African Journal of Business Management Vol. 6(4), pp. 1760-1768, 1 February, 2012
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM11.1283
ISSN 1993-8233 ©2012 Academic Journals

Full Length Research Paper

Analysis of exchange rate fluctuations and external debt: Empirical evidence from Pakistan

Bashir Ahmad Fida*, Muhammad Majid Khan and Muhammad Khalid Sohail

Department of Management Sciences, COMSATS Institute of Information Technology Islamabad, Pakistan.

Accepted 1 November, 2011

The primary purpose of this study is to examine the relationship, with respect to the Pakistani economy, between exchange rates and external debt by utilizing quarterly data from the 1983:Q1 to 2008:Q4 period. Short-run and long-run nominal and real effective exchange rates and their respective equilibrium rates have been assembled. The long run equilibrium exchange rate has been determined by employing the natural real exchange rate (NATREX) model suggested by Stein et al. (1990). We applied the Johanson (1988) cointegration test to examine the long run cointegration relationships among exchange rates and the relevant exogenous variables in the Natrex model. After computing the deviation of exchange rate from its long run, the autoregressive distributive lag model (ARDL) was applied to examine the role of external debt in the fluctuation of exchange rate. The results suggest that there is a long-run cointegration relationship among the relevant variables in the Natrex model and there is a long run cointegration relationship between the exchange rate and external debt variables. We also checked the stability of the functions and performed diagnostic tests. Most of the tests suggested that the functions adopted for the analysis are appropriate and stable over time. Moreover, the obtained results are robust and in according to the predictions of the model.

Key words: Exchange rate, external debt, autoregressive distributive lag model (ARDL), methodology.

INTRODUCTION

Clearly, external debt is one of the significant variables that causes exchange rate to fluctuate over short period as well as longer period of time. A vast body of empirical studies and researches can be found that in detail have discussed the role of external borrowing in the fluctuations of exchange rate. The argument has been supported by Corsetti et al. (1999) and Kawai (2002), when they state that one of the major reasons of East Asian financial and currency crisis was heavy private commercial banks borrowings in late 1990s. The model of Cavallo et al. (2002) asserted that foreign currency denominated debt of an economy causes exchange rate fluctuations, influences capital inflows and outflows and in the process pushes national output during the crisis phase. Devereux and Lane (2001) proposed that external debt is one of the significant determinants of exchange rate fluctuations and their research finding showed that there was a negative relationship between exchange rate volatility and external debt stock.

Pakistan is a developing country with a small open economy and burgeoning and considerable external and domestic debt. Moreover, the problem is compounded with the fact that the external debt is denominated in foreign currencies. The major share of external debt is denominated and accounted in the U.S dollar. This study follows Reza and Victor (2005) in investigating and examining the role of external debt in exchange rate fluctuations in Pakistan, over 1983:Q1 - 2008:Q4.

LITERATURE REVIEW

The significance of this study is justified for several reasons. First, as per our knowledge and understanding, so far no empirical work has been done in the case of Pakistan which many a times have attempted to establish the relationship of external debt to exchange rate. This study attempts to determine the equilibrium exchange rate by employing the purchasing power parity (PPP)

*Corresponding author. E-mail: bashirFida@comsats.edu.pk. Tel: +92-321-9838448.

based nominal long run and natural real exchange rate (NATREX-based) long run equilibrium exchange rate. The application of NATREX approach is justified and quite appropriate in case of Pakistan. As discussed earlier, the country is a small economy which heavily depends upon external borrowings. Though there are few studies which incorporated some other fundamental variables in order to examine the exchange rate behavior, however, the external debt variable has not been incorporated by these studies. Additionally, the degrees of misalignment of spot nominal and real effective exchange rates have also been determined.

Theoretical underpinnings have been discussed prior to describing estimation procedure. To this end, we have constructed nominal effective exchange rate (NEER) and equilibrium of nominal effective exchange rate for short period. In addition, the long run equilibrium exchange rate is constructed by employing the NATREX approach (Stein, 1990). The difference between nominal effective exchange rate and long run nominal effective exchange rate (PPP- based) and the difference between NATREX-based real long run equilibrium exchange rate and real effective exchange rate is defined as fluctuations in exchange rate over the sample period.

Let us share that rigorous econometric techniques are employed in the estimation process. Time series characteristics of the relevant variables are examined by employing Augmented Dickey-Fuller (ADF) and PP-tests. Johanson co-integration technique (1980) was used to determine the long run co-integration relationship among the involving variables in NATREX model. Once the long run co-integration relationship was found, we estimated the NATREX-based long run equilibrium exchange rate. Autoregressive distributive lag model (ARDL) has been employed in examining the role of external debt in the fluctuation of exchange rate. The study found that the Pakistani rupee has been fluctuated from its long run equilibrium point, established by the above discussed measures, over the sample period.

The research has also investigated the short run and long run relationship between exchange rate and external debt by employing co-integration tests. The results proposed that there is a co-integration relationship between the exchange rate and external debt categories.

The research has also surveyed relevant studies that applied the approach in different economies in different time periods. For example, Stein (1995, 1997) applied the NATREX approach in the economy of the USA. Similarly, considering the terms of trade and world interest rate as given, Lin and Stein (1995) examined the NATREX approach for Australia, relatively small economy. The researchers assert that relatively small country, like Australia, has not been able to affect the terms of trade and world interest rate. Also, Stein and Sauernheiner (1996) and Federicied and Gandolfo (2002) adopted the NATREX approach in case of Germany and Italy, respectively. Additionally, Stein and Paladino (1999) applied the NATREX approach in case of France, and Gondolfo and Felettigh (1998) applied for Italy. The NATREX approach has also been adopted in the cases of developing countries, such as, Holger et al. (2002) applied in the case of China and Kardi (2003) applied in Hungry.

The research studies applied the NATREX approach in different time period for different economies. As discussed by Stein (1995), the Natrex approach is not just one model but rather the technique is a family of models that can be applied to alternative economies according to their characteristics. For example, the Natrex approach applied to U.S economy is totally different as that of Germany and Australia. This is because of the nature and scale of the economies and their influences over the world economy. The research has classified the U.S economy as a bigger economy that can influence terms of trade and interest rates. The German economy is considered a medium size economy. Likewise, the Australian economy is classified as a small open economy with given terms of trade and world interest rate.

Holger et al. (2002) applied a modified version of the Natrex approach in case of China. They incorporated internal migration and productivity variables in the approach and employed ARDL methodology to obtain the estimated results. The introduction of modern co-integration techniques makes easy for researchers to establish the long run co-integration relationship among the relevant variables.

In Euro Zone, Duval (2002) applied the Natrex approach by employing time series and Johansen co-integration among the relevant variables. The study, by assuming a single co-integration vector, applied Vector error correction model (VECM) and obtained long run relationship through Stock and Watson (1993) methodology. The obtained results inform us that the time preferences and the relative prices caused the most part of fluctuations of the exchange rate; while the technology variable affects modestly.

Finland Isabell Koske (2008) utilized a semi-structural method and estimated the Natrex model. The author concluded that the model worked appropriately and the predictions of the model are confirmed by the finnish data. The paper also underscores the advantages and disadvantages of the model both from a theoretical and an empirical viewpoint and evaluates it to other equilibrium real exchange rate approaches normally used in empirical research.

Similarly, Carmen (2003), following a general macro-economic approach, advocated a closed micro –founded structural model to determine the long run real exchange rate of a developed economy. Particularly, the analysis follows the structure of a Natrex model. The main contribution of this research paper is the development of a solid theoretical framework that in detail analysis the basis of the real exchange rate and explains the functions of the equilibrium dynamics after any shock influencing

the steady state. In our case, the inter-temporal factors derived from the stock flow relationship will be particularly determined. The main results of the paper can be summarized as following.

In first place, a complete well-integrated structural model for long-run real exchange rate determination is developed from first principles. Moreover, within the concrete dynamics of the model, it is found that some convergence restrictions will be necessary. On one hand, for the medium run convergence the sensitivity of the trade balance to changes in real exchange rate should be higher that the correspondent one to the investment decisions. On the other hand and regarding long -run convergence, it is also necessary that there exists a negative relationship between investment and capital stock accumulation and that the global saving of the economy depends positively on net foreign debt accumulation. In addition, there are interesting conclusions about the effects that certain shocks over the exogenous variables of the model have on real exchange rates.

All aforementioned studies have applied the NATREX approach in a one -country framework where the "rest of the world" is treated as given. However, Mariama and Daniela (2007) have extended one-country NATREX approach to two-country case and have constructed a two-country model considering USA and Euro zone as two big countries.

Reza and Victor (2005) have focused on the evaluation of rapid accumulation of external debt in the context of overshooting of exchange rate in Asian Countries. Whether the rapid growth of external debt has influenced the overshooting of exchange rate is the fundamental point of the analysis.

As noted by the authors that most of the previous studies are largely theoretical and hardly any study deals with the country-by- country case of the 1997 financial crisis-effected East Asian Economies. This is where the authors contribute the existing literature by empirically analyzing the possible role of external debt in explaining the fluxes in the local currencies of Indonesia, the Philippine, Thailand and South Korea during the pre- and post 1997 financial crisis.

Several attempts have been made recently to particularly examine the role of external debt/borrowing in explaining the fluctuations of the local currency. Corsetti et al. (1999) and Kawai (2002) have argued that external borrowings, particularly by private commercial banks and firms are among the key factors responsible for the severity of the East Asian financial and currency crises during the late 1990s. Taking into account the features of currency crises, Cavallo et al. (2002) developed a model that suggests that the size of foreign currency denominated debt of a country contributes to the occurrences of exchange rate overshooting, sudden stop of capital flows and output drop in the domestic economy.

Cavallo (2005) further argues that the exposure to foreign currency liabilities magnify the cost of exchange rate depreciation. Likewise, Devereux and Lane (2001) underline the need "to extend the list of variables important for understanding bilateral exchange rate volatility beyond those suggested by optimal currency area theory" (pp.27). Their study shows that for developing countries, in particular, volatility in their bilateral exchange rates is strongly and negatively affected by the stock of external debt.

Supporting the findings of those early studies, Calvo et al. (2003) find that the high debt level was partly responsible for the high swings of the real exchange rate of the Argentine peso during the collapse of the currency board regime in that country in January 2002. Combining insights from the third-generation currency crisis models with simple trade theories, Menzies and Vines (2004) have developed a model of exchange rate overshooting due to a debt service multiplier.

External debt role has been investigated in some other variables such as growth, foreign direct investment (FDI). For instance, Zahoor (2005) pin downs vital role of the emerging field of external debt and debt indicators in Turkish economy with emphasis on empirical relationship of external debt, debt indicators between growth, investment and exports over the period 1983 - 2002. The results suggest that the substantial raise in the stock of external debt put negative effect on investment, positive effect on exports and has no effect on growth. Moreover, the results imply that if policy maker wants to increase social welfare and growth, then it may be necessary to endow the political, military and social environment with appropriate enforcement devices with respect to the economy's targets, choices and preferences. Furthermore, results suggest that external debt and debt indicators has low effect on the improvement of Turkish economy, which is dominantly, influenced by political authorities and bureaucracy. In nut shell, the conclusion supports the idea that the setting of external debt by authorities must be disciplined which, in some instances is possibly over ruled by the structural adjustment programs, which can remove economic distortion, accelerate exports, growth and encourage external debt management.

RESEARCH FRAMEWORK

Theoretical underpinning

As we discussed in the introduction part, one of the primary objectives of the study is to examine the relationship of exchange rate to external debt. In this regard, we have adopted the NATREX approach (Stein, 1990) to determine the real equilibrium exchange rate and examine the role of external debt in the fluctuations of exchange rate to its equilibrium point for the economy of Pakistan over the period of 1983:Q1 -2008:Q4.

The NATREX approach offers an alternative paradigm, among other approaches, for the determination of real exchange rate equilibrium. The equilibrium concept proposes simultaneous internal and external equilibrium

and explains the behavior of fundamental variables that are main driving forces behind the investment and saving decision in the absence of cyclical factors, speculative capital movements and international reserves movements.

The salient features of the NATREX approach are; the identification and modeling the fundamental variables; thrift, productivity, capital intensity, and net debt to foreigners which influence desired long-term capital flows and fluctuate real exchange rate equilibrium.

The plunge in thrift lowers desired savings and an increase in the marginal product of capital raises desired investment that leads to new borrowing from foreigners. The usage of the borrowings determines how the country grows over time, whether wealth and consumption would tend to rise or fall in the long run. The NATREX theory proposes the following two outcomes:

i) When the borrowing funds are utilized in financing new consumption, in the long run perspective, wealth and consumption will decrease and the economy would face higher net debt and large interest payments to foreigners.
ii) If the borrowing from foreigners is used to finance new investment, long-run wealth and consumption will go up and borrower country can be turned into creditor one. In our case we consider the former case where the borrowing is mostly used to finance the new consumption.

The NATREX approach is not a single model rather; we can say broadly, a family of NATREX models that posses a number of common attributes.

A great deal of empirical studies already has adopted the NATREX approach in their context to explain the medium-long term dynamics of the real exchange rate. Primarily the NATREX approach distinguishes from other approaches in the sense of modeling and examining the behavior of equilibrium exchange rates. For instance, other approaches such as PPP etc, examine the equilibrium exchange rate in long-run sense. Whereas the NATREX approach approaches the equilibrium exchange rate in medium to long run trajectory. Therefore, the main difference between the NATREX approach and other approaches is how the trajectory of real exchange rate is considered in respective approach.

Theoretical context encircles the goods and services market, money market and international asset market. The international asset market is incorporated with the help of uncovered interest parity condition. According to the empirical findings of Obstfeld and Rogoff (1998), that the risk premium is significantly large in foreign exchange market. This point supports us to modify the basic Dornbusch (1976) model by incorporating risk premium into the uncovered interest parity. The risk premium is influenced by the size of the external debt of any economy. The excess of external debt causes high risk premium and depreciation of the domestic currency. The size of the external debt is taken as exogenous in the study.

Given the aforementioned short theoretical explanation, the study proceeded to its empirical step. Given the fact that Pakistan is a small open economy having multiple trade partners, the study adopted the nominal effective exchange rate (NEER) index. The nominal effective exchange rate is constructed as the trade weighted sum of the nominal exchange rate of Pakistan rupee against its major trade partners. These top trade partners comprise 68% of total trade. The nominal effective exchange rate (NEER) can be stated in the following equation:

$$\mathrm{NEER} = \sum_{i=1}^{N} \omega_i \, \mathrm{ER}_i \qquad (1)$$

Where, NEER is the domestic nominal exchange rate, ω_i,denotes the trade weight allocated to each bilateral nominal exchange rate of Pakistan Rupee against the trading partner (i) currency (ER_i).The trade weighted weight is calculated as the percentage share ratio of the trade of each trade partner country (i) with Pakistan .The rise in NEER and ER_i leads to the depreciation of the domestic currency. The long-run nominal effective exchange rate($\bar{e}$) can be generated by using the Purchasing Power Parity (PPP) concept. This is captured in the following equation:

$$e = \sum_{i=1}^{N} \omega_i \left[\frac{P}{P^*}\right] \qquad (2)$$

As defined earlier P and P* are the domestic and trade partner price level that is consumer price index (CPI) respectively.

Long run NATREX- based equilibrium exchange rate

First, we calculate the real effective exchange rate using the nominal effective exchange rate as follows:

$$\mathrm{REER} = \sum_{i=1}^{N} \omega_i \ \mathrm{RNER}_i \qquad (3)$$

Where, RNER_i denotes the real nominal exchange rate of domestic currency against the foreign currency. On the other hand, the long run real exchange rate is calculated by employing NATREX model.

The basic general equilibrium framework of the NATREX approach explains the dynamics of medium to long-run real exchange rate. In general, there are four endogenous equations in the basic NATREX model. The first equation is about current account, where the size of current account is equal to national saving minus national consumption. The second equation explains the uncovered interest parity condition. In the medium run,

the NATREX equilibrium real exchange rate satisfies two equations. The transition to the long run equilibrium is obtained by considering the dynamics of endogenous fluctuations in capital and foreign debt. Therefore, the accumulation of capital and external debts will directly influence investment and saving in the economy.

Three exogenous variables have been listed in basic Natrex model as the fundamental determinants of the movements of key variables included in the endogenous equations (namely investment, saving, flows of external debt and capital). The first one is the social thrift or time preference variable. The variable can be represents by the sum of private and government consumption. The second variable is productivity and the third variable is terms of trade.

In order to obtain the Natrex equilibrium values, we obtained the estimated values of the exogenous variables by estimating the following equation.

$$RER = \beta_0 + \beta_1 TOT_i + \beta_2 GOV_i + \beta_3 PRD_i + \mu_i \quad (4)$$

The signs of the coefficients of the Equation 4, can be explained as follows: the sign of the terms of trade variable can be negative or positive. As explained by Edwards (1988b), and Edwards and Wijnbergen (1987), dynamic changes in terms of trade generate inter-temporal income and substitution effects. An income effect exists when an increase (decrease) in export (import) prices, ceteris paribus, raises domestic income, which is spent both on tradable and non-tradable goods. With the prices of tradable being exogenous to the system, the prices of non-tradable will increase in relative terms, thereby causing the real exchange rate to appreciate via improvements in current account balance (spending effect). On the other hand, the substitution effect, in case of increase in export prices, shifts the foreign demand away from domestic exports, thereby causing the production of exports to fall. This moves the factors of productions away from tradable to non-tradable. This will reduce the prices of non-tradable in relative terms and hence result in depreciation of domestic currency in real terms through trade deteriorations.

The effect of government expenditure on real exchange rate depends upon whether it is utilized for the consumption of tradable or non-tradable goods. If government utilizes most of the funds to purchase non-tradable, relative price of nontradables to tradable increases and real exchange rate will appreciate via current account improvements (Connolly and Devereux, 1995; Edwards, 1988a).

Otherwise, if government purchases mostly imported goods then relative prices of tradable to non-tradables increases and real exchange rate will depreciate through incipient trade deficit. The empirical literature, however, seems to suggest that the share of government expenditure towards non-tradable outweighs that of tradable, thereby predicting a negative sign of the co-efficient (Baffes et al., 1999; Elbadawi, 1994; Mongardini, 1998). As the current account worsens, the real exchange rate will depreciate in the long run, so its sign would be positive. Similarly, the sign of the productivity can be negative and positive. An increase in the productivity is expected to improve the current account balance and appreciate the real exchange rate, and it can be persistent even in the long run. On the other hand, if productivity decline then real exchange rate can be depreciated.

We estimated the Equation 3 and obtained the Natrex equilibrium exchange rate by inserting the regression estimates of coefficient in Equation 5.

$$LN\ Natrex = \hat{\beta}_0 + \hat{\beta}_1 TOT_i + \hat{\beta}_2 GOV_i + \hat{\beta}_3 PRD_i \quad (5)$$

The size of overshooting and undershooting in case of short run and long run nominal effective exchange rate can be obtained by getting the deviations of exchange rates from their respective equilibrium levels. For this purpose the following mathematical notation is used.

$$(\Delta er_t - \Delta \bar{e}r_t) \quad (6)$$

Δer_t and $\Delta \bar{e}r_t$ are the quarterly percentage changes in the spot and the long-run equilibrium exchange rate of the local currency, respectively. $(\Delta e - \Delta \bar{e}) > 0$, is the case of overshooting of spot exchange rate. On the other hand, $(\Delta e - \Delta \bar{e}) < 0$ denotes the undershooting case.

Similarly the fluctuations in the real exchange rate can be obtained from the difference of Natrex based long-run equilibrium exchange rate and real effective exchange rate. After establishing the overshooting or under-shooting, we use two types of external debt data from Pakistan Economy and investigate the role of external debt in exchange rate fluctuations. The available data series are: 1) Public and publically guaranteed debt, 2) private non-guaranteed debt plus loan from IMF. We employed autoregressive distributive model (ARDL) for the analysis. The ARDL procedure for estimation is specified as follows:

$$(\Delta er_t - \Delta \bar{e}r_t) = \beta_0 + \beta_1 (\Delta er_t - \Delta \bar{e}r_t)_{t-1} + \sum_{i=0}^{q} \theta_i \Delta PGD_{t-i} + \sum_{i=0}^{q} \lambda_i \Delta PVD_{t-i} + \mu_t \quad (7)$$

Where $(\Delta er_t - \Delta \bar{e}r_t)$ indicates the exchange rate deviations from its equilibrium rate.

PGD = Publically guaranteed debt; PVD = privately held debt and μ_t = Error term

Table 1. Unit root tests for NATREX model.

Variable	ADF test	PP test	Conclusion
Model without constant and without trend[a]			
$Ln(TOT_t)$	-0.942	-1.074	Non-stationary
$\Delta ln(TOT_t)$	-4.46*	-4.314*	Stationary
$ln(GOV_t)$	4.465	7.222	Non-stationary
$\Delta ln(GOV_t)$	-4.277*	-7.848*	Stationary
$Ln(PRD_t)$	1.521	2.443	Non-stationary
$\Delta ln(PRD_t)$	-2.122*	-2.622*	Stationary
Model with constant and without trend[b]			
$ln(TOT_t)$	-2.298	-1.770	Non-stationary
$\Delta ln(TOT_t)$	-4.862*	-4.427*	Stationary
$ln(GOV_t)$	-1.381	-1.782	Non-stationary
$\Delta ln(GOV_t)$	-5.682*	-7.148*	Stationary
$Ln(PRD_t)$	-0.290	0.394	Non-stationary
$\Delta ln(PRD_t)$	-3.195*	-3.134*	Stationary
Model with constant and trend[c]			
$ln(TOT_t)$	-2.864	-2.3400	Non-stationary
$\Delta ln(TOT_t)$	-5.378*	-4.335*	Stationary
$ln(GOV_t)$	-2.670*	-3.120*	Non-stationary
$\Delta ln(GOV_t)$	-5.916*	-7.550*	Stationary
$Ln(PRD_t)$	-1.712	-1.199	Non-stationary
$\Delta ln(PRD_t)$	-4.721*	-3.768*	Stationary

[a]MacKinnon critical values for 1, 5 and 10% are -2.58,-1.94 and -1.61, respectively; [b]MacKinnon critical values for 1, 5 and10% are -3.73, -2.99 and -2.63, respectively; [c]MacKinnon critical values for 1, 5 and 10% are-4.39,-3.61and -3.23,respectively; * indicates that the variable is significant at 5% level.

DATA DESCRIPTION, ESTIMATION AND RESULTS

As stated earlier, we employed the quarterly data from 1983-Q1 - 2008-Q4 of Pakistan economy in our study. The data of main variables are extracted from International Financial Statistics (IFS) of International Monetary Fund (IMF) CD- ROM (2007) and online version. The nominal and effective exchange rates have been constructed by considering trade weights of major trade partners. The details are given in the appendix. The descriptions of other variables are also given in the appendix.

In estimating the data, we employed unit root tests, Johanson (1988) cointegration test, and autoregressive distributive lag specification (ARDL).

NATREX equation results

Before, obtaining the NATREX-based equilibrium real exchange rate, we checked the stationarity order of the relevant variables. We employed ADF test and PP test along with exchange rate, for exogenous variables; government and private spending, productivity and external terms of trade. The results are given in the Table 1.

The results of Table 1 postulate that the concerned variables in the NATREX equation are stationary at first difference. This fulfills the basic requirement of the usage of Johanson (1988) cointegration technique to exhibit the long run relationship among the variables. So, we applied the Johanson cointegration test and the results confirmed the existence of at least one cointegration vector. The results are given in the appendix.

After, the confirmation of the long run co-integration relationship among the variables, regression has been run and the results are reported in the Table 2. The estimated coefficients can be explained as follows: Coefficient of government consumption has a significant positive sign. It indicates that the Pakistan government has spent most of the funds to purchase non-tradable, which in turn has depreciated Pak-rupee in real terms via current account deficit.

Similarly, the real exchange rate is significantly negatively affected by terms of trade, suggesting that spending effect of this variable dominates substitution effect. The estimated elasticities are plausible in the light of existing literature.

The productivity coefficient is negative and insignificant, this indicates that improvement in the productivity,

Table 2. Regression results of REER and exogenous variables.

Variable	Coefficient	t-Statistic	Prob
Constant	6.0338	19.328 (0.31217)	0.000
TOT	-0.1936	3.0836* (0.06281)	0.0026
PRD	-0.0177	0.2943 (0.06035)	0.769
GOV	-0.8120	9.8895* (0.0821)	0.000
R-squared	0.851086	Mean dependent var	2.086486
Adjusted R-squared	0.846619	S.D. dependent var	0.094751
S.E. of regression	0.037108	Akaike info criterion	-3.712253
Sum squared resid	0.137702	Schwarz criterion	-3.610546
Log likelihood	197.0372	Hannan-Quinn criter.	-3.671048
F-statistic	190.5094	Durbin-Watson stat	2.167472
Prob(F-statistic)	0.000000		

Table 3. Johanson cointegration results.

Ho: No C.R	Eigen-value	Trace statistic	Critical value 5%	Critical value 1%	L-max statistic	Critical value 5%	Critical value 1%
r=0	0.316	52.87*	29.68	35.65	38.47*	20.97	25.52
r≤1	0.102	14.40	15.41	20.04	10.87	14.07	18.63
r≤2	0.034	3.528	3.76	6.65	3.52	3.76	6.65

The critical values are reported from Osterwald-Lenum, given by E-views-6. The trace statistic tests the null of r co-integrating relations against the alternative of N co-integrating relations, where N denotes the number of endogenous variables. On the other hand, the maximum eigen-value (L-max) statistic tests the null hypothesis of r co-integrating relations against the alternative hypothesis of R+1 co-integrating relations and proceeds sequentially for R=0,1,…..,m-1. The first row (R=0) tests the null hypothesis of no co-integration and the second row (R≤1) tests the null of at most one co-integrating vector. * denotes the significant level at 5%.

generally, concentrated in the tradable sector and thus leads to an appreciation.

By using the estimated values of coefficients, we calculated the values for NATREX and consequently obtained the size of overshooting of the exchange rate by differentiating the real effective exchange rate from the NATREX-based long-run real exchange rate.

Based on Equation 6, the size of the real and nominal effective exchange rate fluctuations was estimated by taking the difference between $(\Delta e - \overline{\Delta e})$. Δe and $\overline{\Delta e}$ are the quarterly percentage changes in the spot and the long-run equilibrium exchange rate of the local currency, respectively. In a nutshell, an overshooting situation occurs when the spot rate of the local currency has weakened further than the long-run fundamentally determined equilibrium rate or the spot rate has not strengthened as strongly as the long-run equilibrium rate. The opposite circumstances are true for the undershooting cases.

Our findings suggested, the presence of overshooting and undershooting of Pakistan exchange rate during the sample period. The graph given in the appendix shows the deviation of the real exchange rate from its equilibrium exchange rate. The real exchange rate for Pakistan has been undervalue in some period of time and also has been remained overvalued in some other point of time.

Application of co-integration tests

It has been elaborated previously in methodology that two categories of debt have been taken into account; public and publicly guaranteed debt, private non-guaranteed debt plus loan from IMF. The data extracted from the State Bank of Pakistan and World Development Indicators (WDI) for this purpose. We expressed the series as the percentage of GDP shares to examine the relative size of external debt with respect to overall economy.

Before proceeding to estimation process, we first checked the stationarity of the variables using ADF and PP unit-root tests. The results are given in the appendix. All variables are found to be integrated of order one. Findings indicate that the estimated equation can form a long-run relationship of exchange rate overshooting with all explanatory variables.

To examine the long run co-integration relationship between the fluctuations in exchange rate and the categories of external debt, we apply the Johanson cointegration technique and the results are also given in the Table 3.

Table 4. ARDL results.

Dependent variable ($\Delta er_t - \Delta \bar{er}_t$)	ARDL lag order (0,1,1)
Constant	-0.108(-1.93)*
PVD	-0.092(-2.14)*
PGD(-1)	0.311(2.007)*
($\Delta er_t - \Delta \bar{er}_t$)(-1)	0.912(22.87)*

Adjusted-R Square : 0.84; FF Ramsey Test: χ(1)=0.34 [0.55]; DW-statistics 1.84; Serial correlation LM test: χ^2 (=1.03 [0.35]. Heteroscedasticity B.P.G Test: χ (2)=1.30 [0.19]Note: i). *, denotes 5% of the significant level. Ii). The numbers in parenthesis are t-statistics. Iii). The numbers in the brackets are p-values of the diagnostic tests.

The Johanson co-integration results revealed that, a long run co-integration relationship exists among the fluctuations in exchange rate and external debt. To verify, the findings of Johanson test, we also applied the Wald-based F-test suggested by Pesaran et al. (2001). The calculated F-statistics are greater than the critical F-statistics drawn by Pesaran et al. (1996, 2001). So the test reinforces the outcome of Johanson co-integration test. The results are given in the appendix 1.

We employ the general to specific single equation approach of Hendry (1976) in the estimation of the following the autoregressive distributive lag (ARDL) specification to examine the short run impact of the external debt on the fluctuations of exchange rate. The following equation has been estimated:

$$\left(\Delta er_t - \Delta \bar{er}_t\right) = \beta_0 + \beta_1\left(\Delta er_t - \Delta \bar{er}_t\right)_{t-1} + \sum_{i=0}^{q} \theta_i \Delta PGD_{t-i} + \sum_{i=0}^{q} \lambda_i \Delta PVD_{t-i} + \mu_t \quad (8)$$

Where $(\Delta er_t - \Delta \bar{er}_t)$ indicates the exchange rate deviations from its equilibrium rate. *PGD*= Publicly guaranteed debt; *PVD*= privately held debt and μ_t= Error term.

The expected signs for the coefficients, θ_i and λ_i, are positive, as external debt increases, it causes exchange rate to deviate from its equilibrium level. β_1 demonstrate the rate of adjustment and it can be positive or negative. The estimated results are given in the Table 4. We choose the maximum of four lags for the estimation, and only significant coefficients are reported.

The obtained coefficients for all explanatory variables found to be in line with the projection of the theoretical model discussed earlier. The sign of publicly guaranteed debt is positive and significant. This reveals that an increase in it leads to increase in the deviation between the spot exchange rate and the long run equilibrium exchange rate. The deviation via risk premium leads to the depreciation of the real exchange rate substantially. This finding is realistic and much near to the actual situation of the Pakistan economy. Pakistan's currency over the few years has been depreciated at a substantial pace. The sign of privately held debt variable is negative. Though, it influence the deviation as other way round as compare to public held debt, but its magnitude is very small. The adjustment coefficient demonstrates no adjustment process at least in short run period. Though, there are some other variables that affect the exchange rate, but we consider all those variables as constant for simplicity to reach any conclusive decision.

Another worth mentioning finding is that publicly held external debt influence exchange rate fluctuation more substantially due to its massive size. Our results overwhelmingly support the propositions of the theoretical model. We perform a battery of diagnostic tests in order to check the stability and robustness of the coefficients.

Some other findings are very robust to incorporate in discussion. The diagnostic tests, including Durbin-Watson and Adjusted R-square, serial correlation LM test, functional form test and heteroscedasticity test propagate the robustness of the obtained results. Serial correlation LM and D.W test indicates that there is no serial correlation in the regression. The ARDL methodology is superior as compare to some other estimation technique, especially in our case when the problem of endogeneity and omitted variables can be present.

Conclusion

The relationship between exchange rate and the external debt is examined. The researchers utilized short run and long run nominal and real effective exchange rates and their respective equilibrium rates have also been constructed. The long run equilibrium exchange rate has been determined by employing the natural real exchange rate (NATREX) model.

The research results suggested that there is a long run co-integration relationship among exchange rates and external variables, terms of trade, government and

private consumption and productivity. The terms of trade and government consumption affects the real exchange rate significantly, while productivity variable has turned out to be insignificant.

The research has identified fluctuations from equilibrium exchange rates. The research indicates that incidence of overshooting and undershooting are present in the spot rates relative to the long run equilibrium rates. Moreover, the study has investigated the short run and long run relationship between exchange rate and external debt by employing co-integration tests. The results suggest that there is a long co-integration relationship between the exchange rate and external debt categories. The study shows that the increase in external debt fluctuates the exchange rate through the risk premium and therefore, depreciates the real exchange rate over time.

Our research results are robust, realistic and in line with the theoretical assumptions. Moreover, the results suggest the policy implications for burgeoning and to some extend unbearable external debt economies such as Pakistan. To achieve the commercial policy objectives, policy makers have to heed towards the stability of exchange rate. External debt can help the economy to overcome its bleak economic condition, but this can be a curse if the usage becomes unproductive. Most of developing countries, like Pakistan, where institutional soundness is vulnerable and line share of external borrowing turn out to be unproductive and unbeneficial. In this situation the blessings of external borrowing change to curse and accumulate the external liabilities and make a nation vulnerable to repay its loan in the future. Moreover, the credibility of the nation is also affected which can ultimately influence the overall economic scenario.

Pakistan, like most other developing countries, heavily depends on imports of manufacturing goods, oil and petroleum products and other commodities. The depreciation of the domestic currency ultimately raises the import price in terms of domestic currency and penetrates the effect into the domestic inflation. This phenomenon not only impedes the development process but also impairs the purchasing power of a lay man.

REFERENCES

Calvo GA, Izquierdo A, Talvi E (2003). Some Stops,The Real Exchnage Rate, and Fiscal unstainability: Argintina'slessons, NBER Working Paper, No. 9828

Cavallo M (2005). To Float or Not to Float/ Exchange Rate Regimes and shocks, The federal Reserve Bank of San Francisco (FRBSF) Econ. Lett., No. 20005-01

Cavallo M, KisselevK, Perry F, Roubini N (2002). Exchange Rate overshooting and the Costs of Floating, mimeo, New York University.

Connolly M, Devereux J (1995). "The Equilibrium Real Exchange Rate: Theory and Evidence for Latin America", in J. L. Stein, P. R. Allen and Associates (Eds.), Fundamental Determinants of Exchange Rates, (Oxford University Press, New York 1995), pp. 154-181.

Corsetti G, Pesenti P, Roubini N (1999). What caused the Asian Currency and Financial Crises? Jpn. World Econ., 11: 305-373

Devereux MB Philip RL (2001). "Exchange Rates and Monetary Policy for Emerging Market Economies," CEPR Discussion Paper, No. 2874

Dornbusch R (1976). Expectations and Exchange Rate Dynamics. J. Pol. Econ., 84: 1161-1176.

Duval R (2002). What Do We Know about Long Run Equilibrium Real Exchange Rates? PPPs vs Macroeconomic Approaches, Australian Econ. Papers, 41(4): 382-403.

Edwards S (1988b). Exchange Rate Misalignment in Developing Countries, Baltimore and London: Johns Hopkins University Press

Edwards S, Wijnbergen SV (1987). Tariffs, the Real Exchange Rate and the Terms of Trade: On Two Popular Propositions in International Economics. Oxf. Econ. Papers, 39: 458-464.

Elbadawi IA (1994). Estimating Long-Run Equilibrium Real Exchange Rates, in J. Williamson (ed.), Estimating Equilibrium Exchange Rates, Institute for International Economics, Washington D.C., pp. 93-131.

Federici D, Gandolfo G (2002). Endogenous Growth in an Open Economy and the NATREX Approach to the Real Exchange Rate: The Case of Italy. Austr. Econ. Papers, 41(4): 499-518.

Gandolfo G, Felettigh A (1998). The NATREX: An Alternative Approach, CIDEI Working Paper, No. 52, Universita di Roma, La Sapienza.

Holger VE, Liu ED, Romyn BG, Yang XG (2001). NATREX and Determinants of the Real Exchange Rate of RMB. J. Syst. Sci. Complexity, 14(4): 356-372.

Isabell K (2008). A Semi-Structural Method to Estimate the NATREX for a Small Open Economy. The Case of Finland. Appl. Econ. Q., 54(2): 73-93.

Johansen S (1988). Statistical Analysis of Cointegrating Vectors. J. Econ. Dyn. Control, 12: 231–254.

Kawai M (2002). Bank and Corporate Restructuring in Crisis-Effected East Asia: From Systematic Collapse to Restructuring, in G. De Brouwer (ed),Financial Markets and Polices in East Aia, London: Routledge

Lin GC, Stein JL (1995). The Dynamics of Real Exchange Rate and Current Account in a Small Open Economy: Australia, in J. L. Stein, Allen PR (Eds.), Fundamental Determinants of Exchange Rates, Oxford University Press.

Mariama KT, Daniela V (2007). Stiglitz versus the IMF on the Asian Debt Crisis: An Intertemporal Model with Real Exchange Rate Overshooting University of Oxford, Centre for Economic Policy Research (CEPR).

Mongardini J (1998). Estimating Egypt`s Equilibrium Real Exchange Rate IMF Working Paper 98/5.

Obstfeld R (1998). Risk and Exchange Rates,NBER Working Paper No. w6694.

Pesaran M, Hashem YS, Rechard JS (2001) Structural Analysis of Vector Error Correction Models with Exogenous I Variables. J. Econom., 97: 293–343.

Pesaran MH, Shin Y, Smith RJ (1996). Testing for the existence of a long run relationship.In DAE working Paper, V.9622, Department of Applied Economics, University of Cambridge.

Reza YS, Victor P (2005). External Debt and Exchange Rate Overshooting: The Case of Selected Asian Countries, Working Paper 2005-14, University of Adelaide, Australia.

Stein JL, Paladino G (1997). Recent developments in international Finance: A Guide to Research, J. Bank. Finan., 21: 11-12

Stein JL Paladino G (1998). Recent Developments in International Finance: A Guide to Research, J. Banking Financ., 21: 1685-1720.

Stein JL (1990). The Real Exchange Rate, J. Banking. Financ., 14 (5): 1045-1078.

Stein JL (1995). Determinants of Real Exchange rate, Washington. D.C.

Stein JL (1995).The Fundamental Determinants of t he Real Exchange Rate of the US Dollar relative to Other G-7 Countries, IMF working Paper, W /P/95/81, Washington. D.C

Stein JL, Sauernheimer KH (1996). The Equilibrium Real Exchange Rate of Germany. Econ. Syst., 20: 97-131

Stock J, Watson M, (1993). A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica, 61(4): 783-820.

Zahoor HJ Ahmet S (2005).External Debt: Some Experience From Turkish Economy, J. Appl. Sci., 5(2): 363-367,