The Impact of Exchange Rate Volatility on South African Exports

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Abstract

Exchange rates have been highly volatile in South Africa especially after the end of the Bretton Woods system and this has raised a lot of debate amongst interested parties in South Africa such as the South African government and the Congress of South African Trade Union. Therefore, this paper investigates the impact of exchange rate volatility on aggregate South African exports flows to the rest of the world for the period 2000 to 2009. The results obtained suggest that, there exist no statistically significant relationship that is there is an ambiguous relationship between South African exports flows and exchange rate volatility. Although the results were not robust, at the same the study found some sensitivity of South African exports to movements of the exchange rate. We find that, depending on the measure of volatility used, exchange rate volatility either does not have a significant impact on South Africa's exports flows, or it has a positive impact on aggregate goods and services.

Keywords: *exchange rate volatility ,Bretton Woods*

1. Introduction

After the collapse of the Bretton Woods system of fixed exchange rate, exchange rates across the world have fluctuated widely. A number of countries such as South Africa adopted a flexible exchange rate regime despite its exposure to exchange rate volatility. This condition is well thought-out to be a risk to the growth of global and macroeconomic stability, because of the existence of heading facilities that would be employed to protect against exchange rate risk (Sekantsi, 2007). However, the confinement of this new system of exchange rate has engendered a boiling and extensive theoretical debate regarding the impact of the exchange rate unpredictability on foreign trade (Johnson, 1969; Kihangire, 2004).

Since then, there has been an extensive debate about the impact of exchange rate volatility on international trade. The mainly commonly held certainty is that greater exchange rate volatility create insecurity thereby escalating the level of riskiness of trading activity and this will eventually depress trade (Munyama and Todani, 2005).A wide variety of studies on this study, however, contains vastly uncertain and contradictory empirical and theoretical results on this matter. At theoretical level, there are models that have been put forward that demonstrate that increased danger associated with high volatility is apt to incite risk averse agents to channel their assets to less risky economic activities. Cote (1994) cited Hooper and Kohlhagen (1978) and Clark (1973), amongst others, to support the claim that volatility depresses trade. In contrast, other theoretical models that have been put forward , indicate that higher risk of exchange rate volatility can present large opportunities for profits and, as a result it should increase trade. The vagueness of theoretical predictions that has been put forward has made the debate on exchange rate volatility to become a primarily empirical one.However, much of the findings obtained from empirical literature are also filled with the same uncertainty and inconsistencies .

South Africa has not escaped the debate on exchange rate volatility, having witnessed consistent depreciation of exchange rate to the lowest levels in December 2001 and a sharp appreciation thereafter (Munyama and Todani ,2005).The contest in South Africa is not just about the unpredictability of the exchange rate, but also its level. The debate is rather eye –catching in South Africa because the debate seems to be taking place in a research vacuum in which there is no persuasive empirical verification to authenticate either claim. It is because of this reason that the debate in South Africa has been associated with conflicting views about the impact of exchange rate on exports.

In June 2001 the exchange rate between the US dollar and South African rand was eight in December 2001 it was twelve .Within six months down the line, the rand had depreciated 50% against the US dollar and many other currencies. Situations like this up to today ,although extreme ,have become frequent in South Africa where, the exchange rate volatility has gradually increased since the 1990s.This volatility has not gone unobserved and has caused some worry among policymakers and different market participants, to the point that former President Thabo Mbeki went on to create the Myburgh Commission to investigate the causes of the acute depreciation in 2001.More lately, the Economist Intelligence Unit country report for South Africa remarks that the rand remains one of the most volatile of emerging market currencies, and is prone to sharp movements (Economist Intelligence Unit, 2007).South African firms share these concerns, as revealed by the World Bank's (2007) South Africa Investment Climate Assessment, where concern about the exchange rate is rated the second most serious constraint to the enterprise operations and growth for a representative sample of south African firms. The creation of the European Monetary Union (EMU) which was created recently has been at least partially based on the idea that exchange rate volatility is detrimental for trade. This idea seems to find some anecdotal support among the results of the South Africa's Investment Climate Survey (ICS), where a fraction of firms that reported macroeconomic volatility as a major or severe obstacle, was significantly higher among exporter than nonexporter firms (World Bank, 2007)

As stated by Aziakano *et al* (2005) and Todani and Munyama (2005), the requirement by South African government to promote exports in an environment of a flexible exchange rate requires a comprehensive understanding of how the highly fluctuating rand impacts on upon the South Africa exports and the resultant effects on the economy at large. Therefore, this paper serves to fill the vacuum on whether the rand volatility endangers uncertainty with regard to profits and whether it impacts negatively on exports production in South Africa since currently, there is little empirical evidence on the impact of the exchange rate volatility on South African exports. Acquisition of such information is, in fact, of paramount importance to the design of both exchange rate and trade policies. For example, if the policy makers are knowledgeable about the volatility of exchange rate, they would always ensure that trade adjustment programs that put emphasis on export expansion are successful (Sekantsi, 2007).

A lot of studies on this study have been undertaken both locally and internationally, that is both at empirical and theoretical levels. Researchers have used the two most popular and related methods in the analysis of trade and exchange rate volatility. The most commonly used approach is to estimate a simple export demand equation with real exports as a dependent variable and exchange rate volatility together with relative prices and a measure of economic activity variable as regressors. The other approach being to use the so-called gravity equation models, which explain bilateral trade flows between countries as depending positively on the product of their GDPs and negatively on their geographical distance from each other .This section reviews some of the empirical literature and their findings. This review will be in short and for further study ,readers are referred to, for example, Omojimite and Akpokodje (2010),Todani and Munyama (2005), Cote (1994), McKenzie (1999), Poonyth and Zyl (2000), and Clark et al. (2004) that is, for more detailed and comprehensive surveys.

In order to analyse the impact of the exchange rate on UK exports to the European Union , De Vita and Abbott (2004) applied the ARDL technique. The analysis estimated an export demand equation using disaggregated monthly data for the period 1993 to 2001.The results obtained indicated that UK exports to the EU are unaffected by exchange rate movements. In addition to those findings Morgenroth (2000) obtained identical findings while looking at the flow of Irish exports to Britain.Doyle (2001),applied the estimated error correction model analysing also the impact of exchange rate volatility on exports looking also at Irish export to Britain, and the findings revealed that nominal and real volatility are significant determinants of fluctuations in total exports.in this study positive and negative short-run elasticities for exchange rate movements were estimated, but positive elasticities predominated. Another study was carried by Wang and Barrett (2002) who analysed the effect of exchange rate on international trade by examining Taiwan's exports to the United States for the period 1989-1999.The results suggested that real exchange rate has insignificant effects.

Dell' Ariccia (1999) used a different approach and used the gravity model to examine the impact of the exchange rate on the bilateral trade of the 15 EU members and Switzerl and for the period 1975 to 1994.The findings suggested that, exchange rate volatility has a small but significantly negative impact on trade. Other researchers such as Bayoumi and Eichengreen (1998), and Tenreyro (2004) also examined the impact of exchange rate volatility on trade using the gravity model and the results also suggested that exchange rate volatility is insignificant on trade. Munyama and Todani (2005) applied the ARDL bounds testing procedure in order to test the impact of the exchange rate volatility on South African exports and the findings indicated that depending on the measure of volatility used ,exchange rate volatility either does not have a significant impact on South Africas export flows or it has a positive impact. All in all, the conclusion drawn from empirical literature is that earlier studies tended to find that there exist an ambiguous relationship between export and exchange rate volatility. Studies where significant relations were found, it was either negative or positive. However, recent literature applying econometric techniques such as the error correction methods are beginning to find exports and exchange rate being statistically significant .

Methodology

1.1 Vector autoregressive model

Vector autoregressive models (VARs) were popularised in econometrics by Sims (1980) as a natural generalisation of univariate autoregressive models. A VAR is a systems regression model (i.e. there is more than one dependent variable) that can be considered a kind of hybrid between the univariate time series models and the simultaneous equations models. VARs have often been advocated as an alternative to large-scale simultaneous equations structural models. An important feature of the VAR model is its flexibility and the ease of generalisation. A useful facet of VAR models is the compactness with which the notation can be expressed. For example, k = 1, so that each variable depends only upon the immediately previous values of y_{1t} and y_{2t} , plus an error term (Brook, 2003).

The VAR model can estimate a vibrant simultaneous equation system without putting any prior restrictions on the structure of the relationships. Because it does not have any structural restrictions, the VAR system enables the estimation of a reduced form of correctly specified equations whose actual economic structure may be unknown.

VAR models have several advantages compared with univariate time series models or simultaneous equations structural models, for example a researcher does not need to specify which variables are endogenous or exogenous. All variables are endogenous. This is an important point, since a requirement for simultaneous equations structural models to be estimable is that all equations in the system are identified. Essentially, this requirement boils down to a condition that some variables are treated as exogenous and that the equations contain different right hand side variables.

VAR models allows the value of a variable to depend on more than just its own lags or combinations of white noise terms. Therefore VARs are more flexible than univariate autoregressive models; the latter can be viewed as a restricted case of VAR models.VAR models can therefore offer a very rich structure, implying that they may be able to capture more features of the data (Brook,2003).

It is essential that all of the components in the VAR and GARCH model are stationary. However, most time series data are not stationary in their levels such that estimations based on this technique will be meaningless (spurious). Differencing the variables to mechanically turn them stationary has been a preferred approach to deal with this problem, but it throws away useful long run information that may be useful. These problems led to the emergence of new generation models based on cointegration and error correction modelling (Brooks, 2003:400).

There are several cointegration based methods but most of them suffer from numerous problems when applied to multivariate models. These include not being able to test for cointegration when there are multiple cointegrating relationships and sample problems amongst others. The technique in this category that has emerged as the most powerful and popular is the Johansen technique, which is the technique employed in this article.

The Johansen (1991;1995) technique has become an essential tool in the estimation of models that involve time series data. This approach is preferred as it captures the underlying time series properties of data and is a systems equation test that provides estimates of all cointegrating relationships that may exist within a vector of nonstationary variables or a mixture of stationary and nonstationary variables (Harris,1995:80).

The Johansen technique has several advantages over other cointegration based techniques, which will be discussed in the following sub-sections. The Johansen technique is preferred in this article as it allows for the estimation of a dynamic error correction specification, which provides estimates of both the short and the long run dynamics in the empirical model.

A number of steps are required in estimating the Johansen technique and these include, the need to determine the stationarity of the variables in the empirical model, the next step is performing cointegration tests in order to identify any long run relationships between the variables, a short run vector error correction model is then estimated on condition of finding cointegration in the previous step and finally, residual diagnostics tests form the last step. Impulse response and variance decomposition is performed when the variables pass the necessary diagnostics tests.

It is likely that, when a VAR includes many lags of variables, it will be difficult to see which sets of variables have significant effects on each dependent variable and which do not. In order to address this issue, tests are usually conducted that restrict all of the lags of a particular variable to zero (Brook, 2003).

However, before one proceeds to test for the rank of, Π there are two issues that have to be attended to. The first is determining the appropriate order (k) of the VAR. Brooks (2002:404) argues that the Johansen test can be affected by the lag length employed in the VECM, thus it is crucial to attempt to select the lag length optimally. By optimally, it is meant that the chosen lag length should produce the number and form of cointegration relations that conform to all the a priori knowledge associated with economic theory (Seddighi et al., 2000:309).

On the one hand, Brooks (2002:334) states that economic theory will often have little to say on what an appropriate lag length is for a VAR and how long changes in the variables should take to work through the system. Brooks recommends the use of multivariate versions of the information criteria, which includes the sequential modified likelihood ratio (LR), Akaike information criterion (AIC), Final prediction error (FPE) Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). However, these information criteria usually produce conflicting VAR order selections. In light of these problems, we will use both the information criteria approach and the priori knowledge from economic theory to select the appropriate order of the VAR.

Once the appropriate VAR order (k) and the deterministic trend assumption have been identified, the rank of the $\prod$ matrix can then be tested. There are two likelihood ratio (LR) test statistics for cointegration under the Johansen approach: the trace (trace λ) and the maximum eigenvalue (max λ) statistics, which are specified as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{N} \ln(1-\lambda_i) \qquad (1)$$

And

$$\lambda_{\max}(r, r+1) = T\ln(1-\hat{\lambda}_{r+1}) \qquad (2)$$

where r is the number of cointegrating vectors under the null hypothesis, λ_i is the estimated value for the ith ordered eigenvalue from the Π matrix .The trace statistic sequentially tests the null hypothesis that the number of cointegrating relations is r against the alternative of k cointegrating relations, where k is the number of endogenous variables. The maximum eigenvalue conducts separate tests on each eigenvalue and has as its null hypothesis that there are r cointegrating vectors against an alternative of $r+1$ (Brooks, 2002: 405). To determine the rank of the Π matrix the above trace and maximum eigenvalue test statistics are compared to the (non- standard) critical values from Osterwald-Lenun (1992),which differ slightly from those originally reported by Johansen and Juselius (1990).

For both tests, if the test statistic is greater than the critical values, the null hypothesis that there are r cointegrating vectors is rejected in favour of the corresponding alternative hypothesis.

However, the trace and maximum eigenvalue statistics may yield conflicting results. To deal with this problem, Johansen and Juselius (1990),recommend the examination of the estimated cointegrating vector and basing one's choice on the interpretability of the cointegrating relations. Alternatively, Luintel and Khan (1999: 392) show that the trace test is more robust than the maximum eigenvalue statistic in testing for cointegration. The two approaches will be considered in this study when faced with such a problem.

Once the number of cointegrating vectors in the model have been identified, a VECM can be estimated by specifying the number of cointegrating vectors, trend assumption used in the previous step and normalising the model on the true cointegrating relation(s).Thus, a VECM is merely a restricted VAR designed for use with nonstationary series that have been found to be cointegrated. The specified cointegrating relation in the VECM restricts the long run behaviour of the endogenous variables to converge to their cointegrating relationships, while allowing for short run adjustment dynamics. The coefficients of the VECM have already been explained and they will not be repeated here. Once estimation is complete, the residuals from the VECM must be checked for normality, heteroskedacity and autocorrelation.

In order to consider further the effect of the exchange rate volatility on exports in South Africa, the impact multipliers that orthogonalised impulse responses should also calculated for the estimated VAR model. The forecast error variance is decomposed to determine the proportion of the movements in the unemployment rate that are a consequence of its own shocks rather than shocks to other variables. Moreover, all variables to be included in the VAR are required to be stationary in order to carry out joint significance tests on the lags of the variables. Hence, all variables are subjected to Augmented Dickey--Fuller (ADF) tests.

Data

Monthly data covering the from period 2000 to 2010 was used in this study. The data was obtained from South African Reserve Bank (SARB), the International Financial Statistics (IFS) published by the International Monetary Fund (IMF), Johannesburg Stock exchange and Department of Trade and Industry.

Estimation and Interpretation of Results

The dependent variable exports is regressed against the explanatory variables; inflation (LINF), real interest rate (INSI), real exchange rate (LFX) and money supply (LM3). The results are shown by the table below:

Table 1: Estimation Results

Variable	**Coefficient**	**t-statistic**	**Standard error**
C	99.07646	3.88495	25.5026
DLINF (-1)	0.228901 0.403506	0.53588 0.92591	11.5110 0.09786
DLFX	1.1274435 -2.740432	0.35603 -0.87327	3.16667 3.13811
DL M3	5.208773 1.169181	11.5110 11.1788	0.45250 0.10459
DLINSI	1.168657 -1.382189	0.33967 -0.39954	3.44052 3.45948
DLGDP	-13.23397 -13.65674	-1.41052 -1.46556	9.38232 9.31845

R-squared: 0.375012
Adjusted R-squared: 0.303585
Probe (F-statistic): 5.250265

Inflation has a t-statistic value of 0.53588 and 0.92591 signifying that the variable is not significant. The coefficient of inflation is 0.228901 and 0.403506 in the first and second month respectively representing a positive relationship that exists between exports and inflation. Interest rates has a t-statistic value of 0.33967 in the first month meaning it is insignificant and in the second month also it has a figure of -0.39954 which is less than 2 meaning that also it is not significant and the coefficient in the first month is 1.168657 which is positive meaning there is a positive relationship within the first month and in the second month there is a negative relationship as the coefficient is negative which is -1.382189.

GDP has a t-statistic value of -1.41052 and -1.46556 in the first and second month, respectively, meaning that it is insignificant in both the first two months. The coefficient value of GDP is -13.23397 and -13.65674 in the first and second month respectively meaning there is a negative relationship between exports and GDP. When it comes to the real exchange rate the t-statistic is 0.35603 and -0.87327 in the first and second month respectively meaning that it is insignificant and the coefficient value in the first month is positive meaning there is a positive relationship in the first month and in the second month it is negative which is -2.740432 meaning there is a negative relationship between exports and exchange rate in the second month. The standard errors of money supply are less than two in the first and second month respectively that is we have 0.45250 and 0.10459 respectively meaning that it is statistically insignificant and the coefficients are both positive meaning that they is a positive relationship as we have 5.208773 and 1.169181 in the first and second month respectively .

A joint analysis of the variables was made through the assessment of the overall statistical significance of the model. The coefficient of multiple determination ($R^{2)}$ measures the goodness of fit of the regression equation. That is, it gives the proportion or percentage of the total variation in the dependent variable Y explained by the (single) explanatory variable X (Gujarati, 2004). The R^2 is 0.375012 showing that jointly, all the explanatory variables account for a little over 37 percent of the changes in the dependent variable. The adjusted R^2 of 0.303585 takes into account the degrees of freedom and is reflecting that up to 30 percent of the changes in the dependent variable are being explained in the model. To test the predictive power of the model, there is also the F-statistic. The F-statistic is closely related to R^2 such that when R^2 is equal to zero then the F-Statistic will be as well equal to zero (Gujarati, 2004).

Conclusion

The study shows that exchange rate has an ambiguous effect in explaining its impact on exports in South Africa. One of the major concerns, since the flexible exchange rate regime was introduced, has been whether the increase in exchange rate volatility has impacted on trade. The perceived detrimental effect of exchange rate volatility on exports implies that the government of South Africa has searched for intervention policies targeting at minimising the excess volatility of the rand. Malaysia adopted a relatively successful approach in tackling volatility during the Asian crisis in 1998. A proposition can therefore, be made that South African authorities might find it appropriate to impose the Tobin tax on foreign exchange transactions (Bah and Amusa, 2003). The advocates of the Tobin tax argue that such policies reduce its short term deleterious effects by discouraging short-term speculative capital and thereby making exchange rates to better reflect the long term factors in the economy.

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