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Exchange Rate Volatility and Export Competitiveness Nexus: Empirical Evidence from South Africa

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ABSTRACT
The objective of this study was to analyze the impact of real exchange rate volatility on export competitiveness of the South African economy during the period 2000:q1 to 2011:q4. Volatility of the real exchange rate was computed using the GARCH approach. The one-step Engle-Granger error correction model (ECM) was applied to investigate the magnitudes to which real exchange rate volatility affects the economy's export competitiveness in both short- and long-run periods. Results from the estimated export competitiveness function indicate that real exchange rate volatility demonstrates adverse impacts on export competitiveness; with relatively more pronounced detrimental impact being demonstrated in the long-run period.
KEYWORDS: exchange rate volatility, export competitiveness, error correction model

1. INTRODUCTION

Like many other emerging economies across the world, real exchange rate is one of the essential economic indicators of the South African economy's international competitiveness. The issue of the extent to which real exchange rate volatility depressingly affects an economy's export competitiveness has consistently dominated the center stage in most international financial policy discussions at global level. According to Todani & Munyama (2005), real exchange rate volatility refers to a measure that captures the uncertainty experienced by exporters as a result of unpredictable fluctuations in the exchange rates.

Following the collapse of the Bretton Woods system, most countries in the global economy drifted their exchange rate policies from fixed exchange rate regimes to flexible regimes to allow adjustment of exchange rate trends based developments in macroeconomic fundamentals (Mukhtar & Malik, 2010). Until today, consistent monitoring of the real exchange rate volatility and export competitiveness remains an issue of serious concern amongst numerous economic agents (Ganyaupfu, 2013). Intuitively, higher real exchange rate volatility raises confusing signals and uncertainty on profitability of the country's tradables sector.

The aim of this paper was to contribute significantly to the debate on the extent to which real exchange rate volatility detrimentally affects export competitiveness of the South African economy. The research paper was structured as follows: Section 2 covered literature survey and theoretical framework on real exchange rate volatility and export competitiveness. Section 3 presented the econometric methodology and estimation procedure applied in the study. Section 4 specified analysis and interpretation of the research findings, while Section 5 provided some concluding remarks and recommendations for further studies.

2. LITERATURE REVIEW

According to Edwards (1989), widespread theoretical and empirical literature linked to the theme of real exchange rate volatility export competitiveness remains dominant in most international finance policy discussions. Empirical findings from numerous research studies specify that occurrence of persistent exchange rate volatility for prolonged periods depressingly affect export competitiveness of the economy's tradables sector (Tandrayen-Ragoobur & Emamdy, 2011).

Similar empirical studies that have found such results also include Virgil (2000), Esquivel & Felipe (2002), Onafowora & Owoye (2007) and Ganyaupfu (2013). However, De Vita & Abbott (2004) and Hondroyiannis et al. (2006) on the other hand did not find any significant correlation between export competitiveness and real exchange rate volatility. According to Mustafa & Nishat (2004), substantial literature survey connected to the theme of effective real exchange rate management divulges that economies that have monitored their exchange rates properly to avoid volatility of the real exchange rate have been observed to more successful in promoting development of their exports in the medium to long run.

Numerous empirical studies carried out in most developing economies, especially those whose export baskets largely comprise of primary commodities; show that exchange rate volatility depressingly affect international competitiveness of a country's exports. An empirical study by Prasad (2000) on determinants of exports in Fiji

shows that for each period Fiji experienced real exchange rate appreciation over the period 1969 to 1999; there was corresponding decline in its real exports. Comparatively, periods of depreciation were associated with significant growth in exports. The reported negative elasticity of Fiji's exports with respect to the real effective exchange rate of about 0.72 clearly illuminates that exchange rate volatility depressingly affect an economy's export competitiveness.

A similar study carried out by Nabli et al (2004) in the Middle East and North Africa (MENA) shows that a reduction in the region's manufactured exports (as a percentage of GDP per year) by about 18 percent over 1970 to 1999 was largely attributed to volatility of currencies by most countries in that region. About 10 percent variation in the MENA region's total exports was found to be accounted for by the real effective exchange rate over the same period. The experience of Turkey from World War II also provides a good lesson of the problems associated with currency overvaluation in the medium to long run. In 1953, a fixed nominal exchange rate, accompanied by accelerating inflation in Turkey implied a real appreciation of the lira and a bias against export growth. Following decline in exports, foreign exchange in Turkey became scarce and the country embarked on import licensing in 1954 to restrict flow of imports into the economy (Shartz and Tarr, 2000).

The conclusions that can be drawn from empirical literature surveyed above largely demonstrate that real exchange rate volatility negatively affects export development. Diallo (2011) accentuates that proper supervision of the real exchange rate enhances production of tradable goods to be profitable and sustainable in the long run. From the other side, Edwards (1989) expresses that maintaining the real exchange rate at "wrong levels" generates incorrect signals in the external sector and significantly impairs international competitiveness of the economy's tradable goods and services.

3. METHODOLOGY AND ESTIMATION

3.1 DATA

The macroeconomic time series data used for approximation of the export competitiveness function were collected from the South African Reserve Bank (SARB) and the International Monetary Fund's (IMF) financial statistics macroeconomic databases. The data were collected on quarterly basis over the sample period of the study from 2000 quarter 1 to 2011 quarter 4. The macroeconomic variables used to develop the export competitiveness function were the real exchange rate volatility, equilibrium real effective exchange rate, growth in real gross domestic product, capital controls and trade openness. The time series properties of the macroeconomic data variables were examined using E-Views modelling software prior to estimation of results.

3.2 STATIONARITY TESTS

The methodological procedure followed in estimating the export competitiveness function began with the investigation of time series properties of macroeconomic data used. For each distinct data series, the Augmented Dickey-Fuller (ADF) test was undertaken to detect the presence of unit root both at the intercept plus trend regression forms.

3.3 DIAGNOSTICS

The primary diagnostic tests undertaken include stability tests, specification of the functional form, normality; serial correlation and heteroskedasticity tests. The CUSUM and CUSUM of squares tests, Ramsey RESET, Jacque-Bera normality test, and Breusch-Godfrey serial correlation LM test methods were used to scrutinize the properties of model residuals. The normality test was undertaken to detect if the residuals were normally distributed, mean zero, homoscedastic and serially uncorrelated. Following analysis of these properties, the export competitiveness model was then specified and estimated.

3.3 EMPIRICAL MODEL AND ESTIMATION

The standard approach adopted in estimating the export growth function was based on the imperfect substitution model proposed by Munoz (2006). The empirical specification of the demand and supply functions of exports, which simultaneously determine the export price and export quantity, is based on this approach. The underlying assumption behind the conventional theory of demand is that consumers maximize utility subject to the budget constraint. Correspondingly, the proposition of the supply side theory is that, growth in exports is a positive function of the real exchange rate.

Based on the conventional theories of demand for and supply of exports specified above, the empirical estimation of the export competitiveness function proceeded as below:

$$export\_comp = \alpha + \beta_1 rer\_vol + \theta_i \Psi + u_t \quad (5)$$

$$\beta_1 < 0 \text{ --------}$$

where: θ_i = m x n vector containing coefficients of the explanatory variables; and

Ψ = vector of economic fundamentals that influence export competitiveness.

Volatility of the real exchange rate is tested using autoregressive conditional heteroscedasticity (ARCH) and the generalized autoregressive conditional heteroscedasticity (GARCH) models:

$$RER_t = \delta_0 + \delta_1 RER_{t-1} + u_t \quad (9)$$

$$\sigma_t = \eta_0 + \eta_1 u^2_{t-1} + \eta_2 \sigma_{t-1} \quad (10)$$

where RER_t is the real exchange rate; expressed in natural logarithm and u_t is a random error term. The conditional variance represented by equation (10) is a function of three terms; namely:

(i) the mean (η_0),

(ii) (ii) the ARCH term; which captures news about volatility for the previous period measured as the lag of the squared residual from the mean equation (u^2_{t-1}); and

(iii) GARCH term, which is the last period's, forecast error variance (σ_{t-1}).

Following the above, the stationarity tests of all variables were performed to analyze the order of integration at which all model variables became stationary. Practically, this was done to confirm whether the difference between non-stationary series became stationary when the same variables moved together in the long run, even though they could have drifted apart in the short run.

Proceeding on with the analysis following investigation of the order of integration, the study further tested for the presence of cointegration among variables using the Johansen (1988) maximum likelihood cointegration technique. Following Hamilton (1994), the maximum eigenvalue (λ_{max}) method was applied to detect existence of cointegrating vectors based on the principle that the technique is more reliable in small samples.

$$\lambda_{max} = -T \log\left(1 - \lambda_{r+1}\right) \quad (11)$$

where the null hypothesis $r \leq g$ cointegrating vectors, with (g = 0, 1, 2, 3, ---) is tested against the alternative hypothesis r = g + 1.

4. ESTIMATION AND INTERPRETATION OF RESULTS

4.1 REAL EXCHANGE RATE VOLATILITY

Before conducting stationarity and cointegration tests, the real exchange rate was initially tested for the presence of volatility using the autoregressive conditional heteroskedasticity; ARCH (Engle, 2001) and the generalised autoregressive conditional heteroskedasticity - GARCH (Bollerslev, 1986) models.

Table 1: ARCH Model - Exchange Rate Volatility

Variance Equation:		Diagnostic Tests on Residuals:		ARCH LM Test:	
ARCH Prob	9.462983 (0.0000) **	Normality Prob	4.474958 (0.106727)**	F- Statistic Prob	36.71173 (0.0000) **

The coefficients of the variance equation are significant at 5 percent level; with the p-value of the ARCH (1 1) variance equation (p = 0.0000) indicating presence of volatility (ARCH effect) in the real exchange rate during the period 2000 quarter 1 to 2011 quarter 4.

4.2 ADF STATIONARITY TESTS

The first step prior to estimation of the one-step error correction equation is investigation of the order of integration of the variables. The ADF tests are conducted for the series in levels, as well as at first differences, with trend and intercept. The ADF tests are applied on the premise that they perform satisfactorily even when the sample is small (Hamilton, 1994).

Table 2: ADF Stationarity Test Results

Variable	With Intercept and Trend	
	Level	First Difference
Export Competitiveness	-7.541803***	-13.37452***
Exchange rate volatility	-5.087186***	-9.312937***
Equilibrium real effective exchange rate	-2.105840	-6.074203***
Real gross domestic product growth	-3.115130	-6.625385***
Capital control	-2.490484	-7.860942***
Openness	-1.958349	-4.867080***

***;**; * denote significance at 1 percent, 5 percent and 10 percent levels; respectively.

The results from the stationarity tests signified that the all the macroeconomic variables used in the study were stationary in first difference at 1 percent level, with intercept and trend. Proceeding further, the presence of cointegrating relationships between variables was tested using Johansen eigenvalues and L.R. statistics given in Table 3 below.

Table 3: Cointegration Test Results with Linear Deterministic Trend - Lag Interval: 1 to 1

Eigenvalue and L.R. Test Statistics				
H_0 H_1	r = 0 r = 1	r ≤ 1 r = 2	r ≤ 2 r = 3	r ≤ r = 4
Eigenvalue L.R. statistic	0.656350 159.8160**	0.607230 109.6138**	0.451698 65.69086*	0.292790 37.44719
*(**) denotes rejection of the null hypothesis at 5% (1%) significance level				
Critical Values				
1% Sig. level 5% Sig. level	124.75 114.90	96.58 87.31	70.05 62.99	48.45 42.44

The eigenvalue and the likelihood ratio test statistics confirmed existence of three cointegrating relationships at 5 percent level of significance. In light of the presence of cointegrating equations, the ultimate estimates of the export competitiveness model were computed using the one-step Engle Granger error-correction mechanism.

Table 4: One-Step Error Correction Model for Export Competitiveness

Dep Var: log(Export Competitiveness)	Coefficient	Std. Error	T-Statistic	Prob.
Adjustment Speed	-0.323320	0.116675	-2.771111	0.0086
Long-Run Parameters:				
log(RER_VOL(-1))	-0.772244	0.315405	-2.448424	0.0191
log(EREER(-1))	0.457404	0.225519	2.028230	0.0496
log(RGDP_G(-1))	2.910065	1.055906	2.75988	0.0089
Constant	88.89986	45.62013	1.948698	0.0587
Short-Run Parameters				
dlog(RER_VOL(-2))	-0.681701	0.330030	-2.065573	0.0457
dlog(RGDP_G)	2.296305	0.931525	2.465102	0.0183
dlog(CAP_CON(-1))	-8.031100	1.794145	-4.476282	0.0001
dlog(OPENNESS)	1.170601	0.285208	4.104384	0.0002
R-squared	0.691944	Mean dependent var		3.697872
Adjusted R-squared	0.627090	S.D. dependent var		17.44107
S.E. of regression	10.65063	Akaike info criterion		7.739532
Sum squared resid	4310.565	Schwarz criterion		8.093816
Log likelihood	-172.8790	F-statistic		10.66927
Durbin-Watson stat	1.813570	Prob(F-statistic)		0.000000

The estimated adjustment coefficient of the cointegration is statistically significant and thus different from zero. The coefficient signifies a moderate adjustment to the past disequilibrium in the country's ;export competitiveness indicating that the error correction mechanism is stable. The result of the adjustment parameter asserts that, on average, 32.3 percent of the departure from the equilibrium is adjusted in the current period, while the remaining 63.2 percent is corrected as variables become cointegrated. Overall, the adjusted R-squared show that about 58 percent of the variation in export growth is accounted for by the variables captured in the estimated model.

The estimated results of the all the exogenous variables incorporated in the export competitiveness model were consistent with theoretical predictions and have the expected signs. In the long-run period, the elasticity coefficient for exchange rate volatility indicates that a 1 percent rise in exchange rate volatility leads to about 0.77 percent decline in the country's export competitiveness. With regards to the equilibrium real exchange rate, a 1 percent improvement in equilibrium real effective exchange rate stimulates export competitiveness by approximately 0.45 percent in the long-run. Growth in real gross domestic product by 1 percent significantly leads to approximately 2.91 percent improvement in export development. The significant positive impact of growth in real gross domestic product on export competitiveness is consistent with the previous findings by Diallo (2011). The results confirms the Balassa-Samuelson effect which states that productivity increases faster in tradables sector than in the non-tradables sector.

In the short-run period, a 1 percent increase in real exchange rate volatility translates into nearly 0.68 percent decline in export competitiveness. , while 1 percent increases in real gross domestic product growth and country' trade openness translate into 2.29 percent and 1.17 percent increases in export competiveness; respectively. Thus; an increase in the country productivity in form of gross domestic product and improvement in trade openness are significant indicators that stimulate an economy's international competitiveness. However, capital controls demonstrate a strongly significant adverse impact on export competitiveness, signifying that a 1 percent rise in tightening of capital flow leads to nearly 8.03 percent decrease in export competitiveness. The result is consistent with the findings by Tamirisa (1998) and Ganyaupfu (2013) in which capital controls were found to be a significant impediment to export competitiveness.

Table 5: Diagnostic Statistics

Diagnostic Test	Statistic		Prob.
Normality: Jacque-Bera	JB – statistic Skewness Kurtosis	1.184991 0.325785 2.575079	0.552946 - -
Serial Correlation: Breusch-Godfrey Serial Correlation LM Test	F – Statistic Obs*R^2	0.455496 0.571566	0.503932 0.449637
Specification Error: Ramsey RESET Test	F - Statistic LR- Statistic	0.505473 5.943151	0.842477 0.653600
Autoregressive Conditional Heteroscedasticity: ARCH LM Test	F – Statistic Obs*R^2	0.027647 0.028886	0.868703 0.865044
Heteroscedasticity: White Heteroscedasticity Test	F - Statistic Obs*R^2	1.062287 16.99782	0.427959 0.385738

The results derived on the diagnostic tests of the estimated export competitiveness function signify that the model was correctly specified (RESET) and normally distributed based on the JB statistic. Moreover, there was no presence of both serial correlation (LM) and heteroscedasticity (ARCH) in the residuals. Finally, the stability of the export competitiveness model parameters was analyzed by adopting the CUSUM and CUSUM of Squares approaches as indicated by figure 2 and figure 3 below; respectively.

Figure 2: CUSUM

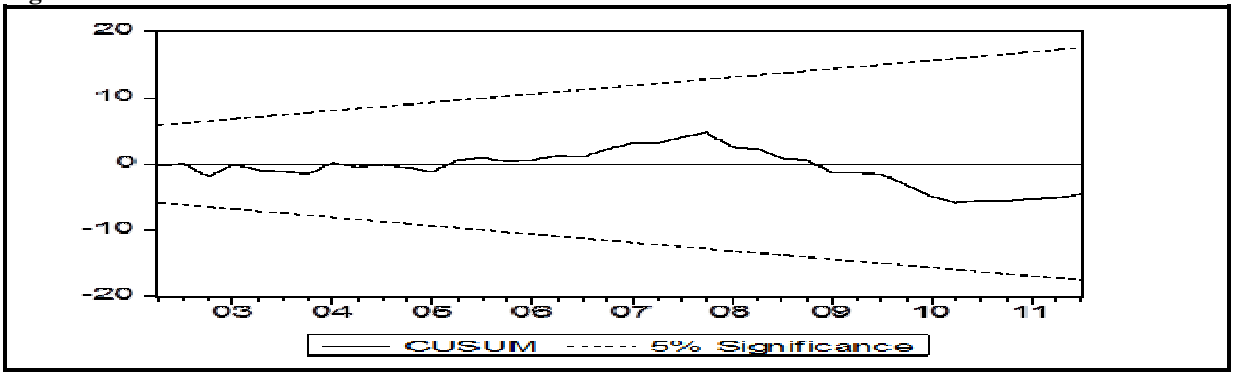
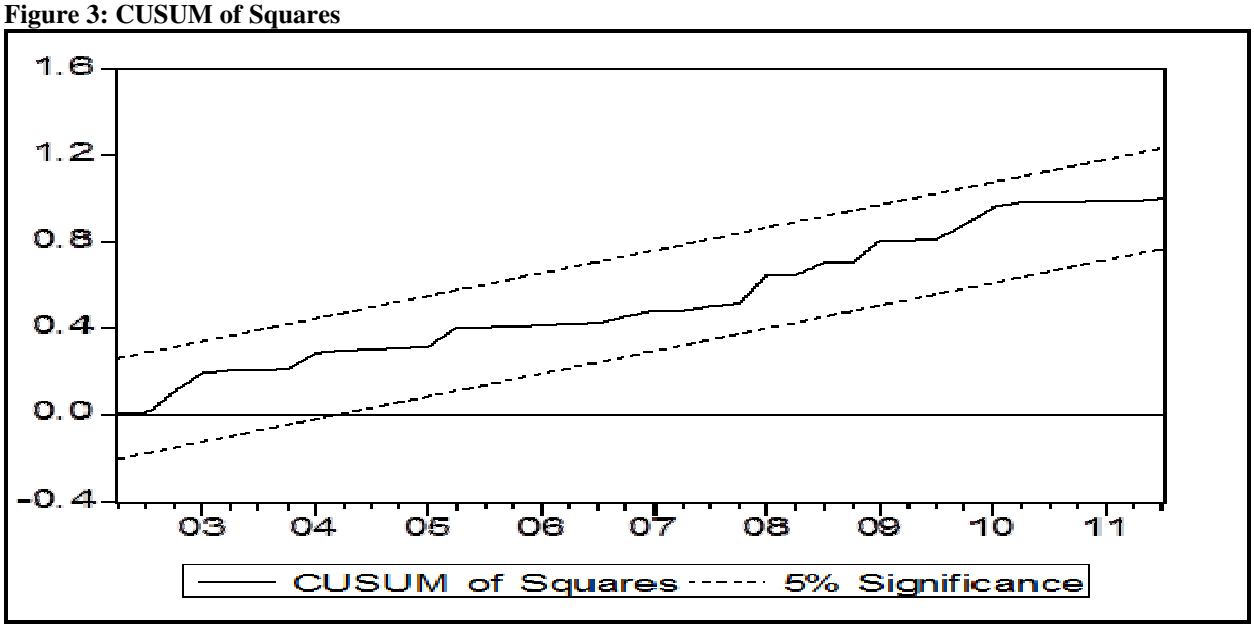


Figure 3: CUSUM of Squares



The stability tests on the entire estimated export competitiveness model indicate that the coefficients in the error correction model are stable. The realisation that neither CUSUM nor CUSUMSQ plots cross the critical bounds confirms absence of significant structural stability.

5. CONCLUSION AND RECOMMENDATIONS

This paper analyzed the effect of real exchange rate volatility on export competitiveness of the South Africa economy during the period 2000 quarter 1 to 2011 quarter 4. Based on the results from the cointegration analysis undertaken, there exists a long run equilibrium relationship among export competitiveness, real exchange rate volatility, growth in real gross domestic product, the economy's trade openness and capital controls. Results from the one-step Engle-Granger error correction approach indicate that real exchange volatility has a statistically significant detrimental impact on the country's international competitiveness. As per the theoretical expectations, trade openness and growth in the country's real gross domestic product have strong positive influences; while capital control demonstrates a statistically significant negative impact on the economy's export competitiveness.

From the macroeconomic management and policy perspective, persistently high levels of real exchange rate volatility could lead to miserable performance of the country's tradables sector due to the increased level of risk uncertainty faced by the country exporters in different economic sectors. Moreover, poor monitoring of the real exchange rate development, if not maintained in line with inflation differential based on the purchasing power parity developments, may also result in economic overheating; thereby exerting unintended pressure on the inflation frontier which would ultimately lead to generation of unexpected currency appreciation. It is in light off this background that effective monitoring of the real exchange rate developments therefore becomes vital. Having focused this study on the linear relationship between the exchange rate volatility and export competitiveness, future studies on this theme will apply nonlinear techniques to establish whether significantly improved results can be obtained.

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