



TRADE FLOWS AND EXCHANGE RATE SHOCKS IN NIGERIA: AN EMPIRICAL RESULT

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ABSTRACT

In this paper, we explored the J-curve effect based on Nigerian data by adopting the vector error correction methodology. The results of the study indicated a cyclical feedback between the trade balance and the real exchange rate depreciation of the Naira. However, the analysis finds no empirical evidence in favour of the short-run deterioration of the trade balance as implied by the J-curve hypothesis. Rather, what is empirically supported is the cyclical trade effect of exchange rate shocks. As it were, a real exchange rate shock will initially improve then worsen and then improve the country's aggregate trade balance. The instant improvement in the trade balance which is correlated with real depreciation provides no support for the J-curve hypothesis in the Nigerian trade balance. Hence, the short-run predictions of the J-curve are not observable in Nigeria.

Keywords: Trade flows, Exchange rate shock, VECM, Nigeria

JEL Classification: D82, F36, F44 G11, G15

INTRODUCTION

The response of trade balance to changes in exchange rate has been observed to be a crucial factor in the co-ordination and implementation of trade and exchange rate policies. The classical insight is that a nominal devaluation of exchange rate improves the trade balance in the long run while deteriorating it in the short run. As it were, a change in the exchange rate has two effects on the trade balance; the price effect and volume effect [Krugman and Obstfeld \(2001\)](#). While the price

effect works to make imports more expensive to foreigners, it causes domestic exports to be cheaper for foreign buyers, at least, in the short run and as the volume of exports and imports do not adjust instantaneously in the short run, trade balance may initially experience some deterioration in the short run, following the exchange rate devaluation. However, subsequent to eventual adjustment process of exports and imports to the devaluation, volume effect dominates in the long run, and thereby reversing the overall effect in favour of an improvement in the trade balance assuming that the Marshall-Lerner¹ condition holds. In spite of the numerous studies (McKenzie, 1998; Isitua and N.Igue, 2006; Afolabi and Akhanolu, 2011)etc.) So far conducted on the relationship between exchange rate adjustment and trade balance, there is still a substantial disagreement concerning such relationship and the effectiveness of exchange rate devaluation as a tool for improving the balance of trade. Consequently, the effect of exchange rate variability on trade balance must be considered an open question especially from an empirical viewpoint. The premise that there is no clear empirical resolution so far on the subject matter thus, calls for an unmarked reassessment at the issue using recent data and recent advancements in the field of time series econometrics. Moreover, the enormous depreciations of the Naira since the 1980s offer a tremendous opportunity for such a reassessment of the response of trade flows to currency devaluations. In light of the foregoing, the author aims at re-evaluating the relationship between the aggregate trade balance and real exchange rate in Nigeria. This is addition to re-exploring empirically, the response of the aggregate trade balance to real exchange rate shocks in Nigeria using the generalized impulse response functions. The research question thus holds, what is the pattern of dynamic adjustments that occur in the short-run for possible determination of the long-run relations in response to various shocks to the exchange rate system. Organization of the rest of the paper is as follows, section two provides a trend analysis of the trade flows and exchange rate dynamics in Nigeria. Section three reviews the empirical literature. The theoretical framework and model specification are discussed in section five, methodology and data of the study are discussed in section six. Section seven is devoted to estimation results including those of the lag length, polynomial degree, linear restriction tests conducted under weak exogeneity, exclusion restriction, unit root and VAR co-integration tests analysis and the short-run vector error correction dynamic analysis are contained. Section eight concludes.

¹The Marshall-Lerner condition states that, for a currency devaluation to have a positive impact on trade balance, the sum of price elasticity of exports (in absolute value) must be greater than one. As a devaluation of the exchange rate means a reduction in the price of exports, quantity demanded for these will increase. At the same time, price of imports will rise and their quantity demanded will diminish. The net effect on the trade balance will depend on price elasticities. If goods exported are elastic to price, their quantity demanded will increase proportionately more than the decrease in price, and total export revenue will increase. Similarly, if goods imported are elastic, total import expenditure will decrease. Both will improve the trade balance.

Trend Analysis of Nigeria's Trade Flows and Exchange Rate Dynamics

This section presents some trend analysis on Nigeria's export and imports in order to convey more information on the relationship between trade flows and exchange rate dynamics in Nigeria. In 2009, the Federal government of Nigeria liberalized the exchange rate system. In theory, this means that the naira is free to float against other currencies. In practice, the government still attempts to manage the rate of the naira against the US Dollar. According to [Sambo \(2012\)](#), "fundamental structure of the Nigeria's economy as an import-dependent economy which is largely responsible for the incessant decline of its external reserves is not acceptable because of its negative multiplier effect on the real economy. In terms of foreign investment, Nigeria is the third largest recipient of foreign direct investment (FDI) in Africa subsequent to Angola and Egypt. The stock of FDI in Nigeria was US\$60.3 billion in 2010. In 2010, FDI in Nigeria was estimated at US\$6.1 billion, down 29 percent from US\$8.65 billion in 2009 ([Transparency International, 2009](#)). As expected, most of Nigeria's FDI is situated in the oil and gas sector. Nigeria is the number one sub-Saharan African exporter of crude oil to the U.S. followed by Angola and the Republic of Congo. Nigeria's oil exports to the U.S. have in recent years been affected by the combination of sharply rising or falling export volumes and prices. For example, export dropped by 22.3% from N9.5689 trillion in 2008 to N7.4345 trillion in 2009. In naira value, crude oil exports also dropped by 28.2% from N8, 751.6 billion to N6, 284.4 billion while non-oil exports appreciated significantly by 40.7%.

In 2009, a total of US\$13.894 billion went out of the country ([Transparency International, 2010](#)). While about US\$757 million went out in September, the amount of foreign exchange flowing out of the country as capital flight rose to US\$1.359 billion in 2009 ([World Fact Book, 2010](#)). It however dropped to US\$452 million on the third of October and moved astronomically to US\$3.290 billion on 17th October ([World Fact Book, 2010](#)). The foreign exchange outflow went further up to US\$3.356 billion on the 31st of October and declined a little to US\$2.397 billion on the 14th of November and US\$2.02 billion and US\$1.262 billion for the weeks ending 21st of November and 28th respectively. This has resulted in the crash of the naira exchange rate. The trend became discernible in October 2008 where several billions of dollars were purchased through the banks and bureau de change. According to [Transparency International \(2010\)](#), the movement of funds out of Nigeria is also in travels namely business travel allowance, personal travel allowance, direct remittances etc. Accordingly, the total amount of foreign exchange that went out through travels amounted to US\$72.067 million, debt service/payment stood at -US\$799.19 4 million, wholesale at the Dutch Auction market amounted to -US\$6.276 billion, direct remittance amounted to -US\$851.809 million, letters of credit amounted to -US\$3.205 billion and cash sales to banks and bureau de change stood at -US\$3.170 billion ([CBN, 2011](#)). In 1960, imports were valued at N432 million. This rose to N756.0 million in 1970, to N8.132 million in 1978, to N124, 612.7 million in 1992 and to N681, 728.3 million in 1997 respectively. The bulk of the imports were

finished and semi-finished goods. The country had an unfavourable trade balance from 1960 to 1965, partly because of the aggressive drive to import all kinds of machinery to stimulate the industrialization policy pursued immediately after independence. The growth of the import of capital goods demonstrates the desire of the nation to industrialize. In 2005, import which stood at N1,779,601.6 rose to N2,922,248.5 7 in 2006; N4,127,689.9 in 2007; N3,299,096.6 9 in 2008 and N5,047,868.6 7 in 2009 (CBN, 2010). As at August, 2011 the country's importation stood at US\$7.5 billion (CBN, 2011). Is this not a worrisome trend that should put the Nigerian government on her toes in developing a macroeconomic policy to arrest? As it were, the government is yet to implement policies that could direct a positive trend of the country's import profile. Worst of it all is the fact that about 90% of the country's imports are consumption goods as against production. In 2009, total trade declined by 3% from N12.868.0 trillion in 2008 to N12.4824 trillion. How can the Nigerian government be contented with this import trend? Perhaps, the government is yet to undergo a statistical survey of the time series data on the country's trade balance. Nigeria's main exports partners include USA (30% of total), UK (25% of total), Equatorial Guinea (8% of total), Brazil (6.6% of total), France (6% of total), India (6% of total) and Japan (3% of total) all in 2009. The country's trade volume with Japan is low. For example, for the period, 1975 to 1988, the country's exports to Japan amounted to 0.1% of total exports. Major items of Nigerian export are oil products, cocoa and timber. In terms of total oil exports, Nigeria ranked 8th in the world. Nigeria's export to the UK which was valued at N694.9 million in 1975; it declined to N112.1 million in 1980 and rose to N2.282.9 in 1992 (World Bank, 2009). The analysis of the direction of trade reveals trade deficit over UK trade balance for the period, 1984-1992 while for the European Economic Community (EEC), a favourable trade balance was recorded over the same period (Omotor, 2008). In 2007, the country exports 2.327 million barrels per day (bpd) (IMF, 2007). The country's total export volume stood at US\$45.43 billion in 2009 (World Bank, 2009).

Review of Previous Empirical Studies

The literature on trade effects of exchange rate volatility is vast. Akhtar and Hilton (1984) using the OLS technique found significant negative trade effect of exchange rate fluctuation. (Bélanger *et al.*, 1988) using the instrumental variable method, Koray and Lastrapes (1989) using the VAR methodology found weak negative relationship. Peree and Steinherr (1989) utilizing OLS, Caballero and Corbo (1989) using OLS and instrumental variable methods, Bini-Smaghi and Lorenzo. (1991) using the OLS all found significant but negative effect of exchange rate volatility on trade balance. Feenstra and Kendall (1991) using the GARCH technique also found negative effect. Bélanger *et al.* (1992) using the instrumental variable and the GIVE method of estimation found significant and negative trade effect of exchange rate fluctuation. Chowdhury (1993) using the VAR technique, Caporale and Doroodian (1994) using joint estimation, Hook and Boon (2000) using VAR, Doganlar (2002) using the Engle-Granger Co-integration approach, Vergil (2002) using

the standard deviation analysis, [Das \(2003\)](#) using the ADF, co-integration and error correction methodology, [Baak \(2004\)](#) using the OLS technique, [Clark et al. \(2004\)](#) using the Gravity model, [Arize et al. \(2005\)](#) using the co-integration and ECM and [Lee and Saucier \(2005\)](#) using both ARCH-GARCH techniques found empirical evidence in support of significant negative relationship between exchange rate volatility and foreign trade balance.

Adopting the OLS technique, [Gotur \(1985\)](#), [Bailey et al. \(1987\)](#), [Bailey and Tavlas \(1988\)](#), [Mann \(1989\)](#), [Medhora \(1990\)](#) found little or no effect of exchange rate instability on trade. [Lastrapes and Koray \(1990\)](#) using VAR found weak relationship using the OLS found insignificant but positive effect, [Kumar and Dhawan \(1991\)](#) who based their analysis on standard deviation found insignificant negative effect, [Gagnon \(1993\)](#) utilizing the simulation analysis found no significant effect. Using gravity models, [Aristotelous \(2001\)](#) and [Tenreyro \(2004\)](#) also found insignificant and no effect of exchange rate instability on trade. There are other studies with mixed effect of exchange rate instability on trade. [Tavlas and Ulan \(1986\)](#) and [Akhtar and Hilton \(1991\)](#) using the OLS found insignificant, mixed effects. [Kumar and Joseph \(1992\)](#), [Frankel and Shang-Jin Wei \(1993\)](#) using the OLS found undersized and negative effect of exchange rate instability on trade in 1980 but positive effect in 1990. [Kroner and William \(1993\)](#) using the GARCH-M method found significant trade effects of exchange rate volatility with varied signs and magnitudes. [Daly \(1998\)](#) using the VAR approach found mixed results with a positive correlation. [Hwang and Lee \(2005\)](#) using the GARCH-M found positive effect of exchange rate volatility on import but insignificant effect on export. In a cross section analysis, [Brada and Méndez \(1988\)](#) found positive effect of exchange rate instability on trade. In another cross sectional analysis, [De Grauwe \(1988\)](#) found significant positive trade effects of exchange rate volatility. [Asseery and Peel \(1991\)](#) using the OLS-ECM methodology found significant and positive effects of exchange rate instability on trade for the UK. [McKenzie and Brooks \(1997\)](#) utilizing the OLS technique found significant positive effect.

In the year that follows, [McKenzie \(1998\)](#) single-handedly adopted the ARCH method and found positive effects of exchange rate instability on trade. [Kasman and Kasman \(2005\)](#) using the method of co-integration and ECM found significant positive effect of instability in the exchange rate on export. In their study of the impact of exchange rate volatility on trade flow in Nigeria, [Afolabi and Akhanolu \(2011\)](#) using *generalized autoregressive conditional heteroskedasticity (GARCH)* found an inverse and statistically insignificant relationship between total trade and exchange rate volatility in Nigeria. [Isitua and N.Igue \(2006\)](#) investigates the effects of exchange rate volatility on US-Nigeria trade flows using GARCH modeling, co-integration, error-correction apparatus and variance decomposition on data for the period of 1985:1 to 2005:4. These authors found that exchange rate volatility has a negative and significant effect on Nigeria's exports to the US. In line

with theoretical expectation, US *GDP* exerts a positive effect on Nigeria's exports but curiously, the effect is insignificant in the export function. There is this strand of the literature that relates to exchange rate elasticity² of trade. Empirical studies on exchange rate elasticity of trade balance include Hopper *et al.* (2000), Meltiz (2003), Campa (2004), Campa and Goldberg (2005), Hummels and Klenow (2005), Marquez and Schinder (2007), Chaney (2008), Cline and Williamson (2008), Helpman *et al.* (2008), (Beggs *et al.*, 2009), Bernard *et al.* (2009), Cheung *et al.* (2009), and Thorbecke and Smith (2010), Arkolakis and Muendler (2010), Eaton, (Kortum and Kramarz, 2010), Gopinath and Itskhoki (2010), (Gopinath *et al.*, 2010) and Berman *et al.* (2010). The general consensus in the aforementioned studies is that the aggregate exchange rate elasticity of trade is less than unity. Elsewhere, the trade balance effects of exchange rate shocks have also been empirically investigated in several studies to determine the possible effects of the real exchange rate shocks on the aggregate trade ratio Magee (1973), Miles (1979), Himarios (1985), (Rose and Yellen, 1989), Demirden and Pastine (1995), Bahmani-Oskooee and Pourheydarian (1991), Backus *et al.* (1994), Marwah and Klein (1996), Bayoumi (1999) and Bahmani-Oskooee and Brooks (1999).

Some of these studies utilized adjustment lags to explain the dynamic pattern of adjustments that occur in the short-run in order to establish long-run relations in response to various shocks in the exchange rate system. However, the empirical evidence is mixed. Magee (1973) finds evidence in support of J-curve effect of the trade response to exchange rate. Miles (1979) found an improvement in the trade balance through the capital account and as such the devaluation mechanism involved only a portfolio stock adjustment. By contrast, Himarios (1985) results validated the *J-curve* hypothesis of trade balance. Rose and Yellen (1989) found no response of the trade balance to real exchange rate movements in the short-run, in the bilateral US trade and the rest of the world. On their part, Bahmani-Oskooee and Pourheydarian (1991) found evidence to support the fact that the Australian trade balance deteriorated in the short-run and improved in the long-run, a scenario that conformed to the predictions of the *J-curve* phenomenon. The empirical estimates of Backus *et al.* (1994) reveals unfavourable movements in the terms of trade that were associated with declines in the balance of payments. Under this scenario, their results corroborated the *J-shape* effect. Marwah and Klein (1996) found a delayed reaction of the aggregate trade balance to exchange rate changes

²The elasticity approach focuses on demand conditions by assuming that the supply of domestic (foreign) exports (imports) are perfectly elastic so that changes in demand have no effect on prices. In effect, domestic and foreign prices are fixed so that changes in relative prices are solely caused by changes in nominal exchange rate. Accordingly, the elasticity approach distinguished between the direct and indirect effects of exchange rate devaluation on the trade balance, one that works to reduce the trade deficit and the other that works to worsen the deficit.

in the US and Canada with a discrete propensity for total trade balances to worsen at first when exchange rate devaluation is instituted and to later improve for both US and Canada. Bahmani-Oskooee and Brooks (1999) found that a real depreciation of the dollar had only a long-run effect on the US trade balance in relation to her trading partners.

THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

The thrust of the theories of exchange rates is the determination of equilibrium relationship among exchange rates. The *PPP theory* holds that a unit of domestic currency should purchase the same amount of goods in the home country as it would of identical goods in a foreign country. Thus, the *absolute PPP is the "law of one price"*: price of similar products to two countries should be equal when currency. International arbitrageur and the "*Law of One-price*" insure that risk adjusted expected rates of returns are approximately equal across countries. Acknowledging market imperfections such as transport costs, tariffs and quotas measured in common. The *relative PPP* then holds that rate of change in the prices of products should be similar when measured in a common currency. Algebraically,

$$e_1[1 + \pi_f] = e_0[1 + \pi_d] \quad (3.1)$$

In what follows, the percentage change in exchange rate $\%(\Delta e_0)$ is given by the difference between domestic (π_d) and foreign (π_f) inflation rates:

$$\pi_d - \pi_f = [\Delta e_0]\% \quad (3.2)$$

In effect, the currency of countries with high inflation rates should devalue relative to countries with low inflation rates. The rationale is that if $\pi_d > \pi_f$, then domestic imports increase while domestic exports decrease, foreign imports decrease while foreign exports increase, demand for foreign currency increases while supply decreases, demand for local currency decreases while supply increases and foreign currency appreciates while local currency depreciates. In the Fisher's theorem,

$$[1 + i = (1 + r^*)(1 + \pi)] \quad (3.3)$$

with the dominion effect that equilibrium real interest rate is made equal to the difference between nominal rate and inflation,

$$i = r^* + \pi \Leftrightarrow r^* = i - \pi \quad (3.4)$$

real rates of interest are equalized across countries through arbitrage. Otherwise funds would flow from countries with low expected real rates of interest to countries with high expected real rates of interest in the absence of segmented markets (Stucta, 2003). By intuition, it thus implies that real foreign and domestic rates are equal such that the difference between foreign nominal rate of interest and inflation is made to equalize the difference between domestic nominal rate of interest and inflation. In accord with the *PPP model*, inflation differentials between countries affect the exchange rate.

The *theory of portfolio balance* approach takes into consideration the diversification of investors' portfolio assets in order to reduce risk. The crux of the theory is that an increase in the money supply will induce to a depreciation of the exchange rate. As it were, with an increase in the domestic money supply, a lower interest rate and a higher exchange rate can be expected to absorb the excess supply, which in turn will result in the reduction of bonds. The *balance of payments (BOP) theory* to exchange rate determination is based on the Marshall Lerner condition which holds that if the sum of the price elasticity of demand for imports and exports is greater than one, then a fall in the exchange rate will improve the current account of *BOP*. A currency's price depreciation or appreciation affects the volume of a country's imports and exports and consequently, an expected fluctuation in the exchange rates can add to *BOP* instability. In effect, depreciation will increase the value of exports in the home currency terms and the larger the exports demand elasticity the greater the increase. On the contrary, imports will become 'more expensive' and their value will be reduced in the home currency and the larger the imports demand elasticity, the greater the decline. Consequently, we can argue that unless the value of exports increases less than the value of imports, the depreciation will improve the current account. More specifically, we can finally assess the impact of the currency's depreciation on the current account only by considering the price sensitivity of imports and exports.

$$H_e + H_m > 1 \quad (3.5)$$

Where H_e is price elasticity of exports volumes and H_m is price elasticity of import volumes. Theoretically, the low price elasticity of demand for imports and exports in the instantaneous effect of an exchange rate change enhances the dominion short-run effect of the J curve that a depreciation of the domestic currency can initially worsen the current account balance before its improvements. According to the *monetary theory*, exchange rates adjust to ensure that the quantity of money in each currency supplied is equal to the quantity demanded (Parkin and King, 1992). Theory has it that currency devaluations bring about competitive advantage in international trade. Accordingly, when a country devalues its currency, domestic export become cheaper relative to the country's trading partners. This results in an increase in the quantity demanded of domestic exports and hence the trade balance improves. However, there is a time lag before the trade balance

improves following a real depreciation. The time path through which the trade balance follows generates a *J-curve*. Theoretically, the trade balance deteriorates initially (short-run effect) after depreciation and some time along the way it starts to improve (long-run effect) until it reaches its long-run equilibrium. The short-run and long-run effects of depreciation on the trade balance are different. The time path comes about as an impact of several lags such as recognition, decision, delivery, replacement and production [Junz and Rhomberg \(1973\)](#). The recognition lag is the time taken by traders to recognize the changes in market competitiveness following a real depreciation in the exchange rate. Such recognition takes longer time in the international markets than in the domestic markets due to language barriers. As it were, some time is spent, deciding on what trade relationships to venture into and other time, for the placement of new orders [Junz and Rhomberg \(1973\)](#). There is a delivery lag that explains the time taken before new payments are made for orders that were placed soon after the price shocks. According to [Omotor \(2008\)](#) procurement of new materials may be delayed to allow inventories of materials to be used up, this is a replacement lag. Lastly, there is a production lag which is the time taken by producers to become certain that the existing market condition will provide a profitable opportunity.

Using the theory of lags to further explain the dynamic pattern of adjustments that occur in the short-run for possible determination of long-run relations in response to various shocks in the exchange rate system, [Magee \(1973\)](#) categorized the time taken for devaluation to impact on trade balance into currency-contract, pass-through and quantity-adjustment time periods. The currency-contract period is the short period of time which follows instantaneously after the devaluation policy has been implemented. This short period is the immediate period that characterizes the exchange rate variation associated with the devaluation given that there are previously made contracts before the variation occurs. Due to currency contracts, the trade balance initially worsens as a result of a real depreciation since prices and trade volumes are not allowed to change. According to [Gandoloe \(2002\)](#), the short-run deterioration is due to the fact that import and export orders are placed several months in advance and are such predetermined by the previous contracts which would still be in force. The pass-through period is also a short period that corresponds to exchange rate variation by which prices can change but with unchanged quantities due to rigidities of demand and supply of exports and imports [Gandoloe \(2002\)](#). According to [Hsing \(1999\)](#), the degree of foreign and domestic producer's price pass-through to consumers and the scale of supply and demand elasticities of exports and imports, determine the value of the *J-curve* effect. Thus, the *J-curve* effect can be explained by both a perfect pass-through and a zero pass-through. Under a perfect pass-through, domestic import price increases while domestic export price remains unchanged and this produces a deteriorating effect in the trade balance. In zero pass-through situation, domestic export price increases and domestic import prices remain constant hence the real trade balance improves subsequent to devaluation. Accordingly, the trade balance slowly

improves as demand elasticities of exports and imports approach their long-run values. The quantity adjustment period is the period long enough for prices and quantities to adjust. The prices of imports rise soon after real depreciation but quantities take time to adjust downward at the initial stage because current imports and exports are based on orders placed some time back [Yarbrough and Yarbrough \(2002\)](#). As time passes by, importers have enough time to adjust their import quantities with respect to the rise in prices while quantity demand for exports increases and this result in an improvement in the trade balance. In the long-run, the volume effect dominates the price effect of a real depreciation. Hence, the balance of trade ought to improve following the fulfillment of the *Marshall-Lerner* precondition, that is, the sum of imports and exports demand and supply elasticities must be greater than unity [[Marshall \(1923\)](#) and [Lerner \(1944\)](#)]. The *Marshall-Lerner* condition is therefore the necessary and sufficient condition for an improvement in the trade balance following devaluation. These dynamic analyses in the transition process of exchange rate shocks with different speed of adjustments are complex [[Campos \(2010\)](#)] and are characterized by coefficients of the exchange rate lags.

Vector Error Correction Model (VECM) Specification³

Given a VAR (p) of $I(1)$ vector of Z variables with μ_t as the stochastic disturbance

$$Z_t = \phi_1 Z_{t-1} + \dots + \phi_p Z_{t-p} + \mu_t \tag{3.6}$$

There always exists an error correction representation (VECM) of the VAR (p) model and it takes the form:

$$\Delta Z_t = \Pi Z_{t-1} + \dots + \sum_{i=1}^{p-1} \phi_i^* \Delta Z_{t-p} + \mu_t \tag{3.7}$$

Where Π and the ϕ_i^* are functions of the ϕ 's. By definition therefore,

$$\Pi = - (I - \phi_1 L - \dots - \phi_p L^p) = -\phi(1) \tag{3.8}$$

The characteristic polynomial is $I - \phi_1 L - \dots - \phi_p L^p = \phi(L)$. If $\Pi = 0$, then there is no co-integration and non-stationarity of $I(1)$ type peters out by taking differences. If Π has full rank, k , then the explanatory variables cannot be $I(1)$ but are stationary, that is,

³The model ignores constant and deterministic trends

$$\Pi^{-1}\Delta Z_t = Z_{t-1} + \Pi^{-1}\mu_t \quad (3.9)$$

The case of rank $\Pi = M$, $0 < M < K$ indicates co-integration and this is algebraically given as:

$$\Pi = \alpha\beta' \quad (3.10)$$

The columns of β contain the M co-integrating vectors and the columns of α , the M adjustment vectors. Given that the co-integration equation describes a long term relation, we thus, set $\Delta Z = 0$, that is, $\Pi Z^* = 0$ to validate the long run relation. This may be written as:

$$\Pi Z^* = \alpha(\beta' Z^*) = 0 \quad (3.11)$$

The long run relation does not hold perfectly in $(t - 1)$ period. Thus, there will be some deviation, an error such that:

$$\beta' Z_{t-1} = \varepsilon_{t-1} \neq 0 \quad (3.12)$$

The adjustment coefficients in α multiplied by the stochastic errors, $\beta' Z_{t-1}$ induce adjustment. They determine ΔZ_{t-1} , so that the Z 's move in the correct direction in order to bring the system back to 'equilibrium'. The co-integration scenario opted for in this study is the one in which rank $\Pi = M$ such that $0 < M < K$ and $\Pi = \alpha\beta'$ with the dimensions, $\alpha_{(K \times M)}$ and $\beta'_{(M \times K)}$. Given that the rank of Π is M where $M < K$, we factorize Π in two ranks of M with matrices α and β' such that rank $(\alpha) = \text{rank}(\beta) = M$. Both α and β are $(K \times M)$.

$$\Pi = \alpha\beta' \neq 0 \quad (3.13)$$

Baseline Empirical Model

In order to examine the pattern of dynamic adjustments that occurs in the short-run for possible determination of long-run relations in response to various shocks to the exchange rate system, the following baseline empirical vector error correction (VECM) representation is estimated.

$$\Delta Z_t = \alpha\beta'Z_{t-1} + \sum_{i=1}^{p-1} \phi_i^* \Delta Z_{t-i} + \omega ECM_{t-1} + \mu_t \quad (3.14)$$

In the *VECM*, the variables are integrated of order one, that is, $I(1)$, there are M eigenvalues such that $\lambda(\Pi) \neq 0$ and the variables are co-integrated. In effect, there are M linear combinations, which are stationary.

Where,

$$Z_t = \begin{bmatrix} Ln(X/M)_{j,t}, LnQ_{j,t}^R, LnY_{j,t}^W, LnY_t^N, \\ LnM_t^N, LnM_{j,t}^W, Q_{j,t-1}^R, LnG_t^N, LnG_{j,t}^W, \\ G_t^N - G_{j,t}^W, M_t^N - M_{j,t}^W \end{bmatrix}$$

Where (X/M) is the trade ratio, which is measured as the ratio of Nigeria's total exports to all her trading partners [US, Japan, China] over Nigeria's total imports from her trading partners, $Q_{j,t}^R$, is the real effective exchange rate, $Y^N(Y^W)$ are the domestic (world) real income measured as an index numbers to make them unit free, $M^N(M^W)$ are the domestic (world) ratios of real high powered monies to aggregate national output, $G^N(G^W)$ are the domestic (world) ratios of real government consumption to national output, Y_t is an *i.i.d.* normal error term and Ln denotes the natural log of a variable. All the variables are logged such that the parameter estimates would be interpreted as elasticities. The *VECM* is estimated in order to explore the response of trade balance to real exchange rate shocks in Nigeria.

By definition, Z_t is a $(p \times 1)$ vector of stochastic variables, i and k are the lag order and maximum lag length respectively, t is a time index and U is the vector of stochastic error terms. Π is an $[n \times n]$ impact matrix of long-run parameters among Z_t variables. The rank of Π determines the number of independent co-integrating vectors, say $r (< n)$. If this matrix is of full rank, all variables in the system are stationary and the model may be estimated with variables in levels. However, if the matrix is of zero rank, there is no co-integrating relationship among the variables and, hence, the model could be estimated in first difference without error-correction term. When the rank of the matrix lies in the interval $[0 < r < n]$, there are r linearly independent co-integrating vectors. Thus, matrix Π can be decomposed into two $[n \times r]$ dimensional matrices α and β , that is, $\Pi = \alpha\beta'$ where α is the vector of adjustment coefficients (the loading vector), and β is the vector of co-

integrating relations. In trailing the footsteps of Magee (1973), Miles (1979), Krugman and Obstfeld (2001) and Bahman-Oskooee (2005), it is theoretically expected that an increase in the real effective exchange rate will of the trade improve the trade ratio. Thus, the *J-curve* hypothesis suggests that the partial derivative of the trade ratio with respect to the real effective exchange rate will be negative in the short-run and positive in the long-run. This is adjudged on the ground that a real depreciation policy of the naira will encourage export and discourage imports. Accordingly, because of the price effect, currency depreciation will lead to a decrease in the export-import ratio in the short run [Miles (1979)]. In the long run, when the trade volume effect takes over, the trade ratio improves. This is in compliance with Krugman and Obstfeld (2001) argument that in the short run, import value effects prevail, whereas the volume effects dominate in the longer run. We expect a negative (positive) relationship between the trade balance and the growth of domestic (world) government consumption. Theoretically expected also, is a negative (positive) correlation between the trade balance and the growth of domestic (world) high powered money. The coefficient of domestic high powered money is expected to be negative because, an increase in domestic money stock lead to an increase in aggregate spending (including import spending) and increased imports deteriorate the trade balance Miles (1979) and Bahman-Oskooee (2005). However, Miles (1979) argued that the theoretically expected negative coefficient for the domestic high-powered money could turn positive if money constitute an insignificant proportion of the increase in aggregate wealth and also if such increase in wealth fails to generate significant increases in aggregate expenditure. At this point, it can be establish that the theoretical relationship between money growth and the trade ratio is far from being conclusive. This makes it imperative for us to agree with Douglasson (2009) that the need for more empirical tests of the aforesaid relationship is desirous and hence, the need for a study with a lengthened time series data set. The aggregate trade ratio is negatively correlated with domestic real income. This is because an increase in demand for foreign goods (imports demand) put much restraint on domestic income as such demand is offset by home government income. In the literature, the argument also hold that if an increase in domestic income is induced by increases in the production of import-substitution goods, imports could actually decrease [Magee (1973) and Bahman-Oskooee (2005)]. In this gaze, [ψ_3] will be positive. Thus, if the demand side factors dominate supply side factors, [ψ_3] will be negative and positive if the supply side factors exceed the demand side factors. An increase in world income growth leads to an increase in the exports of the domestic country and as such the coefficient of the world income [ψ_2] will report a positive sign. However, if world income increases due to an increase in the production of import-substitution goods in the trading partner

countries, then Nigeria's exports could decrease. By standard therefore, $[\psi_2]$ will be negative.

METHODOLOGY AND DATA

To empirically determine the response of the aggregate trade ratio to exchange rate shocks and subsequent dynamics, we utilized the *VECM* methodology under which we captured the direct and feedback effects of real exchange rate depreciation on the trade ratio. The direct effect on the trade ratio is demonstrated by taking the partial derivative of the trade ratio with respect to the real effective exchange rate. The feedback effects arise from a contemporaneous effect of the exchange rate on both the trade balance as well as the future exchange rate [Gupta-Kapoor and Ramakrishna \(1999\)](#). As practicalized in this study, the estimation of our *VECM* [equation 3.10], proceeded in four stages which include, sequential determination of the appropriate lag order (length) for each variable in the *VECM* and the degree of polynomial to be associated with the Almon lag structure, unit root test for each variable in the *VECM*, *VAR* co-integration test for all the variables in the *VECM*. Finally, we estimated the *VECM* to generate the generalized impulse response functions and trace out the potential J-curve effects for Nigeria country. Given that the existence of an error correction representation is a function of the co-integrating relations, the *VECM* is estimated in such a way that the error-correction terms (*ECT*) derived from the long-run co-integrating vectors are included as explanatory variables in the estimation process of equation (3.10) in order to recover all the long-run information that was lost in the process of differencing.

The generalized impulse response functions as developed by [Pesaran and Shin \(1998\)](#) are utilized in order to examine the pattern of dynamic adjustments that occurs in the short-run for possible determination of long-run relations in response to a range of standard error shocks in the exchange rate system. To further rationalize, the method of generalized impulse responses which are unique and invariant to the reordering of the variables in the *VAR* is employed to possibly trace out a curvature (curve effect) as regards the trade response to exchange rate shocks. The main thrust for using the selected methodology is to estimate the amount of the shocks in the real effective exchange rate to the forecast error of the aggregate trade ratio in Nigeria. The *augmented Dickey-Fuller (ADF)* due to [Dickey and Fuller \(1981\)](#) is engaged in the unit root tests. The [Johansen \(1988\)](#) and [Johansen and Juselius \(1990\)](#) *maximum eigenvalues and trace statistics* were utilized in the test for co-integration. The *maximum eigenvalue* test the null hypothesis that there are r co-integrating vectors against the alternative that there exist $r + 1$ co-integration vectors. The trace statistics on the other hand, test the null of $r = k$ [$k = 1, 2, \dots, n-1$] against the alternative of unrestricted r . The procedure is to determine the rank of the long-run matrix Π , which involves finding the number of linearly independent columns of Π . This in fact gives us the number of co-integrating relationships that exist amongst the variables in the study. Both the *maximum eigenvalue* statistics and the trace

statistics tests are standard likelihood ratio tests with non-standard distributions. The appropriate lag length selection is determined on the basis of the frequently adopted *Akaike Information Criterion (AIC)* and *Schwarz Bayesian Criterion (SBC)* due to their small sample properties as in the case of the present study. The *F-test statistic* is utilized in the determination of the polynomial degree. Our terms-of-trade measure is the trade balance expressed as a ratio of total exports to total imports. The advantage of this ratio is that it is insensitive to the unit of measurement. It also gives an exact measure of the *Marshall-Lerner* condition in logarithmic modeling [Boyd *et al.* (2001)]. According to Odusola and Akinlo (1995), the use of export to import ratio as dependent variable over trade balance is of the advantage that we can take logs without worrying for the possible negative values of the bilateral trade balance as in case of trade deficit. The US *GDP* volume index and M_3 monetary aggregate are utilized as proxy variables for world income and high-powered money stock respectively. The reason for choosing the United States income is none other than the significant role the US economy plays in world trade. The major sources of data used in this empirical work include the data bases of the International Monetary Fund and Central Bank of Nigeria.

ESTIMATION AND RESULTS

Results of Appropriate Lag Length and Polynomial Degree

The study employed the two most common methods for estimating the optimal lag length for a *VAR*. These include the *Akaike and Schwarz-Bayesian* information criteria. Both criteria reported an appropriate lag length of 2 series. We further conducted a sequential *F-test* for the determination of the degree of the polynomial having in mind that we imposed the *Almon lag structure* on the real effective exchange rate. Coincidentally, the degree of polynomial was found to be 2 just as the lag length. Based on these factors facilitated the unit root, co-integration, restriction tests and subsequent estimation.

Unit Root Test and Co-integrating VAR Analysis

At the preliminary stage of our empirical exploration, we examined the time series properties of the variables in the study using the classic augmented *Dickey-Fuller (ADF)* unit root tests. Results of these tests are summarized in Appendix A1. Critical examinations of *ADF* results show that all the variables of the model have unit roots at levels. However, the variables became stationary at first differences. By implication, the vector of variable is $I(1)$. Appendix A3 gives the co-integration results based on the *maximum eigenvalue and trace statistics*. To determine the co-integration rank; we estimated the *maximum eigenvalue statistics and the trace statistics* for the *VAR* model 3. Both tests indicated the existence of only one co-integration relationship amongst the variables in the study.

Linear Restriction Tests: Weak Exogeneity Tests on α

Given the rank of Π to be one, linear restrictions on α and β was tested. The linear restrictions test on α , the vector of adjustment coefficients is the weak exogeneity tests. The variable Z_{it} is weakly exogenous⁴ for β if and only if ΔZ_{it} does not contain information about the long-run parameters β . The weak exogeneity condition can thus be accomplished if the rows of α corresponding to that Z_{it} are equal to zero. Appendix A4 summarizes the results of these tests. Assessment of the results epitomizes the fact that *weak exogeneity* could only be accepted for the aggregate trade balance, real effective exchange rate and world income. *Weak exogeneity* is rejected for domestic income, domestic (world) ratios of real high powered monies to output, and domestic (world) ratios of real government consumption to national output.

Linear Restriction Tests: Exclusion Tests on β

The linear restrictions on β , the co-integration vector, are basically the exclusion restriction tests. This is tested in order to determine the long-run relationship amongst the parameters. Results of these tests are summarized in Appendix A5. We at the outset tested the exclusion of every variable from β . The results reveal that the exclusion of domestic income, the ratio of domestic (world) real high powered monies to output, and the domestic (world) ratios of real government consumption to national output are accepted at the one percent level. Thus we can conclude that in the long-run, real effective exchange rate and world income are the only variables that determine the aggregate trade ratio. The result of the restrictions on β simultaneously with the weak exogeneity restrictions is not rejected. This specification is however, adopted for our co-integration vector. The results for restricted co-integrating coefficient vector β , restricted adjustment coefficients vector α , and restricted long-run impact matrix Π arising from such specification is given in Appendices A6 through to A8. These results show that in the long-run real exchange rate and world income are the main variables that influence the aggregate trade balance in Nigeria. In particular, the co-integration analysis showed that a real depreciation of the naira improves the aggregate trade ratio in the long-run.

VECM Regression Analysis

The vector error correction results are presented in Appendix A9. The variables in the *VECM* are all in first difference with two lags based on the *ADF* unit root results of Table 3. The model is conditioned on domestic income, domestic (world) real high powered monies, domestic (world)

⁴ If a variable is weakly exogenous, it means that it is possible to dynamized a model on the basis of the variable, that is, condition the short-run dynamic model on that variable without any loss of information, and this provide parsimony. For the α and β vectors, see Appendix A2

real government consumption by using the weak exogeneity result of Appendix A4. Base on the Wald coefficient restriction test, all insignificant variables were dropped from the model and the parsimonious vector error correction results of Appendix A9 were obtained. The coefficients of adjustment are -0.6626, -0.8248 and -0.5628 respectively. Thus, adjustment to long-run equilibrium in the event of deviation is rapid. Close looks at the results show that domestic income, domestic (world) of real government consumption and domestic (world) high powered monies are not included in the model estimation since both the first and the second lags of the variables were extremely insignificant in all the equations. In the short-run, the estimated set of vector error correction results for the aggregate trade ratio reveals that in addition to the autoregressive terms, both lag values of the real effective exchange rate and the second lag of world income are the significant determinants of aggregate trade balance in Nigeria. Just as predicted by theory, the coefficient of world income is positive. This implies that an increase in the world income lead to an improvement in the Nigerian trade balance.

Even when the real effective exchange rate is dynamized, its coefficients in the trade equation turns out positive. By inference, real effective depreciation of the naira increases exports and lowers imports assuming the *Marshall-Lerner* condition is satisfied. By economic intuition, the country's aggregate trade effect of exchange rate shocks is not supportive of the predicted short-run J-curve effect. Thus, the aggregate trade balance does not deterioration in the short-run as made evident by the parsimonious short-run vector error correction estimates. In the real effective exchange rate equation, both first and second lags of the aggregate trade balance are significant and negative. In the main, the results point towards the fact that, an improvement in the trade balance in the short-run would cause a real appreciation of the Naira. This in essence indicates a feedback effect between the aggregate trade ratio and the real effective. The positive coefficients of the real exchange rates and the negative coefficients of the trade balance in the aggregate trade balance and real effective exchange rates equations have economic implications. By intuition, a real depreciation of the Naira (an increase in the real effective exchange rate) improves the trade balance. Consecutively, such improvement in the aggregate trade balance leads to a real effective appreciation (a fall in the real exchange rate); which in turn engenders deterioration in the country's aggregate trade balance, and again propels the real effective exchange rate to further depreciate. By inspection, cyclical effect of the exchange rate shocks is passed on to the aggregate trade balance. The error correction terms are significant and negative. This is an indication that there will be a short-run adjustment towards the long-run equilibrium value of the trade balance, exchange rate and world income.

Impulse Response Analysis

Generalized impulse responses⁵ are constructed as an average of present and the past, and the baseline for impulse responses is defined as the conditional expectations based on the history. These show the impact of one standard error shocks in the trade balance equation and real effective exchange rate equation respectively. An insight into the time profile of responses of the trade balance equation reveals that cumulative effect of real exchange rate shock is an improvement on the trade balance. Indeed, a real exchange rate shock will initially improve then deteriorate and then improve the aggregate trade balance. This is a contrary observation to the *J-curve* effect. If the *J-curve* hypothesis was to be valid for the Nigerian data, we would expect to see an initial decline (negative responses in the short-run) in the responses of the trade balance to a shock in the exchange rate and a later improvement (positive responses in the long-run) to portray the *J-curve* trend. Rather, what we observed is an initial improvement, then a worsening and an improvement and so on. Thus, a cyclical pattern emerges which approximately dies out after nine years. This is the feedback effect. In line with the feedback that we have earlier observed, a trade balance shock appreciates the real effective exchange rate of the Naira vis-à-vis the US dollar.

Diagnostics, Model Stability and Robustness Checks

The diagnostic results show that only the world income equation suffers a setback in terms of normality of the distribution of the residuals. All other estimated equations are devoid of the problems of autocorrelation or heteroskedasticity. For example, the *DW* test for autocorrelation is step down as it will be misleading in view of the fact that our *VAR* modeling contains lagged regressands on the right hand side of the model. In particular, the *LM* test for autocorrelation was employed. The results of the diagnostic checks are reported in Appendix A10. The stability of the *VECM* was tested based on the *CHOW* tests, *CUSUM* and *CUSUMSQ* plot of the recursive residuals. The plots are as shown in figures 1 and 2. This figure shows that all break-point lie within the 5% critical bands. Thus, the hypothesis of absence of parameter constancy and hence model instability cannot be valid for the estimated *VECM*. By implication, our estimated coefficients are stable over the sample period despite the fact that the country had earlier experienced a number of major events such as shift from import substitution to export-oriented industrialization strategy, shift from a de-facto dollar peg to a managed float exchange rate system and exchange rates liberalization that affected the variables in the model.

Synthesis

Our results reveal that a cyclical effect of the exchange rate shocks is passed on to the aggregate trade balance. Thus, the country's aggregate trade effect of exchange rate shocks is not supportive

⁵ For sake of brevity, the plot of the generalized impulse responses is omitted.

of the predicted short-run *J-curve* effect. In effect, the aggregate trade balance does not deteriorate in the short-run as made evident by the parsimonious short-run vector error correction estimates. This pattern does not support the classical *J-curve* hypothesis but rather in support of an *S-curve* pattern of Backus *et al.* (1994). These cyclical effects are consistent with those obtained by Akbostanci (2002) for the Turkish economy as against the findings of Marwah and Klein (1996) for the US and Canadian bilateral trade relations. Marwah and Klein (1996) found that there is a propensity for trade balance to worsen initially after a depreciation and then to improve, but after several quarters there appears to be a tendency to worsen again for both the US and Canada. The empirical evidence in the present study also corroborates the finding of Roberts (1995). Roberts (1995) finds an *S-curve* in terms of trade account dynamics. The co-integration analysis showed that a long-run relationship between the trade balance and the real exchange rate in Nigeria. This result is consistent with the long-run result found by Brada *et al.* (1997).

CONCLUSION

An attempt has been made in this paper to unravel the short-run and long-run response of aggregate trade balance to exchange rate adjustment in Nigeria on the basis of the *VECM*. The co-integration analysis shows a long-run relationship between the trade balance and the real exchange rate in Nigeria. The results of the study indicated a cyclical feedback between the trade balance and the real exchange rate depreciation of the Naira. However, the analysis finds no empirical evidence in favour of the short-run deterioration of the trade balance as implied by the *J-curve* hypothesis. Rather, what is empirically supported is the cyclical trade effect of exchange rate shocks. As it were, a real exchange rate shock will initially improve then worsen and then improve the country's aggregate trade balance. The instant improvement in the trade balance which is correlated with real depreciation provides no support for the *J-curve* hypothesis in the Nigerian trade balance. Hence, the short-run predictions of the *J-curve* are not observable in Nigeria and it can indeed be concluded that Marshall-Lerner condition does hold in the long-run for the Nigerian economy during the study period.

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APPENDICES

Appendix-A1.ADF Test for Unit Root

Variables	Level Relationship		Transformation Relationship		Critical Values	Decision
	Lag	Test Statistics	Lag	Test Statistics		
$Ln(X/M)$	2	-1.6266	2	-4.8892*	-3.5686	Stationary
$LnY_{j,t}^W$	2	-1.5224	2	-6.6842*	-3.5686	Stationary
LnY_t^N	2	-1.0068	2	-8.5482*	-3.5686	Stationary
LnM_t^N	2	-1.2466	2	-5.6642*	-3.5686	Stationary
$LnM_{j,t}^W$	2	-1.2509	2	-9.2276*	-3.5686	Stationary
LnG_t^N	2	-0.3828	2	-4.5202*	-3.5686	Stationary
$LnG_{j,t}^W$	2	-1.3562	2	-5.6502*	-3.5686	Stationary
$Ln(Q_{j,t}^R)$	2	-1.4642	2	-8.6446*	-3.5686	Stationary

Note: The ADF test equations include a constant and a trend. * indicates first difference stationary at the 99% level

Appendix-A2. Co-integration Test Results based on Rank (r) Determination for Π

H_0	H_1	Max. Eigen	99% CV	H_0	H_1	Trace Statistics	99% CV
$r = 0$	$r = 1$	54.28*	32.65	$r = 0$	$r = 1$	68.22*	60.55
$r \leq 1$	$r = 2$	33.82	38.62	$r \leq 1$	$r = 2$	44.62	58.66
$r \leq 2$	$r = 3$	20.42	30.22	$r \leq 2$	$r = 3$	36.44	50.28
$r \leq 3$	$r = 4$	18.92	26.84	$r \leq 3$	$r = 4$	30.48	42.65
$r \leq 4$	$r = 5$	16.42	22.22	$r \leq 4$	$r = 5$	28.32	34.52
$r \leq 5$	$r = 6$	10.26	18.84	$r \leq 5$	$r = 6$	20.24	30.26

Note: * indicates significance at the 99% level, CV represents critical value.

Appendix-A3. Vectors of Adjustment Coefficients and Co-integration Vector

$$\alpha = \begin{pmatrix} \psi_0 \\ \psi_1 \\ \psi_2 \\ \psi_3 \\ \psi_4 \\ \psi_5 \end{pmatrix} \quad \beta' = (\psi_6 \psi_7 \psi_8 \psi_9 \psi_{10} \psi_{11} \psi_{12})$$

Appendix-A4. Linear Restrictions on α , Weak Exogeneity Tests

Variable(s)	β Unrestricted, Rank = 1
$\ln(X/M)$	$\chi^2(1) = 56.262 [0.000000]^*$
$\ln(Q_{j,t}^R)$	$\chi^2(1) = 44.0562 [0.000006]^*$
$\ln Y_{j,t}^W$	$\chi^2(1) = 20.0064 [0.000000]^*$
$\ln Y_t^N$	$\chi^2(1) = 0.0028 [0.256622]$
$\ln[G_t^N - G_{j,t}^W]$	$\chi^2(1) = 0.6842 [1.866455]$
$\ln[M_t^N - M_{j,t}^W]$	$\chi^2(1) = 0.0262 [0.000048]$

* indicates significance at the 99% level

Restrictions	LR-Tests
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$\psi_6 = 0$	$\chi^2(1) = 42.4682 [0.000000]^{***}$
$\psi_7 = 0$	$\chi^2(1) = 52.6664 [0.860000]^{***}$
$\psi_8 = 0$	$\chi^2(1) = 6.0342 [0.000002]$
$\psi_9 = 0$	$\chi^2(1) = 0.0629 [0.000048]$
$\psi_{10} = 0$	$\chi^2(1) = 1.2262 [0.268585]$
$\psi_{11} = 0$	$\chi^2(1) = 0.2468 [0.006862]$
$\psi_{12} = 0$	$\chi^2(1) = 10.0096 [0.002224]^{***}$
$\psi_6 = \psi_7 = 0$	$\chi^2(1) = 46.246 [0.000000]^{***}$
$\psi_8 = \psi_9 = 0$	$\chi^2(1) = 2.5662 [0.000000]$
$\psi_{10} = \psi_{11} = 0$	$\chi^2(1) = 2.4652 [0.000000]$
$\psi_{10} = \psi_{11} = \psi_{12} = 0$	$\chi^2(1) = 38.2246 [0.000000]^{***}$
$\psi_3 = \psi_4 = \psi_5 = \psi_9 = \psi_{10} = \psi_{11} = 0, \psi_6 = 1$	$\chi^2(1) = 6.2456 [1.866455]$

* indicates significance at the 99% level

Appendix-A5. Exclusion Restrictions Tests on Π

Appendix-A6. Restricted Co-integrating Coefficients Normalized on $\ln(X/M)$

[Restriction: $\psi_3 = \psi_4 = \psi_5 = \psi_9 = \psi_{10} = \psi_{11} = 0, \psi_6 = 1$]

Standardized Eigenvector(s) β'						
$\ln(X/M)_{j,t}$	$\ln Q_{j,t}^R$	$\ln Y_{j,t}^W$	$\ln Y_t^N$	$\ln[G_t^N - G_{j,t}^W]$	$\ln[M_t^N - M_{j,t}^W]$	Trend
1.000	1.5628**	2.2064**	-1.0246	0.0000	0.0000	1.5644**
	[2.9962]	[12.458]	[-1.6405]			[26.546]

Appendix-A7. Standardized Coefficient(s)

Standardized Coefficient(s) for α

$\ln(X/M)$	-0.6556
$\ln Q_{j,t}^R$	-0.6484
$\ln Y_{j,t}^W$	2.8646
$\ln Y_t^N$	-1.0246
$\ln[G_t^N - G_{j,t}^W]$	0.0000
$\ln[M_t^N - M_{j,t}^W]$	0.0000

Appendix-A8. Restricted Long-Run Matrix with Rank, r = 1

Restricted Long-Run Coefficient Matrix [$\Pi = \alpha\beta'$] with Rank, r = 1

$Ln(X/M)$	$LnQ_{j,t}^R$	$LnY_{j,t}^W$	LnY_t^N	$Ln[G_t^N - G_{j,t}^W]$	$Ln[M_t^N - M_{j,t}^W]$	Trend	
$Ln(X/M)$	-0.6556	1.2682	1.0256	0.2468	0.0000	0.0000	1.2224
$LnQ_{j,t}^R$	-0.6484	0.0468	1.2622	1.0452	0.0000	0.0000	0.6428
$LnY_{j,t}^W$	2.8646	1.0625	1.2986	0.2852	0.0000	0.0000	2.0682
LnY_t^N	-1.0246	-0.0644	2.0922	-1.2264	0.0000	0.0000	1.0862
$Ln[G_t^N - G_{j,t}^W]$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
$Ln[M_t^N - M_{j,t}^W]$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix-A9. Parsimonious Short-run Dynamics, Vector Error Correction Results

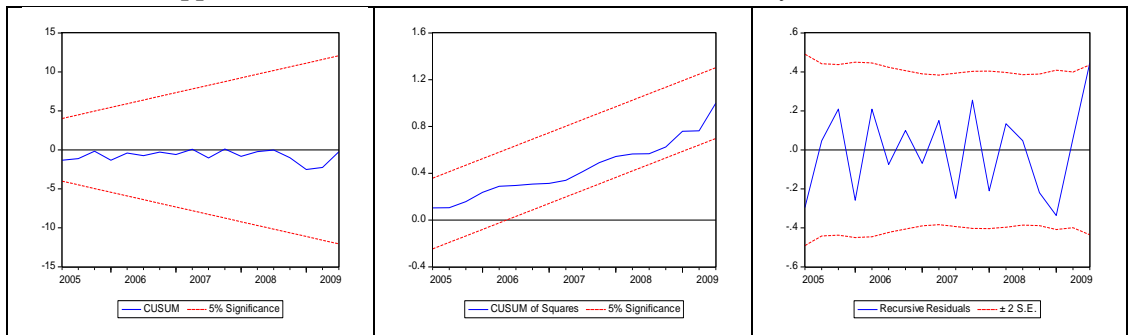
Coefficients	Equation 1	Equation 2	Equation 3
	$\Delta Ln(X/M)$	$\Delta Ln(Q_{j,t}^R)$	$\Delta LnY_{j,t}^W$
Constant	28.0226 [-8.0562]	8.5366 [-1.9926]	-89.3244 [-48.662]
$\Delta LnQ_{j,t-1}^R$	0.5824** [2.6862]	-1.0248** [5.2862]	0.5248 [1.8924]
$\Delta LnQ_{j,t-2}^R$	0.5826** [8.2325]	-1.0248** [-4.6266]	0.0628** [6.0246]
$\Delta LnY_{j,t-2}^W$	0.5824* [1.9426]	-1.0289 [1.4622]	0.5248** [2.9224]
ECM_{t-2}	-0.6626** [-8.0562]	-0.8248 [-5.2866]	-0.5628 [-2.0462]
$\Delta Ln(X/M)_{t-1}$	-1.5824** [-1.5446]	1.0289** [-5.4622]	-0.5248 [-1.9964]
$\Delta Ln(X/M)_{t-2}$	-1.6626* [-2.0562]	-2.0024** [-4.4426]	-0.5066** [-6.2262]

Vector Error Correction Model

$$ECM = Ln(X/M)_{j,t} + 1.5628**LnQ_{j,t-1}^R + 2.2064**LnY_{j,t}^W - 1.0246 LnY_t^N + 1.5644**Trend$$

**(*) indicates significance at the 99% and 95% levels respectively

Appendix-A10. Plot of CUSUM and CUSUMSQ Stability Test Statistics



Appendix-A11.Diagnostics Tests

Tests	Equation 1 F- statistics[Probability]	Equation 2 F-statistics[Probability]	Equation 3 F-statistics[Probability]
Normality	0.8624 [0.6862]	0.0248 [0.2002]	10.5248 [0.0000]*
ARCH	0.4802 [0.2325]	1.0248 [1.6266]	0.0628 [0.0246]
Ramsey RESET	1.6824 [0.8446]	0.4826 [0.2325]	1.0248 [1.6266]
LM Serial correlation	0.4224 [0.9426]	1.0289 [1.4622]	0.5248 [0.9644]
White Heteroskedasticity	0.6626 [0.0562]	0.8248 [5.2866]	0.6628 [2.0462]
Overall Model			
Tests		F-statistics[Probability]	
Normality		0.6624 [0.6862]	
ARCH		0.2026 [0.2325]	
Ramsey RESET		1.5424 [0.5446]	
LM Serial correlation		0.4424 [1.0426]	
White Heteroskedasticity		0.6626 [0.0562]	
*indicates non normality at the 99% level			