Determinants of Exchange Rates: A Case Study of SAARC Countries

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Abstract

The exchange rate is an important ingredient in designing the monetary and commercial policies. However, the existing literature does not have consensus on the determinant of the exchange rate. Different researchers have found a different set of determinants based on different theoretical models. In order to develop a consensus on the determinants of exchange rate this study applies general to specific and encompassing approach on the data from 1980 to 2013 for SAARC countries. In addition, we also have applied panel co-integration and error correction techniques to find out long-run and short-run relationship between exchange rate and the factors determining the exchange rate. Our findings show that foreign exchange reserves, relative money supply, relative interest rate, trade balance and real income are significantly correlated with the nominal exchange rate both in the long run as well as the short run. We find that the equilibrium exchange rate for SAARC countries is determined by the relative money supply, trade balance, foreign exchange reserves relative income and relative interest rate. Furthermore, using Granger causality test we found two-way causality between exchange rate and foreign exchange reserves. Bidirectional causality also exists between exchange rate and relative interest rate.

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1. Introduction

The exchange rate plays an important role in determining the level of competitiveness of different economies by affecting the volume of trade, capital mobility, foreign direct investment and the economic development. Moreover, the exchange rate has attained great importance in macroeconomic policy

discussions after the breakdown of fixed exchange rate system in the early 1970, which worked since the Bretton Woods conference (1944). It is widely acknowledged that stability in exchange rate ensures macroeconomic stability which formats economic growth. Therefore, the exchange rate attracts significant attention in macroeconomic policy discussions. Several studies including Freund and Warnock (2007) found that current account deficit is also associated with the exchange rate. Exchange rate management has been proven to be an important element in stabilization of external imbalances (Kutan & Dibooglu 1998). Therefore, the exchange rate behavior occupies a central role in policy evaluation and design (Edwards 1989). Thus, keeping in view the importance of exchange rate, it becomes important to explore its behavior and to know how it is being determined. In this regard, while explaining the importance of exchange rate Kia (2013) states that the fundamental determinants of exchange rate are not known. According to Della Corte et al. (2013), fundamentals matter a lot for exchange rates, they showed that nominal fundamentals are more important than real fundamentals. Gallego et al. (2019) found that exchange rate regimes also impact flows of goods between different countries.

In spite of the importance of the exchange rate in international economics for economic stability, a set of determinants that explain long term and short term dynamics of exchange rate is still controversial. Some studies use one or more macroeconomic variables and some have used fiscal variables as determinants of exchange rate (Abbas et al. 2011; Khan & Qayyum 2008; Saeed, Awan et al., 2012; Khan & Sajjid 2005). Some studies have ignored macroeconomic variables in determining exchange rate; rather they have focused on chartist approch and define exchange rate on the bsis of its lag values (Messe & Rogoff 1983; Engel 1993 & Hamilton, 1990). Yet, some authors have found that the macroeconomic determinants and past values both are relevant in determining the exchange rate (Abbas et al. 2011; Faust et al. 2003).

As South Asian economies are the emerging economies where the capital markets are volatile, the studies conducted on South Asian countries have mainly focused on the determinants of the exchange rate(Abbas et al. 2011; Khan & Qayyum 2008; Saeed, Awan et al. 2012; Khan & Sajjid 2005; Ahmed et al. 2013). The studies conducted on the nominal exchange rate determination are mostly confined to Purchasing Power Parity (PPP) based theories (see Rashid 2009; Bhatti & Din 2001; Jabeen & khan 2014).

The existing literature presents contradictory results regarding the variables determining the exchange rate and their significance. On the basis of the empirical studies, it is inferred that after the demise of the Bretton woods system, high volatility in the nominal exchange rate is observed as compare to real exchange rate in the short run (Obstfeld et al. 1995; Mussa 1986; Rogoff 1996). However, the fact is that the nominal exchange rate in the period of floating exchange rate is what the policy maker can focus on and the question is how to determine the nominal exchange rate. The identification of the determinants of the nominal exchange rate is a key question to be resolved in order to provide useful information regarding the market participants and the policy makers.

In this paper, we construct a nominal exchange rate model using a novel approach called encompassing technique. To the best of our knowledge, no earlier study has used both macroeconomic and fiscal variables for developing a model for the nominal exchange rate. Our study would be helpful for the central banks of the south Asian countries in designing an appropriate exchange rate policy to stabilize exchange rate in the long run and in the short run.

The next section of the study elaborates the methodology and data description and is followed with Section 3 of empirical results based on encompassing results, cointegration and granger causality results. Section 4 is based on conclusion and policy implications.

2. Methodology and Data Description

2.1 Methodology

Various models on the exchange rate have been used in the literature. Instead of focusing any one of them, this study proceeds by taking into account variety of the models and comparing them with the help of a novel encompassing approach which has rarely been used in literature to find the determinants of the exchange rate.

2.1.1 Model Selection by Encompassing Technique

A number of models have been used in previous studies carrying different set of variables as determinants of exchange rate. Ignoring any of these variables may cause omitted variable bias, while considering all variables used in past studies simultaneously may result into model too big to estimate, leading to low precision and insignificant results. Therefore, we have followed the encompassing technique developed by (Harvey, Leybourne, & Newbold 1998) for exchange rate determination. It considers different models with the intention to select the best representation among the available models. The approach is stated as follows;

1. Suppose there are ‘n’ models based on different theories that have been used earlier to find the determinant of the exchange rate.
2. Estimate all of these models and rank the models according to their standard error.
3. Suppose Mi is the model having smallest prediction error, then the following tests will be applied.

$$H_0(1): M_i \text{ encompasses } M_1$$

$$H_0(2): M_i \text{ encompasses } M_2$$

$$H_0(n): M_i \text{ encompasses } M_n$$

4. The model, for which Ho is not rejected, will be ignored since their prediction power is already present in M_i.
5. The models that are not encompassed by M_i, their variables would be used to construct a most general model. This most general model would contain variables of M_i and the models that are not encompassed (Bontemps et al., 2008). The general model contains the information which cannot be obtained from M_i. The comprehensive model is simplified using general to specific methodology.

2.1.2 General to Specific Approach

The most general model may contain some variables which have insignificant effects on the dependent variable. To get the most efficient estimates, the variables may be tested for their significance and the insignificant variables would be eliminated. Unbalanced panel data model and Wald coefficient restrictions are then applied to all the variables to test their significance level.

2.1.3 Avoiding Spurious Regression by Co-Integration Testing

In order to avoid occurrence of spurious regression, panel unit root test is used to find the stationarity and panel co-integration test is used to point out the long run relationship among nominal exchange rate and its determinants.

Panel Unit Root Test

Econometric literature suggests that the unit root based on panel analysis gives more precise and accurate results as compared to time series analysis. Therefore, we have applied the panel unit root test to check the stationarity of variables included in our study. In particular lm, Pesaran and Shin (2003) panel unit root test is used. This technique begins with separate ADF regression for every cross section by individual effect with no time trend. The equation of the Im, Pesaran and Shin panel unit root test is as under:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{\rho_i} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \qquad (1)$$

where the null hypothesis is

$$H_0: \alpha_i = 0 \text{ for } all\ i\ series\ and$$

$$H1: \alpha_i \neq 0 \text{ for } i = 1, 2 \ \ldots \ N1$$

$$\alpha_i < 0, for\ i = N + 2 \ldots\ldots N$$

We check the unit root of the variables for all the sample countries.

Panel Cointegration

After finding the stationarity of variables, the next step is to apply cointegration so that it could be verified that there is no spurious regression. The panel cointegration could be tested as under.
Suppose have the model.

$$Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon \quad (2)$$

where X_{it} is a vector of all the regressors
Apply panel unit root test to the residuals ε_{it} if the residuals are stationary, cointegration exists.

2.1.4 Error Correction Model

The long run relationship is tested with the help of Engel Granger procedure. In order to find the short run relationship of the variables the error correction method (ECM) is used. The regression form equation of basic form ECM is as follows:

$$\Delta Y_t = \alpha + \beta_0 \Delta X_{t-i} - \beta_1 EC_{t-i} + \varepsilon_{it} \quad (3)$$

While the single equation ECM is as follows:

$$\Delta Y_t = \alpha + \beta_0 \Delta X_t - \beta_1 (Y_{t-1} - \beta_2 X_{t-i}) + \varepsilon_{it} \quad (4)$$

In equation (3) the portion in parenthesis shows the error correction mechanism. The short term effect of an increase in X on Y is shown by β_0**,** while the speed of return to an equilibrium after deviation is shown by β_1 . When the ECM approach is appropriate, then we get the result as -1< β1<0. If the error correction term is significant and negative, it means that any short term fluctuation among the variables, including both dependent and independent variables, will result to stable long run relationship.

2.1.5 Multivariate Granger Causality based on Toda- Yamamoto Approach

The causality testing method of Toda and Yamamoto (1995) tackles the problem of the order of integration, whether it will be I(0), I(1) or I(2), or whether cointegration exist or not. Toda and Yamamoto's method is an augmented causality approach. It demands that the maximum order of integration and the lag length of the series (k) should be determined. So that the VAR (k+d_{max}) must be estimated in order to use the Wald test from the linear restrictions on the parameter of the VAR (k), it contains an asymptotic distribution. Hence, in this case, the value of k would be determined by using the sequential modified LR test statistic, Akaike information criteria, final prediction error, Schwarz criteria and Hannan-Quinn information criteria. While the stationarity of the variables and the maximum order of integration d_{max} is find out with the help of Im, Pesaran and Sin (2003).

2.2 Data

In this study we have used annual data of Bangladesh, India, Pakistan, and Sri Lanka from 1980 to 2013. The USA is considered as foreign country in each case. We have extracted the required data from International Financial Statistics (IFS) of the IMF and World Development Indicator (WDI).

2.2.1 Variable Construction

This section elaborates the methods we have used to construct the variables, which are used in the models. These variables are selected from the models which are selected for the encompassing technique. Following the methodology given in literature, the following variables are constructed accordingly.

Relative Interest Rate (RI)

It is constructed as the ratio of the domestic (r) and foreign interest rate(r*).

$$\mathrm{RI} = \frac{\mathrm{r}}{\mathrm{r}^*} \tag{5}$$

For interest rate money market rates are used for Pakistan, India and Sri Lanka and Treasury bill rates are used in case of Bangladesh.

Inflation Ratio $(\boldsymbol{R_{inf}})$

In order to analyze this variable, we consider the consumer price index as a proxy for all the sample countries of SAARC.

$$\mathrm{R_{inf}} = \frac{\mathrm{I}}{\mathrm{I}^*} \tag{6}$$

R_{inf} is the relative inflation rate and I and I* are domestic and foreign inflation levels respectively. Consumer prices index is used as a proxy for inflation ratio.

Terms of Trade (TOT)

This variable is constructed as ratio of level of exports to level of imports respectively.

$$TOT = \frac{p^x}{p^y} \tag{7}$$

TOT is the terms of trade,p^x is the level of exports and p^y is the level of imports prices respectively.

Trade Restriction (TR)

Trade restriction is obtained by dividing the nominal GDP (NGDP) with sum of export (X) and imports (M) of all four countries including Pakistan, India, Bangladesh and Siri Lanka.

$$TR = \frac{NGDP}{M + X} \tag{8}$$

TR is the trade restriction.

Foreign Exchange Reserves (FOREX)

It is constructed by taking ratio of foreign exchange reserves and GDP deflator. FOREX shows foreign exchange reserves and GDP shows GDP deflator.

$$\text{FXRES} = \frac{\text{FXRES}}{\text{GDPd}} \tag{9}$$

Excess Supply of Domestic Credit (ESDC)

RDCP is the rate of domestic credit to private sector and NGDP denotes nominal Gross Domestic product.

$$\text{ESDC} = \frac{\text{RDCP}}{\text{NGDP}} \tag{10}$$

Trade Balance (TB)

Trade balance is obtained by taking the ratio of difference between level of exports and level of imports with the GDP. We have obtained this variable as.

$$TB = \frac{X - M}{GDP} \tag{11}$$

TB is the trade balance, X denotes exports and M denotes imports of the sample countries.

Net Capital Inflow (NCI)

This variable is constructed as ratio of sum of capital accounts and financial accounts to nominal GDP.

$$\text{NCI} = \frac{\text{CA} + \text{FA}}{\text{GDP}} \tag{12}$$

NCI is the net capital inflow. CA denotes capital account and FA denotes financial accounts.

Relative Income (RY)

This variable is constructed by taking ratio of domestic GDP and Foreign GDP. RY is the relative income and y is domestic real GDP and y* is the foreign real GDP.

$$\mathrm{RY} = \frac{\mathrm{y}}{\mathrm{y}*} \tag{13}$$

Relative real GDP is used as proxy of relative income following Yadav and Mishrai, (2013).

Technological Progress (TP)

This variable is constructed by taking ratio of manufacturing value added (current US dollar) and real GDP.

$$\mathrm{TP} = \frac{\mathrm{MNU}}{\mathrm{RGDP}} \tag{14}$$

TP is the technological progress, MNU is the manufacturing production index and RGDP denotes real gross domestic product.

3 Empirical Results

3.2 Specifying Model for Nominal Exchange Rate

In literature different models have been estimated for South Asian countries, which represent different theories of exchange rate determination. In these models, the researchers have tried to determine exchange rate from different channels. In this study we have used related models for exchange rate determination using encompassing technique because these models are considered for exchange rate determination for selected SAARC countries. The selected models are estimated for each country in order to apply encompassing technique.

Model 1

Kemal & Haider (2004) used the following model in determination of Pak Rupee exchange rates.

$$ER_t = c + \alpha_1 RMS_t + \alpha_2 RINF_t + \alpha_3 RY_t + \alpha_4 RI_t + \varepsilon_t \tag{15}$$

where RMS is relative money supply and it is taken as M_2, R_{inf} is relative inflation rates, taken as consumer price index, RY is relative real income it is taken as a proxy of relative real GDP and RI is relative interest rate taken as money market interest rate as monetary determinants.

Model 2

Zakaria et al. (2007) have employed following model in determining exchange rate at the level.

$$ER_t = c + \emptyset_1 RP_t + \emptyset_2 TOT_t + \emptyset_3 TP_t + \emptyset_4 TR_t + \emptyset_5 NCI_t + \emptyset_6 lnFOREX_t + \varepsilon_t \quad (16)$$

where RP_t is the relative price level. TOT_t shows the terms of trade. TP_t is the technological progress it can be capital or labor intensive. NCI_t is the net capital flows; $FOREX_t$ is the foreign exchange reserves.

Model 3

Abbas et al. (2011) have followed a monetary approach in finding the determinants at the level on Selected South Asian countries.

$$r_t = c + \beta_1 RINF_t + \beta_2 RI_t + \beta_3 TOT_t + \beta_4 TR_t + \beta_5 NCI_t + \beta_6 TB_t + \varepsilon_t \quad (17)$$

where $Rinf_t$is the relative inflation levels, RI_t is the relative interest rates, ,$TOT_t$is the terms of trade. TR_t is the trade restrictions, NCI_t is the net capital flows. TB_t is the trade balance ratio.

Model 4

Saeed et al. (2012) have analyzed nominal exchange rate by analyzing some monitory variables.

$$ER_t = c + \pi_1 RMS_t + \pi_2 FOREX_t + \pi_3 DBT_t + \varepsilon_t \quad (18)$$

where RMS is a function of stock of relative money supply, FOREX is foreign exchange reserves and DBT is debt.

Model 5

Kohli and Kletzer (2001) have followed monitory approach in determining exchange rate of India.

$$ER_t = c + \sigma_1 RMS_t + \sigma_2 RY_t + \sigma_3 RI_t + \sigma_4 R_{inft} + \sigma_5 P_t + \varepsilon_t \quad (19)$$

RMS is relative money supply, RY is relative income relative real GDP is taken as a proxy of relative income, RI is relative interest rate, R_{inf} is the relative

inflation and P is price variable which is expected to take positive value of non-tradable goods in domestic market.

Model 6

Yadav and Mishrai (2012) have employed a model by relating Exchange rate with five very important macroeconomic variables namely money supply (MS), real interest rate (RI), real Output (Y), inflation rate (IR) and trade balance (TB) on India.

$$ER_t = c + \delta_1 RMS_t + \delta_2 RY_t + \delta_3 RI_t + \delta_4 R_{inft} + \delta_5 TB_t + \varepsilon_t \quad (20)$$

Model 7

Khan and Qayyum (2011) employed following variables in determining the nominal exchange rate.

$$ER_t = c + \emptyset_1 RI_t + \emptyset_2 INF_t + \emptyset_3 MS_t + \emptyset_4 RY_t + E_t \quad (21)$$

where RI is the interest rate, INF is the inflation it is used as consumer price index, MS is the money supply and RY is the relative income.
Models M_1, M_2, M_3, M_4, M_5, M_6 and M_7 are estimated and then ranked according to their standard errors. Model M_2 contains smallest prediction error at an average 0.070 as shown in Table 1.

We have tested the null hypothesis as we have mentioned in Section 2.1.1 and M_2 contains smallest prediction error and is encompassed with other models including M_1, M_3, M_4, M_5, M_6 and M_7. According to the encompassing results shown in Table 2, It is clear that the null hypothesis; M_2 encompasses M_1 is rejected because of the significant p-value in case of all sample South Asian countries. It means M_2 does not encompass M_1. Hence the variables of M_1 are included in the general model. Similarly in case of the null hypothesis; M_2 encompasses M_3 because of significant P-value of Bangladesh and India null hypothesis is rejected, the variables of M_3 are included in the final model. Same is the case for the null hypothesis of M_2 encompasses M_4, due to significant P-values in case of Bangladesh and Sri Lanka the null hypothesis is rejected, the variable of M_4 are included in the final model. According to the null hypothesis of M_2 encompassing M_5, due to the presence of significant p-value in all sample countries the null hypothesis is rejected and concludes that the variables of M_5 can also be included in the final model. Same results are shown in case of the null hypothesis of M_2 encompassing M_6, due to presence of significance in case of all sample countries the null hypothesis is rejected, as a result the variables of the model M_6 are included in the final model.

Table 1: Standard Errors of Model M1-M7

	Std. Error				
	Pakistan	**Bangladesh**	**Sri Lanka**	**India**	**Average**
Model 1	0.023	0.021	0.018	0.024	0.088
Model 2	0.016	0.017	0.016	0.019	0.070
Model 3	0.023	0.019	0.019	0.023	0.086
Model 4	0.024	0.018	0.017	0.023	0.084
Model 5	0.023	0.016	0.016	0.023	0.080
Model 6	0.023	0.020	0.016	0.025	0.085
Model 7	0.023	0.019	0.018	0.028	0.090

Contrary to the results shown by other null hypothesis, the null hypothesis of M_2 encompasses M_7 is accepted. Hence, the variables of Model M_7 are not included in the final model. On the basis of this analysis we have constructed a final model which contains the variables of the model including M_1, M_2, M_3, M_4, M_5 and M_6.

$$ER = \beta_0 + \beta_1 RP_t + \beta_2 TOT + \beta_3 TP_t + \beta_4 TR_t + \beta_5 NCI_t + \beta_6 FOREX_t + \beta_7 ESDC_t + \beta_8 Rinf_t + \beta_9 TB + \beta_{10} RI_t + \beta_{11} RMS + \beta_{12} RY + \beta_{13} DBT + \varepsilon_t \quad (22)$$

As a result of encompassing technique, equation (22) is obtained, which is the general model. This model contains twelve independent variables. The independent variables includes relative price, terms of trade, technological progress, trade restrictions, net capital inflow, foreign exchange reserves, excess supply of domestic currency, relative inflation, trade balance, relative interest rate, relative money supply, relative income, net capital inflows and debt variable. Among these independent variables some of the variables might be insignificant.

The results of Table 3 show the estimation result of the most general model. According to the test results some of the variables including foreign exchange reserves, relative income, relative money supply, trade balance and relative interest rate are found highly significant at one percent level of significance. Contrary to that some of the variables including excess supply of domestic currency, relative prices, and terms of trade, technological progress, debt, and relative inflation and trade restrictions are found to be highly insignificant. In

order to include the highly significant variable in the final model we have applied the general to specific methodology.

Table 2: Results of Hypothesis M Encompasses M_i

Hypothesis	Test statistics	Pakistan	Bangladesh	India	Sri Lanka
M_2 encompasses M_1	COX	-0.730* (0.052)	-3.932*** (0.000)	-2.436** (0.014)	-4.600** (0.014)
	Ericsson IV	3.876** (0.000)	0.205 (0.052) *	0.725** (0.042)	1.056 (0.290)
M_2 encompasses M_3	COX	-0.173 (0.862)	-4.287*** (0.000)	-6.162*** (0.000)	0.6111 (0.541)
	Ericsson IV	3.999 (0.721)	-0.313*** (0.001)	2.948 (0.003)**	0.4951 (0.620)
M_2 encompasses M_4	COX	1.141 (0.253)	-3.878*** (0.000)	-1.216 (0.223)	-4.394*** (0.000)
	Ericsson IV	-0.280 (0.779)	-0.279* (0.524)	2.442 (0.014)	0.130 (0.896)
M_2 encompasses M_5	COX	1.913** (0.055)	-4.71*** (0.000)	-3.210** (0.001)	-5.206*** (0.001)
	Ericsson IV	3.641*** (0.000)	-0.584 (0.5587)	15.20 (0.000)**	8.206 (0.041)*
M_2 encompasses M_6	COX	1.682* (0.092)	-5.214*** (0.000)	-3.279** (0.001)	-4.609*** (0.000)
	Ericsson IV	3.723** (0.000)	0.547 (0.584)	5.777 (0.000)**	8.430 (0.037)*
M_2 encompasses M_7	COX	0.3090 (0.757)	-0.7603 (0.447)	3.095 * (0.002)	-1.026 (0.304)
	Ericsson IV	3.847 (0.453)	0.9895 (0.322)	0.2806 (0.779)	0.7457 (0.455)

Note: ***presents significance at 1 percent, ** presents significance at the 5 percent and *Shows significance at ten percent.

Table 3: Estimation Results of the Most General Model. Dependent Variable: LNER

Variable	Coefficient
CONSTANT	1.519***
LESDC	0.001
LDEBT	0.045
LFOREX	0.160***
LRY	0.402***
LRMS	0.341***
LRP	-0.014
LTB	-0.108**
LTOT	0.000
RI	-2.152***
Rinf	-0.004
LTP	-0.001
LTR	0.020
NCI	0.054
Wald coefficient restriction test	
F-statistic = 1.141926	P-value = 0.3428

Note: *** shows significance level at one percent, ** shows significance at five percent and * shows significance at ten percent.

3.2.1 General to Specific Methodology

The general to specific approach and encompassing approach are related with each other (Mizon, 1995; Hendry & Richard, 1987). Following the methodology of general to specific approach mentioned in 2.1.2. Wald coefficient restriction test is applied on highly insignificant variables in order to construct a single

model. According to the results given in Table 3 the null hypothesis of Wald coefficients restriction (exclusion is valid) and the alternate hypothesis (the exclusion is invalid), the null hypothesis is accepted in our case. Table 3 shows the acceptance of null hypothesis because the p- value 0.342 is greater than 0.05 at the 5% level of significance. Hence, on the basis of this result our final model is constructed, which is composed of foreign exchange reserves, relative income, relative money supply, trade balance and relative interest rate. These selected variables can be called as fundamental determinants of nominal exchange rate of selected SAARC countries.

3.2.2 Final Model

After dropping highly insignificant variables, we have developed and estimated following model.

$$ER_t = \beta_0 + \beta_1 FOREX_t + \beta_2 Ms_t + \beta_3 RY_t + \beta_4 TB_t + \beta_5 Ri_t + \varepsilon_t \qquad (23)$$

Table 4: Estimation Results of the Simplified most General Model. Dependent Variable: **LNER**

Variable	Coefficient	Std. Error
CONSTANT	1.718***	0.352
LFXREX	-0.015**	0.081
LRMS	-0.012	0.038
LRY	0.338***	0.069
LTB	-0.181	0.224
RI	0.000 ***	0.941

Note: $***$ = Significant at the 1 percent. $**$ = Significant at the 5 percent. $*$ = Significance at the 10 percent.

Table 4 shows the coefficient values of the variables and the standard errors of the determinants of nominal exchange rate in the final model. According to the results out of five variables, relative income and relative interest rate are significant at the 1% and foreign exchange reserves are significant at the 5% level of significance. Foreign exchange reserves are proved to be significant variable in determining nominal exchange rate of selected SAARC countries and the negative sign of foreign exchange reserves shows the depreciation of the exchange rate of the sample countries. As the nominal exchange rate appreciation and depreciation is related with the pattern of consumption on tradable and non-tradable same as the pattern of net capital inflows. Money supply possess negative sign, which shows negative relationship between money supply and exchange rate, hence when money supply increases exchange rate decreases.

Real income shows significant and positive sign in determining nominal exchange rate. Theoretically, real GDP and exchange rate shows negative

relationship because increase in GDP leads more demand for importable goods it results in increase in imports of the country. As a result demand for foreign currency increases and the exchange rate decreases. In our case real GDP is showing positive relationship it can be because of overshadowing of the GDP of South Asian countries by the US GDP.

Trade balance impacts exchange rate. Our results show a negative value which leads to the existence of a negative relationship among trade balance and exchange rate. Hence, it shows that increases in trade balance of the selected SAARC countries lead to currency depreciation.

Relative interest rate possesses a significant positive effect in determining the nominal exchange rate of the selected SAARC countries. The interest rate and the exchange rate have positive relationship when currency value changes as a result of any external factor, by decreasing the domestic interest rate currency will depreciates. Foreign capital can be attracted as a result of rise in domestic interest rate which results in appreciation of the local currency.[1]

3.3 Long Run and Short Run Dynamics of Nominal Exchange Rate

3.3.1 Panel Unit Root Test

In order to find the long-run relationship among the nominal exchange rate and its fundamental determinants, before testing the co integration, the variables are tested for the stationarity, the order of integration on level and also in first difference form. Specifically, we tested whether all the variables including dependent and independent are integrated of same order. The results are obtained by applying the panel unit root test. The procedure adopted is discussed above. The results of panel unit root test are given in Table 5. According to the test results all the variables are proved to be insignificant on level. Therefore the null hypothesis of trend stationary is rejected at level. As a result it can be concluded that all the variables follow unit root (non-stationary) at levels. All the variables are of same order of integration I (1).

3.3.2 Panel Cointegration

In order to find the long run relationship among the nominal exchange rate and its fundamental determinants, we have used the panel Cointegration test. We have followed the procedure described earlier.

[1] Dornbusch (1976).

Table 5: Results of lm, Pesaran and Shin Unit Root Result

Variables	level T-Statistic	1st Difference T-Statistic	Order of Integration
Nominal exchange rate	-0.858	- 3.433***	I(1)
Relative money supply	3.597	-4.356***	I(1)
Relative interest rate	8.246	-3.738***	I(1)
Relative income	8.144	-4.326***	I(1)
Trade Balance	-0.431	-7.798***	I(1)
Foreign Exchange reserves	2.626	-6.050***	I(1)
Residual series			I(0)
T-statistic at level = -6.492***			

Note: ∗∗∗ = Significant at 1 percent. ∗∗ = Significant at 5 percent. ∗= Significance at 10 percent.

3.3.3 Unit Root Test for the Residual Series

Here in this section we tested the residual series for the unit root. If the residuals are stationary then Cointegration exists. In Table 5, the unit root test results for the residual series are shown. As the formal investigation of the variables have shown unit root at levels. On taking first difference the economic variables become stationary. In order to determine the long run relationship among nominal exchange rate and its determinants. We have used the Engel-Granger two step procedures, the Im, Pesaran and Shin W-stat test is applied on residuals series. In Table 5 the result of the stationarity of the residual series is mentioned. Accordingly, the null hypothesis of no cointegration or presence of unit root is rejected. Thus, there exists a long run relationship among the variables. The presence of the co integration is implying that nominal exchange rate and determinants including relative interest rate, foreign exchange reserves, relative real income, relative money supply, and trade balance are related in long run for selected SAARC countries.

3.3.4 Short-Run Relationship between NER and Independent Variables

In order to find the adjustment process in the long and short run, the error correction method is used. This approach is used to find the short run responses of the nominal exchange rate and its determinants including relative money supply, relative interest rate, relative prices, foreign exchange reserves, excess supply of domestic credit, terms of trade, and relative income.

According to the empirical results, both long run and short run relationship between the nominal exchange rate and its fundamental determinants is evident in case of selected SAARC countries specifically Pakistan, India, Bangladesh and Sri Lanka. Convergence towards equilibrium can occur in long run. Both dependent variable (nominal exchange rate) and the determinants can adjust to restore equilibrium in the long run.

Table 6: Error Correction Representation. Dependent Variable (LNER)

Regressor	Coefficient	Std. Error
CONSTANT	1.6828	0.032***
DLFOREX	0.006	0.015
DLTB	0.028	0.107
DLRMS	0.162	0.031***
DLRRGDP	0.131	0.046***
DRI	0.006	0.013
ECT(-1)	-0.020	0.011*

Note: ∗∗∗ = Significant at the 1 percent. ∗∗ = Significant at the 5 percent. ∗ = Significance at the 10 percent.

3.3.5 Granger-Causality Test

Granger causality test is applied to check whether determinants of nominal exchange rate cause nominal exchange rate. Granger-Causality testing is applied in order to check whether the determinants of nominal exchange rate granger cause the nominal exchange rate.

According to the results of Granger-Causality/Block Exogeneity Wald test in Table 7, the nominal exchange rate granger cause foreign exchange reserves at 1 percent level of significance and foreign exchange reserves also Granger causes nominal exchange reserves, hence we can say bidirectional causality exist between nominal exchange rate and foreign exchange reserves. Similarly, bidirectional causality exists among nominal exchange rate and relative income. On contrary, one way causality exists among trade balance and nominal exchange arte. Moreover, one way causality exists among relative income and nominal exchange rate.

Table 7: Method: Granger-Causality/Block Exogeneity Wald Test

Direction of causality	$X^2 - Squares$ (4)	Decision
LNER ⟶ LFOREX exist	16.303***	Bidirectional causality
LFOREX ⟶ LNER	10.804**	
LNER ⟶ LTB	7.4814	Unidirectional causality
LTB ⟶ LNER	9.297*	
LNER ⟶ LRMS	0.849	No Causality
LRMS ⟶ LNER	2.453	
LNER ⟶ RI	12.665**	Bidirectional causality
RI ⟶ LNER	72.837***	
LNER ⟶ RY	1.266	Unidirectional causality
RY ⟶ LNER	34.236***	

Note: *** presents significance level at one percent, ** at five percent and * at ten percent of significance level. The values in parenthesis show probability values.

4 Conclusion

In this study, we analyzed the exchange rate of the SAARC countries; Pakistan, India, Sri Lanka, and Bangladesh using encompassing technique. We have used annual data of nominal exchange rate of Pakistani rupee, Bangladesh Taka, Sri Lankan rupee and Indian rupee in terms of US Dollar and macroeconomic fundamentals from 1980 to 2013 making a total of 136 annual observations. On the basis of our results we conclude that that the long run determinants of the nominal exchange rate are relative interest rate, relative money supply, trade balance, relative income and the foreign exchange reserves. The panel unit root test indicates that these variables are co-integrated with the exchange rate. In the short run, relative money supply and relative income significantly determine the nominal exchange rate.

Moreover, the results of Granger causality testing showed that bidirectional causality exist among the foreign exchange reserves and relative interest rate with the nominal exchange rate of the SAARC countries including Pakistan, India, Bangladesh and Siri Lanka. In addition, one way causality exists among relative real income and trade balance with the nominal exchange rate.

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