that the real effective exchange rate and private domestic investment do have an effect on each other in the short-run, however, the effect is not significant. Thus, these two variables are not interlinked together in the short-run, but there is a relationship between the two variables in the long-run.

Table 9 above illustrates the results of the Augmented Dickey-Fuller unit root test for the study period. These results show that the p-values of both the real effective exchange rate and the foreign direct investment at level are greater than the 0.05 significance level of these two variables. This means that the null hypothesis is accepted, meaning that there is no stationarity with regards to these two variables at level. However, there exists stationarity at 1^{st} difference for both the real effective exchange rate and foreign direct investment. These two variables both have a unit root.

These results show that both the exchange rate and foreign direct investment have a unit root at level and become stationary at 1^{st} difference. The two variables are I(1), which implies that there is a possibility of co-integration between the two variables. Thus, the need for the results of the co-integration test should be presented. But the before the results of the co-integration test are presented, the number of lags in the model need to be identified first with the information criteria being used to select the optimal number of lags to be used in the analysis of the exchange rate and foreign direct investment.

Table 10 illustrates the results of the Johansen co-integration tests for the real effective exchange rate and foreign direct investment from 1970 until 2013. The results show that the p-values of the Trace statistic and the Maximum Eigen Value of no co-integrating equation are less than 0.05; meaning that at the 5 percent level of significance the null hypothesis for no co-integrating equation is rejected. However, the p-values of the Trace statistic and the Maximum Eigen Value of at most 1 co-integrating equation are more than 0.5; meaning that at the 5 percent level of significance, the null hypothesis for of at most 1 co-integrating equation is accepted. This means that there exists 1 co-integrating equation between the two variables; implying that there is a long-run relationship between the real effective exchange rate and private domestic investment in South Africa. Equation 13 below explains this long-run relationship.

$$Exchange\_Rate = 4.8687 - 0.025476\ Foreign\ Direct\ Investment \tag{13}$$

Equation 13 shows the co-integrating equation, which shows that foreign direct investment has a long-run negative effect on the real effective exchange rate. The equation above shows that, in the long-run, foreign direct investment is negatively correlated to the exchange rate. This means that when the foreign direct investment falls by 1% then the real effective exchange rate increases by approximately 2.55%. The existence of the 1 co-integrating equation means that the Vector Error Correction (VECM) can be estimated to capture the speed of adjustment to long-run equilibrium, which is the nest test to be conducted for the real effective exchange rate and foreign direct investment for the duration of this paper

Table 11 represents the results of the short-run VECM test which was conducted for the real effective exchange rate and foreign direct investment. The table shows that when the exchange rate is the dependent variable, then 1 co-integrating equation exists. The error correction term has a significant but negative coefficient (t-values ? 1.96), which means that a long-run relationship between the exchange rate and foreign direct investment that emerges when the exchange rate is the dependent variable. The value of the error correction coefficient of 0.369 means that approximately 36.9% of deviation from equilibrium is eliminated in every month of the year, and that the current growth in the real effective exchange rate is because of a result of the previous quarter's growth in both the real effective exchange rate and in the private domestic investment. The model takes approximately 2.7 years to adjust to full equilibrium, suggesting a slow adjustment to the equilibrium.

The exchange lags are not significant (t-values ? 1.96), meaning that past changes in the real effective exchange rate have no effect on the current changes in the real effective exchange rate. Thus, short-term changes in the real effective exchange rate have no effect on the real effective exchange rate.

In the foreign direct investment, the lags of the exchange rate are not significant (t-values ? 1.96), meaning that previous changes in the real effective exchange rate have no effect on current changes in the foreign direct investment. Therefore, it can be concluded that short-run changes in the real effective exchange rate have no effect on foreign direct investment in South Africa.

Figure 3 above represents the results obtained from the impulse response analysis for the real effective exchange rate and foreign direct investment from 1970 until 2013. The figure shows that when there are shocks in the real effective exchange rate then the effect that this has on the real effective exchange rate is one of a downward spiralling effect, which is shown by the top left graph. The real effective exchange rate started declining in the 2^{nd} period, and continued to decline throughout the period. This downward spiral started steading in the 6^{th} period, and maintained consistent trend until the 10^{th} period. However, the effect that changes in foreign direct investment have on the real effective exchange rate is that of a negative but increasing trend, which is shown by the top right graph. This increasing trend, however, does not go above the 0% point.

Shocks in the real effective exchange rate have an upward trending effect on foreign direct investment, with the increase sharpening in the 4^{th} period. Shocks in foreign direct investment have a positive, but seemingly declining effect on foreign direct investment. These results indicate that shocks in the real effective exchange rate has a more significant effect on both the real effective exchange rate and foreign direct investment, while the real effective exchange rate and foreign direct investment reacts in a less significant manner to shocks in the foreign direct investment.

Table 12 represents the results of the Granger causality test, which was conducted for the real effective exchange rate and foreign direct investment for the period of the study. The results show that there exists a one-way causal relationship between the real effective exchange rate and foreign direct investment. This one-way causal relationship is shown by the value of the F-statistic being greater than the 5 percent significance level. This means that the change in the real effective exchange rate Granger causes foreign direct investment, but the change in the foreign direct investment does not Granger cause the real effective exchange rate.

These results are consistent with the results found by the VECM test and the variance decomposition tests, in that there is a one-way causal relationship between the real effective exchange rate and foreign direct investment and the real effective exchange rate has a more significant effect on foreign direct investment

Table 13 illustrates the results obtained from the Augmented Dickey-Fuller unit root test conducted for the real effective exchange rate and foreign portfolio investment for the period of the study. The table shows that at level, the p-values of the real effective exchange rate (RER) is 0.105 which is greater than the 0.05; meaning that the null hypothesis that RER has a unit root is accepted at the 5 percent level of significance. This means that RER is not stationarity at level. However, at 1^{st} difference, the p-value of the real effective exchange rate is 0 (p-value < 0.05); meaning that the null hypothesis for unit in RER is rejected at the 5 percent level of significance. . Therefore the real effective exchange rate is stationarity at 1^{st} difference, implying that it I(1).

The results of the unit root test for the foreign portfolio investment variable shows that at level indicate the p-value is greater than 0.05, meaning that, at the 5 percent level of significance, the null hypothesis that foreign portfolio investment has a unit root is accepted. At 1^{st} difference, however, the foreign portfolio investment becomes stationary as the null hypothesis is rejected at the 5 percent level of significance (p-value < 0.05). This means that the Credit Extended is stationarity at 1^{st} difference. These results show that both the two variables have a unit root at level but become stationary at 1^{st} difference. Thus both the variables are I(1). This means that there is a possibility that the two variables may be integrated; thus, the co-integration test should be conducted next.

Table 14 represents the results obtained from the Johansen co-integration test conducted for the real effective exchange rate and foreign portfolio investment for the period of the study. The results show that the p-values of the Trace statistic and the Maximum Eigen Value of no co-integrating equation are less than 0.05; meaning that at the 5 percent level of significance the null hypothesis for no co-integrating equation is rejected. However, the p-values of the Trace statistic and the Maximum Eigen Value of at most 1 co-integrating equation are more than 0.05; meaning that at the 5 percent level of significance, the null hypothesis for of at most 1 co-integrating equation is accepted. This means that there exists 1 co-integrating equation between the two variables; implying that there is a long-run relationship between the real effective exchange rate and the foreign portfolio investment. The equation that describes this long-run relationship is shown by equation 14 below.

$$Exchange\_Rate = 4.816485 - 0.00000101\ Foreign\ Portfolio\ Investment \tag{14}$$

Equation 14 shows the co-integrating equation, which shows that foreign portfolio investment has a long-run negative effect on the real effective exchange rate. The equation above shows that, in the long-run, foreign portfolio investment is negatively correlated to the exchange rate. This means that when the foreign portfolio investment falls by 1% then the real effective exchange rate increases fall by approximately -0.000101%. The existence of the 1 co-integrating equation means that the Vector Error Correction (VECM) can be estimated to capture the speed of adjustment to long-run equilibrium, which is the nest test to be conducted for the real effective exchange rate and foreign direct investment for the duration of this paper

Table 15 above illustrates the results of the short-run Vector Error Correction Model (VECM) conducted for the study period for the real effective exchange rate and foreign portfolio investment. The table shows that there exists one co-integrating equation, which was also found by the Johansen co-integration test that was conducted in Table 5.37 above. The table shows that when the exchange rate is the dependent variable, then 1 co-integrating equation exists. The value of the error correction coefficient of 0.097 means that approximately 9.7% of deviation from equilibrium is eliminated in every month of the year. It takes the model approximately 10.31 years to adjust to the full equilibrium, suggesting that there is slow adjustment to the equilibrium.

The exchange rate lags are not significant (t-values ? 1.96), meaning that the previous changes in the exchange rate have no effect on the current changes in the exchange rate. The lags of the foreign portfolio investment are also not significant (t-values ? 1.96), suggesting that previous changes in the foreign portfolio investment have no effect on the current changes in the real effective exchange rate. Thus, it can be concluded that short-run changes in the real effective exchange rate have no effect on the foreign investment, and short-run changes in the foreign portfolio investment have no effect on the real effective exchange rate.

Source: Own estimates

Figure 4 represents the graphical representation of the impulse response analysis for the real effective exchange rate and foreign portfolio investment for the period of the paper. From the figure, it can be seen that when there are changes in the real effective exchange rate then the real effective exchange rate responds in a falling manner, as shown in the top, left graph. The graph shows that in the 2^{nd} period, the effect of shocks in the real effective exchange rate had a high, positive effect on the real effective exchange rate; however, this was met by a sharp fall during the 3^{rd} period onwards. This means that the changes in the real effective exchange rate have a negative effect on the real effective exchange rate over time. The top, right graph shows that when there are shocks in the foreign portfolio investment then the real effective exchange rate tends to have a fluctuating impact, moving up and down but always below the positive line. During the 1^{st} period, the effect of shocks in the foreign portfolio investment on the real effective exchange rate began the falling pattern, while a sharp fall being experienced during the 4^{th} period of the study. However, there was an upward trend during the middle of the 4^{th} period throughout the beginning of the 7^{th} period. This was, however, met by a fall in the middle of the 7^{th} period of the study.

The bottom, left graph shows that when there are shocks in the real effective exchange rate, foreign portfolio investment tends to increase over time. The bottom, right graph shows that when there are changes in the foreign portfolio investment, then the effect on the foreign portfolio investment is positive and increasing, over time.

The results obtained from Figure 5.12 show that the response of the real effective exchange rate to changes in both the real effective exchange rate and foreign portfolio investment is more negative, but the response of the foreign portfolio investment to changes in both the real effective exchange rate and foreign portfolio investment is positive and increasing over time, suggesting that there is a long-run relationship between the real effective exchange rate and foreign portfolio investment.

Table 16 illustrates the results of the Granger causality test which was conducted for the real effective exchange rate and foreign portfolio investment for the period of the study. The table shows that there is a one-way causal relationship between the real effective exchange rate and foreign portfolio investment. This one-way causal relationship means that the foreign portfolio investment Granger causes the real effective exchange rate but the real effective exchange rate does not Granger causes the foreign portfolio investment.

The results obtained from the Granger causality test are consistent with the results obtained from the impulse response analysis, in that the foreign portfolio investment has an effect on the real effective exchange rate over the long-run.

5 Discussion of results

This section focuses on the discussion of the results that were obtained through the conduct of the empirical tests for the real effective exchange rate and different types of investments in South Africa since 1970. The findings in this study for all the variables showed that unit root tests at level were non-stationary, but once the 1^{st} difference was estimated then there was stationary. The VECM results showed that there was 1 co-integrating equation in the analysis of all the variables, with the real effective exchange rate being the dependent variable, as well as the co-integrating coefficient in all of the co-integrating tests conducted.

There existed autocorrelation in all the variables, but there was no sign of heteroscedasticity in neither of the variables. The conduct of the Granger causality yielded different results for the variables. The Granger causality tests for the relationship between the real effective exchange rate and credit extended to the domestic private sector, and the real effective exchange rate and private domestic investment yielded a two-way causal relationship, while the Granger causality tests for the real effective exchange rate and foreign direct investment, and the real effective exchange rate and foreign portfolio investment both yielded a one-way causal relationship.

The findings from the all the tests conducted for the real effective exchange rate and different types of investments suggested a long-run relationship between the real exchange rate and different types of investments in South Africa during the study period of 1970 to 2014. This negative, long-run is consistent with the findings of Darby *et al* (1999), who found evidence that exchange rate fluctuations tend to have a negative effect on investments in the long-run. This is because when investors are uncertain about the future movement of an exchange rate, then these investors are more likely to move their investments from the country to economies that are perceived to have more stable and healthy investment environments. This long-run relationship between the exchange rate and different types of investments in South Africa proved to be negative in nature, and was mostly linked with the depreciation of the South Africa rand.

During 2002, the rand experienced the lowest point of depreciation in the study period, and foreign investment was affected the most by it, while domestic investment grew slightly during this period. The findings that there was a growth in domestic investment during the worst depreciation period is consistent with the findings of Harchaoui*et al* (2005), Campa& Goldberg (1999) and Gomez (2000), who found that a depreciation of a local currency tends to result in exports being more attractive due to the cheaper prices, thus income increases and eventually leads to an increase in investment spending. Similarly, in 1982 the rand experienced its highest recorded appreciation rate that saw no change in the level of foreign investment inflows into the country. Thus, it seems that the inflow of foreign investment into South Africa is affected by the depreciation of the currency, while the rate of domestic investment into the country does not seem to be affected significantly by a depreciation of the currency.

In the short-run, it was found that there was a relationship between the exchange rate and different types of investments in South Africa from 1970 to 2014, however, this relationship proved to not be statistically significant enough to cause any big implications for the economy. Thus, suggesting that short-run changes in the exchange rate do not have a significant effect on the current changes in investments, and similarly, short-run changes in investments do not have a significant effect on the current changes in the exchange rate.

6 Conclusions

The conclusion that this paper came to was that movements in the exchange rate plays an important part in the behaviour of foreign and domestic investors making investments in the South African economy. The use of a free-floating exchange rate in South Africa has resulted in the rand being exposed to any shocks in the global economy. This paper has shown that the real effective exchange rate and the different types of investments in South Africa are linked together in the long-run. This means that movements in these variables have an effect on each other over time, which is the reason why the changes in these variables need to be analysed more in the future. If the South African economy is to improve, and if the goal of the government is to ensure exchange rate stability and increasing investment prospects into the country, then the exchange rate needs to be carefully analysed in order to ensure that it does not depreciate or appreciate to a point where it becomes a hindrance to investments both domestically and internationally.

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Table 1: Unit root test results: exchange rate and domestic credit extension

		Level		1st difference	
		RER	Credit Extension	RER	Credit Extension
ADF	t-statistic	-2.367	-0.665	-11.807	-17.739
	p-value	0.152	0.851	0.000	0.000

Source: Own estimates

Table 2: Johansen co-integration test results: exchange rate and domestic credit extension

Hypothesized No. of CE(s)	Trace statistic		Maximum Eigen Value	
	Trace statistic	p-value	Trace statistic	p-value
None	34.537	0.003	27.750	0.002
At most 1	6.786	0.367	6.786	0.367

Source: Own estimates

Table 3: Short-run VECM results: exchange rate and domestic credit extension

Error Correction:	D(EXCHANGE_RATE)	D(CREDIT_EXTENSION)
ECT	-0.04705 -0.01974 [-2.38346]	-56.01001 -45.7862 [-1.22330]
D(EXCHANGE_RATE(-1))	0.235713 -0.06442 [3.65919]	-9.282952 -149.412 [-0.06213]
D(EXCHANGE_RATE(-2))	-0.150097 -0.06472 [-2.31933]	72.50769 -150.105 [0.48305]
D(CREDIT_EXTENSION(-1))	3.49E-05 -2.80E-05 [1.23652]	-0.131394 -0.06552 [-2.00544]
D(CREDIT_EXTENSION(-2))	-3.41E-05 -2.80E-05 [-1.20014]	0.071858 -0.0659 [1.09036]
C	-0.097012 -0.18222 [-0.53239]	664.8784 -422.646 [1.57313]

T-values in []

Source: Own estimates

Table 4: Granger causality test of exchange rate and domestic credit extension

Null Hypothesis:	F-Statistic	Prob.
ΔRER does not Granger Cause ΔCREDIT_EXTENSION	0.653	0.521
ΔCREDIT_EXTENSIOND does not Granger Cause ΔRER	1.182	0.308

Source: Own estimates

Table 5: Unit root test of exchange rate and private domestic investment

		Level		1st Difference	
		RER	**PDI**	**RER**	**PDI**
ADF	**t-statistic**	-2.27	-.0.1639	-5.435	-5.692
	p-value	0.1824	0.9380	0.000	0.000

Source: Own estimates

Table 6: Johansen Co-integration test for exchange rate and private domestic investment

	Trace statistic		Maximum Eigen Value	
Hypothesized No. of CE(s)	**Trace statistic**	**p-value**	**Trace statistic**	**p-value**
None	14.481	0.021	14.054	0.015
At most 1	0.426	0.577	0.426	0.577

Source: Own estimates

Table 7: Short-run VECM results for exchange rate and private domestic investment

Error Correction:	D(EXCHANGE)	D(DOMESTIC_INV)
CointEq1	-0.161497 -0.06161 [-2.62143]	0.016156 -0.02768 [0.58362]
D(NEW_EXCHANGE_RATE(-1))	0.024182 -0.10878 [0.22229]	-0.036976 -0.04888 [-0.75644]
D(NEW_EXCHANGE_RATE(-2))	-0.126093 -0.10422 [-1.20989]	-0.029672 -0.04683 [-0.63360]
D(NEW_EXCHANGE_RATE(-3))	0.224294 -0.1044 [2.14845]	-0.038312 -0.04691 [-0.81670]
D(DOMESTIC_FIXED_INVEST(-1))	-0.218466 -0.23758 [-0.91955]	0.515 -0.10675 [4.82415]
D(DOMESTIC_FIXED_INVEST(-2))	-0.09168 -0.2666 [-0.34389]	-0.085881 -0.11979 [-0.71691]
D(DOMESTIC_FIXED_INVEST(-3))	0.124615 -0.23493 [0.53045]	0.005508 -0.10556 [0.05218]
C	0.002517 -0.00904 [0.27838]	0.014732 -0.00406 [3.62610]
R-squared	0.162619	0.257031

T-values in []

Source: Own estimates

Table 8: Granger causality test of effective exchange rate and private domestic investment

Null Hypothesis:	F-Statistic	Prob.
ΔDOMESTIC_INVESTMENT does not Granger Cause ΔRER	1.3137	0.2749
ΔRER does not Granger Cause ΔDOMESTIC_INVESTMENT	0.15137	0.9286

Source: Own estimates

Table 9: Unit root test of exchange rate and foreign direct investment

		Level		1st difference	
		RER	**FDI**	**RER**	**FDI**
ADF	**t-statistic**	-2.134	-0.444	-5.596	-5.297
	p-value	0.232	0.8919	0.000	0.000

Source: Own estimates

Table 10: Johansen Co-integration test of exchange rate and foreign direct investment

	Trace Statistic		Maximum Eigen Value	
Hypothesized No. of CE(s)	**Trace statistic**	**p-value**	**Trace statistic**	**p-value**
None	21.665	0.001	21.538	0.0006
At most 1	0.128	0.768	0.128	0.7684

Source: Own estimates

Table 11: Short-run VECM results for exchange rate and foreign direct investment

Error Correction:	D(EXCHANGE_RATE)	D(FDI)
CointEq1	-0.369077	0.782018
	-0.14999	-0.23025
	[-2.46061]	[3.39637]
D(EXCHANGE_RATE(-1))	0.236814	0.11535
	-0.18285	-0.28069
	[1.29511]	[0.41095]
D(FDI(-1))	-0.070903	-0.04518
	-0.11116	-0.17063
	[-0.63787]	[-0.26478]
C	0.006883	0.180296
	-0.02173	-0.03336
	[0.31676]	[5.40478]
R-squared	0.251224	0.354711

T-values in []

Source: Own estimates

Table 12: Granger causality test of exchange rate and foreign direct investment

Null Hypothesis:	F-Statistic	Prob.
ΔDIRECT_INVESTMENT does not Granger Cause ΔRER	3.91987	0.0546
ΔRER does not Granger Cause ΔDIRECT_INVESTMENT	21.4428	0.00004.

Source: Own estimates

Table 13: Unit root test of exchange rate and foreign portfolio investment

		Level		1st difference	
		RER	**FPI**	**RER**	**FPI**
ADF	**t-statistic**	-2.581	-0.577	-2.495	-3.504
	p-value	0.105	0.865	0.014	0.013

Source: Own estimates

Table 14: Johansen Co-integration test of exchange rate and foreign portfolio investment

	Trace Statistic		Maximum Eigen Value	
Hypothesized No. of CE(s)	**Trace statistic**	**p-value**	**Trace statistic**	**p-value**
None	14.073	0.025	14.073	0.015
At most 1	6.31E	0.996	6.31E	0.996

Source: Own estimates

Table 15: Short-run VECM results for exchange rate and foreign portfolio investment

Error Correction:	D(EXCHANGE)	D(PORTFOLIO_INVEST)
CointEq1	-0.09664 -0.13351 [-0.72381]	231406 -75200.3 [3.07719]
D(EXCHANGE_RATE(-1))	0.2388	-229878.1

	-0.20382	-114800
	[1.17161]	[-2.00242]
D(EXCHANGE_RATE(-2))	-0.196844	-65749.94
	-0.21425	-120676
	[-0.91874]	[-0.54485]
D(EXCHANGE_RATE(-3))	0.280723	-87585.11
	-0.18205	-102538
	[1.54200]	[-0.85417]
D(EXCHANGE_RATE(-4))	-0.163629	-117773
	-0.17825	-100397
	[-0.91797]	[-1.17307]
D(PORTFOLIO_INVEST(-1))	-7.64E-08	0.450808
	-4.60E-07	-0.25686
	[-0.16750]	[1.75507]
D(PORTFOLIO_INVEST(-2))	4.80E-08	-0.105273
	-4.20E-07	-0.23404
	[0.11560]	[-0.44981]
D(PORTFOLIO_INVEST(-3))	-5.17E-07	-0.622953
	-4.00E-07	-0.22705
	[-1.28274]	[-2.74370]
D(PORTFOLIO_INVEST(-4))	1.14E-06	0.313415
	-4.10E-07	-0.23259
	[2.77162]	[1.34753]
C	-0.013765	39676.43
	-0.02644	-14890.8
	[-0.52066]	[2.66449]
R-squared	0.404326	0.820234

T-values in []

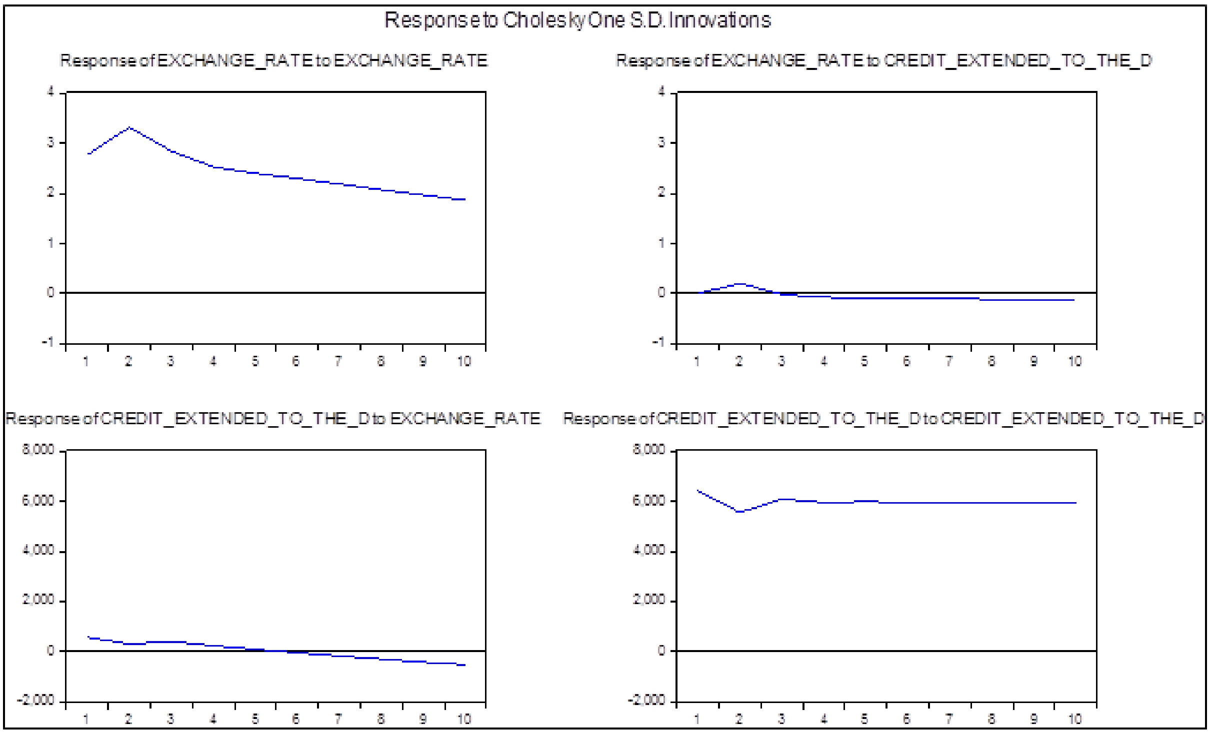
Source: Own estimates

Table 16: Granger causality test of exchange rate and foreign portfolio investment

Null Hypothesis:	F-Statistic	Prob.
ΔPORTFOLIO_INVESTMENT does not Granger Cause ΔRER	4.05831	0.0093
Δ RER does not Granger Cause ΔPORTFOLIO_INVESTMENT	1.00207	0.4214

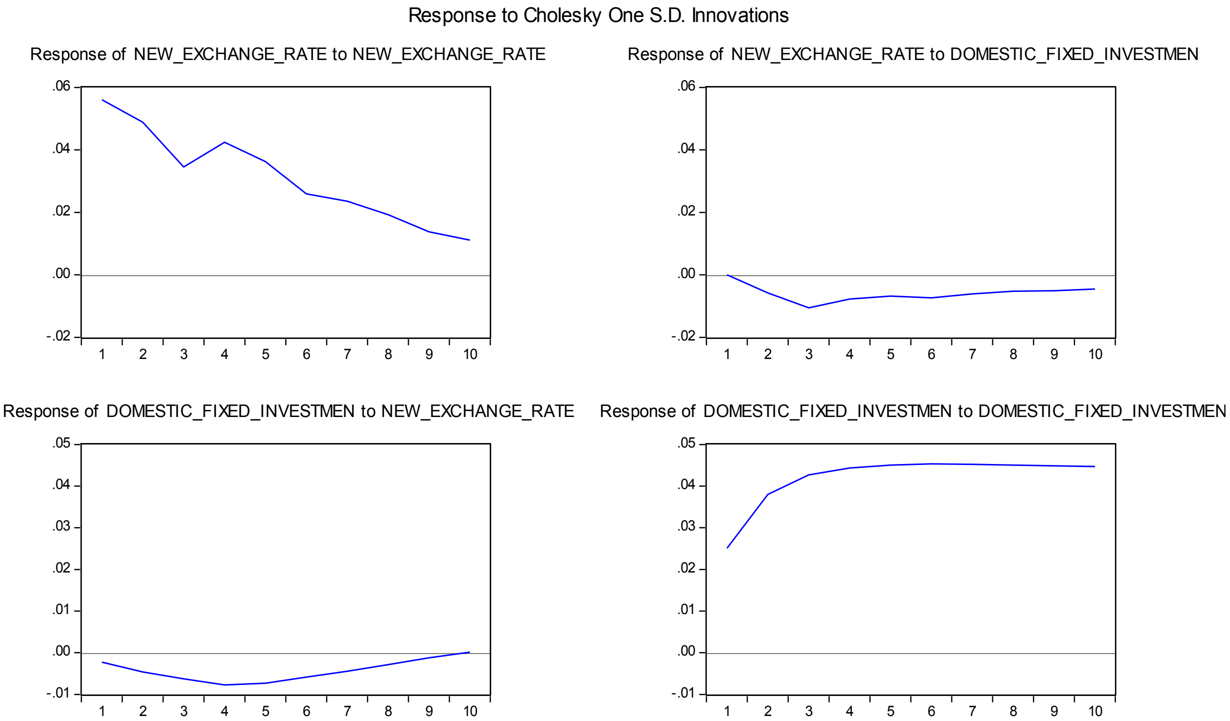
Source: Own estimates

Figure 1: Impulse response analysis of exchange rate and domestic credit extension



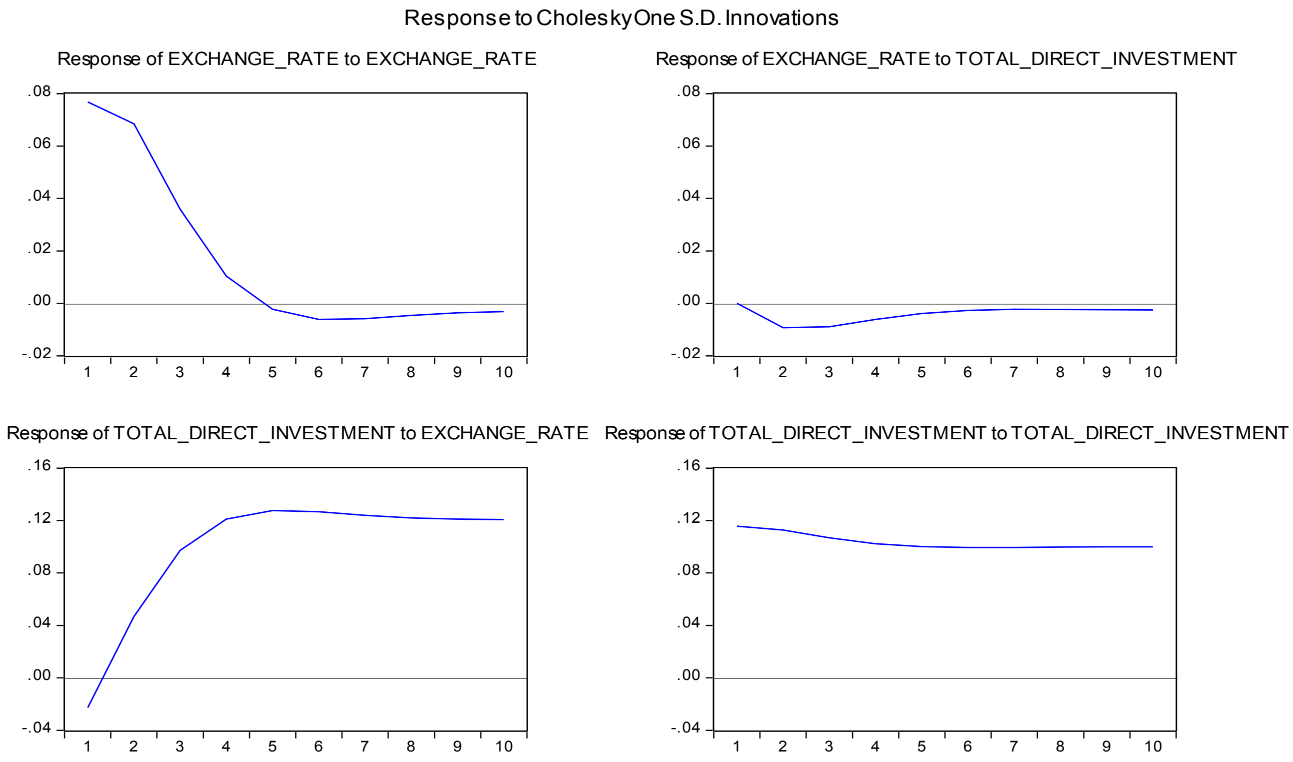
Source: Own estimates

Figure 2: Impulse response analysis of exchange rate and private domestic investment



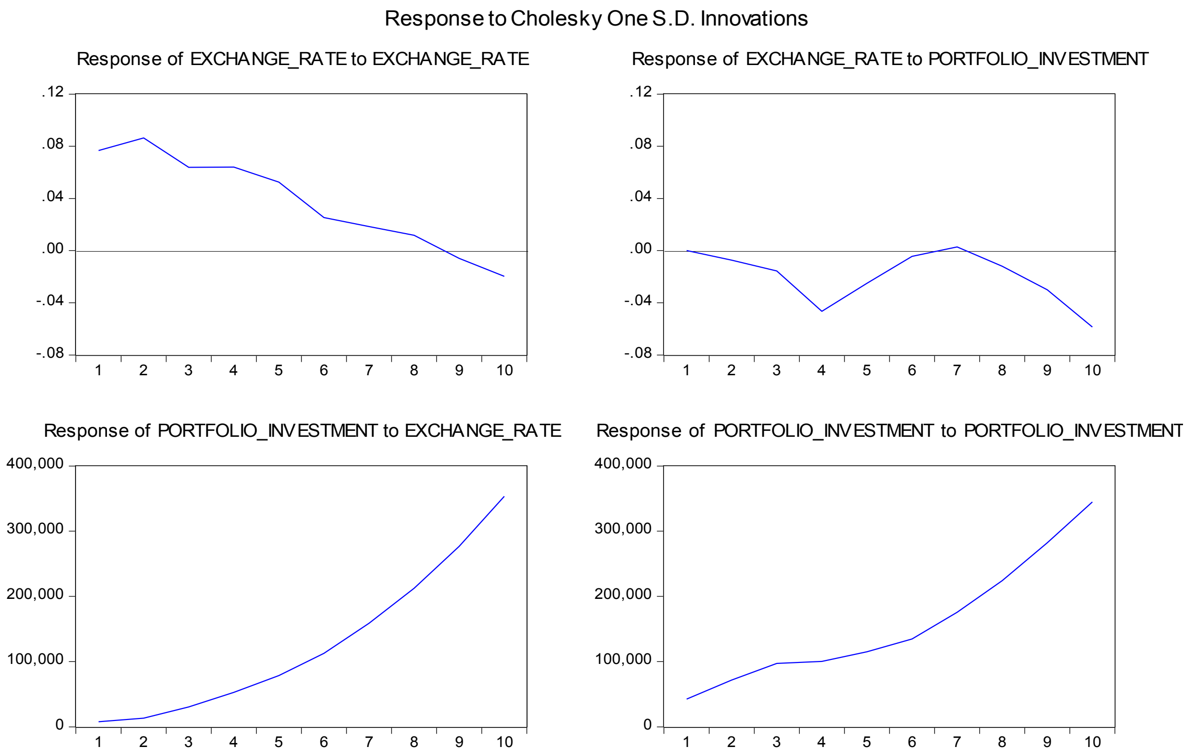
Source: Own estimates

Figure 3: Impulse response analysis of exchange rate and foreign direct investment



Source: Own estimates

Figure 4: Impulse response analysis of exchange rate and foreign portfolio investment



Source: Own estimates