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Long run Determinants of Real Exchange Rate: An Econometric Analysis from Pakistan

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Abstract

Real Exchange rate is an important player in the growth of the economy as it may lead to higher export by stabilizing currency value at any specific level. This study aims to analyze the determinants of real exchange rate in Pakistan. Time series data is collected from 1972 – 73 to 2012 – 13. Johansen co-integration test and error correction model is utilized for examining long run and short run elasticity's. The study concludes that real exchange rate is depreciated by terms of trade and Price level. While trade restrictions and workers' remittances are exerting negative effect or appreciating real exchange rate of Pakistan in the long run.

Keywords: real exchange rate, price level, terms of trade, trade restrictions, workers' remittances and Johansen co-integration test.

1. Introduction

Real Exchange rates are relative prices of two goods of two countries, and under a floating rate regime they may be viewed as being determined by the interplay of supply and demand in foreign exchange markets. Exchange rates play a vital role in a country's level of trade, which is critical to most every free market economy in the world. For this reason, exchange rates are among the most watched analyzed and governmentally manipulated economic measures. But exchange rates matter on a smaller scale as well: they impact the real return of an investor's portfolio. Exchange rate regimes (fixed or floating) are chosen by central banks (or governments). It is important to distinguish nominal exchange rates from real exchange rates. Nominal exchange rates are established on currency financial markets. Rates are usually established in continuous quotation (they may be fixed). Real exchange rates are nominal rates corrected by inflation measures.

After witnessing the continuous decline in depreciation of average annual exchange rates during 2009-10 and 2012-13, the Pakistani currency remained under pressure through most of fiscal year 2011-12. This pressure is emerging from the deficit in the overall external account of the country during July-April 2011-12. As a result Pakistan's currency vis-à-vis the US dollar depreciated during July-April 2011-12. In absolute terms, the exchange rate averaged Rs. 85.50/US$ during July-April 2010-11, whereas it averaged at Rs. 88.55/US$ during July-April 2011-12. The Pak Rupee depreciated by 3.4

percent during July-April 2011-12 over the depreciation of 2.2 percent in July-April 2010-11 periods due to the widening current account deficit and speculations on account of the repayment of IMF loan during the period. Apart from the deficit in the current account balance during July-April 2011-12 other domestic factors as well as the speculative environment in the foreign exchange market added volatility to the exchange rate.

This paper attempts to find the main determinants of the real exchange rate in Pakistan. The present study has its importance in terms of latest data from 1972 to 2013 used in analysis. There is an introduction of new variables like Trade Restrictions, Price Level, Workers' Remittances and Terms of Trade. Apart from the introduction with the brief overview of the Pakistan's exchange rate this paper is structured as follows. The second section reviews literature pertaining to real exchange rate determination. The third section presents model, data and methodology for analyzing the determinants of the real exchange rate. Fifth section gives the empirical findings, and the last section summarizes the paper and draws some conclusions.

2. Literature Review

Several studies have been conducted on the determinants of Real Exchange rate at national level as well as at international level. In this section, we have summarized few of them below;

Heller (1978) analyzed economic characteristics influencing exchange rate regime. The research analyzes the factors like large size, a relatively small foreign trade sector, a high degree of international financial integration, an inflation rate that differs from the world average, and a well-diversified foreign trade pattern.

Modeste (1994) determines the determinants of real exchange rate which are influenced by exchange rate policy or income policy or by combination of both policies. Faruqee (1995) examines net foreign assets as the long-run determinants of the real exchange rate like net foreign assets, and other factors affecting trade flows using postwar data for the United States and Japan.

Aron et al. (1997) present short run and long run influences in a model for the real exchange rate in South Africa. In their research, conducted over the quarterly data from 1970 to 1995, they find that real exchange rate is depreciated due to number of factors like terms of trade, real dollar gold price, tariffs, capital flows, gross reserves of bank and government expenditure.

Drine and Rault (2001) analyze the factors effecting real exchange rate in MENA countries by applying new panel data unit root tests, panel co-integration technique. The results investigate that per capita output, government consumption, real interest rate differentials and openness are factors affecting real exchange rate.

Mkenda (2001) has analyzed the main determinants of the real exchange rate in Zambia and estimated the degree of misalignment in the real exchange rate. Johansen co-integration analysis is conducted on time series data from 1971 to 1993. The study explores that terms of trade and government consumption are depreciating real exchange rate while investment share, growth of real GDP, central bank reserves and trade taxes are appreciating real exchange rate.

Dvine and Rault (2003) have tackled the empirical issues of the real exchange rate literature by applying recently developed panel co-integration technique. Forty five developing countries are selected for the analysis. The researchers determine that domestic investment, GDP per capita, foreign direct investment and terms of trade have depreciated the real exchange rate while share of public spending and trade policy are appreciating real exchange rate.

Zalduendo (2006) has disentangled the effects of oil prices from other factors underlying Venezuela's equilibrium real exchange rate and examined the role of the foreign exchange controls in supporting the official exchange rate. In the analysis, it is concluded that real exchange rate is appreciated by UK Brent oil price deflated; differentials in PPP based real GDP per capita and differentials in real interest rat. Real exchange rate is depreciated by government expenditure.

Hyder and Mahboob (2006) have estimated the equation of equilibrium real effective exchange rate, measured the degree of exchange rate misalignment and provided guidance to policy makers in implementing exchange rate policy. Annual data of 1978 – 2005 explains that terms of trade, real investment, workers' remittances, and total factor productivity differentials are significant cause of depreciation of Pak rupee while trade openness, government expenditure and capital to GDP ratio are appreciating Pak rupee.

Frankel (2007) has econometrically investigated the determinants of real value of South African rand. The author has taken quarterly data from 1981 to 2006. He has employed ordinary least square method to analyze the relationships and has concluded that real weighted mineral and metal price index and real interest rate differentials are increasing real exchange rate. While dummy for capital market liberalization and dummy interacted with real interest rate differentials are appreciating real exchange rates.

Zakaria et al. (2007) have provided estimates of a model for the determination of nominal bilateral exchange rates of Pak – rupee vis–a–vis its twelve major trading partners. The authors have used time series data from 1983 to 2004. By utilizing autoregressive method, they have deduced that terms of trade, technological progress, net capital inflows and foreign exchange reserves are causes of depreciation of bilateral nominal exchange rate of Pak rupee. On the other side, Pak rupee is appreciated by relative price of foreign tradable, trade restrictions and excess supply of domestic credits.

Staník and Cerge (2007) use ATARCH (autoregressive conditional Heteroskedasticity) model for analyzing the factors affecting to exchange rate volatility in the European countries. Economic openness is the factor which effect exchange rate volatility of each country of Europe. Candelon et al. (2007) estimate bilateral equilibrium real exchange rates for European states using panel co-integration techniques. They reveal significant link of productivity levels, openness, inflation and real exchange rate.

Carrera and Restout (2008) take Latin American from the time period from 1970 to 2006 for investigating behavior of real exchange rates by using non stationary panel econometrics. They explore various factors for exchange rate in the long run such as government spending, terms of trade, the openness, foreign capital flows.

Guclu (2008) has empirically analyzed the determinants of exchange regimes for the period from 1970 to 2006. Using Ordered Probit model, he explores that exchange rate is depreciated due to GDP, GDP per capita, openness, capital account to GDP ratio, capital account openness, terms of trade and capital account restriction. Inflation, Geographical

trade and money growth may depreciate and appreciate exchange rate. On the other side, bank reserves and nationalist are causes of lower exchange rate.

Al Samara (2009) describes the factors which determine the equilibrium real exchange rate and affects its volatility. ARCH model is applied on the time series data from 1980 to 2009. The study concludes the productivity differentials, trade openness and gross capital formation as the factors which depreciate and total government spending appreciates the exchange rate in Syrian economy.

Rehman et al. (2010) have analyzed the impact of foreign exchange inflows on equilibrium real exchange rate of Pakistan for the period 1993 to 2009 through behavioral equilibrium real exchange rate approach. They have employed Johansen Co-integration test and monthly data for the results. The study shows that productivity, foreign direct investment and foreign remittances are increasing real exchange rate while openness is decreasing real exchange rate in Pakistan.

Parveen et al. (2012) collect data from Economic survey of Pakistan and International Financial Statistics from 1975 to 2010 to examine the major factors which contribute to exchange rate variability. They employ ordinary least square method for analysis of results and conclude that inflation, economic growth, exports and imports bring variation in exchange rate of Pakistan.

Fida et al. (2012) have attempted to estimate the long run equilibrium real exchange rate for Pakistan economy by employing Natural real exchange rate (NATREX) given by Stein (1985) for the period of 1983 to 2010. They have chosen Johansen Co-integration technique and determined that terms of trade, government expenditure and productivity are appreciating Pak rupee in the long run.

Saeed et al. (2012) have undertaken an econometric analysis of determinants of exchange rate for US Dollar in terms of Pakistani rupee within the framework of monetary approach. They have utilized monthly data from 1982 to 2010 and have applied ARDL technique for estimation. In the study, relative money, relative Forex reserves and relative debt are depreciating exchange rate.

Fida et al. (2012) have examined the relationship with respect to the Pakistani economy between exchange rates and external debt. The quarterly data from 1983 to 2008 has been utilized. By employing Johansen co-integration test, they examine that terms of trade, government expenditure and productivity are appreciating exchange rate.

Ajao and Igbekoyi (2013) use time series data from 1981 to 2008 to investigate the determinants of real exchange rate volatility through GARCH technique accompanying with Error correction model and co-integration technique for long run and short run determinants. The study concludes that openness, government expenditure, interest rate and lagged exchange rate are major determinants of real exchange rate.

Insah and Chiaraah (2013) determine the sources of exchange rate volatility in Ghana based on the Autoregressive Distributed Lag (ADL) Model and use annual data covering the period 1980 to 2012. The study suggests the government expenditure, domestic and external debts are major determinant of real exchange rate volatility.

Kia (2013) develops a monetary model of the real exchange rate using first quarter of 1972 – 3rd quarter 2010 of Canada. It is found that in the long run real money supply, domestic and foreign interest rate, real GDP, real government expenditure, deficit per

GDP, domestic and foreign outstanding debt per GDP, domestic and foreign externally financed debt per GDP and commodity price is a factor affecting real exchange rate.

Gan et al. (2013) develop measures of the direction and extent of misalignment based on a reduced-form real effective exchange rate (REER) model using unit root tests and co-integration presented by Johansen and Juselius (1990) procedures. Openness, money supply, productivity and government spending are having long run relationship with exchange rate. Error correction model suggests also short run relationships with error correction term 0.85.

3. Data and Methodology

3.1Model Specification

To examine the macro econometric determinants of real exchange rate and to find the real exchange rate elasticities with respect to various factors, the study follows log – log model. The real exchange rate model is specified as follows;

$$\ln RER_i = \alpha + \beta_0 \ln TR_i + \beta_1 \ln INF_i + \beta_2 \ln TOT_i + \beta_4 \ln WR_i + u_i$$

In the above model, the study utilizes the following variables.

lnRER = Log of Real exchange rate

lnTR = Log of trade restrictions

lnINF = Log of Price Level

lnTOT = Log of terms of trade

lnWR = Log of workers remittances

α , $\beta's$ are intercept and slope coefficients and u_i is error term of real exchange rate model.

3.2 Definition of Variables

The variables used in the above real exchange rate model are briefly defined in this section. Concepts and Expected relationships (based on previous literature and Economic Literature) are also presented in the following section.

3.2.1Real Exchange rate

Real exchange rate can be defined as the nominal exchange rate of Pakistan that takes the inflation differentials among the countries into account. It is also defined as the ratio of nominal exchange rate (Price of a US dollar in terms of Pakistani rupees) to price level (GDP Deflator) of Pakistan. It is important because it is an indicator of competitiveness in the foreign trade of Pakistan. Real Exchange rate is used as dependent variable in the study.

$$\text{Real Exchange Rate} = \frac{\text{Nominal Exchange rate}}{\text{GDP Deflator}}$$

3.2.2 Terms of trade

Terms of trade variable are the relative price index of exportable commodity to price index of importable commodity. Algebraically, it may be written as;

$$\text{Terms of Trade} = \frac{\text{Price index of Exportable commodity}}{\text{Price index of Importable commodity}}$$

If price index of Pakistan's exportable commodity will increase relative to price index of importable commodity, it will lead to better terms of trade. A country can get higher revenue and real exchange rate will appreciate. On the other side, due to higher export price, exports of country may decrease as well. This will lead to depreciation of Pakistani currency. Finally, it is concluded that terms of trade may be cause of appreciation or depreciation of real exchange rate.

3.2.3Trade Restrictions

Trade restriction is known as commercial policy variable. It is measured using following formula;

$$\text{Trade Restriction} = \frac{\text{Nominal Gross Domestic Product}}{\text{Price of Exports} + \text{Price of Imports}}$$

Trade restriction variable is opposite to trade openness. Due to trade restrictions, if export tariff is imposed, it will reduce exports of a country. Due to this real exchange rate will depreciate. Conversely, if import tariff is imposed, it will affect imports of a country resultantly real exchange rate to reduce or appreciate.

3.2.4 Price Level

The GDP deflator is an economic measure that tracks the cost of goods produced in an economy relative to the purchasing power of the dollar. If price level is increased inflation will increase. Exported items will become costly for foreigners. In the result, exports of Pakistan will reduce. Lower exports will reduce supply of dollars in Pakistan causing an increase or depreciation of real exchange rate.

3.2.5Workers' Remittances

A remittance is a transfer of money by a worker in any other country to an individual in Pakistan. Workers' remittances are expected to be negatively or positively related with real exchange rate. Contrary to this, it may also depreciate real exchange rate in the long run. Due to higher workers remittances, income of people may increase, they may consume this income on imported items. Resultantly imports may increase, and real exchange rate may depreciate in the long run. Conversely, workers' remittances may appreciate real exchange rate. Because remittances come in US dollars in Pakistan due to more supply of dollars relative to its demand it may be a cause of appreciation of Pakistani rupees.

3.3Data Sources and Range

The study explores the determinants of real exchange rate using time series annual data of Pakistan. Data range is selected from 1972-73 to 2012-13. We have followed various reliable sources for data collection like World Development Indicators (World Bank Web Site), Handbook of Statistics on Pakistan Economy 2010, and Economic Survey of Pakistan 2012 – 13. All the variables are taken in units and Pakistani rupees. Data sources and expected relationships are also given in table 1.

Table 1: Expected Relationships and Sources of Data

Variables	Expected Relationship	Source of Data
Real Exchange rate	Dependent Variable	World Development Indicators
Terms of Trade	Appreciation or Depreciation of Real Exchange rate	Handbook of Statistics on Pakistan Economy 2010, Economic Survey of Pakistan 2012-13.
Trade Restrictions	Appreciation of Real Exchange rate	World Development Indicators (GDP), Handbook of Statistics on Pakistan Economy 2010, Economic Survey of Pakistan 2012-13.
Price Level (GDP Deflator)	Depreciation of Real Exchange rate	World Development Indicators
Workers' Remittances	Appreciation or Depreciation of Real Exchange rate	Handbook of Statistics on Pakistan Economy 2010, Economic Survey of Pakistan 2012-13.

3.4 Methodological Discussion

For any time series or cross sectional data, selection of proper methodology for estimating econometric model needs great attention. Time series variables of developed and developing nations are having plenty of econometric problems. The most common and popular problem among them is of non-stationarity. To overcome this, a group of Econometricians have worked a lot and have given various solutions. The most appealing solution is to use Johansen Co-integration technique and Error Correction model when all the variables of time series are integrated of order 1. Apart from that, this technique has some important steps to be followed preliminary as described below;

- Check the stationary level of all the variables using unit root tests (ADF, PP or Ng-Perron). All variables must be integrated of order 1 or I(1) and same. It may not be integrated of order two.
- Apply VAR Lag order selection criteria on all variables to examine appropriate lag length of regression model.

- Using Trace Statistics and Maximum Eigen Statistics, number of Co-integrating equations must be analyzed.
- After having Co-integrating equations, Normalized equation may be used for long run coefficients or Elasticity's.
- For short run results, we apply Error correction model and we must concentrate on error correction term whether it is negative or positive.

4. Results and Discussions

This section estimates and interprets the econometric results regarding determinants of exchange rate of Pakistan. For examining order of Integration, we have made use of Ng-Perron unit root test. Null hypothesis of this test is: "Series has a unit root". Series would be stationary if absolute values of test statistics are greater than critical values for MZ_a and MZ_t. Conversely test statistics should be less than critical values for MSB and MPT to be stationary of series. In table 2, results of Ng – Perron test are reported and conclusions are also drawn based on above decision rules. It is determined that all variables are integrated of order one.

Table 2: Ng-Perron Unit Root Test

Variables	MZ_α		MZ_t		MSB		MPT		Conclusion
	TS**	CV**	TS	CV	TS	CV	TS	CV	
At Level by including Intercept									
lnRER	1.89	-13.80	1.54	-2.58	0.81	0.17	56.10	1.78	---*
lnINF	1.90		2.01		0.17		90.61		---*
lnTOT	-5.46		-1.45		0.26		5.00		---*
lnTR	1.45		1.16		0.80		51.00		---*
lnWR	1.82		2.11		1.15		105.66		---*
At Level by including Intercept and Trend									
lnRER	-2.89	-23.80	-1.17	-3.42	0.40	0.14	30.64	4.03	---*
lnINF	-4.11		-1.36		0.33		21.42		---*
lnTOT	-8.16		-1.93		0.23		11.41		---*
lnTR	-10.02		-2.21		0.22		9.21		---*
lnWR	-2.63		-1.14		0.43		34.47		---*
At 1st Difference by including Intercept									
lnRER	-18.03	-13.80	-2.98	-2.58	0.16	0.17	1.41	1.78	**I (1)***
LnINF	-17.50		-2.90		0.16		1.58		**I (1) ***
lnTOT	-18.94		-3.07		0.16		1.29		**I (1) ***
lnTR	-19.49		-3.09		0.15		1.35		**I (1)***
lnWR	-17.03		-2.83		0.16		1.75		**I(1)***

* Critical values are taken at 1 percent level of significance

** TS shows Test Statistics and CV denote critical values of the Ng – Perron test.

For selection of model, Econometricians suggest that lag order to be selected based on Akaike Information Criterion. An appropriate lag length would be finalized with minimum values of Akaike Information Criterion. Table 3 exhibits values based upon the same lag order selection criteria. This table finalizes '2' as an appropriate lag length for Johansen Co-integration test.

Table 3: Lag Order Selection

Lag	LR	FPE	AIC
0	NA	5.99e-07	-0.138850
1	470.2451	1.42e-12	-13.10665
2	42.70269*	1.19e-12*	-13.34969*
* indicates lag order selected by the criterion			
LR: sequential modified LR test statistic (each test at 5% level)			
FPE: Final prediction error			
AIC: Akaike information criterion			

For existence of long run relationship in real exchange rate model, Trace Statistics and Maximum Eigen Statistics are used and described in table 4 respectively. These statistics report a number of co-integrating equations. The study concludes that there exist long run relationships among these variables as 2 co-integrating equations are indicated on the basis of trace test and 2 co-integrating equations are indicated on the basis of Maximum Eigen value.

Table 4: Long run Relationship

Unrestricted Co-integration Rank Test (Trace)				
Hypothesized No. of Co-integrating Equations	**Eigenvalue**	**Trace Statistic**	**Critical Value**	**Probability**
None *	0.789127	147.7783	76.97277	0.0000
At most 1 *	0.742197	88.63135	54.07904	0.0000
At most 2 *	0.394430	37.12010	35.19275	0.0306
At most 3	0.273948	18.05984	20.26184	0.0977
At most 4	0.143693	5.894783	9.164546	0.1990
Unrestricted Co-integration Rank Test (Maximum Eigen value)				
Hypothesized No. of Co-integrating Equations	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value**	**Probability**
None *	0.789127	59.14699	34.80587	0.0000
At most 1 *	0.742197	51.51125	28.58808	0.0000
At most 2	0.394430	19.06025	22.29962	0.1334
At most 3	0.273948	12.16506	15.89210	0.1766
At most 4	0.143693	5.894783	9.164546	0.1990

* denotes rejection of the hypothesis at the 0.05 level

The results of Johansen Co-integration test are presented in table 5. The coefficients are given in 2nd column against their respective variables. First variable, terms of trade shows

the positive relationship with real exchange rate of Pakistan in the long run. Statistically, the relationship is significant explaining us that due to increase in price of exportable goods, our exports will decline and ultimately country will face depreciation in real exchange rate. It may be interpreted as if a term of trade is increased by 1 percent; real exchange rate will depreciate by 0.29 percent.

With respect to trade restrictions, it is seen that due to more trade restrictions and import barriers on the nation, it would lead to exports and it appreciation of real exchange rate. In the study, negative relationship is found between trade restrictions and real exchange rate with statistically significant coefficient value. 1 percent increase in trade restrictions would lead to 0.28 percent appreciation of real exchange rate on the average in the long run.

Table 5: Johansen Co-integration test

Variables	Coefficients	Standard Errors	T-Statistics
lnTOT	0.29	0.10	2.91
lnTR	- 0.28	0.11	-2.42
lnINF	0.26	0.18	1.41
lnWR	-0.35	0.03	-12.72
Constant	- 4.08	0.93	-4.38

As Regards, the coefficient of price level depicts us depreciation of real exchange rate with highly statistically insignificant coefficient value. It may be explained as higher price level of domestic goods reduces exports and depreciates domestic currency. One percent rise in domestic price level depreciates real exchange rate by 0.26 percent in the long run on the average. In the long run, on the average, the study explores that real exchange rate is appreciated by 0.35 percent if workers' remittances are increased by one percent. Coefficient of this variable is 0.35 having highly significant value. When workers' remittances are increased, Pakistan will receive more of US dollars. Higher supply of dollars would be cause of appreciation of real exchange rate in the long run.

Table 6: Error Correction Model

Variables	Coefficients	Standard Errors	T-Statistics
Error Correction Term	-0.14	0.07	-2.01
D(lnRER(-1))	-0.02	0.22	-0.11
D(lnRER(-2))	-0.33	0.25	-1.28
D(lnTOT(-1))	-0.24	0.36	-0.65
D(lnTOT(-2))	-0.31	0.32	-0.96
D(lnTR(-1))	-0.38	0.68	-0.55
D(lnTR(-2))	-0.25	0.61	-0.42
D(lnWR(-1))	-0.08	0.05	-1.51
D(lnWR(-2))	-0.08	0.06	-1.23
D(lnINF(-1))	1.04	0.68	1.53
D(lnINF(-2))	0.21	0.62	0.34
Constant	-0.08	0.09	-0.90
R-squared	0.54	**F-statistic**	3.24

Short run results are presented in table 6. Coefficient for Error Correction term is -0.14 and it is significant as well. It suggests that short run disturbances may be removed and equilibrium will be restored by taking 14 percent annual adjustments.

5. Conclusion and Policy Recommendations

The current study aims at investigating the long run determination of Real Exchange rate in Pakistan. For that purpose study collects data for the time period from 1972 – 73 to 2012 – 13. Various econometric techniques are applied like Ng- Perron test for unit root examination. We have determined that all variables are stationary at first difference. Lag length 2 is selected on the basis of Akaike information criterion. Long run relationship is significantly found using trace and max Eigen statistic.

Johansen co-integration test analyzes that real exchange rate is appreciated by trade restrictions and workers' remittances. On the other side, terms of trade and Price level are found to depreciate real exchange rate of Pakistan in the long run. Error Correction term suggest 14 percent annual adjustments that is to be taken to restore equilibrium.

On the basis of results, the research gives some policy recommendations to the higher authorities. Appreciation of currency is better for improving the value of country. But for underdeveloped countries where exports are already low and economy is facing problems of energy; in such economies, there should be sustainable level of real exchange rate. The value of currency should be fixed for the long run whether through fixed exchange regimes or flexible. Depreciation invites the foreigners in domestic market at cheaper rate, it leads to higher exports but on the other side it is harmful for debt accumulation. Due to depreciation, foreign debt will also increase in the same proportion of depreciation of currency. So, Govt. should always try to fix real exchange rate at specific level.

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