DETERMINATION OF EXCHANGE RATE ON THE BASIS OF MONETARY, TRADE AND FOREIGN EXCHANGE MODEL

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CERTIFICATE

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I **Muhammad Umar Ayaz** hereby state that my MSc thesis titled **"Determination of Exchange Rate on the Basis of Monetary, Trade and Foreign Exchange Model"** is my own work and has not been submitted previously by me for taking any degree from this University **Pakistan Institute of Development Economics** or anywhere else in the country/world.
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Dedication

This Humble Effort is Dedicated to

"My Family for Their Love, Wishes, Support Patience, Understanding

and Guidance and All Those Who Seek Knowledge to Reach At

Truth"

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Muhammad Umar Ayaz

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LIST OF ABBREVIATIONS

PPP	Purchasing Power Parity
ER	Exchange Rate
ECM	Error Correction Model
PBM	Portfolio Balance Payment
CPI	Consumer Price Index
IMF	International Monetary Fund
SDR	Special Drawing Rights
BOT	Balance of Trade
ADF	Augmented Dickey-Fuller Test
GUM	General Unrestricted Model

Abstract

Exchange rate plays a vital role for maintaining equilibrium of balance of payment within country. The stable exchange rate is key for sustainable growth. This study has constructed a specific model for determination exchange rate of Pakistan with UK, USA, Japan and Euro Area by using Hendry General to Specific approach. Monthly time series data is taken for this study from 2000:1 to 2018:5 and determinants of monetary, trade and foreign exchange reserves model includes real output differential, real money differential, real interest differential, price differential, imports, exports and foreign reserves. The existing long run relationships among variables have been observed by Johenson and Juselious (1992) cointegration technique. While the error correction model (ECM) is applied for estimating short run relationship. The results suggest that all variables has significant role in all cases except Pak-Euro. In case of Pak-Euro, real money differential, real interest differential, exports and imports are dropped from model because they are insignificant and are not playing any role in the model. On the basis of results, it is suggested to maintain money supply and to increase foreign reserves in order to improve the exchange rate.

CHAPTER 1

INTRODUCTION

Exchange rate stability is essential for economic growth as it maintains the equilibrium in balance of payment. Due to globalization, the international transactions are based on foreign currency due to which demand for international currency has been increased. Simply exchange rate is the price at which goods are traded between countries in the world market. This issue has acquired great intention in developing economies as they are growth driven economies and depends largely on the capital imports from developed countries. Exchange rate plays fundamental role for maintaining external as well as internal equilibrium according to (Khan and Qayyum, 2007). A competitive exchange rate positively influences the foreign currency and international transaction that leads toward economic growth.

Through assets market and goods markets, exchange rate gives macroeconomic links between countries. In goods market, a relationship between foreign and domestic prices is developed by exchange rate, as foreign currency is used for international transactions. It has feedback effects on domestic economy, higher the import prices, higher the cost of living, cost of production and decrease competitiveness (Moosa and Bhatti, 2009).

There exist many models for determination of exchange rate and each model is bases on strong theories. Most popular models are purchasing power parity Cassel (1920), Keynesian approach Robert Mundell (1962) and James Fleming (1963), monetary model (Mussa 1976), Portfolio models (Branson 1972). Initially the theory that was introduced for determining exchange rate was Purchasing power parity. It takes significant position in modern theories for determining exchange rate. Many studies are presented on this in Pakistan that provides mixed results. Chishti and Hasan (1993) are not in the favor to support this theory for explaining variations in exchange rate. According to Bhatti and Moosa (1994) under flexible exchange rate PPP fails as expectations are absent for exchange rate determination. Bhatti (1997) in his study shows evidence of ex ante version of purchasing power parity that explains exchange rate in current relative price and in expected real exchange rate. Bhatti (1996), Qayyum et al. (2004), Khan and Qayyum (2008) also favor the validity of relative PPP in case Pakistan.

For determination of exchange rate PPP theory emphasize on arbitrage concept and neglects the significance of capital movement in whole process. To fill this gap, Keynesian approach was introduced by the Robert Mundell (1962) and James Fleming (1963) also known as Mundell Fleming model that introduced the capital flows through balance of payment. Bhatti

(2001) tested this model empirically and proposed that for Pakistan, nominal exchange rate determine by relative income level, interest rate differentials and relative price level.

The asset approach models were emerged during the 1970's with global financial market liberalization. These models help to improve the Keynesian flow model by merging the assets stock market in ER determination. Asset approach involves both the portfolio balance and monetary models. The monetary models were originated by Dornbush (1976a), Moosa (1976) Frenkel and Johnson (1978) and Bilson (1978a). They developed various models like Frankel real interest rate differential, Flexible price and Sticky price for capturing behavior of ER through monetary variables. In the early ninety's, the most dominant model for the determination of exchange rate was monetary model.

In portfolio balance model (PBM), exchange rate determines due to stocks. The significant feature under this model is as it considers the imperfect substitution between foreign and domestic bond and also consider the wealth effect of current account surplus for the determination of exchange. To determine exchange rate, it is essential that we take all models or including all the relevant determinants because omitting any relevant variable may cause to provide spurious and biased results. According to Charemza and Deadman (1997), Gujrati (2004), if we omit any variable form our model then the results will not be reliable for policy implementation and forecasting. He suggests that it is alright to have an over estimated model rather than under estimated. Because over estimated model do not provide bias results but the under estimated.

1.1 Objective of this study

The overriding purpose for this study is to construct a general to specific model by including the determinants of monetary, trade and forex model for determination exchange rate.

Accordingly, followings are the objective under this study;

- To construct a general model by including all the determinants of monetary, trade and foreign exchange model.
- To construct a specific model for determining exchange rate based on general model.
- To observe long run as well as short run association among variables.

1.2 Hypothesis of the study

This study has the following hypothesis;

- All the determinants of exchange rate are insignificant according to null hypothesis
- All the determinants are significant according to alternative hypothesis

1.3 Organization of the study

This study is ordered in to 5 chapters. Chapter 2 provides literature review on previous studies of exchange rate determination. Chapter 3 presents data and econometric methodology of this study. Chapter 4 will discuss results and finally chapter 5 concludes and provides the policy recommendation of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical literature

The earlier approach used for determining exchange rate was purchasing power parity (PPP) initially introduced by Cassel in 1920. This theory is also known as "Law of one price" means that a bucket of identical commodities has same price in two different countries. Purchasing power parity also categorized into two versions, absolute version and relative version. The absolute purchasing power parity is same just like law of one price but the relative approach shows variations in exchange rate among countries. In other words, it provides an association between countries inflation rate during a specific time.

There is some criticism on this theory. PPP phenomenon has been completely undergoes under floating market in short run (Coleman 1995) and it also didn't take the demand and supply of capital flows for determining exchange rate. Beside this traditional flow model of Mundal and Flaming (1962) assumes both capital and current accounts for determining exchange rate. But this model also has some gaps. It assumes that interest rate increases at constant rate to finance current account deficit and ignores the interaction between stock and flows. Secondly, this model assumes that there exists a static expectation about exchange rate and an expansionary monetary policy will depreciate domestic currency.

To fill these gaps the asset approach was introduced during the decade of 1970's, by (Taylor, 1995). This approach focuses on international trade flows as a primary determinants of exchange rate. One main reason for this is that on international flow of financial capital, tight restrictions was maintained by the government during the 1960's. Asset approach was further categorized into two approaches, portfolio approach and monetary approach.

Monetary approach shows importance of monetary policy for determine exchange rate. This approach uses two dynamics for determining the exchange rate i.e. price and interest rate. It was firstly introduced by the Frenkel (1996), Mussa (1996), Dronbush (1976a) and Bilson (1998). For observing exchange rate behavior through monetary variables, different models were developed including sticky price, flexible price and Frenkel real interest rate differential. The resemblance among these models is that a stable money demand function is assumed and money supply and demand are key determinants of exchange rate. But these models also have some gaps. The flexible price model assumes that under long and short run wages, prices and exchange rate are impeccably flexible and purchasing power parity holds continuously. Dornbusch (1976), introduced a sticky price model with an idea that sticky price model determines the wages and prices and they change slowly over the time due to different shocks. But later on, Dornbusch model was modified by Frankel. He incorporated expected inflation rate in the equation of expected exchange rate.

The portfolio model was initiated by Branson (1976), Israd (1978) and kouri (1978). It is the extension of the monetary approach that includes assets like bonds. It assumes that there is imperfect substitutability between domestic as well as foreign bonds. The main assumption under this approach is that relative demand and supply of money and bonds are main determinants of exchange rate between countries. Sinn (1983) combines both monetary model and portfolio balance approach to incorporate them into IS-LM Keynesian model under the flexible exchange rate regime and compared with capital movement hypothesis.

A general model for exchange rate determination was developed by Gylfason and Helliwell (1983) and Ahtiala (1984). In this model significant features of the traditional models were included and it is simply combination of Monetary, Keynesian and Portfolio approaches under flexible exchange rate. It is argued that the former models are generally based on one part and ignore other important parts of the system that results to generate contrasting results from each other.

2.2 Empirical Evidences:

Purchasing power parity is important and simple theory for the determination of exchange rate. Many international and national studies are available on this topic. Many studies are in the favor to support this theory while other are in against to this theory. Chishti and Hasan (1993), Engle Grainger technique was used for testing the relevance of PPP. For this quarterly data was used from 1957-Q1 to 1992-Q2.

Bhatti and Moosa (1994) stated that by neglecting the role of expectations and uncertainty in ER determination, then conventional PPP will not hold. Bhatti and Moosa (1994) explains that conventional purchase ng power parity model will not hold if under flexible exchange rate uncertainty and expectations will neglect from determination of exchange rate. Ex ante PPP concept was presented that explains the ER behavior with relative prices as well as with expected ER.

Bhatti (1996) empirically studied long run validity of PPP Pakistani exchange rate against eight industrial countries including British pound, German mark, Austrian schilling, Netherlands guilder, Japanese yen, US dollar, Swedish krona and Canadian dollar. Quarterly data was used from 1982-94 for determining long run association between nominal exchange rate and relative prices. For this Johansen cointegration technique was adopted. Result shows that relative PPP exists in all countries except UK. Furthermore, according to Sims (1988) he used Bayesian test and conclude that the over the time real exchange rate behaves as a mean reverting. On the bases of these results it is concluded that Pakistani rupee depreciation will improve the competitiveness of the country and trade deficit will also reduce.

Bhatti (1997) presented a paper that shows some evidences on expectation's role in determining the Pakistani ER vis-à-vis pond, yen and dollar. For this monthly data was used from 1982 to 1993. Explanatory variable was expected real exchange rate along with relative prices. The results support the ex-ante PPP implying that random walk trend is shown by real exchange rate. Beside this, anticipated inflation rate prevailing in Pakistan is much higher as compare to other countries that inspire Pakistani residents to convert into foreign assets. The Dickey Fuller (1979) and Phillips Ouliaris (1990) used integration tests that show the integration of all variables at frequency one, I (1). Though, the conventional PPP exist for rupee-dollar and rupee-yen.

Ahmed and Ali (1999) simultaneously examine the determination of nominal exchange rate and domestic price level in case of Pakistan. They observe that if a change occurs in money supply, import and export prices and foreign reserves, ultimately changes occurs in both price leval and exchange rate. Both domestic and foreign shocks are observed here. Real and financial shocks are the domestic shocks that are examine in this paper while foreign reserves, export and import prices are the external shocks. For this study, the data was taken from the 1982-Q2 to 1996-Q4. By having a temporary increase in foreign exchange reserves and export prices, a positive effect is observed on exchange rate (increase) and price level (decrease). If money supply increases temporary, the price level will rise initially while exchange rate will depreciate but in long run this shock does not exist and convergence holds. The findings show that in short run PPP model does not exist. There is also existing unidirectional association between price level and exchange rate. Beside this due to permanent money change, there exist permanent inflation and exchange rate depreciation.

Siddique and Akhter (1999) observed the pass-through effect that what will be the effect on domestic prices due to change in exchange rate during 1972-98. The data shows that on average nominal devaluation is 8.85 per annum while real devaluation of exchange rate is insufficient. While the domestic inflation looks higher as compare to the foreign inflation. For determining the order of stationary, unit root test was used. Cointegration test was applied for determining integration and causality between ER and domestic prices. The Error Correction Model is practices for estimating the relation between variable. Result shows that no association is existing between change in domestic prices and exchange rate. In case of Pakistan, imported inflation has no effect but the domestically controlled money supply and attempt for promoting economic activities may be the key determinants of domestic prices.

Bhatti (2001), tested traditional flow model for the determination of exchange rate of Pak rupee with six industrial countries including German mark, Swiss franc, US dollar, Japanese yen, British pound and French franc. For this quarterly data was taken from 1982-2000 for observing long run relationship among domestic relative prices, nominal ER, domestic relative income and difference in foreign and domestic interest rates. Johansen multivariate cointegration technique was used. The results support this model in Pakistan except two currencies, US dollar and French franc. Moreover, traditional flow model is used for determining nominal ER in Pakistan.

Choudhery and khan (2002) have challenged the famous view that is devaluation of rupee causes inflation. For this purpose, quarterly data from 1982-1 to 2002-2 of ER, CPI, index of FCPI are taken for examine ER pass-through to consumer prices. ADF test recommends that all variables will enter with first difference in regression equation because they were integrated at order one. But on the other hand, if variables cointegrated, the relevant information will ignore just because of first difference relation. For Pakistan, if PPP and real exchange rate is stationary, the variables will be cointegrated. The result shows no short run significant pass-through of Pakistani rupee deprecation and consumer prices. It suggests that there exists a weak association between inflation and change in ER under short run. Under long run, inflation rate did not show full reflection of rupee deprecation.

Qayyum et al. (2004) analyzed the efficiency of PPP theory in case of Pak rupee vs U.S. dollar and then used to measure the ER misalignment in Pakistan. For this study quarterly data was used from 1982-Q2 to 2004-Q4. The augmented Dickey Fuller (1979) unit root test is applied that reveals that WPI and nominal exchange rate both are integrated of same order so it is possible to test presence of cointegration. For testing cointegration's presence,

Johansen (1988) and Juselius & Johansen (1990) multivariate cointegration technique is used. If actual rate is greater than the implied rate then we can say domestic currency is more valued but if it is lower than domestic currency is less valued. Result shows that cointegration coefficient between nominal exchange rate and whole price index is near to one. Beside this coefficient restriction was tested by using maximum likelihood ratio statistic, which supports existence of long run PPP. Due to liberalization policy reforms PPP works more efficiently in case of Pakistan.

Kemal and Haider (2004) examines nominal and real exchange rate's behavior under regime of flexible exchange rate. Monthly date from 2000 to 2004 and consider Pakistani rupee ER with US, UK, Japan and Euro Area. Three models were adopted including monetary model, trade model and forex model. The vector autoregression mode was used for the estimation of monetary model while structural vector autoregression model was used for testing ER links with other variables in forex and trade model. The results show that trade model was dominant on forex and monetary models for determining exchange rate. Significant results were obtained from trade models in all cases except Euro.

Khan and Qayyum (2008) used the persistence profile approach introduced by the Pesaren & Shin (1996) for testing the conformity and proportionality assumptions of PPP for Pak-rupee against US-dollar. Basically, this study observes symmetry & proportionality between foreign and domestic prices under PPP. The data was used from 1982Q2-2005Q4 and the vector error-correction and multivariate cointegration approaches were used. Johansen and Juselius (1990) method was adopted for estimating long-run association between foreign and domestic prices and nominal exchange rate. The findings was not in the favor to support the validity of the strict form of purchasing power parity in Pakistan. One significant vector was found that shows the presence of LR relationship between ER and foreign and domestic prices. There exist long run cointegrated relationship of nominal ER with foreign and domestic prices. On domestic price level, the cointegration coefficient is near to unity while the coefficient of foreign prices is below unity. The validity of PPP is weak for Pakistan. Beside this the adjustment of PPP is slow towards long-run equilibrium path and takes 4 to 5 years for achieving equilibrium.

Dash and Narayanan (2010) examined the influence of trade dynamics on foreign exchange reserves in India. For this exports and imports functions are estimated form 1994M1 to 2008M10. The results supported long run association between real interest rate and exports under export function and between real exchange rate and imports under import function. They recommended that at least to keep precautionary foreign reserves is favorable for adjusting exchange rate and unnecessary outputs.

Alam and Rahim (2011) examines the factor that affect the foreign exchange reserves. For this, they use foreign reserves, nominal exchange rate, current and capital account balance for case of Bangladesh from 1996-M7 to 2012-M6. They find that there exists positive association between exchange rate and foreign reserves. Due to a one unit change in the foreign reserves there is a 285.6 unit change in exchange rate.

Yongzhong and Freeman (2013) stated that foreign reserves helps to minimize the home currency crises and external debt risks. To holding a sufficient amount of foreign exchange reserves provides broad space to monetary authorities for adjusting macroeconomic policies and boost confidence level of investor.

Mehmood et.al (2015), examined impact of inflation, money supply and interest rate on exchange rate for Pakistan. For this monthly, data was used form 2000M7 to 2009M6 and Johansen cointegration and VECM was applied. The results showed that inflation and exchange rate has positive association while money supply and interest rate has negative association. Beside this there is also existing short run and long run association between exchange rate and inflation.

Dominguez et al. (2010) examined whether decumulation of foreign reserve causes currency appreciation or not. He used data of time-stamped reserve sales and intraday foreign exchange rate. He found that foreign reserves decumulation that occurs daily lead toward significant appreciation of the Koruna.

2.3 Conclusion

The previous literature shows that the main determinants of exchange rate are money supply, inflation, foreign reserves, exports, imports and interest rate. In past, many studies are available on these determinants for determining exchange rate. But in past no one has put all these variables together for determining exchange rate.

2.4 Literature Gap

Our objective is to construct a specific model by including all determinants of theories of exchange rate. The purpose for considering all these determinants is to avoid the problem of spurious unbiased results. According to Charemza and Deadman (1997), the under identified model provides biased results while there is no problem if the model is over identified. It is clear from previous literature that no one has include all the determinants of exchange rate models so there is possible chances of biasness in their results and the suggested policies may not work properly. This study would be include all the relevant determinants including output differential, money differentials, price differential, interest rate, imports, exports and foreign exchange reserves so the chances of spurious and biasness is excluded.

CHAPTER 3

DATA AND METHODOLOGY

3.1 Introduction

As the purpose of this study is to construct a specific model for the determination exchange rate. This chapter discusses the methodology for estimating the general to specific model for exchange rate determination. Following the introduction, the next sections 3.2 explains the economic theory of monetary, trade and foreign exchange model for determination of exchange rate. Section 3.3 will discuss the econometric methodology of general to specific modeling. The last section 3.4 provides the information on the construction of the variable.

3.2 Economic theories of exchange rate determination

Different theories have been available in the literature for determination of exchange rate like purchasing power parity, uncovered interest parity, portfolio approach, Mundle Fleming etc. In this study only considers the three theories including monetary model, trade model and forex model for determining exchange rate because their combination provides the vast list of determinants.

3.2.1 Monetary Model of Exchange Rate

The monetary theory for the determination of exchange rate was initiated in 1970's in the result of collusion of Bretton Wood system, when floating exchange rate was adopted by many countries against dollar. It highlights the importance of monetary factors that determines exchange rate. As exchange rate is relative prices of two countries that determines by relative supply and demand of currency of trading countries. If domestic country adopts an expansionary monetary policy relative to foreign trading country then domestically inflation will rise and the currency will depreciate.

Firstly, the monetary approach was introduced by the Mussa (1976), Frenkel (1976), Dornbush (1976) and Bilson (1978). Different models were developed like sticky price, flexible price and Frenkel real interest rate differential for analyzing the behavior of ER through monetary variables. One thing that is similar in this model is that they assume that demand and supply are the basic determinants of ER and it also assumed a stable money demand function. Beside this perfect substitutability is assumed between foreign and domestic bonds. As there is many similarities in these models but there are many significant difference. Like the flexible prices states that the prices are flexible due to which PPP holds while in sticky prices, the prices of commodities fixed under short run and only under long run PPP holds. Under monetary model the major determinants are money differential, price differential and interest rate differentials.

$$ER = \beta_1(M\text{-}M^*) + \beta_2(P\text{-}P^*) + \beta_3(Y\text{-}Y^*) + \beta_4(i\text{-}i^*) \qquad \text{EQ (1)}$$

According to theory, money supply positively influences exchange rate as increasing money supply will depreciate the domestic currency. Similarly, domestically high prices will lead toward depreciation of domestic currency by reducing the demand for domestic goods by enhancing the demand for foreign commodities. Expected sign with output is positive as if output increases, the exchange rate will depreciate.

3.2.2 Forex Model of Exchange Rate

Forex model of exchange rate is based on foreign reserves kept by the monetary authorities of a country like central bank. According to IMF, foreign reserves are external assets available to monetary authorities that they use for directly financing imbalance of payments by intervention of foreign market. Monetary authorities like central bank keep foreign reserves in different forms like currency, financial securities, special drawing rights (SDRs'), deposits and monetary gold. These reserves increase by increasing foreign investment, exports, remittances, foreign aids and loans. These foreign reserves behave like a shock absorber against any factor having negative impact on exchange rate. Therefore, the central bank uses these reserves as a tool against the adverse shock for maintaining steady rate for currency exchange. Central banks also use foreign exchange reserves to control interest rate, inflation and money supply in the country. In forex model, exchange rate determines by demand and supply of foreign currency. Moreover, foreign reserves also used for serving external debt and perform as a security for international borrowing, Liu (2007). Mostly, reserves kept in form short term with high liquidity and government mostly uses interest bearing securities for the repayment of loans and for purchases all over the world (Neely, 2000). Kemal (1999), found negative association between foreign exchange reserves and exchange rate.

$$ER = \gamma(FR) \qquad \text{EQ (2)}$$

According to theory there exist positive association between foreign reserves and exchange rate. Because of higher foreign reserves, exchange rate will decline resulting to appreciate domestic currency.

3.2.3 Trade Model of Exchange Rate

Imports and exports have a great influence on determination of exchange rate due to its impact on supply and demand of foreign currency. If a country has more imports as compare to its exports then we say there is existing BOT deficit and if there is more exports as compare to imports then there is balance of trade surplus. In trade model, the exchange rate determines by demand and supply of foreign currency. As exchange rate refers to the rate of exchange between two currencies. This relative value influences the demand for foreign currency. If exports are greater than imports, then there is inflow of foreign currency that results in demanding less foreign currency. This will lead to appreciate the domestic currency. While if imports exceed from exports, then this results to demanding more foreign currency so the value domestic currency will declines. Trade policy of a country plays a significant role for determining the quantity of trade and for maintaining exchange rate. As if the balance of trade (BOT) is positive then the currency will appreciate and if it is negative then currency will depreciate. So theoretically, exchange rate having negative association with exports as exports increase, exchange rate will decline. But imports have a positive association with exchange rate as exchange rate increases by increasing imports.

$$ER = \alpha_1 X + \alpha_2 M \qquad \text{EQ (3)}$$

Theoretically the expected sign of exports with exchange rate is negative. When exports increase, the exchange rate will decrease that results to appreciate the currency. While imports and exchange rate have negative association between them. An increase in imports will causes to rise exchange rate and depreciate domestic currency. Kemal and Qadir (2005), exchange rate and imports has positive association while exports and exchange rate has negative association.

3.3 Econometric methodology

In this section we discuss the econometric methodology that we have adopted for this study.

3.3.1 Hendry General to Specific Methodology

There always exists more than one explanation and relationships among the variables especially in case of economics. For example, theory says that exchange rate affects due to changing in exports and imports that means exchange rate is the function of exports.

$$\text{Model 1:} \qquad ER = f(X,M)$$

But beside this exchange also rises because of an increase in money supply that means exchange rate is the function of money supply.

$$\text{Model 2:} \qquad ER = f((M\text{-}M^{*}), (P\text{-}P^{*}), (Y\text{-}Y^{*}), (i\text{-}i^{*}))$$

Likewise, exchange rate effected by the foreign exchange reserves. Increasing reserves will cause to decrease the exchange rate. So here the third model is following

$$\text{Model 3:} \qquad ER = f(FX)$$

So these three models are making economic sense and a proper theory is also existing theories behind these models that means we cannot neglect any model. So, a general model is constructed by including all the models and then a specific model is generated by dropping all the insignificant variables. If we do not include any relevant variable then the coefficients of the excluding variables will become biased. As the above three mentioned models making strong sense so only estimating one model will biased coefficients.

To construct a general model, initially we start with a general model by including all relevant determinants. For constructing a general unrestricted model, the regressors of monetary, trade and forex model are included by taking maximum lags each. For obtaining Hendry general to specific model, a joint restriction is set on the basis of F-test and drop the insignificant variables on the basis of P-value. After this a joint restriction is set on on the lags of the variables. If calculated F-stat is greater than critical value, we drop the specific lag of specific variables. After fulfilling these two restrictions, finally specific model is constructed.

3.3.2 Unit Root Test

As the vision of this study is to construct general to specific model for the determination of exchange rate and time series data is taken for this purpose. Usually, the problem of nonstationarity of data is common under time series data which leads toward spurious results. By spurious results we mean that the data has higher R^2 but has no association between variables or there is low R^2 with a strong association among variables. According to Kemal and Qadir (2005) following are the conditions for the stationarity of data;

- The data series must be mean reversion and must fluctuates around constant mean.
- Series must have a constant variance over the time.
- In two different time periods, auto-covariance value depends on distance but not on actual.

For solving this issue, Augmented Dicky Fuller test is applied that was presented by Dicky and Fuller in 1976.

ADF is used to check the non-stationarity of data under null hypothesis. The auxiliary regression of ADF unit root test is as following;

$$\Delta Yt = \alpha + \beta t + \rho Y\text{t-1} + \sum_{i=1}^{l} \delta i \, \Delta Y\text{t-i} + \varepsilon t$$

Where Yt is the variable of interest, εt is the error term and it is assumed that εt has no correlation with itself. The test statistic of ADF is

$$\tau = \frac{\rho}{\text{SE}\ (\rho)}$$

The calculated value of τ is compared with the critical values provided by the Dicky and Fuller. If the probability is less than 0.05 at level, then we say that the data is stationary at level. If the data is not stationary at level which means the p value is greater than 0.05 then we go for first difference to make data stationary.

3.3.3 Johansen Co-integration Method:

Johansen cointegration test was introduced by Johansen in (1991) to observe the long run association among non-stationary variables. Mostly, time series data having the problem of non-stationary so there is possible chances of existing co-integration among variables. According to Rao (2007) if co-integration exists between different variables then there is possibility of existing long run relationships. Johansen cointegration is used for measuring more than one relationship therefore it is more useful as compare to other tests like Engle Graner(1987) for the identification of cointegrations among variables. Johansen (1990) test is based on two types of test. Trace test and eigen-value test.

3.3.4 Error Correction Method

Error correction method (ECM) is applied to check the relationships that are existing among the variables under short run. Basically, it is used for measuring the speed of convergence. Speed of convergence shows that how much time is required to dependent variable for achieving equilibrium due to a change in independent variable.

3.4 Data and Data Descriptive

This research contains time series monthly data from 2000M1 to 2018M5 for UK, USA, Japan, Pakistan and Euro Area. We take these specific countries on the basis of their trade volume. The data of all variables including consumer price index, interest rate, money supply, nominal exchange rate, foreign exchange reserves, exports and imports are taken from international financial statics for all five countries. But the data of money supply of Pakistan is taken from State Bank of Pakistan and consumer price index of euro area is taken form the European Central Bank. Exchange rate is used in terms of US dollars for all cases except euro area. For euro area the exchange rate is used in terms of national currency per SDR. Money supply is directly taken in terms of M2. For prices the data of CPI is used in case of domestic prices as well as foreign prices. Foreign exchange reserves are taken in terms of dollar while the imports and exports of Pakistan are taken in terms of million rupees. The variables of the model are money differential, price differential, real interest differential, log of imports, log of exports and log of foreign exchange reserves of Pakistan. We generate the series by using equations/formulas below.

Real Money Differential	(RMD) = RM – RM*
Real Money	(RM) = MS/CPI
Price Differential	(PD) = CPI – CPI*
Real Interest Differential	(RID) = RIR – RIR*
Real Interest Rate	RI = I - π
Inflation	$\pi = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$
Log of Imports	Ln (M)
Log of Export	Ln (X)
Log of Foreign Reserves	Ln (FX)

Where,

MS = Money Supply

RM = Real Money Supply (Domestic)

RM* = Real Money Supply (Foreign)

CPI = Consumer Price Index (Domestic)

CPI* = Consumer Price Index (Foreign)

RIR = Real Interest Rate (Domestic)

RIR* = Real Interest Rate (Foreign)

RI = Real Interest Rate

I = Nominal Interest

π = Inflation

LnX = Log of Exports

LnM = Log of Imports

LnFX = Log of Foreign Exchange Reserve

Y = Output

Real money differential is constructed by subtracting the foreign money supply from domestic money supply. As well as the price differential is generated by subtracting the consumer prices of foreign country from consumer prices of domestic country and for interest rate differential, real interest rate of foreign country is subtracted from domestic interest rate. Moreover, log is applied on exchange rate, imports, exports and on foreign exchange reserves.

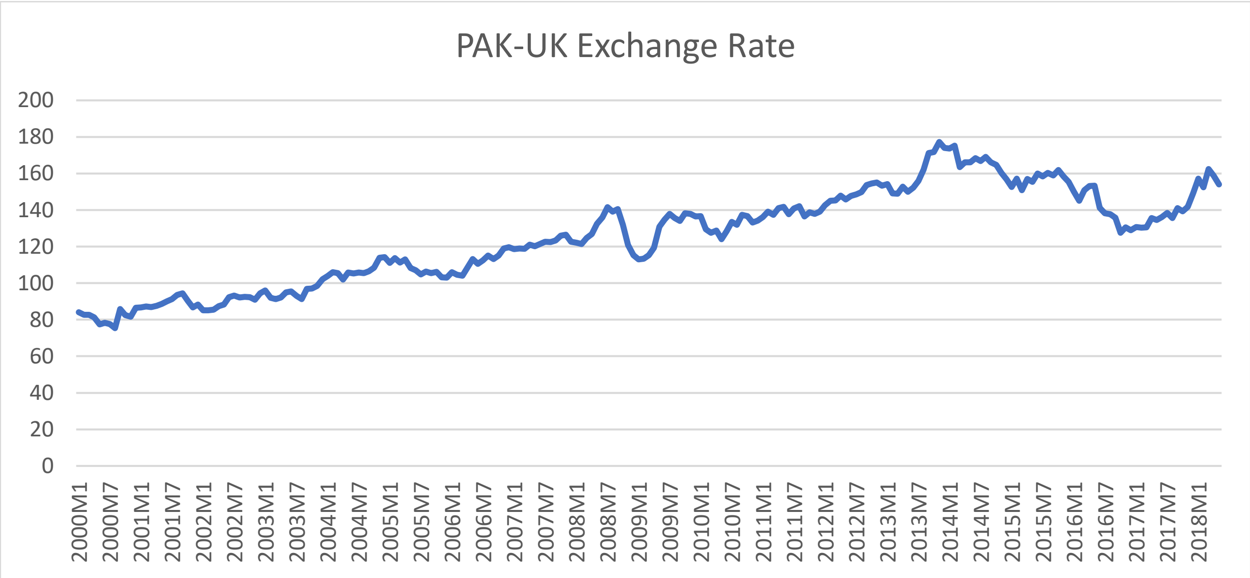
According to economic theories few of them has positive relation while other have negative relation with exchange rate. The independent variables are money differential, price differential, interest rate differential, log of imports, log of exports and log of foreign reserves and dependent variable is nominal exchange rate. Accordingly, money supply, prices, imports has positive association with exchange rate. If they increase domestically then exchange rate will increase. Likewise, interest rate, exports and foreign exchange reserves have negative relation with exchange rate. If anyone of them increase, the exchange rate will decline.

3.4.1 Descriptive analysis in case of PAK-UK

In case of Pak-UK, the maximum value of price differential is 38.160 while the minimum value of price differential is -39.146 as shown in Table 3.1. The maximum value shows higher prices in Pakistan while minimum value shows lower domestic prices. On average price differential remains -10.947. Maximum value of money differential is -5.664 and the minimum value is -6.202. on average money differential remains at -5.918. Negative sign with money supply shows that the money supply is always lower domestically as compare to UK. Interest differential shows the difference between domestic and foreign interest rate. Maximum value of interest differential is 14.23 while the minimum value of interest differential is -3.77 and on average interest rate is 5.566. On average exchange rate remains 123.581 showing that domestic currency is weaker than foreign currency.

Table 3.1: Descriptive analysis in case of PAK-UK

	Max	Min	Mean	Median	SD
PD	38.160	-39.146	-10.947	-23.055	27.142
RMD	-5.664	-6.202	-5.918	-5.895	0.135
RID	14.238	-3.776	5.566	5.419	4.643
ER	177.233	75.367	123.561	122.516	26.671



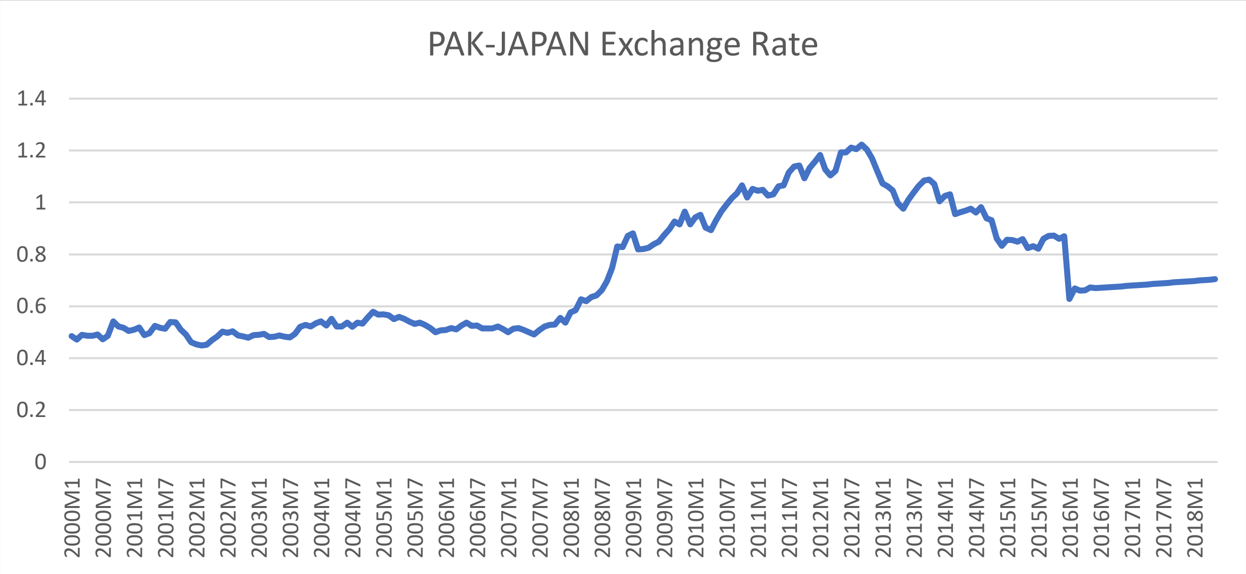
Graph shows that over the time the domestic currency is depreciating against pound.

3.4.2 Descriptive analysis in case of PAK-JAPAN

For Pak-JAPAN, the maximum value of price differential is 1.447 and minimum value 0.408. The maximum value shows higher prices in Pakistan while minimum value shows lower domestic prices. On average price differential remain 0.837. Money supply is always higher as compare to the Japan money supply. On average money supply remains at 7256.151. Maximin interest differential remains at the value of 14.110 while at minimum it is -0.264. on average interest differential is 7.966.

Table3.2: Descriptive Analysis in case of PAK-JAPAN

	Max	Min	Mean	Median	SD
PD	1.447	0.408	0.837	0.701	0.365
RMD	9070.234	5046.681	7256.151	7421.063	1033.299
RID	14.110	-0.264	7.966	8.165	3.231
ER	1.222	0.448	0.732	0.619	0.245



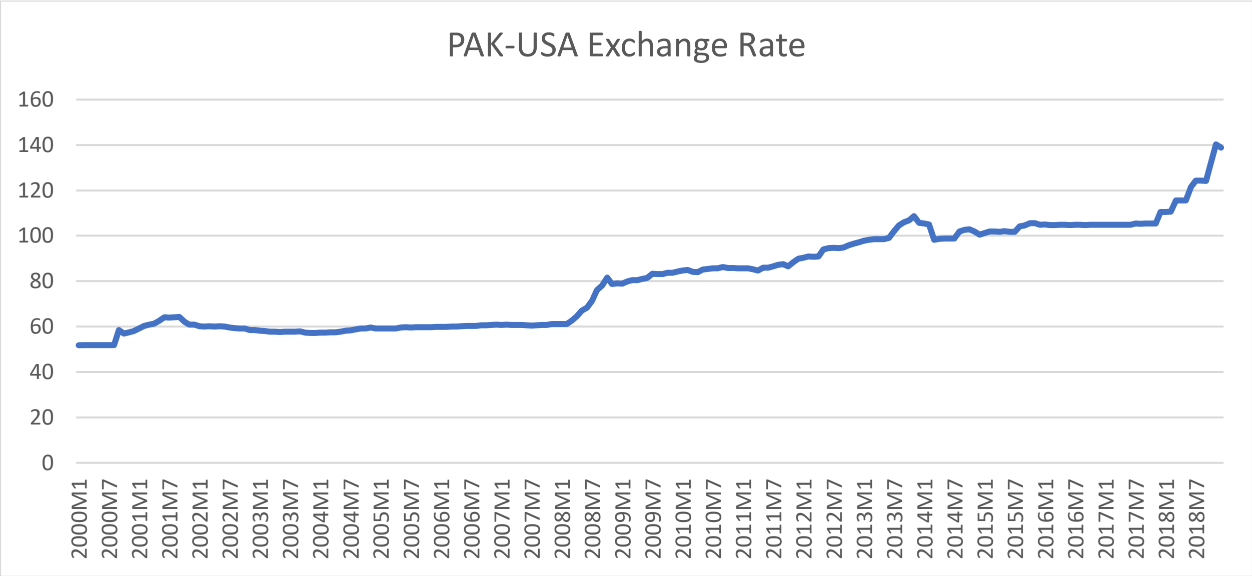
Graph shows that there is a sudden rise in exchange rate after Jan 2008 that stats to fall in Feb 2013.

3.4.3 Descriptive analysis in case of PAK-USA

In case of Pak-USA, the maximum value of price differential is 1.365 while the minimum value of price differential is 0.539. The maximum value shows higher prices in Pakistan while minimum value shows lower domestic prices as compare to USA. On average price differential remain 0.858. Positive sign with money supply shows that money supply is always higher domestically as compare to USA. Money supply on average remains equal to 655.328. Interest differential shows the difference between domestic and foreign interest rate. Maximum value of interest differential is 19.504 while the minimum value of interest differential is -20.598.

Table 3.3 Descriptive analysis in case of PAK-USA

	Max	Min	Mean	Median	SD
PD	1.365	0.539	0.858	0.726	0.297
RMD	835.005	508.412	655.328	648.468	74.439
RID	19.504	-20.598	2.073	4.912	12.928
ER	140.268	51.789	80.520	82.363	21.213



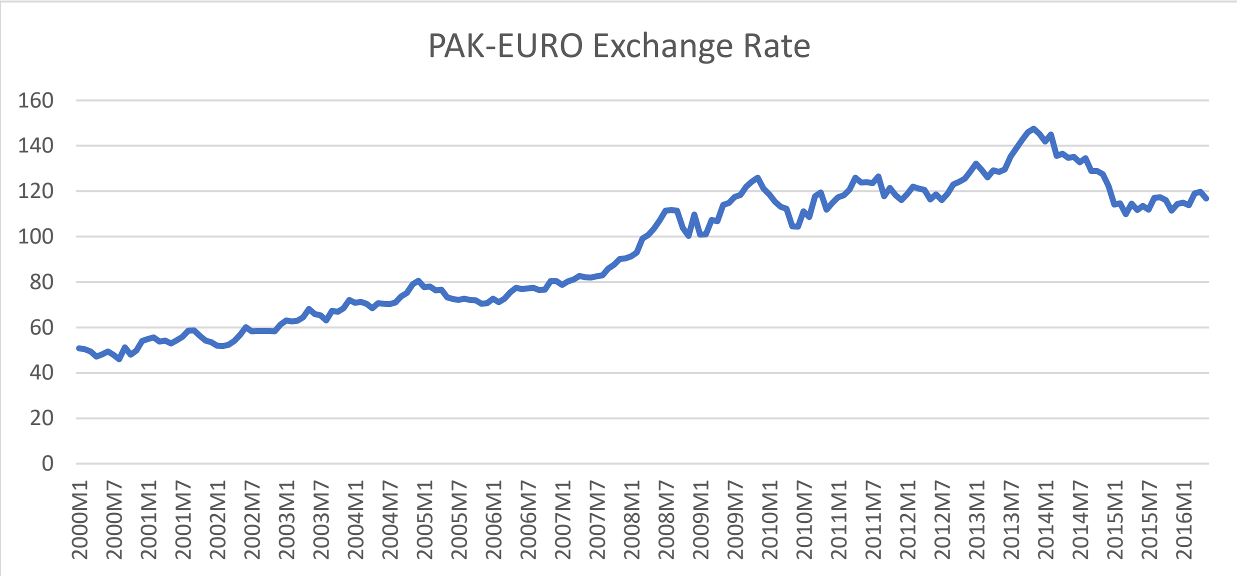
Graph shows that over the time there is a upward trend between Rupee-Dollar exchange rate that shows the domestic currency is depreciating.

3.4.3 Descriptive analysis in case of PAK-EURO

In case of Pak-Euro, the maximum value of price differential is 42.24 while the minimum value of price differential is -40.67. The maximum value shows higher prices in Pakistan while minimum value shows lower domestic prices. On average price differential remain -11.26. Money supply of Pakistan is shows higher as compare to Pak euro's money supply. Interest differential shows the difference between domestic and foreign interest rate. On average interest differential remains equal to 81.26.

Table 3.4: Descriptive analysis in case of PAK-EURO

	Max	**Min**	**Mean**	**Median**	**SD**
PD	42.24	-40.67	-11.28	-26.44	29.20
RMD	861.73	602.77	739.01	746.48	69.21
RID	95.51	65.19	81.26	80.76	7.41
ER	147.548	45.972	93.73	99.173	28.823



As it is clear from the graph that exchange rate is rising over the time that is showing the devalue of the domestic currency against euro.

CHAPTER 4

ECONOMETRIC METHODOLOGY

4.1 Introduction

This chapter provides the specific model of nominal exchange rate bases on determinants of trade, foreign exchange and monetary models against the currencies of UK, USA, Japan, Euro Area. Section 4.2 will discuss the results of specific model of exchange rate of Pak Rs. against pound. In section 4.3, results of exchange rate of Pak Rs against Japanese Yen is reported. Section 4.4 provides the results of exchange rate of Pak Rs against US Dollar. Section 4.5 discuss the results of exchange rate of Pak Rs against Euro.

4.2 Specific model of nominal exchange rate against pound

In order to attain parsimonious model of exchange rate against pound, it is necessary to start with the general model that incorporates all the related determinants of nominal exchange rate. Because excluding any variable from model causes to generating biasness in the results. The observations are taken on monthly basis from 2000-M1 to 2018-M5. Therefore, to construct the General unrestricted model (GUM) the regressors of monetary model, trade model and forex model are combined together and 12 lags are taken for each variable including real money differential, real interest differential, price differential, log of exchange rate, log of exports, log of imports and log of foreign reserves. The reason behind taking 12 lags is that it clears all diagnostic tests that means there exists no problem of heteroscedasticity, normality and autocorrelation. The results are reported Table 4.1.

Table 4.1: Diagnostic test on GUM in case of RS/pound exchange rate model

Tests	**Degree of freedom**	**p-value**
AR 1-12 test:	F(12,81)	1.251 [0.263]
ARCH 1-12 test:	F(12,160)	0.983 [0.466]
Normality test:	Chi^2(2)	2.208 [0.331]

It can be observe from Table 4.1, the P-values associated with autoregressive AR test, heteroskedasticity ARCH test and residual normality test are greater than 0.05 therefore, null hypothesis is accepted. There do not exist problem of autocorrelation, heteroskedasticity and residuals are normally distributed. This implies that further extension of lags are not required anymore in the GUM. So, at 12 lags of each variable we have a decent starting point. To get the specific model a joint restriction on variables are set on basis of F-test for testing null hypothesis that the specific variable is insignificant at all lags. Results are discussed in Table 4.2. Accordingly, P-value is greater than 0.05 therefore null hypothesis is accepted and conclude that all variables except output differential plays significant role in the model. So, we can completely drop output differential variable from the GUM model.

Table 4.2: Joint restrictions on variables

Null Hypothesis	**F-stat**	**Prob**	**Decision**
All 12 lags of ER are equal to zero	F(12,93)= 14.290	0.001	Rejected
All 12 lags of money diff are equal to zero	F(13,93) = 1.7509	0.003	Rejected
All 12 lags of price diff are equal to zero	F(13,93) = 0.486	0.001	Rejected
All 12 lags of real Interest diff are equal to zero	F(13,93) = ` 1.134	0.001	Rejected
All 12 lags of log of exports are equal to zero	F(13,93) = 1.199	0.017	Rejected
All 12 lags of ln imports are equal to zero	F(13,93) = 1.520	0.001	Rejected
All 12 lags of ln forex are equal to zero	F(13,93) = 1.766	0.001	Rejected
All 12 lags of output differential are equal to zero	F(13,93) = 1.023	0.437	Accepted

We estimate the GUM again by dropping the output differential. Now a joint restriction is set on specific lag of all variables on basis of F-test. Accordingly, if calculated value of F-test is less as compare to tabulated value then null hypothesis will be accepted that shows that the specific lag performs insignificant role but if F-calculated is greater as compare to the value F-tabulated then null hypothesis will be rejected and conclude that the specific lag is significant. Table 4.3 is providing results. Accordingly, the null hypothesis of each variable at lag 2,4,6,7,8,9 and 10 is not rejected. Therefore, the variables at these lags are insignificant for nominal exchange rate and we drop them jointly from the GUM. Whereas, variables at lag 1, 3, 5 and 11 provides a significant contribution to the model and will retain in the model.

Table 4.3: Joint restrictions on 12 lags of all variables

Null hypothesis	Variables	F-test	p-value	Decision
Each variable at 1	All variables	F(7,93) = 3.328	0.003	Reject
Each variable at 2	All variables	F(7,93) = 1.771	0.102	Do not reject
Each variable at 3	All variables	F(7,93) = 3.434	0.002	Reject
Each variable at 4	All variables	F(7,93) = 0.475	0.849	Do not reject
Each variable at 5	All variables	F(7,93) =2.228	0.038	Reject
Each variable at 6	All variables	F(7,93) = 0.793	0.594	Do not reject
Each variable at 7	All variables	F(7,93) = 1.686	0.121	Do not reject
Each variable at 8	All variables	F(7,93) = 1.378	0.223	Do not reject
Each variable at 9	All variables	F(7,93) = 1.301	0.258	Do not reject
Each variable at 10	All variables	F(7,93) = 1.229	0.294	Do not reject
Each variable at 11	All variables	F(7,93) = 2.577	0.017	Reject
Each variable at 12	All variables	F(7,93) = 1.120	0.357	Do not reject

The exchange rate model is re-estimated by including only significant lags that is each variable at current, 1, 3, 5 and 11. The results are provided in Table 4.4. It can be seen from the results of Table 4.4 most of the variables are insignificant on the basis of T-value. Now we drop the insignificant lags based on T-stats. If calculated value of T-stat is less than 2 at any lag then the variable is insignificant. Lag 0 is rejected in case of real money differential, price differential, real interest rate differential, log of exports of Pakistan. The lag 1 is rejected in case log of exchange rate. Lag 3 is rejected for log of foreign exchange reserves of Pakistan. Lag 5 is rejected for real money differential and lag 11 is rejected for log of imports of Pakistan. All these lags are rejected because the value of t-test of all these lags are greater than 2 that shows that all these lags perform significant role.

Table 4.4: Re-estimation by including significant lags

Variables	**Coefficient**	**t-value**	**prob**
lnexrs_pound_1	0.748	11.9	0.000
lnexrs_pound_3	0.034	0.459	0.646
lnexrs_pound_5	-0.045	-0.740	0.460
lnexrs_pound_11	-0.055	-1.31	0.191
Constant	-0.347	-0.820	0.413
RMD	0.195	1.90	0.059
RMD_1	0.055	0.503	0.615
RMD_3	-0.103	-1.19	0.236
RMD_5	-0.276	-2.72	0.007
RMD_11	0.063	0.776	0.438
PD	0.004	1.03	0.304
PD_1	-0.002	-0.474	0.635
PD_3	-0.001	-0.200	0.842
PD_5	-0.002	-1.04	0.299
PD_11	0.001	0.835	0.405
RID	-0.002	-0.833	0.406
RID_1	-0.002	-0.991	0.323
RID_3	-0.001	-1.02	0.307

RID_5	0.001	0.220	0.826
RID_11	-0.001	-0.630	0.529
LnX	0.060	2.61	0.010
LnX_1	0.001	0.0296	0.976
LnX_3	0.001	0.0278	0.977
LnX_5	-0.002	-0.0968	0.923
LnX_11	0.008	0.433	0.665
LnM	0.034	1.89	0.060
LnM_1	0.004	0.222	0.824
LnM_3	-0.038	-2.12	0.035
LnM_5	0.017	0.950	0.343
LnM_11	0.054	3.27	0.001
LnFX	0.030	1.50	0.136
LnFX_1	-0.017	0.685	0.494
LnFX_3	-0.033	-1.65	0.100
LnFX_5	0.010	0.618	0.537
LnFX_11	-0.001	-0.198	0.843

After eliminating the insignificant lags from model, the most specific model is re-estimated and results are discussed in Table 4.5. The specific model contains the determinants of trade, foreign exchange and monetary model and the specific model is constructed on the basis of Hendry's General to Specific, therefore, it provides unbiased estimates. The results of Table 4.5 are not directly interpretable. As we are considering time series data and it is common to have a non-stationarity in data. In case of non-stationarity of data, there exist chances of long run association. For attaining long run association between nominal exchange rate and its determinants, we check non-stationarity of variables by applying Augmented Dickey Fuller (1979) test on the level of each variable appear in specific model.

Table 4.5: Most specific model

Variables	Coefficient	Std.Error	t-value	t-prob	Part.R^2
lnexrs_pound_1	0.746	0.033	22.5	0.000	0.743
RMD	0.234	0.050	4.62	0.000	0.108
RMD_5	-0.227	0.044	-5.09	0.000	0.129
PD	0.004	0.001	4.54	0.000	0.105
PD_5	-0.005	0.001	-4.79	0.000	0.115
RID	-0.004	0.001	-5.49	0.000	0.146
LnX	0.061	0.013	4.63	0.000	0.109
LnM_11	0.057	0.009	6.01	0.000	0.170
LnFX_3	-0.014	0.003	-4.05	0.000	0.085

Sigma 0.021	**RSS** 0.078	
Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,168)	1.446 [0.190]
ARCH 1-12 test:	F(7,170)	0.508 [0.827]
Normality test:	Chi^2(2	0.953 [0.620]
RESET test:	F(2,173)	0.669 [0.513]

4.2.1 ADF unit root test

Basically, the ADF unit root test is used for checking stationarity of data. Because if estimate the variables with existing problem of unit root, the regression will be spurious and meaningless. The ADF unit root test is applied and the results are provide in Table 4.5. Result shows the non-stationarity of variables at level as p-value is high than 0.05 so the null hypothesis is rejected. At first difference, series become stationary and the ttab is reported at level of 5%. As the series is non-stationary there is possible chances of existing long run association among variables. For observing long run association Johansson and Juselious (1990) co-integration technique is applied in the next section.

Table 4.6: Unit root test on variables

Variables	At level			At first different			conclusion
	Tcal	Ttab	Constatnt	Tcal	Ttab	Constant	
Lnexrs_pond	-1.293 (0.632)	-2.876	Yes	-13.496 (0.000)	-2.876	Yes	Stationary
RMD	-1.334 (0.494)	-2.876	Yes	-3.089 (0.000)	-2.876	Yes	Stationary
PD	1.487 (0.999)	-2.876	Yes	-5.591 (0.000)	-2.876	Yes	Stationary
RID	-1.396 (0.583)	-2.876	Yes	-13.445 (0.000)	-2.876	Yes	Stationary
LnX	-1.549 (0.508)	-2.877	Yes	-4.948 (0.000)	-2.877	Yes	Stationary
LnM	-1.243 (0.655)	-2.876	Yes	-14.542 (0.000)	-2.876	Yes	Stationary
LnFX	-2.177 (0.215)	-2.876	Yes	-7.127 (0.000)	-2.876	Yes	Stationary

P-value is shown in brackets

4.2.2 Co-integration Test

Johansen Juselius cointegrated (1990) test is useful for estimating LR association among different variables. Johansen Juselius cointegration is based on two types of test, trace statistic vale and maximum eigen test. These two tests ensure the occurrence of long run association. Table 4.7 is showing the results. As the trace value is 210.62, 134.06, 83.51 and 48.73 that is greater the critical value of 125.61,95.75, 69.81, 47.85 at significance level of 5%, therefore, we reject corresponding null hypothesis at none, at most 1, at most 2 and at most 3 cointegrating relations among the variable. Whereas, the calculated is less than critical value at most 4 cointegrating relationships so we do not reject this hypothesis. This implies that there is existing stable LR association among the variables.

Table 4.7: Johansen Cointegration

Hypothesized No. of CE	**Trace statistic**	**Critical value**
None	210.62	125.61
At most 1*	134.06	95.75
At most 2*	83.51	69.81
At most 3*	48.73	47.85
At most 4	26.09	29.79

Trace test indicates 4 cointegrating eqs at 0.05 level

4.2.3 Long run Association

The LR association among exchange rate and its determinants are obtained by using results of ARDL specific model reported in Table 4.5. The static/long run coefficients are obtained by assuming the steady state equilibrium conditions for each variable. Table 4.8 reports the relationship among the variable. Accordingly, the table shows that money supply, exports and imports having a positive relationship while price differential, interest differential and foreign exchange reserves has negative relationship. If domestically money supply increases by 1%, the nominal exchange rate will rise by 0.0266% that causes in the devaluation of the domestic currency as also supported by Jimoh (2004). The interest differential shows that one unit increase in interest differential causes to decline exchange rate by 0.016 units as it causes the inflow of foreign reserves in the country as also supported by Hui Yim (2009). In the same way if domestic prices exceed foreign prices then due to one unit change in prices the exchange rate will depreciate by 0.002 units. According to theory if the domestic prices higher than foreign prices then domestic demand declines foreign demand increase that causes to increase exchange rate. There exists a positive association between exports and exchange rate. If the exports increase by 1% it causes to rise the exchange rate by 0.244%. Temporary increase in exports will lead toward exchange rate appreciation, Ahmed and Ali (1999). Foreign reserves will appreciate the currency by 0.05%. On the other hand, if imports rise by 1%, exchange rate will increase by 0.225%.

Table 4.8: Solved long-run equation for lnexrs_pound

	Coefficient	**Std.Error**	**t-value**	**Prob**
RMD	0.026	0.068	0.392	0.695
PD	-0.002	0.000	-2.32	0.021
RID	-0.016	0.002	-6.79	0.000
LnX	0.244	0.043	5.69	0.000
LnM	0.225	0.034	6.47	0.000
LnFX	-0.057	0.014	-3.86	0.000

4.2.4 Error correction model

If long run association exists among variable there also exists a short run association. With the help of error correction model (ECM) we estimates short run association among variables. To observe short run association, again Hendry general to specific model is again applied on first difference variables. For this, firstly the ECM equation is generated on the basis of long run results as;

ECM = lnexrs_pound - 0.026664*mdiff + 0.00228092*pdiff + 0.0160394*idiff - 0.244808*lnx - 0.225183*lnm + 0.0576454*lnfx;

The results of ECM are provided in the Table 4.9. The value of ECM shows speed of convergence through which it can achieve the equilibrium level in the economy that is 5% per annuum which means that it takes around twenty years for achieving equilibrium level if nominal exchange rate faces disequilibrium. The negative sign with ECM shows the significance. Due to a previous disequilibrium in exchange rate, there is a decline in exchange rate equal to 0.18% in short run. Likewise, if domestically money supply changes in previous time then it causes to rise exchange rate by 0.23%, implying that if the money supply increases domestically, it causes to increase demand due to which exchange rate will appreciate. Exchange rate falls by 0.005% and 0.003% in short run due to a previous change in lag of price differential and interest differential respectively. The reason behind this is under short run, imports and exports has positive association with exchange causes to lead toward depreciation of domestic currency. The model also shows that short run dynamic do not have problem of normality, heteroskedasticity and autocorrelation as reported in Table 4.10.

Table 4.9: Error Correction Model and Short run relationship

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
Dlnexrs_pound_7	-0.189	0.062	-3.02	0.002	0.049
DRMD	0.238	0.085	2.80	0.005	0.043
DRMD_1	0.216	0.077	2.79	0.005	0.042
DPD	-0.005	0.002	-2.63	0.009	0.038
DPD_8	-0.005	0.002	-2.63	0.009	0.038
DRID_1	-0.003	0.001	-2.70	0.007	0.040
DLnX	0.063	0.016	3.76	0.000	0.075
DLnM_11	0.050	0.014	3.57	0.000	0.068
ECM_12	-0.056	0.021	-2.57	0.011	0.036

Table 4.10 Diagnostic test of ECM Model

Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,167)	1.303 [0.251]
ARCH 1-12 test:	F(7,169)	0.519 [0.819]
Normality test:	Chi^2(2	0.105 [0.948]
Hetero test:	F(18,164)	0.979 [0.485]
RESET test:	F(2,172)	1.901 [0.152]

4.2.5 Conclusion

In case of Pak and UK, there is existing positive association of money differential, exports and imports with exchange rate while real interest rate, price differential and foreign exchange reserves has a negative association with exchange rate in both short and long run.

4.3 Specific model of exchange rate against yen

For attaining specific model of exchange rate for yen, initially we start with general model that consider all relevant determinants of exchange rate. The observations are taken monthly basis from 2000M1 to 2018M5. General unrestricted model (GUM) is constructed by including the regressors of monetary, trade and forex model and 12 lags are initially taken for each variable including real money differential, price differential, real interest differential, nominal exchange rate, exports, imports and foreign reserves. We take 12 lags because it clears all diagnostic tests which means there exist no problem of existing autocorrelation and heteroskedasticity as shown in Table 4.11

Table 4.11: Diagnostic test on GUM in case of RS/Yen exchange rate model

Tests	**Degree of freedom**	**p-value**
AR 1-12 test:	F(7,86)	0.186 [0.987]
ARCH 1-12 test:	F(7,170)	0.362 [0.922]
Normality test:	Chi^2(2)	70.065 [0.000]**

In Table 4.11, the P-values associated with autoregressive AR test, heteroskedasticity ARCH test and residual normality test are greater than 0.05. Therefore, null hypothesis do not reject. That means the problems of autocorrelation, heteroskedasticity is not existing and residuals are normally distributed.

In order to attain the specific model a joint restriction on variables are set on basis of F-test for testing null hypothesis that a specific variable is insignificant at all lags but null hypothesis is rejected on the basis of P-value as it is less than 0.05. This means that we do not exclude any variable completely because all of them plays significant role on any lag.

In next step a joint restriction is also set on specific lag of all variables on basis of F-test. If the calculated value of F-test is less than tabulated value then null hypothesis will accepted as the specific lag is insignificant. After this the nominal model of exchange rate is re-estimated by including significant lags of all variable. Now the insignificant lags will be drop on the base of T-stat. if the value of T-stats is less than two then the lag is insignificant and drop from the model. After eliminating the insignificant lags, the most specific model is given in Table 4.12.

Table 4.12: Most specific model of Exchange rate rupees/yen

	Coefficient	**Std.Error**	**t-value**	**prob**	**Part.R^2**
lnexrs_yen_1	0.719	0.073	9.81	0.000	0.377
lnexrs_yen_2	0.084	0.074	1.13	0.258	0.008
Constant	-1.588	0.354	-4.49	0.000	0.112
RMD_4	-0.001	2.071	-5.48	0.000	0.158
RMD_8	3.663	2.419	1.51	0.131	0.014
RMD_9	5.891	2.716	2.17	0.031	0.028
RMD_11	-3.523	1.927	-1.83	0.069	0.020
PD	0.944	0.321	2.94	0.003	0.051
PD_2	-0.658	0.482	-1.36	0.174	0.011
PD_3	1.085	0.613	1.77	0.078	0.019
PD_4	-1.60761	0.4955	-3.24	0.001	0.062
PD_9	0.160	0.277	0.579	0.563	0.002
RID_8	0.001	0.002	0.592	0.554	0.002
RID_9	-0.005	0.002	-1.82	0.070	0.020
RID_12	0.002	0.001	1.24	0.216	0.009
LnM	0.075	0.025	3.00	0.003	0.053
LnM_2	-0.027	0.025	-1.09	0.277	0.007
LnM_3	-0.040	0.024	-1.66	0.099	0.017
LnM_9	-0.049	0.023	-2.09	0.038	0.026

LnM_11	0.059	0.025	2.37	0.019	0.034
LnM_12	0.079	0.025	3.13	0.002	0.058
LnX_4	0.055	0.025	2.18	0.030	0.029
LnFX_8	0.029	0.028	1.06	0.291	0.007
LnFX_9	-0.064	0.037	-1.73	0.085	0.018
LnFX_11	0.053	0.022	2.39	0.017	0.034

Sigma	**RSS**	**No. of observation**
0.034	0.184	184
Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,152)	0.675 [0.692]
ARCH 1-12 test:	F(7,170)	0.273 [0.963]
Normality test:	Chi^2(2	83.174 [0.000]**
RESET test:	F(2,175)	1.759 [0.175]

4.3.1 Unit Root Test

In the next step ADF unit root test is practices for checking non-stationarity of data. Results are provided in Table 4.13. It can be observed from results that at level the series is nonstationary because of high P-value. But at first difference, series become stationary and the value of ttab is recorded at 5%. As the series is non-stationary so there is the possibility of existing of long run association among variables. Cointegration technique is applied for observing long run relation.

Table 4.13: Unit root test on variables

Variables	At level			At first different			Conclusion
	tcal	Ttab	Constatnt	Tcal	Ttab	Constant	
Lnexrs_pond	-1.189 (0.678)	-2.876	Yes	-14.471 (0.000)	-2.876	Yes	Stationary
RMD	-1.746 (0.406)	-2.877	Yes	-2.018 (0.042)	-2.877	Yes	Stationary
PD	1.025 (0.996)	-2.876	Yes	-4.978 (0.000)	-2.876	Yes	Stationary
RID	-0.154 (0.940)	-2.876	Yes	-14.066 (0.000)	-2.876	Yes	Stationary
LnX	-1.549 (0.506)	-2.877	Yes	-4.948 (0.000)	-2.877	Yes	Stationary
LnM	-1.243 (0.655)	-2.876	Yes	-14.542 (0.000)	-2.876	Yes	Stationary
LnFX	-2.177 (0.215)	-2.876	Yes	-7.127 (0.000)	-2.876	Yes	Stationary

P-value is shown in brackets

4.3.2 Johansen Co-integration

Johansen cointegration estimates the existing long run association among variables based on two tests trace and max eigen test. As the Table 4.14 shows the results. It can be seems from table that the trace value is larger than critical value at 5% significant level, so null hypothesis is rejected. But at most 3, we accept the null hypothesis as trace value is now smaller than critical value.

Table 4.14: Johansen Cointegration

Hypothesized No. of CE	Trace statistic	Critical value
None	161.26	125.61
At most 1*	109.63	95.75
At most 2*	70.53	69.81
At most 3	38.53	47.85

4.3.3 Long run relationship

Long run association is obtained by using the results of ARDL specific model reported in Table 4.12. The results are provided in Table 4.15 showing that money differential, price differential and real interest differential has negative association with exchange rate while exports, imports and foreign exchange of Pakistan has positive relationship. If domestically the money supply of Pakistan changes by 1% than nominal exchange rate will depreciate by 0.0002%. According to Pettinger (2017), if domestically money supply increase it will reduces interest rate that causes to reduce the foreign investment that results in the depreciation of the foreign currency. By 1 unit change in domestic prices exchange rate declines by 0.38% and by an increase of 1% interest rate domestically, the exchange rate depreciates by 0.007%. The domestic prices have a significant association that steadily leads toward exchange rate depreciation, Khan and Qassim (1996). As the interest rate increases, there is an inflow of foreign currency within the country that appreciate the domestic currency. Imports of Pakistan shows a positive association with exchange rate. 1% change in imports brings a 0.49% increase in exchange rate because by importing more commodities, foreign currency's demand increases that causes to depreciate the domestic currency. If exports increases by 1% then exchange rate increase by 0.28 units. By one unit increase in foreign reserves, exchange rate will increase by 0.09%. Temporary increase in foreign exchange reserves and export prices have a positive association with exchange rate, (Ahmed and Ali 1999).

Table 4.15 Solved static long-run equation for lnexrs_yen

	Coefficient	**Std.Error**	**t-value**	**prob**
RMD	-0.001	3.985	-6.80	0.000
PD	-0.384	0.236	-1.62	0.106
RID	-0.007	0.006	-1.08	0.281
LnM	0.494	0.153	3.23	0.001
LnX	0.285	0.137	2.07	0.039
LnFX	0.095	0.037	2.54	0.011

Long-run sigma = 0.173624

4.3.4 Error correction Model

Error correction method is used for observing short run association among variables reported in Table 4.12. Hendry general to specific model is used at first differential and ECM equation is generated as

ECM = lnexrs + 8.10114 + 0.000271063*realmdiff + 0.384649*pricedif + 0.00719076*realidiff - 0.49452*lnMpak - 0.285404*lnXpak - 0.0959435*lnFEpak;

Table 4.17 shows diagnostic test of short run dynamics while Table 4.16 provides the short run results of ECM. Coefficient of ECM shows that the convergence level is 9% by which it again achieves the equilibrium level in the economy. The results stats that during short run money differential and imports has negative association with exchange rate. Beside this price differential, interest rate, exports and foreign exchange reserves has mix association with exchange rate.

Table 4.16: Error Correction Model

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
Dlnexrs_1	-0.119	0.076	-1.56	0.122	0.016
Dlnexrs_4	-0.061	0.076	-0.799	0.425	0.004
Dlnexrs_5	-0.313	0.102	-3.06	0.002	0.061
Dlnexrs_7	-0.062	0.100	-0.618	0.537	0.002

Dlnexrs_10	-0.088	0.102	-0.864	0.389	0.005
DRMD_1	-3.662	2.797	-1.31	0.192	0.011
DRMD_4	-9.126	2.565	-3.56	0.000	0.081
DRMD_5	-2.082	3.045	-0.684	0.495	0.003
DRMD_9	-3.693	2.531	-0.146	0.884	0.000
DRMD_11	-5.183	2.601	-1.99	0.048	0.027
DPD	1.090	0.451	2.42	0.016	0.039
DPD_1	1.322	0.630	2.10	0.037	0.030
DPD_2	-0.415	0.564	-0.737	0.462	0.003
DPD_3	0.956	0.513	1.87	0.064	0.023
DPD_7	-0.801	0.480	-1.67	0.097	0.019
DPD_9	-0.725	0.558	-1.30	0.195	0.011
DRID_1	0.006	0.003	1.68	0.095	0.019
DRID_3	-0.002	0.003	-0.736	0.463	0.003
DRID_4	0.008	0.003	2.69	0.008	0.048
DRID_7	-0.003	0.002	-1.34	0.182	0.012
DRID_9	-0.001	0.003	-0.230	0.818	0.000
DRID_12	0.003	0.002	1.37	0.172	0.013
DLnM_2	-0.034	0.026	-1.29	0.199	0.011
DLnM_3	-0.088	0.030	-2.92	0.004	0.056
DLnM_4	-0.031	0.030	-1.02	0.308	0.007
DLnM_5	-0.014	0.027	-0.514	0.608	0.001
DLnM_9	-0.001	0.024	-0.005	0.995	0.000
DLnM_12	0.058	0.027	2.10	0.037	0.030

DLnX	0.055	0.033	1.67	0.096	0.019
DLnX_5	0.024	0.032	0.738	0.461	0.003
DLnX_9	-0.005	0.033	-0.177	0.859	0.000
DLnX_10	0.036	0.036	1.00	0.317	0.007
DLnX_11	0.0163	0.034	0.468	0.640	0.001
DLnX_12	-0.078	0.038	-2.02	0.045	0.028
DLnFX_1	0.016	0.032	0.507	0.612	0.001
DLnFX_3	-0.036	0.033	-1.10	0.271	0.008
DLnFX_7	0.060	0.032	1.85	0.066	0.023
DLnFX_9	-0.047	0.031	-1.49	0.138	0.015
DLnFX_10	-0.016	0.031	-0.532	0.595	0.002
DLnFX_12	0.001	0.031	0.019	0.984	0.000
ECM_12	-0.099	0.029	-3.34	0.001	0.072

Table 4.17 Diagnostic tests of ECM

Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,135)	0.494 [0.837]
ARCH 1-12 test:	F(7,169)	0.153 [0.993]
Normality test:	Chi^2(2	64.112 [0.000]**
RESET23 test:	F(2,140)	38.942 [0.000]**

4.3.5 Conclusion

In case of Pak-Japan, in long run a positive relation is observed for exports, imports and foreign reserves with exchange rate while a negative association is experienced for real money supply, prices and interest rate.

4.4 Specific model of nominal exchange rate against Dollar

For obtaining a specific model of exchange rate against dollar, it is mandatory to start with general model that includes all relevant determinants of exchange rate. General unrestricted model (GUM) is constructed by taking regressors of all three models including monetary, trade and forex model are included. Initially 12 lags are taken for each variable including money differential, price differential, interest differential, exchange rate, exports, imports and foreign reserves. At 12 lags all diagnostic tests are clear as shown in the Table 4.18

Table 4.18: Diagnostic test on GUM in case of RS/Dollar exchange rate model

Tests	**Degree of freedom**	**p-value**
AR 1-12 test:	F(7,86)	1.248 [0.285]
ARCH 1-12 test:	F(7,170)	0.407 [0.896]
Normality test:	Chi^2(2)	24.386 [0.000]**

In Table 4.18, shows that the null hypothesis is only accepted in case of normality as the Pvalue is less than 0.05 which means there is the problem of normality. The autoregressive AR and heteroskedasticity ARCH tests are rejected because of higher p-value which is showing that there do not exist the problem of heteroskedasticity.

Now for testing null hypothesis, a joint restriction is set on all variables which implies that the specific variable is insignificant on all lags but according to P-value we cannot exclude any variable completely as it is greater than 0.05. After that a joint restriction is set on specific lag of all variables on basis of F-test. If calculated value of F-test is less than tabulated value then we accept the null hypothesis which means the specific lag is insignificant. By dropping the insignificant lags the model of nominal exchange rate is reestimated by including significant lags of all variable. Now the insignificant lags drop on the base of T-stat. If the value of T-stats is less than two then the lag is insignificant and can be exclude from the model. After eliminating the insignificant lags the most specific model is given in Table 4.19.

Table 4.19 Most specific model of Exchange rate rupees/dollar

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
lnexrs_1	0.882	0.040	21.6	0.000	0.745
lnexrs_4	-0.048	0.044	-1.10	0.272	0.007
lnexrs_9	0.107	0.044	2.44	0.015	0.035
lnexrs_11	-0.132	0.037	-3.54	0.000	0.072
Constant	1.007	0.176	5.72	0.000	0.169
RMD_5	-0.001	4.919	-4.23	0.000	0.100
RMD_7	0.001	4.926	2.69	0.007	0.043
PD	0.322	0.057	5.62	0.000	0.164
PD_5	-0.481	0.148	-3.24	0.001	0.061
PD_6	0.515	0.180	2.87	0.004	0.048
PD_8	-0.404	0.125	-3.24	0.001	0.061
PD_9	0.192	0.103	1.85	0.065	0.021
RID_5	-0.001	0.001	-2.16	0.032	0.028
RID_6	0.002	0.001	2.90	0.004	0.050
LnM_1	0.012	0.006	2.06	0.041	0.025
LnM_6	0.020	0.007	2.75	0.006	0.045
LnM_8	-0.013	0.006	-1.96	0.051	0.023
LnM_10	-0.015	0.006	-2.18	0.030	0.028
LnM_11	0.021	0.005	3.69	0.000	0.078
LnX_6	-0.031	0.007	-4.25	0.000	0.101
LnX_10	-0.015	0.007	-1.99	0.048	0.024
LnFX_4	-0.022	0.004	-5.63	0.000	0.165

LnFX_8	0.026	0.006	4.00	0.000	0.091
LnFX_11	-0.007	0.005	-1.40	0.164	0.012

Sigma	**RSS**	**No. of Observation**
0.008	0.011	184
Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,153)	0.1845 [0.988]
ARCH 1-12 test:	F(7,170)	1.378 [0.217]
Normality test:	Chi^2(2	16.778 [0.000]**
RESET test:	F(2,158)	4.636 [0.011]*

4.4.1 ADF Unit Root Test

We apply unit root test for checking the nature of data that whether data is stationary or not. The results be seen fom Table 4.20. Results shows non-stationarity of data at level but at I(1), data is stationary. The ttab is reported at 5%. If the series is non-stationary, then there is the possibility of long run association among the variables. For long run relationship, Johnson (1990) method is applied.

Table 4.20: Unit root test on variables

Variables	At level			At first different			conclusion
	Tcal	Ttab	Constatnt	Tcal	Ttab	constant	
Lnexrs_pond	-0.638 (0.857)	-2.876	Yes	-7.570 (0.000)	-2.876	Yes	Stationary
RMD	-2.354 (0.156)	-2.877	Yes	-2.383 (0.148)	-2.877	Yes	Stationary
PD	0.816 (0.994)	-2.876	Yes	-5.049 (0.000)	-2.876	Yes	Stationary
RID	-1.649 (0.455)	-2.876	Yes	-13.576 (0.000)	-2.876	Yes	Stationary
LnX	-1.549 (0.506)	-2.877	Yes	-4.948 (0.000)	-2.877	Yes	Stationary
LnM	-1.243 (0.655)	-2.876	Yes	-14.542 (0.000)	-2.876	Yes	Stationary
LnFX	-2.177 (0.215)	-2.876	Yes	-7.127 (0.000)	-2.876	Yes	Stationary

The figure in brackets are representing P-value

By applying trace test, a long run association is observed among variables. The values of trace test is reported in Table 4.21. As the trace value is greater as compare to critical value showing that there is existing long run relationship. The H0 is rejected at most 3 because here trace value is smaller as compare to critical value.

Table 4.21 Johansen Cointegration

Hypothesized No. of CE	Trace statistic	Critical value
None	183.267	125.615
At most 1*	128.054	95.753
At most 2*	85.638	69.818
At most 3*	53.904	47.856
At most 4	27.164	29.797

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

4.4.2 Long run relationship

For obtaining the long run relationship, Johanson and juselious method is applied on specific model reported in Table 4.19. steady state equilibrium condition is assumed for each variable. The long run association among the variable is reported in Table 4.22. Result shows that real money differential, exports and foreign exchange reserves has a negative relation while price differential, real interest differential and imports have a positive relation. If domestically money supply has an increase of 1 unit, the there is a 0.0003 unit decrease in exchange rate that causes to appreciate the domestic currency as also supported by. If prices increase by one unit then there is an increase of 0.76 units in exchange rate. if the domestic prices are high, domestic commodities become expensive that reduces the demand for domestic commodities results in appreciating exchange rate, Pettinger (2017). One percent increase in real interest rate and imports will cause to increase the interest rate by 0.002 and 0.13% respectively. According to theory if domestically interest rate is higher as compare to foreign, it will causes to inflow of cash within the country so the exchange rate will declines. In case with imports, by increasing imports the demand for foreign currency will increase that results to depreciate domestic currency. If exports and foreign reserves will increase by 1% the it will case to decrease the exchange rate by 0.24% and 0.01% respectively. As in both cases there is inflow of cash in the country that results in appreciating the currency.

Table 4.22: Solved long-run relationship for lnexrs

	Coefficient	Std.Error	t-value	prob
Constant	5.271	0.553	9.52	0.000
RMD	-0.001	0.001	-2.78	0.006
PD	0.761	0.071	10.6	0.000
RID	0.002	0.002	1.43	0.155
LnM	0.135	0.061	2.20	0.029
LnX	-0.244	0.061	-3.99	0.000
LnFX	-0.019	0.01	-2.00	0.047

Long-run sigma = 0.0445281

4.4.3 Error Correction Model

For considering short run relationship Hendry general to specific model is assessed by taking variable at first difference and ECM equation is generated as

ECM = lnexrs - 5.27168 + 0.000394847*realmdiff - 0.761058*pricediff - 0.00296515*realidiff - 0.135154*lnMpak + 0.244985*lnXpak + 0.0199991*lnFEpax;

Table 4.23 is showing the short run association among the variables. ECM value shows that convergence level is 1% per annum. Due to a disequilibrium in previous lag of exchange rate, the exchange rate will declines equal to 0.14% in short run. There exists negative association between money differential and exchange rate that causes to decline with 0.23%. Exchange rate declines by 0.005% and 0.003% in short run due to a previous change in lag of price differential. In short run, imports and exports has positive impact on that causes to depreciate the domestic currency. While the foreign reserves has negative association with exchange rate during short run. Due to a temporary increase in foreign reserves, exchange rate will appreciate according to Ahmed and Ali (1999). The model also shows that short run do not have problem of normality, heteroskedasticity and autocorrelation as reported in Table 4.23.

Table 4.22: Error Correction Model

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
Dlnexrs_8	-0.141	0.050	-2.79	0.005	0.045
Constant	0.004	0.001	3.92	0.000	0.085
DRMD_5	-0.001	6.704	-4.36	0.000	0.103
DRMD_6	-0.001	5.612	-2.86	0.004	0.047
DRMD_7	-0.001	5.427	-2.37	0.018	0.033
DPD	0.295	0.096	3.07	0.002	0.054
DPD_1	0.280	0.094	2.97	0.003	0.050
DPD_5	-0.394	0.117	-3.36	0.001	0.064
DLnM	0.021	0.005	3.72	0.000	0.077
DLnM_1	0.022	0.005	3.83	0.000	0.081
DLnM_10	-0.016	0.005	-3.23	0.001	0.059
DLnX_5	0.020	0.006	3.13	0.002	0.056
DLnFX	0.018	0.007	2.41	0.016	0.034
DLnFX_4	-0.034	0.007	-4.52	0.000	0.110
DLnFX_5	-0.018	0.007	-2.57	0.011	0.038
DLnFX_6	-0.027	0.007	-3.56	0.000	0.07
DlnFX_11	-0.019	0.007	-2.63	0.009	0.04
ECM_12	-0.018	0.013	-1.37	0.173	0.01

Table 4.23 Diagnostic tests of ECM

Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,158)	0.387[0.908]
ARCH 1-12 test:	F(7,169)	1.480 [0.177]
Normality test:	Chi^2(2	38.940 [0.000]**
RESET test:	F(2,163)	35.654 [0.000]**

4.4.4 Conclusion

The result shows that during long run there exists positive association of price, imports and interest rate with exchange rate in long run. Foreign reserves, money supply and exports has negative association with exchange rate under long run. In case of short run imports, price differential and foreign reserves has mix association with exchange rate. Beside this money differential has negative and exports has positive relationship.

4.5 Specific model of nominal exchange Pak Rs against Euro

To construct a specific model for nominal exchange rate against euro, it is required to start with a general model intakes all determinants of exchange rate. For this the general unrestricted model (GUM) regressors monetary, trade and forex model are included. Each variable is included by taking 12 lags initially. The taken variables are real money differential, price differential, real interest differential, nominal exchange rate, exports, imports and foreign reserves. Table 4.24 shows the diagnostic test by taking 12 lags. Null hypothesis is rejected as there is no problem of normality, autoregressive and heteroskedasticity.

Table 4.24: Diagnostic test on GUM in case of RS/Yen exchange rate model

Tests	**Degree of freedom**	**p-value**
AR 1-12 test:	F(7,87)	1.649 [0.132]
ARCH 1-12 test:	F(7,171)	0.306 [0.950]
Normality test:	Chi^2(2)	0.290 [0.864]

Now a joint restriction is set on variables through P-value that implies that specific variable is insignificant at each lag. We accept the null hypothesis in case of money differential, interest rate differential, exports and foreign exchange reserves. As the P-value of all 12 lags of money differential, interest differential, exports and foreign reserves are greater than 0.05 so we completely drop these variables form our model. In next step, a joint restriction is set on specific lag of all variables through of F-test. Null hypothesis is accepted only if value of Ftest is less than critical value. After this we drop all the insignificant lags and re-estimate the model by including only significant lags of all variables. Now we drop insignificant lags on the base of T-stat. If T-stats is less than two then we drop the specific lag from the model. After eliminating the insignificant lags, the most specific model is given in Table 4.25.

Table 4.25 Most specific model of Exchange rate rupees/euro

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
lnexrs_1	0.934	0.023	39.9	0.000	0.897
PD	0.004	0.001	2.47	0.014	0.032
PD_2	-0.004	0.001	-2.53	0.012	0.034
LnM_10	0.024	0.008	2.80	0.005	0.041

Sigma	**RSS**	**No. of Observation**
0.029	0.156	184
Test	**Degree of freedom**	**p-value**
ARCH 1-12 test	F(7,174)	1.182 [0.315]
ARCH 1-7 test	F(7,171)	1.480 [0.177]
Normality test	Chi^2(2)	1.288 [0.525]
Hetero test	F(18,176)	1.321 [0.235]
RESET test	F(2,179)	0.105 [0.900]

Hendry's specific model is adopted by including determinants of trade, foreign exchange and monetary model. As we are encountering with time series data so there is possible chances of existing LR association among variables if data is non stationary. For this Augmented Dickey Fuller(1979) test is performed for checking non-stationarity of variables.

4.5.1 ADF Unit Root Test

ADF unit root tests is useful for checking stationarity of data. The results of ADF are reported in able 4.26. At level all variables are non-stationary because of high p-value. But at first level the series is stationary. The price differential has the breakpoint problem due to which the series was non-stationary. But breakpoint unit root makes data of price differential stationary at I(1). The ttab is reported at 5%. The series are non-stationary at level so Johanson cointegration is applied to observe long-run association.

Table 4.26: Unit root test on variables

Variables	**At level**			**At first different**			**conclusion**
	Tcal	**Ttab**	**Constant**	**Tcal**	**Ttab**	**constant**	
Lnexrs_pond	-1.507 (0.527)	-2.876	Yes	-14.942 (0.000)	-2.876	Yes	Stationary
PD	-3.728 (2.268)	-2.876	Yes	-14.711 (0.010)	-4.44	Yes	Stationary
FX	-2.177 (0.215)	-2.876	Yes	-7.127 (0.000)	-2.876	Yes	Stationary

P-value is shown in brackets

In Johansen cointegration is based two tests i.e. trace and maximum eigen. We observe long run association among variables on the basis of trace test. The values of trace test is mentioned in Table 4.27. As the trace value is greater as compare to the critical value at 5% significant level that shows that there is existing a long run association.

Table 4.27 Johansen Cointegration

Hypothesized No. of CE	Trace statistic	Critical value
None*	38.215	29.797
At most 1*	8.064	15.494

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

4.5.2 Long run relationship

Johansen (1990) method is practices on specific model presented in Table 4.25. for attaining long run association among variables. Table 4.28 shows the existing long run relationships. As it is clear from the table that price differential has a negative relation with exchange rate. If domestically prices increase as compare to the foreign, the exchange rate will declines by 0.002% that is also supported by Ahmed and Qassim (1999). A positive association is observed between imports and exchange rate. If imports of a country increases, there is a decline in exchange rate by 0.37%. As according to the theory because the increase of imports causes to increase the foreign currency that results into the depreciation of the currency.

Table 4.28 Solved long-run relationship for lnexrs_euro

	Coefficient	Std.Error	t-value	t-prob
PD	-0.00235260	0.001449	-1.62	0.1062
M	0.375995	0.003590	105.00	0.0000

Long-run sigma = 0.448263

4.5.3 Error Correction Model

If long run relationship is existing, then there is also existing a short run relationship. For short run relationship OLS is estimated at first difference of all variables of specific model that are presented in Table 4.25 by taking first difference and ECM equation is generated.

ECM = lnexrs + 0.0023526*pricedif - 0.375995*lnMpak

Short run relationship is presented in Table 4.29. ECM value shows that convergence level is 4% per annum. In short run if money supply changes then there is a decrease in exchange rate by 0.0003%. A negative association between imports and exchange rate occurs due to which there is a decline in exchange rate by 0.04% due to a previous fluctuation in foreign reserves.

Imports and exchange rate has negative association during long run but during short run, there do no exist any association.

Table 4.29 Error Correction Model and Short run relationship

	Coefficient	**Std.Error**	**t-value**	**t-prob**	**Part.R^2**
DRMD_5	-0.001	0.001	-2.26	0.024	0.027
DLnFX_3	-0.054	0.021	-2.47	0.014	0.032
ECM_12	-0.040	0.014	-2.76	0.006	0.040

Table 4.10 Diagnostic tests of ECM

Tests	**Degree of freedom**	**P value**
AR 1-12 test:	F(7,174)	0.896 [0.510]
ARCH 1-12 test:	F(7,170)	2.547 [0.016]*
Normality test:	Chi^2(2	3.157 [0.206]
RESET23 test:	F(2,179)	0.403 [0.668]

4.5.4 Conclusion

The results shows that in case of Pak-Euro, prices has a negative while imports has a positive association with exchange rate. Under short run, there exist a negative association of foreign reserves and money differential with exchange rate.

CHAPTER 5

CONCLUSION

This study provides a general to specific model for determination of exchange rate by including the determinants of trade, forex and monetary model. Data is constructed on monthly basis from 2000(1) to 2018(5). Firstly, a general model was constructed by including all the determinants of above-mentioned models and then a specific model for exchange rate is constructed by using Hendry approach.

The result shows that in case of Pak-UK, all variables are playing significant role in the model so all variables are adopted. At first difference, all the variables become stationary. Johansen Juselious cointegration (1990) is applied and it shows that there is existing 4 possible long run association among the variables. A positive long run relation of real money differential, exports and imports with exchange rate is observed showing that exchange rate will rise due to a change in these variables. The real interest rate differential, price differential and foreign reserves has a negative association with exchange rate. If anyone of them increases, exchange rate will decline that appreciate domestic currency. The same results are existing in short run and the speed of convergence is 5% per annum.

The same is the case with Pak-Japan exchange rate, all variables are significant with stationarity at first difference. Four possible relationships are observed among the variables. In long run, money differential, price differential and interest differential has a negative association with exchange rate due to which domestic currency will appreciates. While imports, exports and foreign reserves has a positive relation with exchange rate implying that domestic currency will depreciate if these variables increases. In short run mixed results are observed in all cases except real money differential. The real money differential shows a experiences a negative association with exchange rate and the speed of convergence is 9% per annum.

All the variables are also significant for Pak-USA so null hypothesis is rejected and we include all determinants in our model. At first difference, the data is stationary. Trace test shows that there is existing 4 possible relationships among variables. In long run real money differential, exports and foreign exchange reserves have negative relation with exchange rate. Price differential, real interest differential and imports has positive association with exchange rate. In short run imports, price differential and foreign exchange reserves has mixed relationship. while money differential has negative and exports has positive association with exchange rate and speed of convergence is 1% per annum.

In case of Pak-Euro, the results are quite different as the real money differential, real interest differential, exports and imports show insignificant results so we drop them completely and only estimate by taking exchange rate, price differential and imports. There is break point in the data of price differential that shows the data non-stationary but apply break point unit root and it adopt data as stationary. The results shows that in long run the price differential has negative relation with exchange rate while imports has a positive relation. In short run both money differential and foreign reserves has negative relationship and the speed of convergence is 4% per annum.

5.1 Policy recommendation

According to this study following are the policy recommendations

- The money supply should be controlled as it causes to depreciate the domestic currency.
- Import substation policies may be adopted that promote the domestic production.
- Foreign exchange reserves plays an important role for determining exchange rate therefore, such policies may be adopted that promote the inflow of cash within the country.

5.2 Limitations

For this study great efforts are made for conducting this research in best way. This study covers many important aspects but it can also improved by taking other determinants. This study does not include the affect of oil crises, internal and external shocks of economy and the break points of the data.

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