A Paper Presented at the International Conference on Trade and Investment, 24th- 26th October 2012

Sensitiveness of Trade in Services to Exchange Rate Movements- An African Perspective

***Polodoo. V.**

Mphil/Phd Candidate
Faculty of Law & Management,
University of Mauritius
Reduit
Email: *polodoov@rocketmail.com*

Seetanah.B,

Faculty of Law & Management,
University of Mauritius
Reduit
Email: b.seetanah@uom.ac.mu

Sanassee. R.V

Faculty of Law & Management,
University of Mauritius
Reduit
Email: rvsan@uom.ac.mu

Brooks. C

ICMA Centre,
University of Reading, U.K
Email: c.brooks@icmacentre.ac.uk

ABSTRACT

The present study investigates the sensitiveness of trade in services to movements in exchange rates in a sample of emerging African countries. By employing data spanning the period 1999 to 2011 as well as panel data econometrics, this paper suggests that even though service sector are not the most traded sector of the African countries, it is still significantly impacted by exchange rate fluctuations when employing random coefficient estimation. However, when OLS, Fixed effects and GMM are used, exchange rate volatility does not influence trade in services in the African countries studied.

Keywords: Exchange rate, Services, Africa, Random Coefficient Estimates.

**For correspondences and reprints*

1. INTRODUCTION

Pursuant to the shift to the floating of the US dollar in 1973, capital account liberalisation and the exponential increase in cross border financial transactions during the last three decades, important volatility and uncertainty in exchange rates has now become an important feature in the modern foreign exchange market. This has raised eyebrows among academicians, policy makers and researchers pertaining to the effect of exchange rate volatility on trade. Whilst some theories postulate that exchange rate volatilities hamper trade performance, others advocate otherwise. From a micro viewpoint, Schabl (2007) points out that exchange rate volatility reduces growth in Gross Domestic Product as it raises international trade costs as well as the costs of capital flows. From a macro viewpoint, it would bring macroeconomic instabilities and warrants the practice of 'beggar-thy neighbour' depreciation among well reputed trading blocs.

Furthermore, the recent pronounced currency volatilities of world major currencies of the like of euro and USD and the ensuing economic instability in addition to the economic crises in the past in various parts of the globe such as the Asian Crisis, the peso crisis among others authenticate that volatilities in the forex market have some sort of domino effect and can spread their tentacles to the entire macro economy and stimulate major crises.

Since the early 1980's, many developing countries have embarked into capital account and trade liberalisation. Protections in international trade have radically been reduced but on the other side these economies have had macroeconomic as well as exchange rate instabilities. Mauritius and other African countries are of no exception. The African countries adopt an export led growth strategy, relying mostly on manufacturing and tourism for their survival. Hence, frequent swings in exchange rates have been injurious to the external position and subsequently has had spill over effects on their domestic economies.

Moreover, studies regarding the sensitiveness of trade in services to exchange rate movements in African countries are given less attention as trade in services are deemed by many economists to be non-traded and thus insensitive to changes in exchange rates. The objective of the paper is therefore to assess the sensitiveness of trade in services to exchange rate movements using up to date econometric methodologies.

To achieve its objective, the paper is structured as follows. section 2, reviews the theoretical literature, section 3 reviews empirical literature, Section 4 specifies the models of the study, section 5 gives a brief description of the volatility measure that is employed in the study, section 6 gives the data sources and methodology applied, section 7 gives an analysis of the results and section 8 concludes the paper.

2. THEORETICAL LITERATURE REVIEW

Following the pioneering work of Clark (1973) and Ethier (1973), there have been several theories propounded to explain the impact of exchange rate movements on trade, viz: Hooper and Kolhagen (1978), De Grauwe (1988), Caballero and Corbo(1989), Dellas and Zilberfab (1993) among others and more recently , Ito and Hagiwara (2011). The foregoing studies explicitly explain the impact of exchange rate from a manufacturing sector angle. However, in spite of the mounting importance of the service sector, it became important to important to assess the impact of exchange rate movements on trade in services. Recent studies have placed much greater emphasis on the latter.

According to Baggs et al (2008), exchange rate volatility is expected to influence service firms in the same way it influences manufacturing in the light of increasing cross border service transactions during the recent decades. Accordingly, in the literature, the distinction between manufacturing sector and services sector is more technically done by contrasting between tradables sector and non-tradables sector. Baggs et al (2008) postulate that given that services are increasingly being traded, the theoretical

structures governing services firms resemble the same as manufacturing firms. Despite the pertinence of the services sector in the international macro economy, literature as regards the impact of exchange rate volatility on the services sector is scant and overlooked. According to Baggs et al (2008), the prime reason is unavailability of data.

One of the contributions to the theoretical literature is brought by Bravo-Ortega and di Giovanni (2005). The authors explain through a plain model the impact of international trade costs on real exchange rate. In essence, the authors include the David Ricardo's comparative advantage theory to demonstrate that imperfections in trade influence real exchange rate volatility. Accordingly, Bravo-Ortega and di Giovanni (2005) postulate that with greater costs associated with international trade, there will be a wide variety of non-tradable goods leading to much greater real exchange rate volatility. The authors include productivity shocks to reflect uncertainty and aver that, in the absence of costs associated with international trade, a country's comparative advantage is altered on the back of productivity shocks, albeit there is no violation of the law of one price- it continues to hold. Bravo-Ortega and di Giovanni (2005) postulate that the presence of transport costs 'creates a wedge between the prices for some goods that the domestic and foreign economy specialize in' (Bravo-Ortega and di Giovanni 2005, pg 3). The latter wedge force producers of the trading economies to produce non-tradable goods, the prices of which do not depend on productivity shocks in the economies. Hence, according to Bravo-Ortega and di Giovanni (2005), given the presence of country specific shocks as well as the fact that the price index of an economy consists of tradable and non-tradable goods, the relative prices of the non-tradable goods will never be equal across countries and cause the real exchange rate to alter. In short, exchange rate volatility is an increasing function of trade costs.

Moreover, Baggs et al (2008) develop a model using trade weighted exchange rate in order to identify the risk of exchange rate movements of different currencies on the exports and imports of service sector exports and imports. The model helps to explain the effect of large real exchange rate volatilities on

four parameters in the service sector; sales, profits, leverage and survival and provide an explanation of the response of the firms to exchange rate volatility. The authors postulate that a real appreciation of the domestic currency has more negative impacts on the service firms whilst a real depreciation of the domestic currency has more positive impacts. In essence, the authors aver that a real appreciation lead to a fall in the profits of the service firms, the probability of survival as well as sales are reduced but leverage falls. With a real depreciation, however, the authors stipulate that the profits of the service firms, probability of survival as well as sales increase whilst leverage increases. The authors' postulate is based on the idea that a real appreciation of the home currency leads to a situation where local producers now have to compete with now lower priced imports while at the same time face a dearer price for their exports hence bringing a blow to their comparative advantage. In the same vein, a real appreciation of the local currency, assuming Marshall-Lerner condition holds, improves the competitiveness of the domestic service firms. In essence, labour is assumed to be the sole factor input and a real appreciation of the local currency is beneficial as it reduces the cost of production of the foreign firm in terms of domestic currency. Consequently, competition becomes more acute for local firms in both the local and international markets forcing them to revise their prices downwards. In order to match competition, the local firms need to shrink their mark-up and their profit levels fall. Firms which are unable to match competition are forced to exit.

Fung (2008), however, provide an alternative explanation as regards the impact of exchange rate volatility on service firms. The author postulates that the net impact of exchange rate volatility on profits, probability of survival, sales and leverage is not certain and depend on the direction and relative magnitude of the changes in exports and imports. The impact, according to him, might be both positive and negative. For instance, following a real appreciation of the exchange rate, the cost of production of local firms increase forcing them to reduce their sales and lead to some firms exiting the market, which ultimately gives existing firms larger market share. Thus, the final impact of a real appreciation of the

local currency on existing firm's turnover, should at least in theory explained by the extent to which exchange rate volatility affects exports and local sales as well as the direction of the change. In case of a real appreciation of the local currency, existing firms will have their sales decrease especially when few firms are leaving the industry or when the firms are very small compared to existing firms. On the other hand, if many large firms leave the industry, the total sales of the existing firms might augment following a real appreciation of the domestic currency. This is because despite a fall in sales in the international market, the existing firms benefit more from an increase in market share following the exit of the large domestic firms.

Last, but not least, Chen et al (2009) explain how the imperfect substitute model can be applied to trade of services. Chen et al (2009) takes tourism as the most important tradable service and assumes that domestic and international tourism are imperfect substitute. Accordingly, consumers have a budget constraint, constrained by their income and have a choice to be made between domestic and foreign services. A depreciation of the local currency leads to an increase in the foreign price of services in terms of domestic currency and leads to a fall in the domestic price of services in terms of foreign currency. Export revenue is an increasing function of foreign income and increasing function of exchange rate. Similarly, import expenditure is an increasing function of domestic income but the sign of the relationship with respect to exchange rate depends on the elasticity of demand for imports. Chen et al (2009) mentions that if the elasticity demand for imports is high, a depreciation of the local currency increases the price of foreign services leading to a fall in the quantity of the service and hence imports spending. On the other hand, the depreciation also leads to a fall in the local service price, increasing quantity demanded and hence export revenue. The rise in export revenue coupled with the fall in import spending leads to an improvement in the service trade balance. However, the extent to which depreciation would improve services trade balance would depend on the Marshall-Lerner

Condition, which asserts that the sum of elasticity of demand for imports and exports should be greater than one.

3. REVIEW OF EMPIRICAL LITERATURE.

Studies pertaining to the impact of exchange rate volatility on trade in services are rather scant. Authors who have directly or indirectly studied are Hung and Viana (1995), Wang et al (2003), Barcellina and Molero (2003), Baggs et al (2008) and Mahagaonkar et al (2009).

Hung and Viana (1995) model U.S services trade flows, in particular tourism and other private services. They employed export import price equations for both tourism and other private services and use to time series econometrics viz cointegration and error correction model approach to model tourism and other private services. The empirical findings reveal that tourism is much less responsive to exchange rate change but instead to foreign economic growth. Similar finding is found for other private services. Moreover, Wang et al (2003) examine the impact of exchange rate volatility on international trade of all sectors in Taiwan. The authors employed monthly sectoral and market specific data for the period 1989 to 1998 and use multivariate GARCH in mean estimator as a measure of exchange rate volatility. According to the authors, the employment of aggregate data assumes that the effect of exchange rate volatility is homogenous across sectors and markets and that disaggregated data captures differences in exchange rates across sectoral trade. In view thereof, a multivariate GARCH-M model is employed to capture aggregation bias. The empirical findings reveal that exchange rate volatility is insignificant in explaining service sector trade flows in Taiwan, contrary to agricultural flows, for which exchange rate volatility has a positive significant impact.

Furthermore, Barcellina and Molero (2003) use annual data for the period 1976 to 2000 for 15 European countries to study service export firm. The authors employ an imperfect substitute model with export demand equations for real services, which are a function of relative prices, foreign income and exchange rate. Employing time series econometrics and after applying unit root tests, cointegration and

error correction modelling techniques, the equations are regressed by including two lags to variables in first differences to capture lagged effects after which the variables in difference having t values of less than one are dropped. The empirical findings reveal cointegration between the explained and explanatory variables and that the impact of exchange rate on services exports is positively significant for eight countries only. Barcellina and Molero (2003) find negative and perverse impact of exchange rate on services exports for Belgium and Italy.

One penultimate paper is provided by Baggs et al (2008), who examine the impact of exchange rate changes on service trade in Canada using annual and sectoral data for the period 1990 to 1995. The authors employ real exchange rate and change in trade weighted exchange rate to measure any appreciation or depreciation of the currency. They developed functions relating to profit, survival, sales and leverage and employ panel data econometrics, viz ordinary least squares and Tobit estimation procedure. Baggs et al(2008) find significant negative impact of exchange rate movement on the profit, survival, sales and leverage of the service firms.

More recently, Mahagaonkar et al (2009) examine the impact of exchange rate volatility on manufacturing and service sectors for 14 OECD countries using annual sectoral data for the period spanning 1987-2003. The authors employ real exchange rate, GARCH as measure of exchange rate volatility and use two export functions; one function having export share in production as dependent variable and the other having export-import ratio as dependent variable. As regards methodology employed, Mahagaonkar et al (2009) employ unbalanced panel random effects as well Instrumental variable random effects panel regression and find significant negative impact of exchange rate volatility on research and development intensity and thus exports of both service sector and manufacturing firms.

4. MODEL SPECIFICATION

From Wang et al (2003), an export equation is developed as follows:

Export Equation:

$$\ln X_{i,t} = a_1 + a_2 FGDP_{i,t} + a_3 \log FDI_{i,t} + a_4 Share_{i,t} + a_5 XG_{i,t} + a_3 v_{i,t} + e_{i,t}$$

Where X is real exports of services. The explanatory variables are foreign GDP (FGDP), FDI(Foreign Direct Investment), share of services sector to GDP (Share), Real Exports of Goods (XG) and exchange rate volatility (v)

FGDP measures the per capita real income of the countries' main trading partners. Given that the US is deemed to the most important trade partner of the countries, the real per capita GDP is being used as a proxy. FGDP is obtained by multiplying nominal USA per capita GDP to real exchange rate between the countries' and US currencies. FGDP is expected to have a positive impact of exports of services in the African countries.

FDI- Foreign Direct Investment Stocks, used as proxy for human capital. According to Benáček (2003),The stocks of FDI provides all the required supply side characteristics needed to determine comparative advantage and hence resulting impact of exports. Hence, FDI is expected to have a positive impact on exports of services.

Exports of goods (XG). The higher the exports of goods, the higher is the demand for services like transport, insurance, communication, royalties, consultation fees, assembly costs. Exports of goods are thus expected to affect exports of services positively.

Share of the service sector . The share of service sector denotes the stage of development of an economy. An expansion in domestic service sector means that the firms will be more able to serve

exporters. Hence, share of service sector is also expected to have a positive impact on exports of services.

V represents volatility of the exchange rate and eit is the stochastic error term. It is expected that V can be either positive or negative depending on the direction of exchange rate movement. An appreciation of the exchange rate is considered detrimental as it leads to loss of competitiveness and hence export revenue. However, a depreciation of the exchange rate improves competitiveness and hence economic growth. can either <0 or > 0 depending on the factor considered.

5. CONCEPTUAL FRAMEWORK

Besides trade flows, another important aspect in the empirical literature is the measure of exchange rate and its volatility. Although some authors like Clark et al (2004) mentions that it makes no difference as to whether we use nominal or real exchange rate, some studies employ either nominal only or real only. Yet for sensitivity analysis, and there are also studies that employ both measures of exchange rate. As regards exchange rate volatility, there is a plethora of models developed to date. Here also, some studies employ only one measure whilst others employ more than one measure. Table 1 in the annexure describes the some of the models for exchange rate volatility employed in the empirical literature. For the purpose of this paper, the z-score is to capture real exchange rate volatility.

6. DATA SOURCES AND METHODOLOGY

Data was obtained from the International Monetary Fund's International Statistics, United Nations Educational, Scientific and Cultural Organization (UNESCO), World Bank database as well as Central Bank's annual reports in some countries. Data as regards exchange rates was also obtained from http://fxtop.com as well as from www.oanda.com. Countries included in the sample embrace Kenya, Tanzania, Zambia, South Africa, Botswana, Namibia, Uganda, Rwanda, Morocco and Mauritius. The data spans for over the period 1999-2011 due to unavailability of data for some countries.

The study is a panel data analysis. According to Mouchart (2004), panel data analysis is more advantageous. Panel data analysis considers the fact that the countries differ in terms of economic polocies. Panel data analysis removes all biases associated with the need to averaging or aggregation since in panel data, all countries' data are included.

Moreover, to achieve the aim of this paper, the regression equation is estimated using random coefficient estimates (RC). According to Hondroyiannis (2005), the RC model is a two-stage model which admits both individual-level and population-level effects. It is known to be robust against data that are not missing completely at random. However, the equations are first estimated using OLS to check for heteroskedasticity (Breusch-Pagan/Cook-Weisberg Test), multicollinearity (variance inflating factor) and whether the model is well specified (Ramsey Reset Test). Heteroskedasticity occurs when the variance of the error terms differ across observations. Multicollinearity exists when the independent variables are found to be collinear. Also, Harris-Tzavalis (1999) unit root test will be carried out to check for stationarity of the dataset. Hondroyiannis et al (2005) postulate that (RC) estimates give better estimates than the OLS, GMM and 3SLS. RC is also known as the Time Varying Model as it allows the intercepts and slopes to vary between the countries and through time and at a point in time. Further, there is no need to include dummy variables to take into account omitted variables and it controls for problems like endogeneity (good for simultaneous equations like our model) as well as measurement errors. There is also no need to look for instrumental variables as in GMM. Parameter constancy tests from the RC estimates give an insight as to whether the model is wrongly specified or not.

7. RESULTS AND ANALYSIS

The diagnostic tests and regression results are given in in the annexures.

Turning to the diagnostic tests, it is clear from Table 2 that the dataset does not suffer from unit root problems since the p-values from the Harris-Tzavalis tests are less than 0.05. Similarly, the Ramsey

Reset tests from Table 3 reveal no specification problems for the export equation as depicted by the high F values (7.99) relative to the p-values (0.00022). Similarly, VIFs from Table 4, reveals no multicollinearity problems as depicted by a mean of VIF of 1.098. Despite the fact that we may accept heteroskedasticity in our case as the countries taken practice different economic policies, yet, we have used robust standard errors for the OLS regression to correct for heteroskedasticity in order to have more efficient estimates.

The regression results for OLS, Fixed Effects, GMM and Random Coefficient estimates are given in Annexure 3 in Tables 3 and 4. The P-Value of the model stands at 0.0002, less than 0.05, depicting a statistically significant relationship between the regressands and the regressors. The R-Squared figure of 0.6543 shows that the model explains 65.43% of variance in exports of services. The P-values are the two tail values for each parameter estimates and test the hypothesis that the estimates are different from zero. To reject the hypothesis, p-values have to be lower than 0.05. After correcting for heteroskedasticity, from the OLS estimates with robust SE. The OLS estimates reveal that only exports of goods and share of service sector are significant in explaining exports of services in the countries considered with p-values of 0.00211 and 0.0002 respectively. Despite the fact that the hausman specification tests prescribe the use of random effects, we choose fixed effects. The same results are obtained as under OLS for fixed effects and GMM estimates, that is, only exports of goods and share of services sector are found to be significant explaining exports of services in the countries studied. Looking at the GMM diagnostics, we can safely say that after performing the regressions, the export equation is not over-identified. The Sargan test gives us a Chi-Sq value which is very far from zero and thus no over identification is concluded. We, therefore, do not reject the null hypothesis of the Sargan test that the instrumental variables are not correlated with a set of residuals. In addition to the Sargan tests, the Wald tests indicate fine goodness of fit as indicated by high values for Wald Chi2 value of 51.81.

In contrast with the OLS, fixed effects and GMM estimates, Random Coefficient estimates show that in addition to exports of goods and share of service sector, FDGP (per capita real income of the countries' main trading partners) as well as exchange rate volatility are also significant in explaining exports of services in the economies. The result for Parameter Constancy test gives a $\chi 2$ of 47.78 as against a p-value of 0.0021 which means that the model is well specified and invalid inference is avoided. Wald tests also indicate fine goodness of fit as indicated by Wald value of 8.12.

The results from the foregoing section reveal that in both a static and dynamic framework, exports of goods and share of service sector influence exports of services in the African countries, a finding in line with Wang et al (2003). In essence, the African countries exports a lot of manufacturing and agricultural goods and hence the higher the demand for such goods, the higher are the demand for services like transport, insurance, communication, royalties, consultation fees, assembly costs. During the recent decades, the African countries have become more opened to international trade which has helped to increase their exports of both goods and services.

Moreover, the results also show that share of service sector is also significant in explaining exports of services in the African countries. There have been structural adjustments in many of those economies like Mauritius, South Africa, Uganda and others and we can see a gradual shift from traditional agricultural sectors to more service based economies engaging in financial services, tourism and other services, which explains why the mounting share of service sector explains significantly exports of services in the economies studied.

Furthermore, under the Random Coefficient Estimates, FDGP (per capita real income of the countries' main trading partners) is also significant in explaining exports of services. With the advent of the Africa Growth and Opportunity Act and other trade agreements between the African countries and the rest of the world, there has been growing demand for goods emanating from Africa, which result in higher demand and revenue for their exports of services.

Last, but not least, the results also show that, on average, exports of services in the African economies is also influenced by exchange rate volatility. Major world currencies like the US dollar and the euro has had a volatile trend vis-a-vis the currencies of the African countries. The US dollar has constantly been appreciating and has helped increased export of services revenues. This has however been exacerbated recently due to the depreciating effect of the euro as the African countries also export significantly to the eurozone.

8. CONCLUSION

This paper provides evidence regarding the sensitiveness of trade in services to exchange rate movements in the African region. In both a static and dynamic setting, exports of services are explained by changes in exports of goods and share of service sector. However, more efficient estimates are provided by the Random Coefficient estimation which also reveal that per capita real income of the countries' main trading partners as well as exchange rate volatility also explains exports of services in the economies studied. The higher the demand for goods, the higher are the demand for services like transport, insurance, communication, royalties, consultation fees, assembly costs. Similarly, a gradual shift from traditional agricultural sectors to more service based economies engaging in financial services, tourism and other services explains why the mounting share of service sector explains

significantly exports of services in the economies studied. Last, but not least, the recent volatilities in US dollar and the euro also explains the movements in exports of services in the economies.

The results obtained from this paper have important insights to offer. The main lesson would concern the choice of an appropriate exchange rate regime. If exports of services are adversely affected by exchange rate volatility, it is suggested that a peg arrangement based on currency dollar might be appropriate. For instance, a crawling basket peg might benefit the economies in order to improve their export competitiveness regarding exports of services. In fact, the crawl might be attuned with a view to assist real exchange rate adjustments to pre-empt misalignments. However, the results should be interpreted with caution. The study has employed only ten countries having more or less similar economic characteristics. Moreover, due to unavailability of data, the study uses data for the period 1999-2011 only. A more accurate result could have been obtained if more countries were to be employed and if data were available.

REFERENCES

1. BRAVO-ORTEGA. C and DI GIOVANNI.J (2005): 'Remoteness and Real Exchange Rate Volatility'. IMF Staff Papers, 53, 115-132.

2. BARCELLINA.S and MOLERO.J (2003). 'Service Export Flows: Empirical Evidence for the European Union'. SETI Project, Universidad de Zaragoza, Universidad Complutense de Madrid.

3. BAGGS, J., BEAULIEU E. and FUNG L. (2008). 'Firm Survival, Performance, and the Exchange Rate'. Canadian Journal of Economics 42(2). 393-421.

4. BAGGS. J., BEAULIEU E.and FUNG L. (2010). 'Are Service Firms Affected by Exchange Rate Movements?' Review of Income and Wealth, 56(S1, 156-176

5. CABALLERO. R.J. and CORBO. V. (1989). 'The effects of real exchange rate uncertainty on exports: Empirical evidence', The World Bank Economic Review, 13(2), 177-192

6. CHEN, F., LIM, C., & MCALEER, M. (2009). Modelling multivariate international tourism demand and volatility. Tourism Management, 26, 459–471

7. CLARK, P., TAMIRISA, N., Wei, S., SADIKOV, A., ZENG, L.,(2004). 'A new look at exchange rate volatility and trade flows'. International Monetary Fund, Washington DC, Occasional Paper Series. 235, 1-54

8. CLARK, P.B. (1973), 'Uncertainty, Exchange Risk, and the Level of International Trade' Western Economic Journal 11, 302-13.

9. CABALLERO. R.J and CORBO.V (1989). 'How does uncertainty about the real exchange rate affect exports?', World Bank Policy Research Working Paper Series, 221, 12-45

10. DE GRAUWE, P. (1988). 'Exchange rate variability and the slowdown in growth of international trade'. IMF staff papers 35, 63-84

11. ETHIER, W. (1973). 'International Trade and the Forward Exchange Market'. American Economic Review, 63,494-503.

12. FUNG. L (2008). The impact of real exchange rate movements on firm performance: A case study of Taiwan, Japan and the World Economy, 21(1): 185-96

13. Hung. J and Viana.S. (1995) 'Modeling U.S. Services Trade Flows: A Cointegration– ECM Approach'. Federal Reserve Bank of New York Research Paper No. 9518

14. Hondroyiannis,. Swamy P.A.V.B, George S. T. & Ulan.M (2005). 'Some Further Evidence on Exchange Rate Volatility and Exports', Working Paper No 28, Bank of Greece.

15. Hooper. P and Kohlhagen S.W (1978). 'The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade'. Journal of International Economics Vol 8(4): pg 483–512.

16. Mahagaonkar P. Schweickert. R and Chavali A.S (2009). 'Sectoral R&D Intensity and Exchange Rate Volatility: A Panel Study for OECD Countries'. Kiel Institute for the World Economy, Düsternbrooker Weg 120, 24105 Kiel, Germany Kiel Working Paper No. 1531

17. Mouchart (2004): " The Econometrics of Panel Data' Institut de statistique Université catholique de Louvain, March 2004

18. Wang, K.L., Fawson C., and Barrett C.B. (2002). 'An Assessment of Empirical Model Performance When Financial Market Transactions are Observed at Different Data Frequencies: An

Application to East Asian Exchange Rates'. Review of Quantitative Finance and Accounting, Vol 19:2, 111-129.

ANNEXURE I: Table 1: Exchange rate volatility Measures

Exchange Rate olatility Measure	Description
1. Moving Average of the standard deviation of the exchange rate	According to Arize (1998), this measure was introduced by Kenen and odrik (1986) and suggested by Koray and Lastrapes (1989). According Hondroyiannis et al (2005), this measure is used to test for a stable nd significant response of trade to a one-per cent change in the standard eviation and is computed as follows: $St = [(\frac{1}{m})\sum_{i=1}^{m} E_{t+i-1} - E_{t+i-2}\ ]^{\frac{1}{2}}$ is the order of moving average and can be four if fourth quarter oving average is used and eight is fourth quarter moving average is sed; E is the log of exchange rate. This model has been extensively sed in the literature by Arize (1998), Arize et al (2000), Siregar and ajan (2002), Todani and Munyama (2005), Huchet-Bourdon and orinek (2011) among others.
2. Absolute percentage change in exchange rate	According to Hondroyiannis et al (2005), this volatility measure is nployed to investigate the trade sensitiveness following a % change in change rate. It is computed as follows: $St = \left\|E_t - E_{t-1}\right\| / E_{t-1}$ 1 is the spot exchange rate. This measure is proposed by Thursby and hursby (1987)

3. Mean absolute premium	According to Chit et al (2008), the mean absolute premium is defined the mean absolute difference between the expected and realised xchange rate, that is the difference between the expected forward rate nd current spot rate. It is computed as follows: $St = \sum_{i=1}^{m} \frac{\lvert f_{t-1} - E_t \rvert}{n}$ 1 is the forward rate; E is the spot rate. This measure is used by Ethier 973), Hooper and Kohlhagen (1976) among others.
4. Coefficient of Variation	Here the coefficient of Variation of the exchange rate represents the tio of the standard deviation to the mean exchange rate. This measure as been used by Bénassy-Quéré and Lahrèche Révil (2003), Thorbecke 008) among others.
5. Standard deviation	Here, standard deviation of both the level of exchange rate as used by ooper and Kohlhagen (1976) as well as change in the first difference of e natural logarithm of exchange rate are used in the literature (ell'Ariccia,1998). The standard deviation of the exchange rate level is ven by Hooper and Kohlhagen among others as follows: $St = \sqrt{\sum (E_I - \bar{E})^2} \,/\, N-2$ and the standard eviation of the change inn exchange rate is given by Dell' Ariccia 998) as follows:

	$St = \sqrt{\sum (\Delta E_I - \bar{\Delta E})^2} \;/\; N-2$ This measure has also been extensively used in the empirical literature. lore recent papers using standard deviation are Clark et al (2004), Baak 004), Aguirre et al (2007), among others.
6. ARCH Models and GARCH Models (including GARCH-M, E-GARCH, MODELS)	ARCH (Autoregressive Conditional Heteroskedasticity) was developed y Engel (1982). GARCH (Generalised Conditional Heteroskedasticity) as developed by Bollerslev (1986). These models are used extensively the literature by Adubi and Okunmadeva (1999), De Vita and Abbot 004), Takaendesa et al (2005), Baum et al (2009), Huchet-Burdon and orinek (2011) among others. According to Chit et al (2008), in these odels, exchange rate volatility is calculated by taking the variance of xchange rate as 'a linear function of the expected squares of the lagged alue of the error term from an auxiliary regression determining the ean'. Chit et al (2008, pg 100). Thus, it is derived as follows: $\nu t = \gamma_0 + \gamma_1 \nu_{t-1} + \varepsilon_t$, where ε_t is the stochastic error term aving constant variance and has time varying conditional variance(sually denoted as as follows: $S\langle \varepsilon_t \mid I_{t-1} \rangle = h_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \phi_1 h_{t-1}^2$
7. AR forecasts	Normally, exchange rate volatility is measured by AR(2) forecast here. ccording to Baum et al (2004), Chit el al (2008), AR (N) forecast is

	ased on past monthly volatilities from daily data. It is computed as llows: $V_{t-1}[S_t] = \mu + \sum_{p=1}^{2} \alpha_p \left[\sqrt{\sum_{d=1}^{D_{t-p}} \{100(Sd - Sd - 1)\}} \right]$
8. Sum of squares of forward errors	According to Dell 'Ariccia (1998), the sum of squares of forward rors is the difference between forward and spot rates squared as llows: $S_t = \sum_{1}^{n} (f_t - e_t)^2$
9. Z-Scores	The z-scores measure was developed by Wolf et al (2003) as a measure of exchange rate volatility in this study. This measure combines ovements in exchange rate around a constant level as well as around a steady depreciation/appreciation rate as follows: $Z_t = \sqrt{\mu_t^2 + \sigma_t^2}$ Where μ_t^2 is the arithmetic average changes in the nominal exchange te vis-à-vis US dollar in time t; σ_t^2 is the standard deviation of the ominal exchange rate vis-à-vis the US dollar at time t. In the empirical erature, De Grauwe and Schnabl (2004), Schnabl (2007) among others ed it.

10. Max-Min	The Max-Min measure is obtained by taking the difference between e maximum and minimum nominal spot rate and has been used in the erature by Dell 'Ariccia (1998) and Kandilov (2007) and both find gnificant negative impact of exchange rate volatility on trade.
11. Peree and Steinherr Measure	This measure was developed in 1989 by Peree and Steinherr (1989) nd assumes that volatility is derived from previous experience. Agents emember the highs and lows of the previous period, adjusted for the xperience of last year relative to some idea of the equilibrium exchange te', Sheldon et al (pg 18, 2011). This measure is calculated as follows: $VOL_{ij,t} = \left[\frac{MaxX\ t_{ij,t-n} - MinX\ t_{ij,t-n}}{MinX\ t_{ij,t-n}} \right] + \left[1 + \left| \frac{X_{ij,t} - X\ p_{ij,t}}{X\ p_{ij,t}} \right| \right]$ where $MaxX\ t_{ij,t-n}$ is the maximum absolute value of real exchange rate over e previous n years. $MinX\ t_{ij,t-n}$ is the minimum absolute value of real exchange rate over e previous n years. According to Sheldon et al (2011), the first equation on the right hand de depicts accumulated experience and the second equation depicts isalignment, that is, the deviation of exchange rate from equilibrium xchange rate.

APPENDIX 2- HARRIS-TZAVALIS UNIT ROOT TESTS RESULTS

Table 2: Harris-Tzavalis Unit Root Results

Rho value for	statistic	z-value	p-value
Exports of services	0.4354	-4.1153	0.0000
FGDP	0.4405	-3.2671	0.0000
FDI	0.6124	-1.2341	0.0000
Exports of Goods	0.584	-2.0021	0.0029
Share of service sector	0.7196	-3.8794	0.0000
z-score	0.9882	-2.3651	0.0490

Source: Stata 11 output

APPENDIX 3- STATA REGRESSION ESTIMATES

Table 3: Regression Results

OLS Estimates (at 95% Confidence nterval)			
Predictors	***Coefficient***	***Robust SE***	***P value***
FGDP	0 414	0.366	0.07545
FDI	0.699	0.022	0.06772
Exports of Goods	0.274	0.032	0.00211
Share of service sector	0.323	0.034	0.0002
z-score	-0.044	0.031	0.0781
Constant	1.088	1.538	0.5662
Ramsey RESET test **F value=7.99 Prob> F = 0.00022**			
F(6,97)	***22.87***	***R-Squared***	***0.6543***
Prob> F	***0.0000***	***Adjusted R-quared***	***0.6053***
Fixed Effects Estimates ***Predictors***	***Coefficient***	***SE***	***P value***
FGDP	0.424	0.355	0.07566
FDI	0.689	0.032	0.06882
Exports of Goods	0.287	0.047	0.00322
Share of service sector	0.343	0.036	0.0001
z-score	-0.045	0.032	0.08321
Constant	1.089	1.537	0.6775

Source: Stata 11 Output

Table 4: GMM One Step Results and Random Coefficient Estimates.

GMM Estimates (at 95% Confidence terval)			
Predictors	***Coefficient***	***SE***	***P value***
FGDP	0.477	0.466	0.0872
FDI	0.566	0.072	0.08756
Exports of Goods	0.379	0.056	0.0392
Share of service sector	0.257	0.023	0.0000
z-score	-0.057	0.041	0.07892
Constant	1.097	1.588	0.6775
Wald $\chi^2(6)$ =51.81 ***Prob> χ^2= 0.0000*** ***Sargan Test:$\chi^2(84)$ = 87.12*** ***Prob> χ^2= 0.0029***			
RandomCoefficient Estimates ***Predictors***	***Coefficient***	***SE***	***P value***
FGDP	0.235	0.584	0.0038
FDI	0.033	0.103	0.4650
Exports of Goods	0.004	0.1167	0.0210
Share of service sector	0.867	0.336	0.0042
z-score	-0.763	0.2314	0.0342
Constant	0.827	0.1932	0.0018
Test for Parameter Constancy			

$\chi^2(28)= 47.78$			
Prob> $\chi^2= 0.0021$			
Wald $\chi^2(6) = 8.12$			
Prob> $\chi^2= 0.0019$			

Source: Stata 11 Output

APPENDIX 4- DIAGNOSTIC TESTS.

able 5: Variance Inflating Factors

Regressors	VIF	1/VIF
FGDP	1.12	0.8928
FDI	1.03	0.9708
Exports of Goods	1.09	0.9174
Share of service sector	1.06	0.9433
z-score	1.19	0.8403
Mean VIF	**1.098**	

Source: Stata 11 output

Currencies used by the countries

Countries	Currencies
Kenya	Kenyan shilling (KES).
Tanzania	Tanzanian shilling (TZS) .
Zambia	Zambian kwacha (ZMK)
South Africa	South African rand (ZAR)
Botswana	Botswana Pula (BWP)
Namibia	Namibian dollar (NAD)
Uganda	Ugandan shilling (UGX)
Rwanda	Rwandan franc (RF)
Morocco	Moroccan Dirham (MAD)
Mauritius	Mauritian Rupee (MUR)

Source: Own Illustration