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THE IMPACT OF EXCHANGE RATE ON TRADE BALANCES IN SOUTH AFRICA: A SECTORIAL ANALYSIS

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ABSTRACT

This paper attempts to explore the J-curve phenomenon in the case of South Africanagricultural, mining and the manufacturing sector in order to examine whether the exchange rate can be taken as a policytool for improving sectorial in South Africa. Panel VAR model, cointegration and the impulse response function has been employed in order to see the relationships between the nominal effective exchange rate index (NEER) and trade balance (TB) as well as the real effective exchange rate index (REER) and trade balance(TB) of South Africa . The study found no evidence of "J-curve" in the case of South African trade. On the contrary to the "J-curve" phenomenon as explained by the classical text books, the findings of the study suggest that depreciation of South African exchange rate rather produces an inverted "L-curve" phenomenon indicating that there is no room for improving South African trade imbalance through acurrency devaluation process. However, the VECM impulse response function has revealed that in the long run all three sectors do not behave in a similar way; while trade balances of both manufacturing and mining has a permanent effect, agricultural sector has a transitory effect.

KEY WORDS: *Trade Balance, Exchange Rate, J-Curve*

Article History

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INTRODUCTION

The relationship between the exchange rate and trade balance is one of the most debated issues in international trade and Finance literature. Based mainly on the Marshall-Lerner condition that postulates that currency devaluation may only succeed in improving the trade

balance of a country in the long-run if the sum of export and import elasticities is greater than one, it may appear that the effect of currency on trade balance is not pre-determined. While currency devaluation might have a positive effect on trade balance, the changes in the volumes of exports and imports as a result of currency devaluation may not be instantaneous, hence the deterioration of the trade balance may occur in the short run. This is referred to as the J-curve.

A number of studies assessing the effect of the exchange rate on a trade balance rely on aggregate data. For example, Moffet (1989) highlighted that currency devaluation may deteriorate the U.S. trade balance. In addition, Bahmani- Oskooee (1991) found that long-run currency depreciation can improve the trade balance of lesser developed countries. More recently, using the cointegration approach and error correction model (ECM), Lal and Lowinger (2002) point out that depreciation will in fact increase the trade balance of countries such as India and Pakistan. In addition, Singh (2002) uses Indian data from 1960 to 1995 and suggests that the devaluation of the real effective exchange rate leads to an improvement in the Indian trade balance. In contrast, Narayan (2004) and Duasa (2007), utilize an autoregressive distributed lag (ARDL) approach to show that there is no long-run relationship between a trade balance and the real exchange rate for Malaysia and New Zealand, respectively. Following such an approach may be misleading when it comes to sectoral policy making, due to the sectoral sensitivity of trade balances to the change in the exchange rate. Thus, a policy maker may be interested to know whether the change in exchange rate will impact one sector more than another sector thus the application of cointegration.

As for the South African data, there are a few studies and all of them are at the aggregate level, not at the sectoral one. For example, Kamoto (2006) tests the J-curve hypothesis in the cases of Malawi and South Africa. The study uses quarterly data for the period 1976 to 2003. The study's results indicate a positive long-run relationship between trade balance and the real effective exchange rate in both Malawi and South Africa. Domestic (foreign) income is found to have a long-run positive (negative) in the case of South Africa. This finding suggests that the influence of domestic and foreign incomes on the South African trade ratio maybe supply driven.

Moodley (2010) examines the J-curve hypothesis on South Africa's bilateral trade with the BRIC countries (Brazil, Russia, India, and China) over the period 1994Q1to 2009Q4. The study finds mixed results on the impact of the real exchange rate on the trade balance. For Brazil and India the real exchange rate has a negative impact while for Russia and China

It is found to have a positive impact. The author concludes that devaluation does not necessarily lead to a long term improvement of the trade balance and therefore no evidence of the J-curve was found.

Furthermore, Bahmani-Oskooee and Gelan (2012) test the J-curve hypothesis for nine African countries (Burundi, Egypt, Kenya, Mauritius, Morocco, Nigeria, Sierra Leone, South Africa, and Tanzania). Their results of the short-run indicate that at 10% level of significance thereis at least one coefficient of the differenced real effective exchange rate that is significant in the cases of Burundi, Egypt, Mauritius, Nigeria, and Tanzania. These short-run effects translate into significant long-run positive effects in the results for Egypt, Nigeria, and South Africa. This finding suggests that a real depreciation is expected to improve the country's trade balance in the long run.

A few studies that investigated sector specific responses of the trade balances to the change in exchange rate focused on developed countries. For example, Meade (1988) finds no J-curve adjustment for non-oil industrial supplies, capital goods (excluding automobiles) and consumer goods. Doroodian, Jung and Boyd (1999) reported a J-curve effect for agriculture but not for manufacturing. In addition, Yazici (2006) finds a S-curve for the balance of trade in Turkish agriculture, rising initially before falling and finally increasing. Using export and import data for 66 US industries, Ardalani and Bahmani-Oskoosee (2007) find the evidence of J-curve for only 6 industries using an error correction model. With this limited existing literature on South Africa therefore there is a gap in literature on the impact of exchange rate across different sectors in South Africa.

Very little research on the exchange rate and trade balance across sectors in African economies, especially South Africa, has been conducted to date. Therefore, this study aims at providing a link between the exchange rate and trade balance across the three sectors in South Africa. These sectors were chosen on the grounds that they contribute to more than 50% of the South African gross domestic product. Investigating how the trade balance of an individual sector will react to the exchange rate is important because if the exchange rate is used as a policy tool and, in case a given exchange rate change will generate an undesirable impact on a particular sector, then corrective measures can be adopted to insulate that sector from the negative impact in time.

This study is motivated by the lack of empirical studies that uses disaggregate data to explain how the exchange rate influences the trade balance. Firstly, this analysis contributes methodologically by using panel VAR based on the existing empirical literature and structural models, to quantify the response of the trade balance to exchange rate changes. In consistency, with South Africa policy discussion, we focus on contributions of each sector to the trade balance); assess the long run effects of exchange rate on trade balance. We endeavour to assist policymakers focusing on the trade as a potential driver of the economic growth, to identify which sector is sensitive to an exchange rate shock.

This study contributes to the existing literature twofold. Firstly, the present study is the first study to explore the impact of the exchange rate across the three sectors in the context of South Africa. Secondly, this study assesses the effect of the change in exchange rate on sectorial trade balances by accounting for the interaction of the different sectors. Thus, this is the first study of its kind to apply panel VAR methodology to this particular problem. Sectorial analysis has also the advantage that it will highlight the differences in the response to exchange rate changes of individual sectors that may result from different market structure and behaviour.

Our results show that there is no evidence of "J-curve" in the case of South Africa mining, agriculture and the manufacturing sector. On the contrary to the "J-curve" phenomenon as explained by the classicals the findings of the study suggest that depreciation of South African exchange rate rather produces an inverted "L-curve" phenomenon indicating that there is no room for improving South Africa trade imbalance through a currency devaluation process. Rather than the J-curve, a few other empirical studies have found shapes and curves other than the J-curve effect in terms of the dynamic response of the trade balance. In their analysis of the J-curve effect, Bahmani-Oskooee and Malixi (1992) found in addition to the J-curve, the N-curve, the M-curve and the I-curve effects of the trade balance in relation to exchange rate depreciation. For the Turkish economy, Rose (1990) argued that real exchange rate has no effect on the trade balance over the study period. The empirical results of Brada, Kutan and Zhou (1997) reveals absence of long-run relationship between the trade balance, real exchange rate, domestic and foreign incomes in 1970’s.

The remainder of this paper is organized as follows. Section 2 presents an overview of the literature which outlines the relationship between the exchange rate and the trade balance. In Section 3, the methodology is described. Section 4 presents the main empirical analysis to determine whether the exchange rate affects the trade balance across sectors. Lastly, section 5 concludes and offers suggestions for further study.

LITERATURE REVIEW

Empirical evidence on the effects of the exchange rate on the trade balance has been controversial. Yazici (2006) investigates whether or not the J-curve hypothesis holds in Turkish agricultural sector. Based on the quarterly data covering the period from 1986 to 1998, their results indicate that, following devaluation, agricultural trade balance initially improves, then worsens, and then improves again. This pattern shows that J-curve effect does not exist in Turkish agricultural sector. Another important finding in this study is that devaluation worsens the trade balance of the sector in the long run, a result that contradicts earlier findings for the Turkish economy as a whole.

The other hypothesis that relates to the exchange rate and trade is called the elasticity hypothesis. The hypothesis suggest that transactions under contract completed during the period of devaluation/ depreciation may affect the trade balance negatively in the short run but over time export and import quantities adjust which give rise to elasticities of exports and imports to increases and quantities to adjust. As a result of this, the foreign price of the depreciating country's export is reduced and increases the price of imported goods which directly reduces the demand for imports in the long run which results in an improvement of the trade balance. This theory clearly states that the effect of this is dependent on the elasticity of exports and imports for a particular region (Dornbusch, 2010).

Cheng, Kim and Thompson (2012) investigate the effects of the real exchange rate and income on US tourism export revenue and import spending using quarterly data for the floating exchange rate from 1973 to 2010. Separate estimates of export revenue and import spending functions prove more revealing than estimates of the trade balance. Vector autoregressions capture dynamic adjustments to exchange rate and income shocks. Evidence suggests that depreciation raises US tourism export revenue but does not affect import spending.

Wijeweera and Dollery (2012) use quarterly Australian data over the period 1988 to 2011 to examine whether J-curve effects are different between the two main components of the trade account: the goods sector and the services sector. Using the bound testing approach to cointegration and error correction modelling, they find some evidence to support the J-curve phenomenon, but the impact of real exchange rate on the trade account seemed complex. The services sector displayed a J-curve effect; the goods sector response is quite the opposite - that is, it has a positive response in the short run, but a weak negative response in the long run.

According to the currency pass-through theory, a change (depreciation or devaluation) of a currency may not have the expected effect on the trade balance due to lags. The increase in the domestic price of the imported good may be smaller than the amount of depreciation. That is, the pass through from depreciation to domestic prices may be less than complete. For example, a 10% decrease in the nation's currency may result in a less than 10% increase in the domestic currency price of the imported good. The reason is that firms, having struggled to establish and increase their market share in the country, may be reluctant to risk losing it by a large increase in the price of its imports and are usually willing to absorb some of the price increase out of their profits (Krueger, 1983)

Doroodian *et al.* (1999), who examines the relationship between exchange rate changes and trade balance for both US agricultural and manufacturing sectors, finds that while the trade balance of manufacturing improves following the dollar depreciation, trade balance of agricultural sector first worsens and then improves. Existing evidence indicates that although many studies, such as those by Kamoto (2006), Moodley (2010) and Bahmani-Oskooee and Gelan (2012) have emphasized the relationship between the exchange rate and trade balance, they cannot provide the clear-cut conclusion on the impact of the exchange rate across sectors in South Africa.

Abd-El-Kader (2013) tests the J-curve hypothesis between Egypt and twenty major trading partners using bilateral trade data for the period 1989 to 2010. The main finding of the study is that the real exchange rate variations explain a considerable part of the trade balance change in Egypt. The study's results indicate that, in the short-run, depreciation deteriorates the trade balance, but it improves in the long-run. The author's results provide support for the J-curve effect.

Umoru and Eboreime (2013)examine the J-curve hypothesis for the Nigeria oil sector for the period 1975 to 2009. The study employs the ARDL bounds testing approach. The authors define real oil trade balance as the difference between oil exports and the bilateral imports value between Nigeria and the United States of America in constant 1984 prices. The study finds no evidence in support of the J-curve on the trade balance of the Nigerian oil sector.

METHODOLOGY

Following Abrigo and Love (2015), we implement a Bivariate panel VAR in trade balance, exchange rate, domestic income and world income to analyse the link between the sectorial trade balance and the exchange rate. We consider a k variate panel VAR of order p with panel-specific fixed effects represented by the following system of linear equations:

$$Y_{it} = Y_{it-1} A_1 + Y_{it-2} A_2 + \ldots\ldots Y_{it-p+1} A_{p-1} + Y_{it-p} A_p + X_{it} B + u_{it} + \varepsilon_{it} \qquad (1)$$

$$i \in \{1,2,\ldots.,N\}, t \in \{1,2,\ldots T_i\}$$

where Y_{it} is a $1 \times k$ vector of the trade balance and the exchange rate; X_{it} is a $1 \times l$ vector of domestic income and world income covariates; u_i and e_{it} are $(1 \times k)$ vectors of the trade balance and the exchange rate variables-specific fixed-effects and idiosyncratic errors, respectively. The ($k \times k$ matrices, $A_1, A_2, \ldots, A_{p-1}, A_p$ and the ($k \times k$) matrix B are parameters to be estimated. We assume that the innovations have the following characteristics:

$$\mathrm{E}[e_{it}] = 0, \mathrm{E}[e_{it} e_{it}] = \Sigma \text{ and } \mathrm{E}[e'_{it} e_{is}] = 0 \text{ for all } t > s$$

The parameters above may be estimated jointly with the fixed effects or, alternatively, independently of the fixed effects after some transformation, using equation-by-equation ordinary least squares (OLS). With the presence of lagged dependent variables in the right-hand side of the system of equations, however, estimates would be biased even with large N (Nickell, 1981). Although the bias approaches zero as T gets larger, simulations by Judson and Owen (1999) find significant bias even when T = 30.

GMM Estimation

Various estimators based on GMM have been proposed to calculate consistent estimates of the above equation, especially in fixed T and large N settings. With our assumption that errors are serially uncorrelated, the first-difference transformation may be consistently estimated equation-by-equation by instrumenting lagged differences with differences and levels of Y_{it} from earlier periods as proposed by Anderson and Hsiao (1982).

This estimator, however, poses some problems. The first-difference transformation magnifies the gap in unbalanced panels. For instance, if some Y_{it-1} are not available, then the first-differences at time t and $t-1$ are likewise missing. Also, the necessary time periods each panel is observed gets larger with the lag order of the panel VAR. As an example, for a second-order panel VAR, instruments in levels require that $T_i \geq 5$ realizations are observed for each panel.

However, Arellano and Bover (1995) proposed forward orthogonal deviation as an alternative transformation, which does not share the weaknesses of the first-difference transformation. Instead of using deviations from past realizations, it subtracts the average of all available future observations, thereby minimizing data loss. Potentially, only the most recent observation is not used in estimation. Since past realizations are not included in this transformation, they remain as valid instruments. For instance, in a second-order panel VAR only $T_i \geq 4$ realizations are necessary to have instruments in levels.

We can improve efficiency by including a longer set of lags as instruments. This, however, has the unattractive property of reducing observations especially with unbalanced panels or with missing observations, in general. As a remedy, Holtz-Eakin, Newey and Rosen (1988) proposed creating instruments using observed realizations, with missing observations substituted with zero, based on the standard assumption that the instrument list is uncorrelated with the errors.

While equation-by-equation GMM estimation yields consistent estimates of panel VAR, estimating the model as a system of equations may result to efficiency gains (Holtz-Eakin, Newey and Rosen, 1988).

Suppose the common set of $L \geq kp + l$ instruments is given by the row vector Z_{it}, where $X_{it} + \in Z_{it}$, and equations are indexed by a number in superscript. Consider the following transformed panel VAR model based on equation (1) but represented in a more compact form:

$$Y_{it}^{*} = \overline{Y_{it}^{*}} A + e^{*}_{it} \quad \text{......(2)}$$

$$Y_{it}^{*} = [y_{it}^{1*} \quad y_{it}^{2*} \ldots\ldots\ldots\ldots y_{it}^{k-1*} \; y_{it}^{k*}$$

$$\overline{Y_{it}^{*}} = [Y_{it-1}^{*} \; Y^{*}_{it-2} \ldots \quad Y^{*}_{it-p+1} \, Y^{*}_{it-p} \; X_{it}^{*}]$$

$$e_{it}^{*} = [e_{it}^{1*} \; e^{2*}{}_{it} \ldots \; e_{it}^{k-1*} \; e_{it}^{k*}]$$

$$A^{1} = [A_{1}^{1} \; A_{2}^{1} \ldots \quad A_{p-1}^{1} \; A_{p}^{1} \; B^{1}]$$

Impulse Response

Impulse response enables one to track the evolution of the trade balance over time subsequent to an exchange rate shock, for example, a real depreciation of the currency. Thus it explicitly gives an estimate of the J-curve, if present that is, its shape and the timing.

Without loss of generality, we drop the domestic income and world income in our notation and focus on the autoregressive structure of the panel VAR in equation (1). Lutkepohl (2005) and Hamilton (1994) both show that a VAR model is stable if all moduli of the companion matrix $\overline{A}$ are strictly less than one.

Stability implies that the panel VAR is invertible and has an infinite-order vector moving-average (VMA) representation, providing known interpretation to estimated impulse-response functions. The simple impulse-response function Φ_i may be computed by rewriting the model as an infinite vector moving-average, where Φ_i are the VMA parameters.

$$l_k \qquad , i = 0$$

$$\Phi_i = \{\sum_{j=1}^{i} \Phi_t - j_{Aj} \;, i = 1,2,.. \quad \text{......(3)}$$

The simple IRFs have no causal interpretation, however. Since the innovations e_{it} are correlated contemporaneously, a shock on one variable is likely to be accompanied by shocks in other variables, as well. Suppose we have a matrix P, such that $P'P = \sum$ Then P may be used to orthogonalize the innovations as $e_{it}P^{-1}$ and to transform the VMA parameters into the orthogonalized impulse-responses $P\Phi_i$. The matrix P effectively imposes identification restrictions on the system of dynamic equations. Sims (1980) proposed the Cholesky decomposition of $\sum$ to impose a recursive structure on a VAR. The decomposition however is not unique, but depends on the ordering of variables in $\sum$.

Impulse-response function confidence intervals may be derived analytically based on the asymptotic distribution of the panel VAR parameters and the cross-equation error variance-covariance matrix. Alternatively, the confidence interval may likewise be estimated using Monte Carlo simulation, and bootstrap resampling methods.

Data Description

All the data used in this study are quarterly covering the period from 1989: I to2012: III. To allow for a comparative analysis, all the variables have been standardised by dividing with its respective standard deviations. Data for export and import values for all three sectors are obtained from Trade and lndustry Department. Data for the world income and domestic income is obtained from the World Development lndicators (WDI). Data for the exchange rate is obtained from International Financial Statistics (IFS) of IMF.

Empirical Results

According to the international trade theory, in the short run the devaluation of a country's currency has little influence on the volumes of exports and imports since the elasticities of import demand and export supply are small, but it leads to a drop in the prices of exports and an increase in the prices of imports, which lead to a worsening in the trade balance. However, in the long run the country's elasticities of import demand and export supply increase that is the sum of them is greater than one and therefore, the trade balance improves. This implies that the relationship between the currency devaluation and trade balance is negative in the short run, but as time goes on they tend to have a positive relationship in the long run.

Table 1: Unit Root test: Fisher-type.

Statistic		P-vlaue	
lnverse chi-squared	exchange rate	38.8397	0.0000
lnverse chi-squared	trade balance	21.1342	0.0000
lnverse chi-squared	World income	13.5267	0.0000
lnverse chi-squared	Domestic income	46.7166	0.0000

All four variables strongly reject the null hypothesis that all the panels contain unit roots (see Table1, above).

Before estimatingthe impulse-response functions (IRF), we first check the stability condition of the estimated panel VAR. The resulting and graph of eigenvalues shown below confirms that the estimate is stable as all the eigenvalues lies inside the unit circle. Therefore, panel VAR satisfies the stability condition.

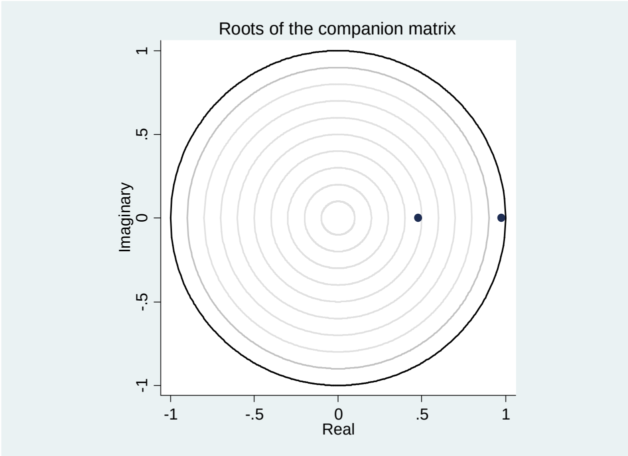

Figure 1: The Eigenvalues Circle.

The result from the Panel VAR analysis shows that all the coefficients in the first lag of

The trade balance are significant (table 2, Annex).

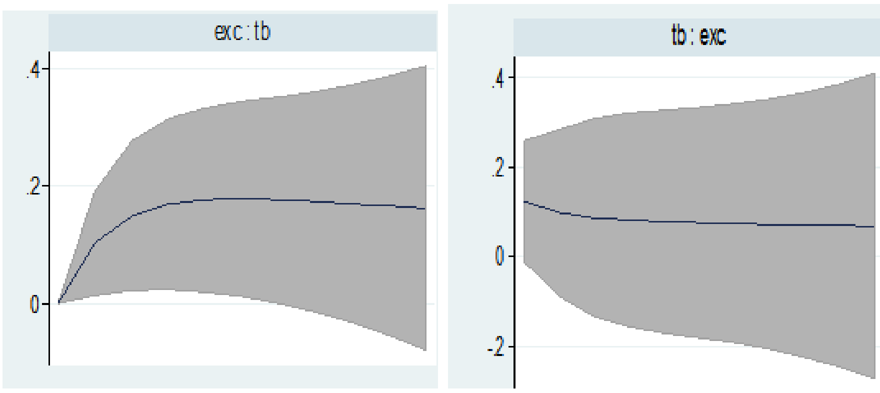

Figure 2: IRFS of TB Following One Standard Deviation Shock on ER.

Figure 2 shows the plot of the impulse response of the trade balance to one standard deviation shock in the real exchange rate in South Africa. We clearly see that after the shock on the RER the trade balance increases for a shorter period before it stabilises. However, the impact of the price effect doesn't stay long as evidenced in the figure above. Shortly, after the initial shock, the trade balance reaches its balance. On average, a 1 % real depreciation of the South African rand has a long-run positive impact of about 3 % on the trade balance. However, at the given confidence level, the J-curve is non-existant. It should be noted that the wider the confidence interval the more insignificant the results become. We therefore reject the null hypothesis that the J-curve phenomenon exist on the trade balance in South Africa.

The effect of a real depreciation on the country's main three sectors is not supportive of the standard J-curve hypothesis. Therefore, this study could not establish classic J-curve exchange rate effect on the trade balance of the South African agriculture, manufacturing and mining sector as it has been found in case of Morocco and Japan wherein trade balances deteriorates almost immediately subsequent to the devaluation of the real exchange rate and recuperates after two years. The finding in the study is in support of an "inverted" L curve trade effect of exchange rate depreciation for the three South African sectors. Though, our results show no long-run pattern to support the J-curve effect in the South African agriculture, mining and the manufacturing sector, the empirical evidence may perhaps be linked with those of Marwah and Klein (1996) that a delayed reaction of the aggregate trade balance to exchange rate changes in the US and Canada is real with a discrete propensity for total trade balances to worsen at first when exchange rate devaluation is instituted and to later improves. Furthermore, our evidence of a delayed response effect could as well, be linked to findings of Gylfason and Risager (1984), Rose and Yellen (1989) and Felmingham (1998) and Umoru and Eboreime (2013) that non-existence of the J curve effect in developing countries after a real depreciation, is as a result of the fact that exports are largely invoiced in foreign currency.

South Africa being a developing country relies more on the exportation of commodities mainly minerals, although exchange rate has an effect on the values of the exported commodities, performance of the receiving (importing countries) tends to play a larger role. For example between 2014 and 2015, we have seen a contraction in the Chinese economy and so did the export prices of commodities.

We believe that the J curve theory will work only in South Africa if the imports and exports are elastic enough to the movement of exchange rate. Major portion of South African imports consists of necessities and capital goods and these show no response to exchange rate movements. Currency depreciation will cause a rise in the value of imports as well as increase the amount of external debt measured in local currency. Given the high amount of external debt payable, the currency depreciation will place heavy burden on economy. Net result of currency depreciation is simultaneous increase in import bill and the debt burden

CONCLUSIONS

The Panel VAR analysis shows that there is no relationship between REER and TB as well as NEER and TB. The graphical representation of the NEER and TB also demonstrates that the nominal depreciation of exchange rate cannot be an effective tool to improve South African agriculture, mining and the manufacturing sector trade balances. Furthermore, the result from the impulse response function demonstrates that there is no presence of "J-curve" phenomenon in response to the devaluation of the exchange rate in the case of South Africa. On the contrary, it shows that devaluation of the exchange rate rather gives rise to a inverted "L-curve" phenomenon: a sharp divergence from the conventionally accepted view in the arena of the International Economics.

Thus, the result confirms that devaluation of nominal exchange rate never improves South African trade deficit, rather exacerbates it persistently by increasing monetary payments for imports. Alternatively, South African trade balance might improve with the appreciation of the South African nominal exchange rate, *ceteris paribus*. Though this seems to be inconsistent, it is not implausible in the sense that appreciation of the nominal exchange rate makes the import much cheaper requiring lesser amount of payments to be made to the foreigners. Though it seems to be contradictory theoretically, it is possible practically in the situation where South Africa need to import most of the necessary machinery and services tofulfil its domestic demand. Volume of South African imports accounts more than six times higher than its exports.

As policy makers may be interested to know whether the change in exchange rate will impact one sector more than another sector this study therefore went further to apply cointegration.

The Model and Econometric Framework

$$TB_{it} = \alpha_1 + \alpha_1 Y_t + \alpha_2 YW_t + \alpha_3 \mathrm{E}_t + \varepsilon_{it} \qquad \text{.............................} \qquad \text{............(1)}$$

where TB is the trade balance defined as the excess of real exports over real imports per sector, Y the real domestic income per sector, YW the real world income per sector , E the nominal exchange rate defined as number of units of domestic currencyper dollar over the production price index per sector and ε_{it} is the error term. The coefficient of the domestic income is expected to be negative because a rise in domestic income will lead to an increase in imports, thus causing deterioration in trade balance. However, Magee (1973), argued that domestic income could lead to an improvement in trade balance if domestic production of importables rises faster than consumption, which will shrink the volume of imports.

All the data used in this study are quarterly covering the period from 1989: I to2012: III. To allow for a comparative analysis, all the variables have been standardised by dividing with its respective standard deviations. Data for export and import values for all three sectors are obtained from Trade and lndustry Department. Data for the world income and domestic income is obtained from the World Development lndicators (WDI). Data for the exchange Data for the exchange rate is obtained from International Financial Statistics (IFS) of IMF.

Existence of a long-run equilibrium relationship between two or more variables has traditionally been examined by the cointegration techniques of Engle and Granger (1987) and Johansen (1991, 1995). If a series must be differenced d times before it becomes stationary, then it contains d unit roots and is said to be integrated of order d . For two or more non-stationary variables, if a linear combination of the variables is stationary, then the time series are said to be cointegrated. The economic interpretation of cointegration is that if two or more series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may contain stochastic trends (that is, be non-stationary) they will nevertheless move closely together over time and the difference between them will be stationary. Further, according to the Granger representation theorem, if two or more series are cointegrated to form a long-run equilibrium relationship, then there exists an error correction model for the variables depicting their short-run dynamics. Equation 1 describes the long-run equilibrium relationship among the variables in the trade balance model whose empirical validity will be tested by the Johansen methodology. If the results indicate the absence of cointegrating vectors between the variables, it means that there is no long-run stable relationship between them. If cointegration exists, then it can be presumed that a one-way or two-way Granger causality exists in at least the stationary series, and further more a dynamic specification of the error correction mechanism is appropriate (Engle and Granger, 1987). If the variables are found to cointegrate, then we estimate the cointegrating vector(s) by applying the method suggested by Johansen (1988) and Johansen and Juselius (1990).

The procedure is implemented using the full information maximum likelihood estimation (FIML) of a system characterised by r cointegrating vectors (for $r \geq n$ r<n, where n is the number of endogenous variables in the system), using the following statistical model:

$$W_t = \sum_{i}^{k} A_i W_t - i + u + \psi D_t + \varepsilon_t \text{ ....(2)}$$

Where W_t is the vector of endogenous variables, namely, $(TB\ Y, NY, E)$ A_i is the matrix of coefficients for the variables, i is the lag order, k is the maximum number of the lag length, u is the vector of constants, D_t Dt is the vector of other deterministic (non-stochastic) components, and ε_t is the vector of independently distributed error terms with constant variance.

lf cointegration is established in Equation 2, in order to examine the pattern of dynamic adjustments that occur in the short-run to establish these long-run relations in response to various shocks to the system, the following vector error correction model (VECM) is estimated:

$$\Delta W_t = \sum \Gamma_i \Delta W_{t-i} + a\beta W_{t-1} + \mu + \varepsilon_t \qquad (3)$$

Where a is the vector of adjustment parameters, β is the vector of cointegrating relationships (the long run parameters), and the rest of the variables are defined as mentioned earlier. We will use the VECM to generate the generalized impulse response functions and trace out the potential J-curve effects for South African agriculture, mining and the manufacturing sector.

The Johansen (1988) procedure allows us to test for the number of cointegrating vector or long-run relationships. Given that Equation 2 has four endogenous variables, there can be up to three cointegrating relationships.However, it is necessary to note that, being a maximum likelihood procedure, the Johansen procedure requires longer samples. The first step in implementing the Johansen procedure was to carry out specification and misspecification tests which included selection of the optimal lag length to be used in the estimated VAR, and normality and autocorrelation tests for the OLS residuals in the unrestricted model of Equation 1. Given that we are using quarterly data, and given the size of our sample, we selected up to three lags, running the cointegration Equation 3 yields results reported in the Table 3, 4 and 5. Both the maximal eigenvalues and the trace statistic indicate one cointegrating vector among the variables. We can therefore conclude that there is a long-run relationship between the variables in equation 2.

Impulse–Response Functions for VECMs for the South African Agricultural Sector

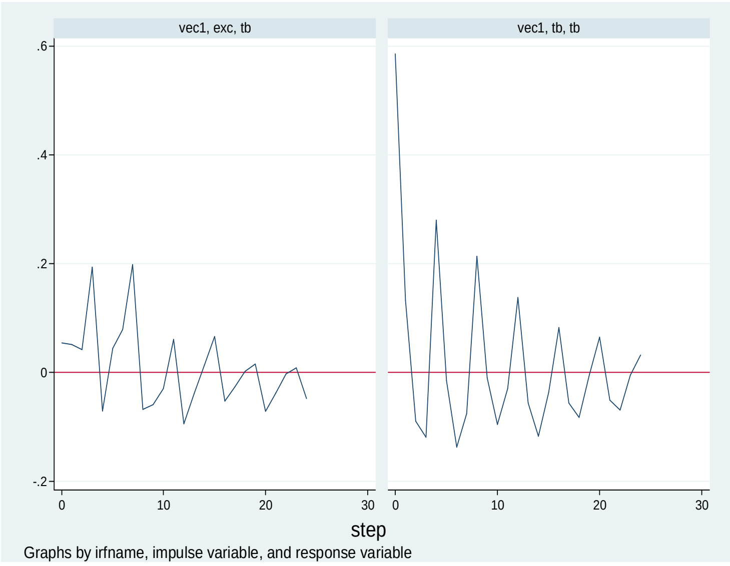

Figure 3: Impulse–Response Functions for VECMs for the South African Agricultural Sector.

The graphs indicate that an orthogonalized shock of the exchange rate to the agricultural trade balance has a transitory effect.

Impulse–Response Functions for VECMs for the South African Mining Sector

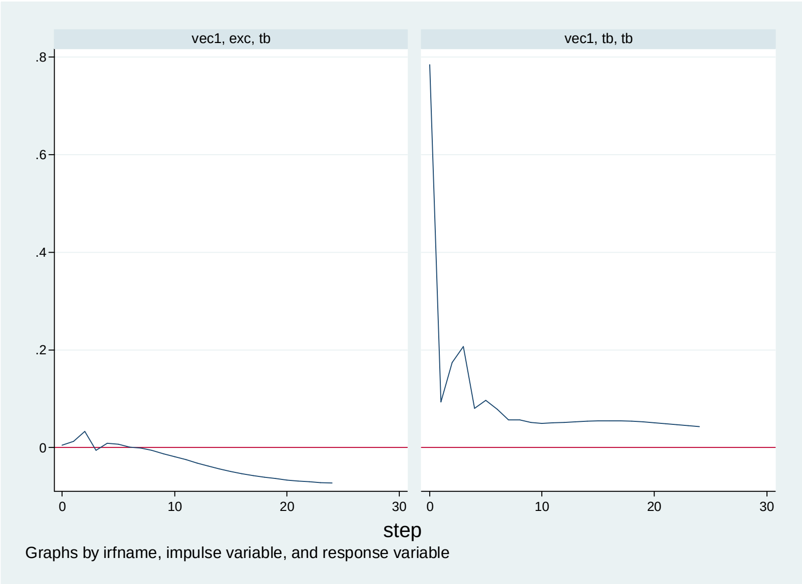

Figure 4: Impulse–Response Functions for VECMs for the South African Mining Sector.

The graphs indicate that an orthogonalized shock of the exchange rate to the South African mining sector has a permanent effect. This means that South African mining sector responds to exchange rate changes differently from South African agriculture.

Impulse–Response Functions for VECMs for the South African Manufacturing Sector

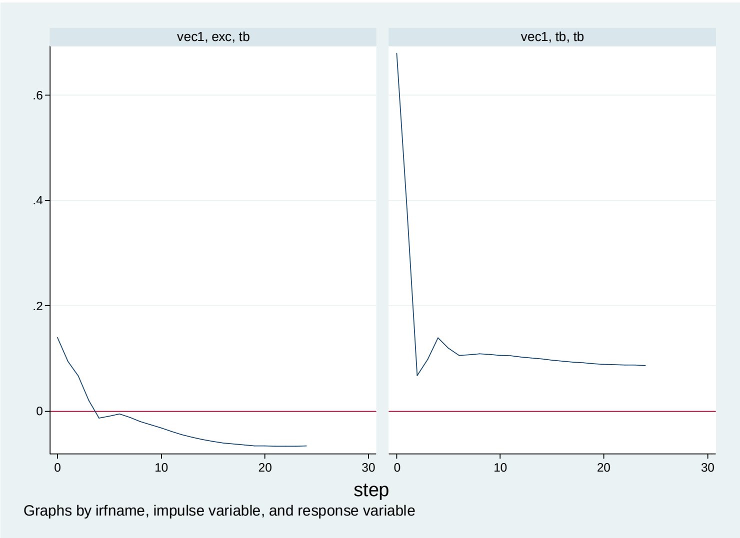

Figure 5: Impulse–Response Functions for VECMs for the South African Manufacturing Sector.

The graphs indicate that an orthogonalized shock to the South African manufacturing sector has a permanent effect. This means that the South African manufacturing sector responds to exchange rate changes differently from South African agriculture.

CONCLUSIONS

Our sectoral study, however, has revealed that in the long run all three sectors do not behave in a similar way; while trade balances of both manufacturing and mining has a permanent effect, agricultural sector has a transitory effect. Unlike the agricultural sector and the aggregate trade balance, South African mining and the manufacturing sector exhibits a distinct reaction to the exchange rate change in the long run, which cannot be detected in an aggregate study.

REFERENCES

1. *Akaike, H. (1969). Fitting autoregressive models for prediction. Annals of the Institute of Statistical Mathematics, 21, 243-247.*
2. *Andrews, D.W.K. and B. Lu (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. Journal of Econometrics, 101(1), 123- 164.*
3. *Bahmani-Oskooee, M., 1991. Is there a long-run relation between the trade balance and the real effective exchange rate of LDCs? Economics Letters 36 (4), 403–407.*
4. *Bahmani-Oskooee, M and Gelan, A.,(2012). Is there a J-curve in Africa? International Review of Applied Economics, 26(1), 73-81.*
5. *Doroodian, K., Jung., C., & Boyd, R. (1999). The J-curve effect and US agricultural and industrial trade. Applied Economics, 31, 687–695.*
6. *Duasa, J., 2007. Determinants of Malaysian trade balance: an ARDL bound testing approach. Global Economic Review 36 (1), 89–102.*
7. *Holtz-Eakin, D., W. Newey and H.S. Rosen (1988). Estimating vector autoregressions with panel data.*
8. *Econometrica, 56(6), 1371-1395.*
9. *Kamoto, E., (2006). The J-curve effect on the trade balance in Malawi and South Africa. Unpublished Master of Arts thesis, The University of Texas at Arlington.*
10. *Love, I. and L. Zicchino (2006).: Estimation of Panel Vector Autoregression in Stata: a Package of Programs: Evidence from panel VAR. The Quarterly Review of Economics and Finance, 46(2), 190-210.*
11. *Meade, E. E. (1988). Exchange rates, adjustment, and the J-curve. Federal Reserve Bulletin,pp. 633–644.Moffett, M.H., 1989. The J-curve revisited: an empirical examination for the United States. Journal of International Money and Finance 8 (3), 425–444*
12. *Moodley, S., (2010). An estimation of the J-curve between South Africa and the BRIC countries. Unpublished research report for Master in business Administration, University of Pretoria.*
13. *Narayan, P. K. and Narayan, S., (2005). Estimating income and price elasticities of imports for Fiji in a co-integration framework, EconomicModelling, 22, 423-438.*
14. *Schwarz, G. (1978). Estimating the dimension of a model. Annals of Statistics, 6(2), 461-464.*
15. *Tarlok Singh (2002). Testing J-Curve Hypothesis and Analyzing the Effect of Exchange Rate Volatility on the Balance of Trade in India. Empirical Economics, 29, 227-245.*

16. *Yazici, M. (2006). Is the J-curve effect observable in Turkish agricultural sector? Journal of Central European Agriculture, 7, 319–322.*

17. *Umoru, David and Matthew I. Eboreime (2013) "The J-Curve Hypothesis and the Nigerian Oil Sector: The ARDL Bounds Testing Approach" European Scientific Journal February 2013 edition vol.9, No.4*

APPENDICES

Table 2: PVAR Output

Variable	GMM Estimates
TB	
TB_{t-1}	**0.4771 (0.000)*** **
ER_{t-1}	**0.0902 (0.025)***
ny	**-0.3232 (0.000)*** **
wy	**0.0730 (0.303)***
ER	
TB_{t-1}	**-0.0136 (0.852)***
ER_{t-1}	**0.9792 (0.000)*** **
ny	**0.0113 (0.941)***
wy	**0.0207 (0.727)***
Notes: P-values are in parentheses. ***, ** and * represent 1%, 5% and 10 % significant levels respectively.	

Table 3: Johansen Tests for Cointegration for the Agricultural Sector

Hypothesized No.of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None		75.1127	40.11
At most 1	0.40201	27.2944	22.66
At most 2	0.17956	8.8881	13.41
At most 3	0.06246	2.8903	1.76

Both the maximal eigenvalues and the trace statistic indicate one cointegrating vector among the variables. We can therefore conclude that there is a long-run relationship between the variables.

Table 4: Johansen Tests for Cointegration for the Mining Sector

Hypothesized No.of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None		41.2534	45.27
At most 1	0.49101	20.6875	27.58
At most 2	0.27956	8.7354	15.31
At most 3	0.01246	2.1265	2.66

Both the maximal eigenvalues and the trace statistic indicate one cointegrating vector among the variables. We can therefore conclude that there is a long-run relationship between the variables.

Table 5: Johansen Tests for Cointegration for the Manufacturing Sector

Hypothesized No.of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None		39.9457	47.21
At most 1	0.20108	19.0679	29.68
At most 2	0.14091	4.9431	15.41
At most 3	0.04792	0.3759	3.76

Both the maximal eigenvalues and the trace statistic indicate one cointegrating vector among the variables. We can therefore conclude that there is a long-run relationship between the variables.