Exchange Rate Forecasting and Model Selection in Pakistan (2000-2010)

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Abstract

Emerging markets like Pakistan are becoming an attractive place for foreign investors. Foreign investment crucially depends on expected exchange rate movements. This study attempts to determine, whether or not, the exchange rate in Pakistan can be forecasted using different exchange rate models. The specific objective of this study is to determine the best model. This is done by analyzing forecasting performance of various univariate and multivariate exchange rate models. Seven models including the Autoregressive (AR), Autoregressive moving average (ARMA), Autoregressive conditional heteroscedasticity (ARCH), Decomposition of time series, Purchasing power parity (PPP), Dornbusch Frankel sticky price monetary (DB) and the Combined forecast models, are all estimated using monthly data over the period January 2000 to June 2010. ARCH model is found to be the best model for forecasting exchange rate in Pakistan for the selected time period followed by combined forecasting and autoregressive (AR) models.

Keywords: Forecasting exchange rates, Purchasing power parity, AR model, ARCH model, ARMA model, Time series decomposition model, Combined forecast model.

1. Introduction

Exchange rate forecasting is important to run a business proficiently and

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avoid losses emanating from the increase and decrease of assets as well as liabilities caused by changes in exchange rate movements. As the world is becoming a global village, collaborations with other countries for the betterment of an economy are increasing. Therefore not only the demand for foreign exchange is increasing the importance of exchange rate and its forecasting has occupied a central place in research work.

As exchange rate forecasting is important for several reasons, there are many institutions in Pakistan like State Bank of Pakistan (SBP), commercial banks, and investment management firms that forecast exchange rate. In Pakistan political instability, terrorism and many other influences like IMF conditionality's, inconsistent monetary and fiscal policies, make exchange rate more volatile. Despite the importance of the subject, limited research is available on the topic with regards to Pakistan. For example Khalid (2007) use interest rate parity model to forecast the exchange rate of Pakistan, India and China. Rashid (2007) analyzed the models of exchange rate by using interest rate parity condition. However, research based on univariate models, to my knowledge, is not available. So there is a need to compare forecasting efficiency among the prevailing exchange rate models for Pakistan.

In this study univariate, multivariate and combined forecast models are used for forecasting the exchange rate of Pakistan. More specifically the study estimates Autoregressive (AR) model, Autoregressive moving average (ARMA) model, time series decomposition model, purchasing power parity (PPP) model, Dornbusch Frankel sticky price monetary (DB) model, and combined forecast model to forecast the exchange rate of Pakistan. On the basis of these estimated models exchange rate is forecasted for twelve months within the sample period, which is then compared with the actual exchange rate of the same period. To measure the forecast efficiency of a particular model, Mean Square Prediction Error (MSPE) is estimated and the best model is chosen on the basis of minimum MSPE criteria.

Objective of this study is to determine the exchange rate model, among univariate, multivariate and combined forecast models that have the best forecasting performance, for Pakistan. Exchange rate forecasts are important inputs for any business decision, especially for international businesses. Moreover, the investors of foreign exchange market need exchange rate forecasts for proper decisions regarding speculation and investments. This study will help Pakistani as well as foreign companies, banks, individuals, foreign currency dealers, and investment management firms etc to forecast exchange rate by using a precise forecasting model.

2. Literature Review

Exchange rate forecasting models based on technical and economic fundamentals were unable to provide satisfactory outcomes. Mussa (1979) shows that spot exchange rate roughly monitors a random walk process and peak changes in exchange rates were unanticipated. Meese and Rogoff, (1983) suggest that random walk performs better than all theoretical exchange rate models. The model comprised of a drift less random walk process and remained a useful standard for exchange rate models. The authors studied various fundamental and time series exchange rate models including flexible price and sticky price monetary models. Each model was used to forecast exchange rate and compared against the random walk model using root mean square error (RMSE). The fundamental forecast approach is based on equilibrium models with variables like GDP growth, trade balance, inflation rates, interest rates, employment rate, money supply, etc.

Evans & Lyons (2005) suggest that within the public information, scope for flourishing exchange rate forecasting model was narrow. Meese and Rogoff (1983), Engel and West (2004) suggest forecasting is impossible from pubic information only. Khalid (2007) showed that the performance of out of sample models was better than the performance given by the random walk model. Elliot and Pesavento (2005) suggest that according to uncovered interest parity (UIP) exchange rate had a strong correlation with interest rate differential. If anticipated forthcoming spot rates can be true forecasts of the genuine spot rates, it means that modification in nominal exchange rates can be correlated with UIP. Meese and Rogoff (1988) correspondingly prove that

UIP and MM show a relationship between interest rates variance and exchange rate.

Khalid (2007) conducting research on Pakistan, China and India showed that the biasedness dilemma was observed in the parameter values for Pakistani rupee over US dollar (PKR/USD), and the Indian rupee over US dollar (INR/USD) beta coefficient was unexpectedly negative. Whereas, Chinese Yuan over US dollar (Yuan/USD) showed a positive sign for the beta coefficient and was in line with the theory. Negative parameter suggests that, as the domestic income increases, people tend to buy more foreign goods thus creating more demand for the foreign currency causing the domestic currency to depreciate. This was in accordance with the traditional theories based on trade and suggested that the exchange rate of the developing countries are mostly dependent on trade rather than the efficiency of financial markets as observed in the developed countries. So a specific model may do fine for exchange rate of a single country but may not be perfect for exchange rate of others countries.

Most of the equilibrium models had no role for exchange in determining the current account. Glick and Rogoff (1995), Krugman (1991) identified that there is a traditional demand and supply relationship in trade and exchange rate determination. Hwang (2003) determined that in the short run forecasting by using Dornbusch Frankel model with a revised money demand description performed better than the random walk model. Because of these results share prices became one of the macroeconomic basics in exchange rate forecasting models.

Khan et al. (2010) accomplished their research on Pakistan using structural Vector Autoregressive (VAR) method. The structural VAR estimates suggest that nominal shocks clarify a significant amount of changes in the real exchange rate of Pakistan. Their results supported the sticky price model of Dornbusch (1976). Kashif, et al. (2008) analyzed exchange rate of Pakistan by using autoregressive moving average model (ARMA), Comprehensive Autoregressive Conditional Heteroscedasticity (GARCH) and the state space model for the period 2001 to 2007. The focus of their research paper is on the modeling and prediction of daily interbank exchange rate of US dollar measured in Pakistan rupees. They conclude that the state space model has received no consideration in Pakistan. After comparing the forecasting performance of three models they find that the state space model is advanced according to the root mean squared error (RMSE) and the inequality co efficient (TIC). In this respect they consider space model better than the ARMA and GARCH models for Pakistan.

Ahmed and Alam (2010) in their study estimated the import demand function for Pakistan over US dollar (PKR/USD). They used quarterly data of Pakistan over US dollar (PKR/USD) from the period 1982 to 2008. Using ARDL, they supported the view that in Pakistan there is a long term affiliation between import demands, comparative price of imports, economic growth, real effective exchange rate and unpredictability of real effective exchange rate. Devaluation of domestic currency and its instability has no effect on decrease in import demand in Pakistan. Therefore, their research determines that import demand is unresponsive or inflexible to real depreciation and its unpredictability.

In sum, none of the individual studies reviewed above provide a comparison of prediction power of models tested in this study. This study aims at overcoming this gap to some extent.

3. Theoretical Framework & Methodology

Exchange rate can be affected by various factors and there is no rule of thumb especially for third world or developing countries in this respect. Pakistan is considered to be a developing country with many other ongoing problems including political uncertainty, terrorism, poverty, natural disasters unnecessary speculation and several more.

However, different approaches can be used to forecast exchange rate that include univariate time series forecasting models and multivariate models also known as forecasting based on fundamentals. Univariate models include autoregressive (AR) model, autoregressive moving average (ARMA) model, autoregressive conditional heteroscedasticity (ARCH) model, and the time series decomposition approach. The multivariate models are based on theory and include covered interest parity (CIP), purchasing power parity (PPP), monetary model (MM), Balance of payments (BOP) model, and their hybrid models. The multivariate models are preferred on the basis of theory, whereas the univariate models are simple to use and require limited information. Therefore in this study a set of univariate, multivariate and combined forecasting models are used to identify the appropriate model for forecasting exchange rate in Pakistan.

The seven theoretical models estimated for exchange rate forecasting are specified as below:

AR model:

$$s_t = \beta_0 + \beta_1 st\text{-}1 + \epsilon_t \quad (1)$$

ARMA model:

$$s_t = \alpha_0 + \alpha_1 s_{t-1} + \ldots + \alpha_p s_{t-q} + \beta_1 \varepsilon_{t-1} + \ldots + \beta_p \varepsilon_{t-q} + \varepsilon_t \quad (2)$$

ARCH model:

$$s_t^2 = \alpha_0 + \sum_i q \ \alpha_1 s_{t-i}^2 \quad (3)$$

Time Series Decomposition model:

$$s_t = \mu t + \gamma + \varphi + \epsilon \quad (4)$$

Purchasing Power Parity model:

$$s_t = \acute{\alpha}(y_t - y^*) + \beta\,(i_t - i^*) + \gamma\,(m_t - m^*) + \epsilon_t \tag{5}$$

Dornbusch Sticky Price Monetary model:

$$s_t = \acute{\alpha} + \beta_0\,(m_t - m^*) + \beta_1\,(y_t - y^*) + \beta_3\,(i_t - i^*) + \beta_4(\pi_t - \pi^*) + \beta_5\,(sp_t - sp^*) + \epsilon_t \tag{6}$$

Combined Forecast model:[1]

$$\ln \hat{s}_{T+1,c} = \sum_{i=1}^{n} w_{T+1,i} \ln \hat{s}_{T+1,i} \tag{7}$$

where,

μ: denotes the trend component
γ: denotes the seasonal component
φ: represents the cyclical component
ϵ: represents the random component
s: denotes exchange rate
m and m* : denote domestic and foreign money supply
y and y* : denote domestic and foreign real income
i and i* : denote domestic and foreign interest rate
π and π* : measure domestic and foreign inflation
sp and sp*: represent domestic and foreign share price

Besides the above mentioned variables, four dummy variables are used to take into account the abnormal trend found in the data for exchange rate. These dummy variables are denoted by DFLOT, D911, DBOP, and DNOR. [2]

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[1] MSPE of all the models is calculated by using the formula $MSPE_{T,i} = \frac{\sum_{t=1}^{T}(\ln s_t - \ln \hat{s}_{t,i})^2}{T}$ and weights are assigned according to the formula $w_{T+1,i} = \frac{1/MSPE_{T,i}}{\sum_{j=1}^{n} 1/MSPE_{T,j}}$. Lastly, combined forecast at $T + 1(\hat{s}_{T+1,c})$ is constructed as $\ln \hat{s}_{T+1,c} = \sum_{i=1}^{n} w_{T+1,i} \ln \hat{s}_{T+1,i}$

[2] See appendix for details

Data used in this study is obtained from reliable sources including International Financial Statistics (IFS), State Bank of Pakistan (SBP) publications and US Bureau of labor statistics etc. The sample period is based on monthly data taken from the period when flexible exchange rate was adopted in Pakistan i.e. January 2000 to June 2010 (M01Y2000 to M06Y2010) with a total of 10 years having 126 observations. Since exchange rate fluctuations were high in the year 2008, therefore forecasting is limited to the period of 12 months starting from July 2009 to June 2010.

As the regression analysis is extensively used for prediction and forecasting purposes, this study also uses the same approach. The forecasting power of exchange rate models is determined by error measurement for which the performance evaluation criterion of MSPE is used

For estimating univariate models, only exchange rate data is required for the entire sample period. The estimation of models involves a few steps, first consistency is data is checked through a graph and abnormal points are identified and represented by dummy variables included in the models. Second, unit root or stationary in data is checked with the help of Augmented Dickey Fuller test. The data on exchange rate is found to be non stationary, therefore for stationarity the first difference of exchange rate data denoted by D(s) is used in the analysis. Third, the specified models are estimated time and again in order to select the optimum forecasting models. The model selection criterion involves the significance level of independent variables, the Durbin Watson statistics, the Akaike info criterion and Schwarz criterion and the residual tests to check autocorrelation, heteroscedasticity and normality etc.

Once univariate models are estimated, their forecast is generated and evaluated against the actual values of the spot exchange rates to generate the performance measures i.e mean prediction error (MPE). To eliminate the positive and negative effects variances are squared and their mean known as MSPE is taken. Performance measures of all models are compared against each other to select the best forecasting model.

In the decomposition model, the deseasonalized exchange rate is calculated by taking annual averages and the seasonal component is obtained by dividing the actual exchange rate by the deseasonalized component. The trend is discovered by taking the fitted values of a simple regression where the dependant variable is the actual exchange rate and independent variables are deseasonalized exchange rate and time with dummy variable of DFLOT. The deseasonalized detrended exchange rate is obtained by dividing deseasonalized exchange rate by trend. Taking the three years average, the cyclical component is calculated while the random component is obtained by dividing the deseasonalized detrended exchange rate by the cyclical component. Monthly average is taken for the seasonal and cyclical components and at the last season, the cyclical and trend components are multiplied to get the forecast.

Empirical exchange rate models for developing economies are also used to forecast exchange rate with multivariate models including PPP and DB models. These models are based on theory and have their own determinants of exchange rate forecasts. To forecast exchange rate, these models are first checked for abnormality in different variables however no abnormality was found in the data. Exchange rate forecasting based on such models involves model estimations using the regression analysis time and again to determine the models with best results based on given significance tests.

In the combined forecasting model different weights are assigned to models based on their performance measured by the MSPE. Higher the MSPE lower the weight assigned and vice versa.

4. Results & Discussion

Results of the three sets of models are presented in this section. An overall comparison of forecasted models with the actual exchange rate is reported in Table 1, while results of individual models are discussed as below.

4.1 Univariate Models

Among the univariate models, results of ARCH model using non stationary data is found to be the best exchange rate forecasting model for Pakistan. All the independent variables are significant at 1 percent significance level and the R square value of 0.998 shows the success of the regression model in predicting the values of the dependant variable within the sample. Durbin Watson statistics of 2.2078 also indicates there is no autocorrelation.

Figure 1 show that ARCH model captures almost all turning points but with some delay and at certain points forecasted exchange rate and actual exchange rate are the same.

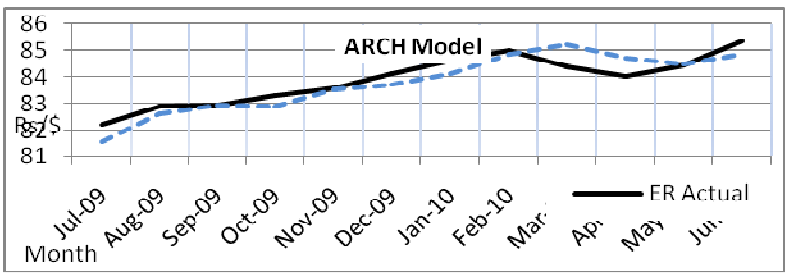

Fig 1 ARCH Model (non stationary data)

ARCH model when estimated with stationary data after removing the unit root, also shows that independent variables are significant at 1 percent significance level. R square value is reported as 0.5829 and the Durbin Watson statistics is 2.3835.

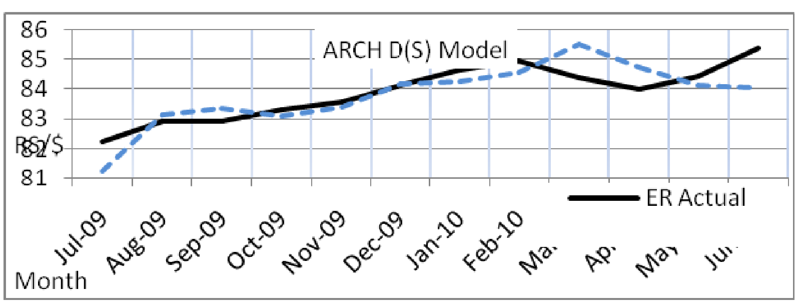

Fig 2 ARCH Model (stationary data)

However, the graph plotting actual and forecasted exchange rates show that forecasted exchange rate moves rougly contradictory to the actual exchange rate. In other words as the actual exchange rate increases, the forecasted exchange rate illustrates a decreasing trend. It is for this reason that it is a poor model and can be ranked among the lowest models of this study.

Results of both the non stationary and stationary data based AR models are significant at 1 and 5 percent significance level. The R square values for both the models are 0.997 and 0.6628 respectively with no indication of autocorrelation.

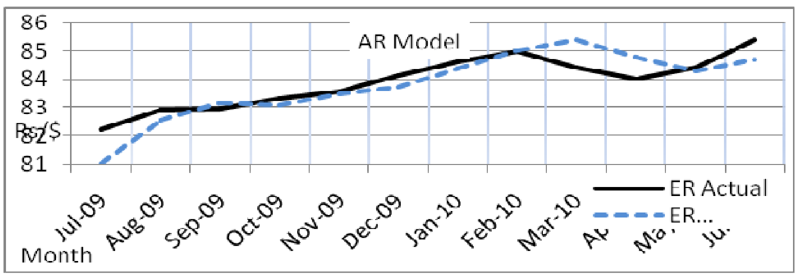

Fig 3 AR Model Forecasts (non stationary data)

Though these results confirm that the models are appropriate, a comparison of both the AR exchange rate forecasting models in figure 3 and 4 show that the exchange rate forecasts do not match the turns in actual exchange rates. In other words, the forecasted exchange rate captures movements in actual exchange rate with some diversity.

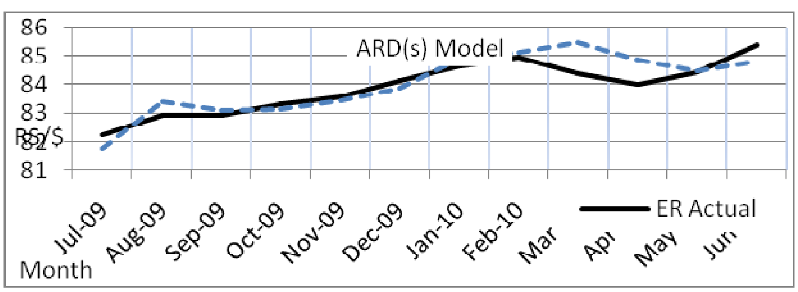

Fig 4 AR Model on Differenced Exchange Rates (stationary data)

Thus the two models can be ranked as the third best among all the models estimated.

Similarly the results of ARMA models with non stationary and stationary data are also significant at 1 percent significance level and the R square values are as high as 0.997 and 0.7369 respectively and there is no indication of auto correlation in the data.

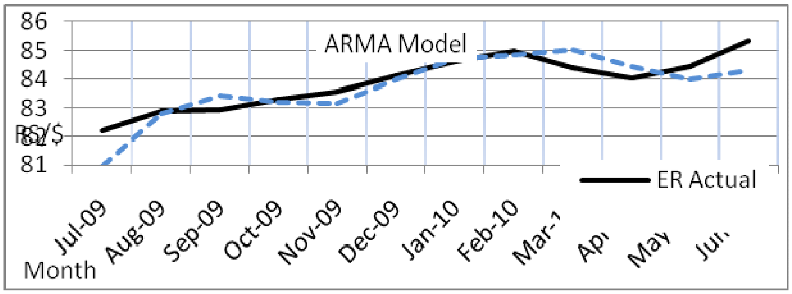

Fig 5 ARMA Model (non stationary data)

The ARMA model estimates given in figure 5 are nearly identical to the actual exchange rate but like other models captures sharp turns with delay. However, as shown in fig 6 the ARMA model after removing unit root forecasting model is unable to predict the correct trail and is almost contrary to the actual trend.

It means both the ARMA exchange rate forecasting models seem to be underprivileged in forecasting exchange rate in Pakistan.

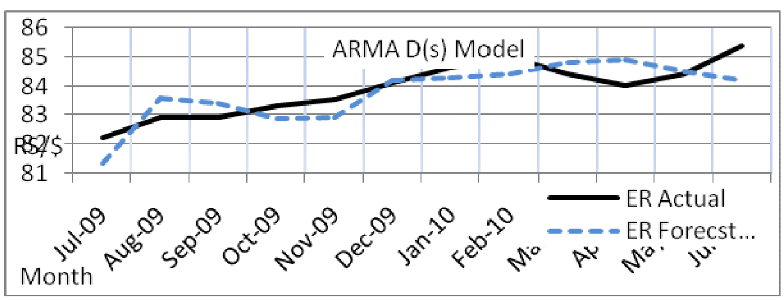

Fig 6 ARMA Model (on differenced exchanged rate)

So far as the exchange rate forecasting based on time series decomposition model is concerned, although overall it is not found to be an appropriate model, it can be considered better than the three fundamental models estimated. This may be because decomposition model fails to get its component, as exchange rate movements in this particular period were much unexpected and large fluctuations were observed.

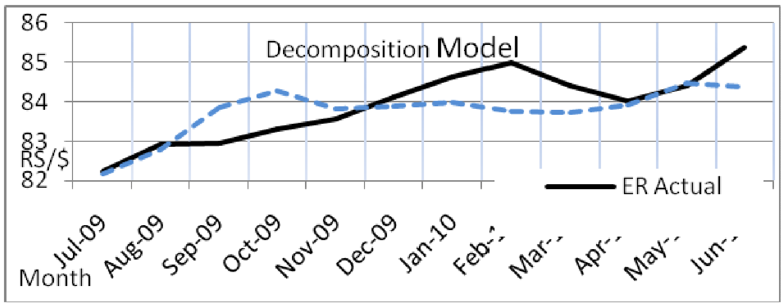

Fig 7 Time Series Decomposition Model

For example in figure 7, at certain points forecasting exchange rate trend is opposite to the actual exchange rate, it means the forecasting power of the model is weak and it is ranked among the lowest forecasting models for exchange rate. However, in the long run forecasts based on decomposition model can be considered as almost a proxy of actual exchange rate.

4.2 *Multivariate Models*

Among the multivariate forecasting models MM model is used before removing the unit root hence data used is non stationary. All the independent variables are significant at the level of 5 percent except for the DBOP*X2 and DBOP*X1 that are insignificant and DFLOT*X1 is found to be significant at 10 percent level. R square value is 0.9953 and Durbin Watson statistics is 1.9337.

A comparison of the actual and forecasted exchange rates in Fig 8 show results contrary to the theory based belief that fundamental models by some means are better than the technical analysis models. The behavior of forecasted exchange rate seems to follow a random walk and at some points is opposite to the actual trend. In other words, the model is not suitable for exchange rate forecasting in case of Pakistan at least for the sample period of this study.

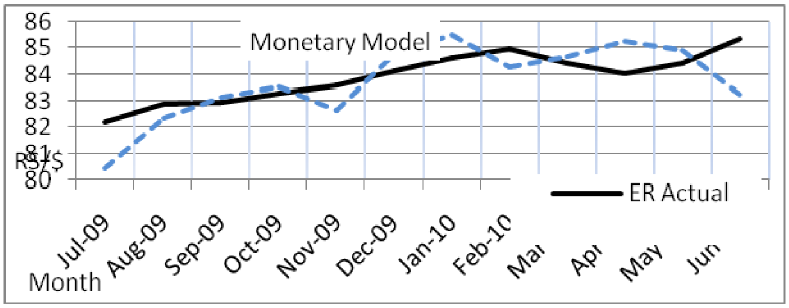

Fig 8 Monetary Model (non stationary data)

Results based on Dornbusch Frankel sticky price monetary model using non stationary data indicate that all the independent variables are significant at 5 percent except for the X1, AR (4), AR (2) that are insignificant though the R square value is as high as 0.9893 and the Durbin Watson statistics is 1.990.

From figure 9, DB model seems to give the impression of a random walk as there is no correlation between actual exchange rate and exchange rate forecasts. Thus this model is found to be the worst among all the models estimated.

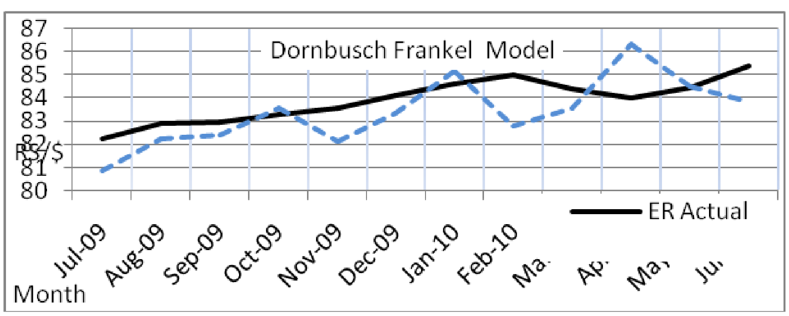

Fig 9 DB Model (non stationary data)

Furthermore, Dornbusch Frankel sticky price monetary model is also used for exchange rate forecasting with ARCH effect and the data used is non stationary. All the independent variables are significant at 5 percent significance level except for the X1 and DFLOT*X1 as both are significant at 10 percent significance level. R square value is 0.9893. Durbin Watson statistics is 1.990.

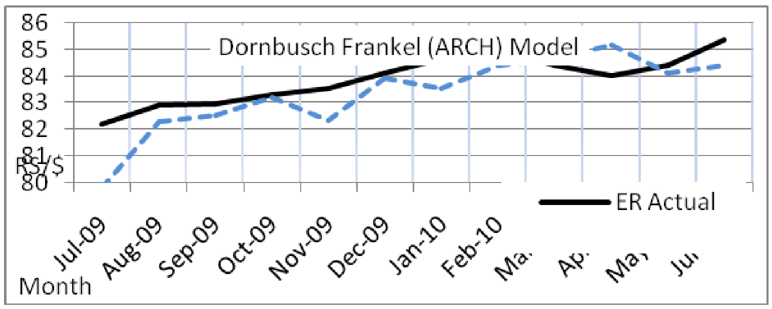

Fig 10 DB Model (with ARCH effect)

Figure 10 indicates that Dornbusch Frankel sticky price monetary model shows no relation between actual exchange rate and exchange rate forecasted. However, its forecasts are better than both the simple Dornbusch Frankel sticky price monetary model and the monetary model.

Overall the study finds the prediction power of multivariate models as weak.

4.3 Combined Forecast Model

Finally, results of exchange rate forecasting based on combined forecast model are almost the same as the actual exchange rate. Although at certain points of time, it catches movements in actual exchange rate slightly late but overall it seems to be an excellent model and the study ranks it as the second best model of exchange rate forecasting in Pakistan for the sample period taken. Combined forecast model also supersedes in some previous studies in the literature.

As shown in figure 11 forecasted exchange rates is parallel to the actual exchange rate and suggests the potency of this model in forecasting exchange rate.

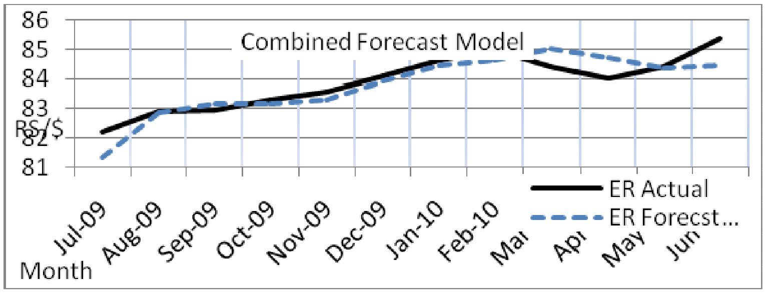

Fig 11 Combined Forecast Model

5. Conclusion

This research provides another drop in the already deep pool of studies about exchange rate forecasting. This study differentiates itself from prior research, on Pakistan, by focusing on seven different models of exchange rate i.e., PPP, DB, AR, ARMA, ARCH, decomposition and combined forecast models.

Conclusions of this study are based on the MSPE, the higher is the MSPE; lower is the rating of a particular model among other exchange rate forecasting models. Further results of this study suggest that ARCH model outperforms all other models for exchange rate forecasting. Predictability of monetary model and Dornbusch Frankel sticky price monetary model might be overstated. A resemblance of results with past studies is that in the short term horizon, forecasting from Dornbusch Frankel sticky price monetary model with share price performed better than that without share prices. One important observation is that all those models for which data contains unit root, when made stationary by taking first difference, are not good predictors of exchange rate of Pakistan. Combined forecast model is outstanding in forecasting of the exchange rate accurately. Results of the combined forecasting models are also similar to the previous studies that showed the strength of combined forecast models over other models.

Despite the political instability and fragile economic conditions of Pakistan, our results confirm that exchange rate can be forecasted using univariate and multivariate models. Moreover, our results confirm the inefficiency of Pakistani financial markets. For future research, one should also use other parameters that affect exchange rate, like political instability, law and order situation etc.

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Appendix

Measurement of Variables

Exchange Rate (s)

Direct exchange rate used denoted by (s) in this study is expressed as the number of units of local currency per one unit of foreign currency. In case of Pakistan it can be expressed as Pakistani rupee over one US dollar (PKR/1USD).

Money supply (m)

The variable measuring money supply (m) takes M2 defined as the sum of currency in circulation and long term and short term deposits of private sector in the commercial banks.

Real Income (y)

Data for real income is required while using DB Model and PPP exchange forecasting approach. As monthly data of real GDP is not available for Pakistan, instead the data of large scale manufacturing production index, a quantum index of industrial production is taken.

Interest Rate (i)

For domestic interest rate (i), six month Pakistan Treasury bill rate is used.
Inflation (π)

Inflation Rate (π)

Annualized monthly inflation rate (π) is calculated as the change in consumer price index (CPI) of a month over the same month of the previous year.

Share Price (sp)

KSE 100 index is used as a proxy for share prices (sp) in Pakistani stock market. Monthly values of KSE 100 index have been calculated as average of daily values over the working days in a month period.

Foreign Money Supply (m*)

Monthly money supply (M2) is defined as the sum of currency in circulation and long term and short term deposits of private sector in the commercial banks is taken as a measure of foreign money supply.

Foreign Real Income (y*)

As monthly data of real GDP is not available for United States of America, therefore data of large scale industrial production index represents the variable measuring foreign real income.

Foreign Interest Rate (i*)

For foreign interest rate (i*), six month US Treasury bill rate is used.

Foreign Inflation (π*)

Annualized monthly foreign inflation rate (π*) is calculated as the change in consumer price index (CPI) of a month over the same month of the previous year.

Foreign Share Price (sp*)

Share price (sp*) of US is calculated by taking monthly values of S&P 500, as average of daily values over the working days in a month's time period.

DFLOT

Exchange rate from the period M01Y2000 to M08Y2000 is constant because of the fixed exchange rate regime. To adjust this period of 8 months a dummy variable denoted by 'DFLOT' is used.

D911

Similarly due to 9/11 incident foreign exchange reserve of Pakistan increased rapidly and Pakistani currency appreciates. This is an odd time period and to adjust for this effect a dummy variable 'D911' is used.

DBOP

Another change in exchange rate of Pakistan was observed from the period M03Y2008 to M10Y2008. During this time period exchange rate jumped from Rs. 61 to Rs. 80 and depreciation of 31 percent was observed in domestic currency. This abnormality in data is taken into account by taking DBOP as a dummy variable.

DNOR

Lastly, a dummy variable DNOR is also used to measure the normalization effect of exchange rate after the artificial hike in M11Y2008.

Table 1
Overall Comparison of Forecasted Models with Actual Exchange Rate

Date	Actual	ARCH D (s)	ARCH	AR	AR D(s)	ARMA	ARMA D(s)	MM	DB	DB ARCH	Decom-position	Combined
Jul- 09	82.22	81.23	81.55	81.02	81.78	80.97	81.37	80.44	80.85	79.79	82.18	81.33
Aug-09	82.90	83.14	82.63	82.55	83.42	82.79	83.58	82.34	82.21	82.28	8.78	82.90
Sep- 09	82.94	83.11	82.94	83.17	83.08	83.45	83.42	83.13	82.39	82.52	83.84	83.20
Oct- 09	83.31	83.39	82.89	83.09	83.14	83.22	82.90	83.51	83.56	83.20	84.26	83.20
Nov-09	83.55	84.20	83.51	83.47	83.46	83.14	82.91	82.67	82.15	82.32	83.83	83.29
Dec-09	84.11	84.27	83.69	83.72	83.86	83.99	84.19	84.77	83.32	83.91	83.87	83.92
Jan-10	84.63	84.55	84.12	84.38	84.92	84.71	84.26	85.47	85.18	83.54	83.98	84.44
Feb-10	84.97	85.51	84.83	85.03	85.13	84.86	84.40	84.26	82.81	84.41	83.77	84.65
Mar-10	84.41	84.72	85.21	85.36	85.48	85.03	85.80	84.68	83.57	84.66	83.74	85.02
Apr-10	84.01	84.72	84.71	84.77	84.86	84.44	84.90	85.23	85.35	85.17	83.91	84.74
May-10	85.42	84.12	84.50	84.29	84.46	83.98	84.50	84.88	84.52	84.14	84.47	84.37
Jun-10	85.37	84.05	84.86	84.70	84.83	84.32	84.19	83.25	83.83	84.40	84.38	84.47

Figure 1 ARCH Model

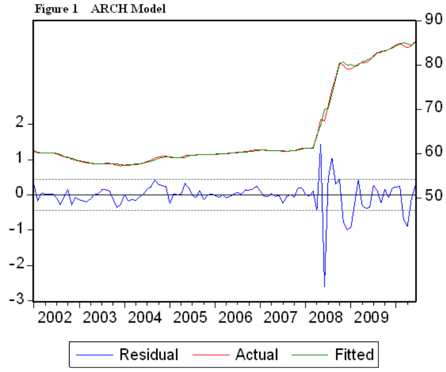

Figure 2 ARCH D(s)

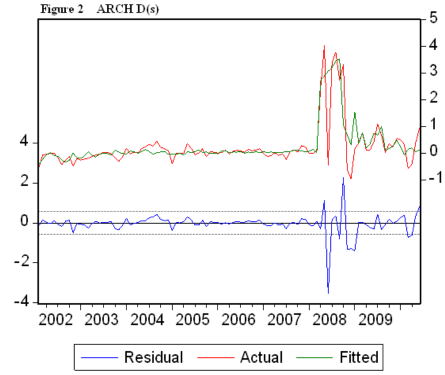

Figure 3 AR Model

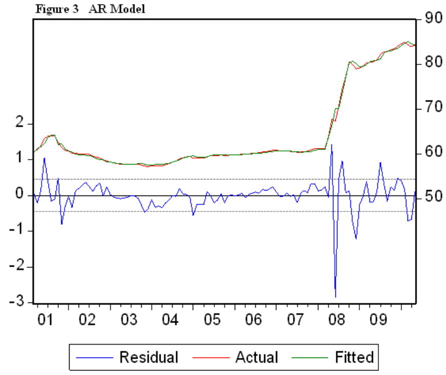

Figure 4 AR D(s)

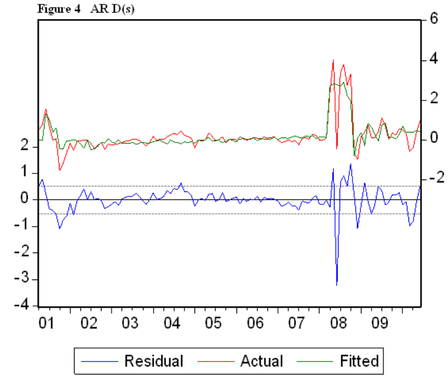

Figure 5 ARMA Model

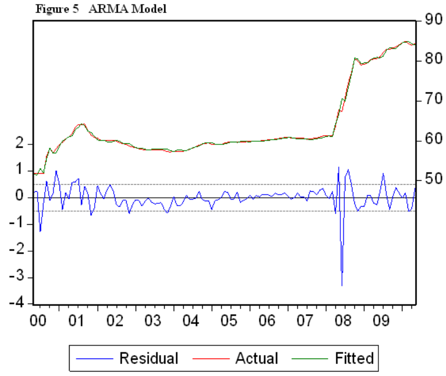

Figure 6 ARMA D(s)

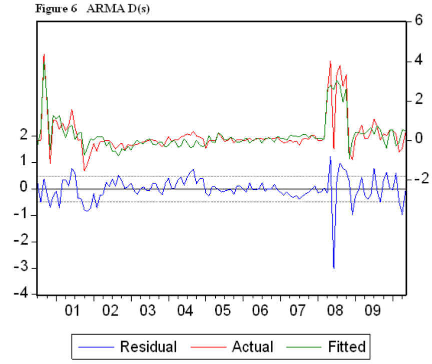

Figure 7 MM Model

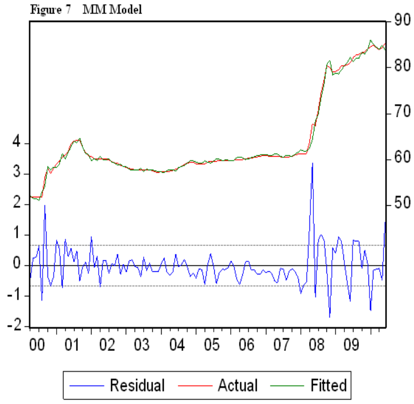

Figure 8 Dornbousch Model

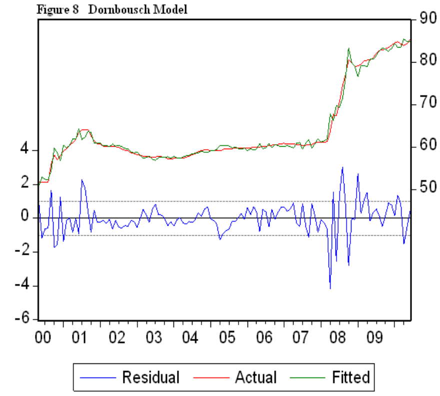

Figure 9 Dornbousch ARCH Model