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PKR Exchange Rate Forecasting Through Univariate and Multivariate Time Series Techniques

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ABSTRACT

The key objective of this study is to examine and compare the accuracy of time series and econometric forecasting models in the context of the exchange rate as we know that fluctuation in the exchange rate may affect the economic activities at the macro – level. For this purpose, the author has chosen the Pakistani Rupee exchange rate against United States Dollars with the annual data from 1980 to 2018. The results revealed that the exponential model provides the most effective accuracy in forecasting rather than the Naïve, ARIMA and ARDL Co-integration model. This paper has also covered the gap of unavailability of literature regarding the application of ARDL and Exponential Smoothing model for the forecasting of the exchange rate in Pakistan. It is also anticipated that historical data do not play a vital role in the forecasting of the future trend of time series i.e. Pakistani Rupees against US Dollars. However, all three-time series anticipated that the recent observations play a significant role in the speculation of the upcoming future trend.

Key words: Forecasting, Exchange Rate, Naïve Model, ARDL Co-Integration model, Econometrics

1. INTRODUCTION

Major economic countries showed their consents over adjustable foreign exchange rate in 1945, however, before World War II, it was observed that the foreign exchange rate was flexible. It was assumed by the delegates of the Bretton conference that a stable exchange rate will promote economic growth in the future (Baillie & McManon, 1989). It was held that under the Bretton conference that every country will implement a monetary policy that maintained the exchange rate. There was a drastic

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change in the history of the exchange rate when the United States deliberately dismissed the convertibility of the US dollar into gold, which ended up the Bretton conference's obligations on all countries & subsequently US Dollar become a reserve currency globally.

The empirical characterization of time variation in international stock market correlations remains a largely unresolved issue in finance (Thong, 2012). Exchange rate can be fixed i.e. adjusted or flexible i.e. free to float. To resolve such issues between these two opposite regimes, there are some arrangements or methods or combinations, for example, IMF categorized the exchange rate regime into eight categories. The FOREX market was initiated in 1970 when the exchange rate system transformed from fixed to floating exchange rate and international trade increased. In each transaction, one currency is supposed to be a local or domestic currency, however, the other currency is considered as foreign, from a geographical aspect, so derived as foreign exchange (Wang, 2009). It is a price, against the domestic currency, which a buyer can purchase any foreign currency which is normally quoted by Foreign Exchange Traders in daily newspapers and their official websites. FOREX markets have no holidays and they work 24/7 therefore any individual can convert any currency by handing over other convertible currency at anytime, anyplace. To avoid the impact of fluctuation in exchange rates, the buyers, investors, traders etc. settle the obligations by different instruments i.e. letter of credit, bills of exchange, bank drafts and acceptance. FOREX markets are not specifically for the traders, investors, importers, exporters, or other business-related individuals, but for every single ordinary person who wishes to buy any other currency against any domestic or foreign currency. This characteristic can describe the diversity of the market itself worldwide. The exchange rate volatility derived due to uncertain demand and supply of foreign payments. Forecasting is ascertaining to control the uncertain volatility to avoid heavy losses and better strategic decisions (Majhi and Sahoo, 2009). The higher volatility in foreign exchange rates produce negative impact on balance of trade and other financial deeds and still the efficient model development for the forecasting of the exchange rate is under process. (Levich, 2001; Colombo et al, 2020; Medeiros et al, 2019; Rudan et al, 2019; Florian et al, 2019; Thomson et al, 2019; Leopoldo et al, 2019; Leiva et al, 2020).

Several tools have been developed for the large data sets to forecast the time series and they have gained popularity (Kotchoni et al, 2019; Casey, E., 2020).

The key objectives of this study are as: (i) to compare the performance of an ARDL with univariate time series techniques, and (ii) to investigate the superior model to estimate the exchange rate forecasting. In the case of Pakistan which accounts as a developing economy (Shabbir et al, 2019; Shah et al. 2020), the foreign exchange rate depreciation produces more debt burden and cause the reason of higher inflation, unbalance the foreign debt payments (Panda and Narasimhan, 2007). Fraz et al. (2019) indicated that the stock market and currency market is supposed as an asset of any economy. Meese et al (1983) stated that the mode of payments, receivables & deferred transactions are mostly calculating in international currency, i.e. US Dollars, therefore an increase in the exchange rate will raise the total cost of payment if they convert it into domestic currency. Meese et al (1983) However, on the other hand, for receivable purpose, it will be an advantage to receive more money if compared to domestic or local currency therefore businessman, lenders, depositors, importers, exporters, Foreign Exchange market, traders, financial institutions, etc. are always keen to know about the upcoming trend in exchange rate time series.

Due to the above reasons, it is important to find out a suitable model for the forecasting of the exchange rate as there is not any consensus among the researchers regarding the superiority among forecasting models in terms of forecasting the exchange rate. There are also some other motivating factors for the investigation of volatility in the exchange rate. Firstly, the FOREX market, like all other financial markets, has characteristics of variation in volatility. As we know that the financial and economical linkage between emerging, frontier, standalone markets with advanced countries have mounted expressively from last decades which plays an important role in the shifting of equilibrium of exchange rate where the exchange rate is not fixed. Another reason is that the recent models of conditional heteroscedasticity. These two mentioned factors induce the author to work on this research gap.

2. LITERATURE REVIEW

The previous literature indicates that there is a continuing huge debate about the predictability of the exchange rate by employing different time series and econometric models. Different models are suggested by different authors and researchers but still, improvement is in progress, for instance, Meese (1990) and Frankel et al (1995) studied whether theoretical or econometric models are more effective in this context as most of the researcher relies on their expertise, therefore, the application of models within individual capacity is limited (Franses, 2021).

The Naïve model is widely acceptable model to estimate forecasting in literature. Dunis et al., (2008) employed the Naïve model as a yardstick for modeling the US Dollar/Euro Exchange Rate. Newaz (2008) ranked the Naïve model as third in forecasting the exchange rate of Saudi Riyal with Indian Rupee. Bo et al, (2020) apply the ARMA model for the forecasting of the inflation rate in their study and found it robust. ARIMA and exponential smoothing models are extensively applied in the literature for the forecasting of different time series. (Ender et al, 2018; Dirk et al, 2018)

Exponential Smoothing is also one of the robust techniques for forecasting. In literature, we can easily find the previous studies in which the researchers utilized the exponential smoothing forecasting technique. Trimuph et al (2018) used the exponential smoothing model because it is highly accurate and flexible in time series data analysis. Borhan et al (2011) examined different models for forecasting of Exchange Rate of Bangladeshi Takka with the US Dollar including the exponential smoothing forecasting model. The researchers concluded that exponential smoothing forecasting is more superior to other forecasted models. In another study, Maria et al (2011) tested various forecasting models for the speculation of the Exchange Rate of major currencies. The researchers found that the Exponential Smoothing model outperforms the ARIMA and other forecasting models integrated by the researchers. The ARDL has various applications in the field of Finance and Economics. In Finance, it has been used for stock markets (Hammoudeh et al., 2012; Satya et al, 2003; Samitas et al, 2007), equity markets (James and Agus Eko, 2003; Tze-Haw and Chee Wooi, 2003) and international trade

(Katsimi and Moutos, 2006; Hoque and Yusop, 2010). It is applied for more topics of Finance by different researchers as well.

ARDL model is also applicable for the forecasting of any time series, for example, Fiess et al (1999) analyzed the relationship exchange rate of the US Dollar against the German Mark and Japanese Yen. The author concluded that the ARDL model outperforms the random walk model findings. Connolly et al (2000) proposed that there is a significant cointegration in the exchange rate expected series and the exchange rate historical series. In the finance literature, researchers do not have any consensus over the determinants of the exchange rate (Tsen, 2010). But still, the exchange rate affects by several significant factors i.e. GDP, local investment, trade openness, government consumption itself and money supply (Amor et al. 2008). Hvding et al. (2004) and Glăvan (2006) stated that an increase in foreign exchange reserves reduces exchange rate volatility.

Yuan (2011) tested the bilateral exchange rates of the USD against the Australian Dollar, Canadian Dollar, Japanese Yuan and British Sterling Pound with five macro-economic variables i.e GDP, Interest Rate, CPI Index, money supply and current account balance. Carrera and Vuletin (2003) the exchange rate will be decreased in case if there is a greater trade openness. Kim et al (1995) employed money supply, interest rate, real growth, trade balance and real income to forecast the USD/DM rates. Islam et al (2006) used three macro-economic factors i.e. money supply, interest rate and real income to evaluate the monetary model of the exchange rate of the US Dollar against the Japanese Yen. Hwang (2001) forecast the exchange rate by using two models, i.e. sticky- and flexible-price models. The author employed four macro-economic variables i.e. GDP, inflation, interest rate and money supply as explanatory variables. Groen (2000) tested the monetary exchange model by including four explanatory variables such as interest rates, real income, price level and money supply. Previous researchers did not focus on finding out the accuracy of predicting exchange rate via econometric and time series techniques in one study therefore the accuracy of predicting exchange rate through these models on the same time series has not been revealed yet.

3. RESEARCH METHODOLOGY

In this study, the authors have taken monthly data from 1980 – 2018 of PKR exchange rate against US Dollars. The data has been extracted from the International Monetary Fund (IMF) published reports. This study being used the following statistical techniques to estimate research objectives.

3.1. Unit Root Test

It is an assumption of time series analysis that before tested, it should be stationary. A stationary time series is a series that does not possess any systematic variation in mean, variance and periodic variation. There is not any involvement of seasonal effect in the given time series, therefore, it is the primary step for every researcher to ensure the stationarity of data i.e. time series. The Phillips-Perron (PP) and ADF tests are available to check whether the time series is stationary or not. Due to the wide acceptance of the ADF test, the author will examine the stationary status of the time series by the Augmented Dicky-Fuller Test (ADF).

3.2. ARMA/ARIMA Model

Generally, the ARIMA model is accepted by most researchers, forecasters because of its effective and efficient speculation of time series (Chen 1997). ARIMA is used to produce the mean equation for volatility investigation. In every time series, the ARIMA model possesses the term error or residual value over time ε_t . In the ARIMA model, lags of forecast errors represent as moving average (MA), lags of difference series appear in the equation called Auto-Regressive (AR). If the series is stationary at level then it will be ARMA Model but on the other hand, if it will be stationary at difference then integrated difference (I) will be included in the ARMA model which subsequently converts into ARIMA. The model is supposed to be integrated and is written as ARIMA (p, d, q). The PACF and ACF define the preliminary p and q terms respectively by running Correlogram. The best model is selected based on the criteria of smallest AIC or SBC.

In the finance literature, the application of the ARIMA model for forecasting the exchange rate is well explained. (Ince and Trafalis, 2006). The ARIMA model employed

historical and present values to forecast the upcoming trend. The ARIMA models are written as ARIMA (p,d,q) where p defines the order of the autoregressive model, q defines the order of the moving average and d indicates the order of the stationary according to the Bo-Jenkins methodology.

3.3. Naïve Model

This model suggests the forecast values of the time series will be equal to the actual values of the time series at the last period available. i.e. $y_{t+1} = Y(t)$ which also corresponds to the exponential smoothing model where $\alpha = 1$. Naïve 1 model was also used as a benchmark to compare with other models having the same characteristics i.e. Exponential Smoothing & ARIMA (McKenzie et al, 2002). However, Naïve 2 model is stated as a growth model. It stated that the behavior of the exchange rate can be predicted by applying the growth rate present in previous values of the time series. In this study, the author will use the Naïve 1 model because Naïve 2 model is discounted. Due to the constant growth feature in Naïve model 2, it is not suitable to apply because the persistent progress feature is not applicable in the exchange rate.

3.4. Exponential Smoothing Model

ES Model (Gardner 1985) is widely used for forecasting in the field of Economics and Finance. According to Brooks (2008), It is a different technique than the ARIMA approach where the model used an earlier linear combination of the previous value of time series for the forecasting of future values. In previous data of time series, the recent values will be more useful than the old values for the forecasting of future time series. However, distant values still may possess some useful information for the development of future values.

In the exponential smoothing model, the ordinary model is the single parameter exponential smoothing model i.e. Next forecast = Last forecast + a proportion of the last error. However, the single parameter model is only applicable to the time series has no trend and seasonal effects. It can define as below:

$$y_t(k) = L(t)$$

$$\text{Where } L(t) = \alpha Y(t) + (1 - \alpha)L(t - 1)$$

y_t (k) is the speculate values of the time series k, $y(t)$ is the observed values at time t and α is the weighting parameter. Its range lies between 0 to 1. High values of α indicate that the impact of historical data will be wiped out soon and vice versa.

A simple exponential smoothing model may be extending by integrating different parameters. For example, by integrating a parameter (γ) indicates the presence of any trend. Similarly if in any exponential smoothing model, a parameter (φ) incorporates than it specifies any damped trend. Furthermore, a parameter (δ) shows the existence of seasonality. All of these parameters lie between 0 to 1 and the optimal value is found by minimizing the SSE. In the case of large values of all three parameters, the more weights will give to recent estimates of trend, damped trend and seasonality however in the case of small values the more weights will be given to past values of these components correspondingly.

3.5. ARDL Co-integration

ARDL is a causal econometric approach with time series analysis. Auto-Regressive Distributive Model (ARDL) has not yet received significant attention from the previous researchers in the case of forecasting of exchange rates. The econometric approach-related models are helpful to evaluate the relationship between explanatory and dependent variables. The exchange rate has its determinants, economists, finance researchers, investors etc. are keen to find out the causes of fluctuation of exchange rate therefore employment of an econometric model for factors influencing exchange rate is vital.

Pesaran and Shin (1995, 1999) introduced the technique of ARDL i.e. a model linking lags of both explanatory and dependent variables. Furthermore, the ARDL approach has several advantages. Limited researches have been done on the exchange rate by employing ARDL methodology therefore this study will also fulfill this research gap by analyzing the factors influence exchange rates of advanced markets economies.

A simple ARDL model is defined as:

$$y_t = \mu + \varphi Y_{t-1} + \omega_0 X_t + \omega_1 x_{t-1} + e_t$$

Where y_t and X_t are stationary variables and ε_t is a white noise error process.

Economists and finance-related fundamentals believed that the exchange rate has its determinants therefore it is a compulsory obligation of the author to test important indicators' impact on the exchange rate. Karo et al, (2020) also include macroeconomic fundamentals for forecasting. From previous studies, it is found that money supply, interest rate, Growth rate, inflation rate, current account balance and trade balance are mostly incorporated as explanatory variables by the previous researchers therefore, in this study, the authors will take all these variables as explanatory or independent variables for the ARDL co-integration analysis.

3.6. Test of Forecast Accuracy- MAPE (Mean Absolute Percentage Error)

In the finance literature, there are several tests used to check the accuracy of performance of tests i.e. forecasting etc. Some of them are Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), Theil-U Statistics and Mean Absolute Error (MAE). Dunis et al (2002) employed exchange rate volatility criteria to evaluate the performance of forecasting tests' accuracy. However, MAPE was found to be the most popular test to check the accuracy among all other criteria. Makridakis (1993) claimed that MAPE is relatively a better measure to assess the accuracy among the various accuracy criteria. Witt et al (1991) It is an advantage of accuracy criterion to measure in unit free terms. Lewis (1992) MAPE value less than 5% where 10% is highly accurate speculation.

4. EMPIRICAL RESULTS

4.1. Unit Root Test.

It is important to find out the unit root of the time series before further analysis. To ensure stationarity, the time series will run at the level or with the 1st and 2nd difference respectively. It is one of the common problems of time series such as exchange rate, interest rate, and inflation rate exhibit trending behavior and are thus non-stationarity in the mean. A times series can be called as stationarity if there is no systematic change in mean over time, variance and periodic variation. The term over time, variance and periodic variation can be defined as no trend, constant spread and

seasonality.

Table 1. Findings of Unit Root Test of PKR/USD Currency

Currency	Test Results
PKR/USD	-4.217673* (0.0020)

**stationarity at first difference*

The results of unit roots revealed that the exchange rate time series is found to be stationarity at first difference.

Table 2. Findings of Unit Root Test of Macro Economic Variables

Variables	GBP
Current Account Balance	-5.655286* (0.0000)
Trade Balance	6.716501** (0.0001)
Interest Rate	-5.131507** (0.0001)
Inflation Rate	-5.247025** (0.0001)
GDP Growth Rate	-3.826651* (0.0001)

stationary at level, **stationarity at first difference, *stationarity at second difference*

Table 2 shows the stationarity test analyzed by the Augmented Dickey-Fuller Test. In this study, the author has taken five macro-economic variables i.e. current account balance, trade balance, interest rate, inflation rate and GDP growth rate for the ARDL Co-integration analysis. The results show that the (CAB) and (GDP) were stationarity at the level and remaining variables i.e. Trade Balance (TAB), Interest Rate (IR) and Inflation Rate (INF) were stationarity at first difference.

4.2. Forecasting of Exchange Rate by Using ARMA/ARIMA Model

Table 3. Findings of ARMA/ARIMA models

Currency	Best Fitted Model	AIC	Adj. R Square	SC
PKR/USD	ARIMA(1,1,3)	8.388628	0.190848	8.561005

The PKR/USD time series found stationarity at 1st difference, therefore, it will result in integrated the model. The best-fitted model against US Dollars was ARIMA (1,1,3). The AIC, Adj R-Squared and SC values are 8.388628, 0.190848 and 8.561005 respectively.

4.3. Exchange Rate Forecasting Using Co-Integration Model

Table 4. Findings of Co-Integration Model					
Currency	Long-Run Coefficients				Diagnostic Test
PKR/USD	$\text{LnER} = 0.000 \cdot \text{InCAB} + 0.000 \cdot \text{InINF} + 18.36 \cdot \text{InIR} - 0.00 \cdot \text{InTB}$ (5.17521) (10.028) (6.8365) (-2.84388) [0.0008] [0.0000] [0.0001] [0.0217]				Bound Test F-statistics= 4.7422 IO B: 3.41 I1 B:4.68

Table 4 exhibits the results of the ARDL Co-Integration model to find out the long-run coefficients. The explanatory variables employed by the author in this study for the ARDL approach are (IR), (INF), (CAB), (TB) and (GDP) Growth rate.

4.4. Exchange Rate Forecasting Using Exponential Smoothing Model.

Table 5. Findings of Exponential Smoothing Model						
Currency	Model	α	B	Φ	g	AIC
PKR/USD	Damped Trend	0.7032	-----	0.4751	-----	16.533

Table 5 shows the results of exponential smoothing forecasting exchange rate model of Pakistani Rupee against US Dollar exchange rate. In the case of selected time series, the high value of α reveals that the impact of historical values on future trends will die out quickly but up to some extent. The higher the value of α , lessen the impact of earlier values on upcoming trends. It is also found that the value of β is unavailable which implies that the weightage of the previous estimation on future values is insignificant. The Φ value shows 0.4751 which indicates that the impact of recent observations on future observations is limited but still significant. Moreover, the missing values of g denote that the influence of historical estimation on the forecasting exchange rate is insignificant. All in all, the significant observations for forecasting exchange rates are the recent values and do not rely on historical values or estimations.

4.5. Forecasting of Exchange Rate by Using Naïve Model.

The Naïve model is the fourth technique of forecasting incorporated by the author in this study. In this model, it is an assumption that the last value has a significant impact on the forecasted observations. For this purpose, it has checked the difference between forecasted and actual values and in the end also calculate the MAPE to find out the accuracy of the models. Following are the results of the Naïve model of time series i.e. Pakistani Rupees against US Dollars.

Table 6. Findings of Naïve Model				
Forecast Error $e_t = Y_t - Y_t^{\wedge}$	ABS	Squared FE	PE	ABS PE
0.0166	0.0166	0.00027556	1%	1%
0.1776	0.1776	0.03154176	9%	9%
0.0584	0.0584	0.00341056	3%	3%
0.8168	0.8168	0.66716224	29%	29%
0.4068	0.4068	0.16548624	13%	13%
0.5219	0.5219	0.27237961	14%	14%
0.3521	0.3521	0.2547941	0%	0%
0.1648	0.1648	0.3146489	0%	0%
1.0025	1.0025	1.00500625	21%	21%
0.5013	0.5013	0.25130169	10%	10%
0.2126	0.2126	0.04519876	4%	4%
0.304	0.304	0.092416	5%	5%
0.0482	0.0482	0.00232324	1%	1%
2.6462	2.6462	7.00237444	31%	31%
-0.1288	0.1288	0.01658944	-2%	2%
-0.019	0.019	0.000361	0%	0%
-0.0188	0.0188	0.00035344	0%	0%
-0.0007	0.0007	4.9E-07	0%	0%
0.0006	0.0006	3.6E-07	0%	0%
-0.0021	0.0021	4.41E-06	0%	0%
-0.0008	0.0008	6.4E-07	0%	0%
0.0019	0.0019	3.61E-06	0%	0%
-0.0018	0.0018	3.24E-06	0%	0%
-0.0002	0.0002	4E-08	0%	0%
-0.2063	0.2063	0.04255969	-3%	3%
-0.2627	0.2627	0.06901129	-3%	3%
-0.5034	0.5034	0.25341156	-7%	7%
-0.4811	0.4811	0.23145721	-7%	7%
0.004	0.004	1.6E-05	0%	0%
-0.2364	0.2364	0.05588496	-4%	4%
-0.2968	0.2968	0.08809024	-5%	5%
-0.0635	0.0635	0.00403225	-1%	1%
-0.1763	0.1763	0.03108169	-3%	3%
0.1521	0.1521	0.02313441	2%	2%
0.2875	0.2875	0.08265625	4%	4%
0.4514	0.4514	0.20376196	6%	6%
-0.4384	0.4384	0.19219456	-7%	7%
0.3719	0.3719	0.13830961	5%	5%
5.1452	10.8194	10.9717947	118.97%	200.79%

4.6. Accuracy of Forecasting Models.

The MAPE results of all four models are as below; the lower the value of MAPE, the higher the level of accuracy of the forecasting model

Table 7. Findings of Forecasting Models				
Currency	ARMA/ARIMA	Naïve	Exponential Smoothing	ARDL Co-Integration Model
PKR/USD	13.52(3)	10.16(2)	6.53(1)	14.102(4)

Table 7 depicts the PKR/USD exchange rate against US Dollars, the exponential smoothing model outperforms other forecasting models with the MAPE value of 6.53. The MAPE values of ARMA, Naïve and ARDL Co-integration are 13.52, 10.16 and 14.102 respectively which are far away from the exponential smoothing model's MAPE value.

5. DISCUSSION

The authors apply univariate and multivariate time series tools in this study to forecast the exchange rate of the PKR/USD. The ARIMA, exponential smoothing model, Naïve and ARDL Co-integration models' accuracy are analyzed by their Mean Absolute Percentage Error value. The exponential smoothing model provides the least MAPE value i.e., 6.53 and found more robust than other time series models.

In the result of the exponential smoothing model, the Φ value shows 0.4751, which indicates that the impact of recent observations on future observations is limited but still significant. It means that the deviation in the PKR/USD is somehow inter-related with the recent values as there isn't any drastic deviation occur in the history of exchange rate whereas, the null values of g symbolizes that the effect of historical estimation on the forecasting exchange rate is insignificant. The second accurate forecasted model is Naïve with the MAPE value of 10.16 which reveals that the recent observation has a greater impact on the future trend of the exchange rate of the Pakistani Rupee against the US Dollar as suggested by the exponential smoothing model. The third accurate forecasting is given by the ARMA/ARIMA model with the MAPE value of 13.52. The third standing of ARIMA indicates that the linear combination of earlier observations does not play an

important role in the forecasting of exchange rates like the exponential smoothing model and the Naïve model.

In the case of ARDL, it provides the highest MAPE value if compare to other forecasting models therefore it is held that it is found as the least efficient model in the forecasting exchange rate of PKR/USD, the results revealed that one percent increase in (CAB) will increase exchange rate but very minor, maybe not noticeable. The increase in (TB) will decrease the exchange rate by a very minor change respectively with a one percent increase in Trade Balance. Furthermore, the one percent of (IR) appreciates the exchange rate of the Chinese Yen by 18%. The insignificant results of other macro-economic fundamentals are consistent with the findings of Nadeem (2018) and AsadUllah (2017). However, the significant relationship of Inflation is inconsistent with the findings of Shaikh et al (2019).

6. CONCLUSION

The objective of this study is to examine and compare the accuracy of time series and econometric forecasting models in the context of the exchange rate as we know that fluctuation in the exchange rate may affect the economic activities at the macro – level. There are two key contributions related to finance literature. First, the ARDL technique is employed to estimate the long run association between PKR/USD and other macroeconomic variables. Second, various methods employed to forecasting using econometric and time series techniques.

For this purpose, the author has chosen the Pakistani Rupee exchange rate against United States Dollars with the annual data from 1980 to 2018. The results revealed that the exponential model provides the most effective accuracy in forecasting rather than the Naive, ARIMA and ARDL CO-integration model. This paper has also covered the gap of unavailability of literature regarding the application of ARDL and Exponential Smoothing model for the forecasting of the exchange rate in Pakistan. It is also anticipated that historical data do not play a vital role in the forecasting of the future trend of time series i.e. Pakistani Rupees against US Dollars. However, all three-time series anticipated that the recent observations play a significant role in the speculation of the

forthcoming future trend. The findings will be helpful for traders, importers, exporters, Foreign Exchange Market, tourists, financial institutions, and government sectors related to financial and economic activities to implement their policies accordingly.

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