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Effect of Economic Policy Uncertainty on Exchange Rate Volatility in Pakistan

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Abstract
This study examines the effect of economic policy uncertainty on Pakistan's exchange rate. Pakistan's exchange rate always remains under pressure due to the widening inflow-outflow gap in foreign exchange. The volatile exchange rates make it harder for businesses to invest and make inflation more uncertain, which ultimately slows down productivity and GDP growth. Due to the close linkages of the exchange rate with the economic indicators, it is required to examine the effect of different economic variables on the exchange rate and its volatility by incorporating the role of economic policy uncertainty. The study uses the sample of Jan 2011 to Dec 2022 for the empirical results. The study employs the EGARCH model for empirical results. The aftermaths of the mean equation of the EGARCH model suggest that economic policy uncertainty has a positive effect on Pakistan's exchange rate. Moreover, an increase in the economic policy uncertainty scale, increases the volatility in Pakistan's exchange rate. The primary source of exchange rate volatility is the nominal variable rather than the real variables. On the basis of the study's findings, certain relevant recommendations were given in order to stabilize the foreign exchange market in Pakistan.

Keywords: Exchange rate, Economic policy uncertainty, Exchange rate volatility, EGARCH model

1. Introduction

The behaviour of exchange rates is crucial for the citizens of each country because the volatility of exchange rates has a direct effect on the price of basic commodities which are mostly imported. The collapse of the Bretton Woods fixed exchange rate system caused significant fluctuations in bilateral exchange rates over the course of time (Devereux & Lane, 2003). The significant shifts taking place in the economy of the world as a whole, there has been an increase in the degree of currency exchange rate volatility (Frommel & Menkhoff, 2003). While though developed and emerging economies experience currency fluctuations for a variety of causes, these shifts are ultimately the result of the fiscal and monetary policies implemented by the governments of each country (Nor, 2015).

Many developing economies struggle with the challenges of managing boom-bust cycles due to the unpredictable nature of capital flows. Such a situation can have a significant impact on the economy, causing instability during times of economic contraction and stability in the period of economic expansion (Chit et al., 2010). Extensive investigations have been conducted into the exchange rates of emerging economies due to the numerous and frequent currency crises that have taken place in the past two decades (Nor, 2015). The findings of a study conducted by Chit et al., (2010) indicate that movements in exchange rates are largely unpredictable. These findings remain relevant, despite the extensive research that has been dedicated to studying exchange rate volatility.

Maintaining a stable exchange rate is crucial for the growth and sustainability of a prosperous economy. The short-term implication of factors contribute to exchange rate instability have less empirical support, although the accuracy of their long-term impacts has been demonstrated (Chen et al., 2015). Temporary changes in the currency rate can be influenced by sudden shocks like the Economic Policy Uncertainty (EPU) (Abid, 2019). Studies have demonstrated that the EPU has a detrimental effect on economic activity (Baker et al., 2016; Beckmann and Czudaj, 2017), as supported by numerous real-world investigations (Arouri & Roubaud, 2016). The anticipated impacts of EPU on fluctuations in exchange rates remain a subject of great interest and intrigue in the subject of Pakistan's economy.

The exchange rate of Pakistan always remain under pressure due to lower level of inflow and higher level of outflow of foreign exchange. More volatile exchange rates can make business profits and net worth more volatile. This makes it harder for businesses to invest, which slows down productivity and GDP growth. More unstable exchange rates can make inflation more uncertain, which can lead to higher interest rates and less spending and investment. Due to close linkages of exchange rate with the economic indicators, it is required to examine the effect of different economic variables on the exchange rate and its volatility by incorporating the role of economic policy uncertainty.

The exchange rate of Pakistan depicting the extreme level of instability over the period of 2011 to 2022. The figure 1 can be seen to investigate the worst performing state of the exchange rate of Pakistan. Over the period of 12 year, almost 2 year was the period of stability in the forex market, while rest period were extremely volatile. The period of 2016 depicting the lower level of economic policy uncertainty which transmit in the forex market, as the said period showing stability in the exchange rate. The period of higher EPU depicting more instable exchange rate. It is possible for greater fluctuations in exchange rates to lead to increased swings in the profits and net worth of businesses. This makes it more challenging for companies to raise capital for investment, which in turn slows both productivity and GDP development (Baum & Caglayan 2010; Ali et al., 2021).

The more the volatility of exchange rates, the greater the uncertainty of inflation, which can lead to higher interest rates as well as a reduction in consumption and investment (Aghion et al., 2009). Last but not least, shifts in relative costs of production and an increase in the transaction risk associated with international trade can be brought about by fluctuations in exchange rates (Grier & Grier 2006). Due to close linkages of exchange rate with the economic indicators, it is required to examine the effect of different economic variables on the exchange rate and its volatility by incorporating the role of economic policy uncertainty.

The connection between EPU and the instability of exchange rates has not gotten much attention because the vast majority of the research literature investigates the varied factors that drive exchange rate instability. The current research indicates, on the one hand, that the effect of EPU has a significant influence on asset prices across a variety of areas, including futures markets,

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insurance markets, and stock markets (Dong et al., 2019; Shahzad et al., 2017; Ali et al., 2023). In principle, the economic policy uncertainty (EPU) has both a direct and an indirect influence on the volatility of the currency rate. In addition, EPU has an impact on the status of the economy; as a result, the purpose of this research is to investigate the relationship between EPU and exchange rate volatility.

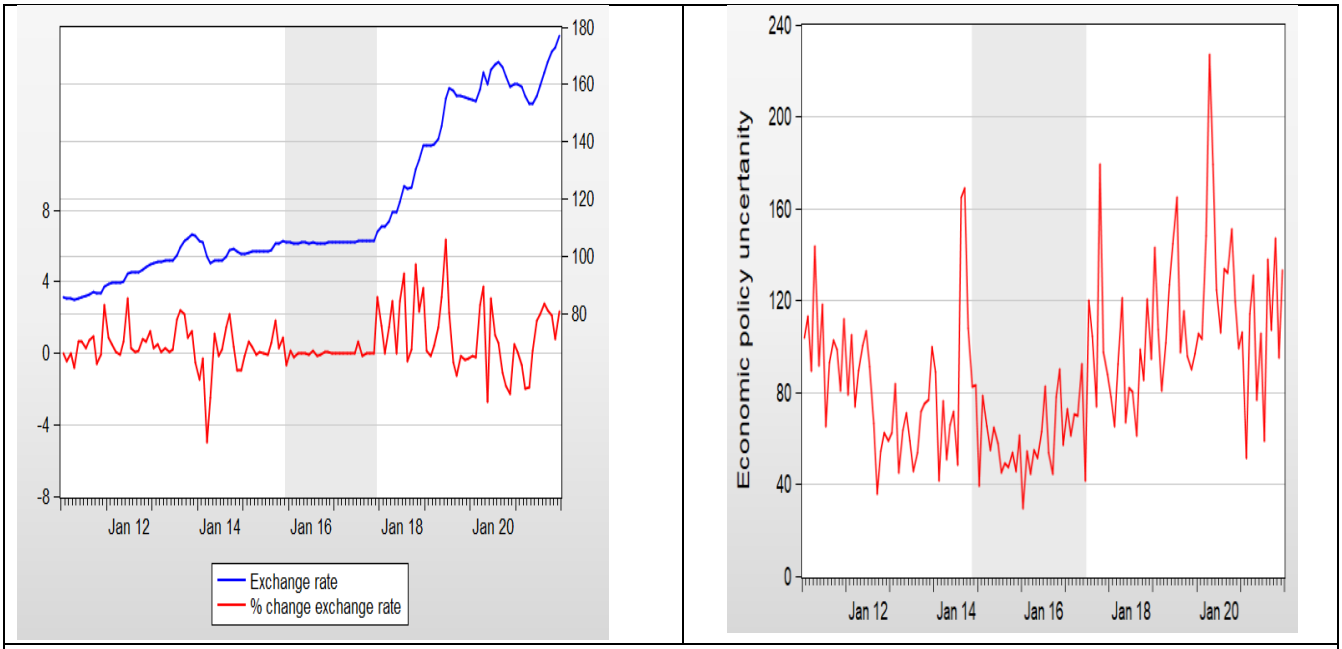

Figure 1 Pattern of exchange rate and economic policy uncertainty

The ongoing research on the connection between economic policy uncertainty (EPU) and exchange rate volatility has not received much attention, despite the fact that a great deal of published material investigates the factors that lead to fluctuations in exchange rates or the many different effects of EPU. While the economic policy uncertainties have a significant impact at the prices of assets traded on a variety of markets, including futures, commodities, stocks, and insurance (Dong et al., 2019; Shahzad et al., 2017). However, academics investigate the factors that have an influence on the fluctuation of exchange rates in the field of international economics (Wang & Morley, 2018). On the other hand, there is a paucity of research regarding the effect of EPU on the volatility of currency rates (Beckmann & Czudaj, 2017; Sulehri & Ali, 2020). According to one line of thought, the EPU can have both direct and indirect effects on the volatility of exchange rates. A more flexible monetary policy will result in faster exchange rate fluctuations for countries with higher EPU levels. In addition to this, EPU has an effect on the status of the economy, which has an impact, in turn, on the degree to which exchange rates are volatile. In light of this, we investigate how the EPU affects the fluctuation of exchange rates.

EPU is a factor that contributes to the instability of asymmetric exchange rates. It is common knowledge that EPU have beneficial impact on level of volatility exhibited by currency exchange rates. The primary cause for this result has been determined to be government regulation (Brogaard & Detzel, 2015). The effects of EPU on exchange rates will vary depending on the policies that are implemented by the central bank in response to the varying degrees of exchange rate fluctuation. On the other hand, when there is a significant amount of volatility in exchange rates, the effect of EPU shock on correlations is minimal. When there is a reasonably large amount of exchange rate volatility, the impact is that changes in significant events are used to respond to different kinds of economic circumstances and shocks (Audi et al., 2022; Audi et al., 2023). As a result, EPU may cause a variety of shocks, some of which are asymmetrical, at varying quantiles of exchange rate volatility.

Predicting and monitoring the volatility of exchange rates has been and will continue to be an important and popular topic all over the world. In the past, the uncertainty of economic policy was estimated with the help of some kind of political events, for instance, uncertainty nearby elections or the consequences of some kind of legislative type actions. In a study of Leblang and Bernhard (2006) put these measures to use in their investigation of the influence of policy uncertainty on the volatility of exchange rates. They found evidence that political events influence exchange rate and also its volatility by employing an empirical method. Studies that are specific to the use of elections as an indicator of degree of economic policy uncertainty also came to the conclusion that elections have a significant impact on the economic indicators. In a study by Bialkowski et al. (2008) and Boutchkova et al. (2012) find that election cycles are accompanied by increased volatility in equity markets.

Recent research conducted by Baker et al. (2016) and Brogaard and Detzel (2015) has resulted in the construction of indices that measure the degree to which economic policy in various economies, including the United States, is uncertain. These indices chart the unending progression of the degree of economic policy uncertainty over the course of time. To the best of our knowledge, essentially no research that focuses on economic policy uncertainty and exchange rate volatility in the context of Pakistan has ever been published. The EPU index for Pakistan was developed in 2020, and it was developed by (Choudhary et al., 2020). This is the reason why the literature is not available. Because the EPU index was just recently developed, there are either very few or no research that investigate the impact of the EPU on the exchange rate and the volatility of it in Pakistan. Given the importance of the EPU in predicting the exchange rate and its volatility, this study set the following objectives:

- To empirically estimate the effect of economic policy uncertainty on the exchange rate and its volatility for the case of Pakistan.
- To empirically estimate the effect of nominal variables (external debt, interest rate, remittances) on the exchange rate and its volatility for the case of Pakistan.
- To empirically estimate the effect of real variables (economic growth, exports, imports) on the exchange rate and its volatility for the case of Pakistan.

Stability of volatility of exchange rate always remain a major problem of world. Pakistan is a developing country and being a developing country mostly rely on import especially in the transition phase. For that purpose, there is need to stabilize the volatility of exchange rate in Pakistan. However, volatility in the exchange rate may cause inflation and effect the projected profitability of the investment project. The findings of the study may help the researchers, portfolio investors, and financial economist in understanding the volatility in the exchange rate.

2. Research Methodology

2.1. Econometric Models

For empirical analysis this study will be used the monthly data ranged from January, 2011 to December, 2022. After collecting the data, it will be required to check the stationarity of the series used in the analysis. The assumption of stationarity in time series analysis robust the results, either it may be at the level I(0) or degree of integration I(d). The most commonly used test for stationarity of a series is the Augmented Dickey-Fuller (ADF) test. In the presence of stationarity in the series, next to capture the volatility in the series by using the ARCH model proposed by (Engle, 1982). However, in line with study objectives, we will rely on the exponential GARCH (EGARCH) model proposed by (Nelson, 1991; Shair et al., 2021). The EGARCH model getting importance due to the limitation of the GACH model to unable to segregate the asymmetry response of negative and positive shocks on volatility. However, the EGARCH model is capable to explain the asymmetry effect on volatility by negative and positive shocks. Moreover, the EGARCH model allows big news to impact greater volatility. The EGARCH model is made up of two steps. The first step is the means equation with the "p" order of the autoregressive process. This is how the AR(p) process is described:

$$r_t = \theta_0 + \theta_i \sum_{j=1}^{p} r_{t-i} + \varepsilon_t \quad (1)$$

The variance equation is the focus of the second step, and the EGARCH (p,q) is characterised by the following definition:

$$\ln(\sigma_t^2) = \varphi + \sum_{j=1}^{q} \theta_j \left|\frac{\varepsilon_{t-j}}{\sigma_{t-j}}\right| + \sum_{j=1}^{q} \gamma_j \frac{\varepsilon_{t-j}}{\sigma_{t-j}} + \sum_{i=1}^{p} \delta_i \ln(\sigma_{t-1}^2) \quad (2)$$

Where α, γ, ω, and δ are the parameters in the equation describing the variance, leverage and asymmetric effect. In aforementioned equation the LHS variable is variance which follow exponential pattern and ensure lag of the variances non-negative. A presence of an asymmetric influence is shown by γ_j and it not being zero. On the other hand, $\gamma_j < 0$ suggest that negative news has a greater impact on the volatility of stock prices than positive news does.

In the analysis, once it had been established that an ARCH effect did indeed exist in the return on the stock market, the following step was to identify the components that affected the volatility of the series. In the equation for the mean and the variance, we added in the determinants. The following is a definition of the specification of the EGARCH model, which includes the addition of the explanatory variables:

$$r_t = \lambda_0 + \lambda_1 r_{t-1} + X\Lambda + \varepsilon_t \quad (3)$$

Where X is vector of explanatory variables which consist on the economic policy uncertainty, imports, exports, interest rate, remittances, external debt and large scale manufacturing production, and Λ is vector of coefficient in the mean equation.

$$\log(\sigma_t^2) = \omega + \alpha \left|\frac{\varepsilon_{t-j}}{\sigma_{t-j}}\right| + \gamma \frac{\varepsilon_{t-j}}{\sigma_{t-j}} + \delta \log(\sigma_{t-1}^2) + X\Omega + \varepsilon_t \quad (4)$$

Where X is vector of explanatory variables which consist on the economic policy uncertainty, imports, exports, interest rate, remittances, external debt and large scale manufacturing production, and Ω is vector of coefficient in the variance equation.

The empirical study of the time series required the stationarity of the series, which makes the time series data more sensitive than other types of data. The stationary series have values that are always the same for their mean, variance, and covariance. To achieve this goal, it is necessary to first decide whether or not the series may be considered stationary, and then to calculate the integration for the variables. To achieve this objective, it is necessary to carry out the unit roots test. The ADF unit root test would be applied for the purpose of conducting the unit root testing on the presumption that the series does not represent a stationary distribution. The testing would furthermore include the intercept as well as the trend, with the intercept being calculated both at the level and the first difference. The falsification of the null hypothesis will make it possible to determine whether or not the series is stationary (see Gujarati & Porter, 2009).

2.2. Data source and definition of variables

The primary objective of study is to evaluate and measure the influence that unpredictability in economic policy has on Pakistan's currency exchange rate. The study covers the data of time span of January 2011 to December 2022. The information regarding the dependent variable that is exchange rate sourced from State Bank of Pakistan (SBP). Moreover, data of economic policy uncertainty, foreign debt, exports, imports, remittances, large scale manufacturing, and interest rate is also obtained from the SBP. The description of the variables used in the study are presented in the table 1.

Table 1: Definition of variables

Sr.	Variable	Explanation	Unit	Sources
1	ER	Bank Floating Average Exchange Rates (PKR per National Currency), Converted into percentage change in exchange rate by $ER_t = \log\left({}^{E_t}/_{E_{t-1}}\right)$	Percentage	SBP
2	EPU	A scale with higher value indicating more economic policy uncertainty and lower indicates less. Value of 100 is for the January 2010 (a base year)	Scale	SBP
3	EXTDEBT	Amount of external debt received on short-term and long-term debt, converted into percentage change in $ED_t = \log\left({}^{D_t}/_{D_{t-1}}\right)$	Percentage	SBP
4	IMPORT	Imports of goods and services, converted into percentage change in $IMP_t = \log\left({}^{M_t}/_{M_{t-1}}\right)$	Percentage	SBP
5	EXPORT	Exports of goods and services, converted into percentage change in $EXP_t = \log\left({}^{E}/_{E_{t-1}}\right)$	Percentage	SBP
6	REMS	Amount of remittances received monthly, converted into percentage change in $REMS_t = \log\left({}^{R}/_{R_{t-1}}\right)$	Percentage	SBP
7	IR	Weighted average lending and deposit rate	Percentage	SBP
8	LSMS	Large scale manufacturing scale, 100 for the base year, converted into percentage change in $LSMS_t = \log\left({}^{LSM}/_{LSM_{t-1}}\right)$	Percentage	SBP

3. Descriptive analysis

3.1. Descriptive Analysis

Table 2 is presented for the descriptive statistics of the variables, while figure 1 illustrates the dynamic pattern of variables over the time span. The duration of this time span is 144 months, beginning in January 2011 and ending in December 2022. The economic policy uncertainty index has a score of roughly 89 on average, with a range that goes as low as 29 and as high as 226. The range of the variable, which is the difference between the lowest possible value and the greatest possible value, as well as the standard deviation of the variable, both demonstrate that the EPU has a lower degree of dispersion than most other variables. Yet, despite the fact that this value is not particularly near to zero, the skewness indicates that EPU has a positive skew. Kurtosis is higher than three a leptokurtic pattern indicating that the majority of the observations are concentrated close to the mean. Because the p-value is lower than 0.1, the findings of the Jarque-Bera test suggest that it is possible to conclude that the null hypothesis stating that the series follows a normal distribution cannot be accepted. This confirms that the EPU does not follow a normal distribution, as shown by the p-value of the test.

Figure 2: Pattern of variables used in the analysis

The value of the exchange rate on average is close to 0.5, which indicates that the pace of depreciation of the exchange rate occurs at an average rate of 0.5% every month. The largest amount of value lost is 6.4 per cent, while the maximum amount of value gained is approximately 5 per cent. The range of the variable, which is the difference between the lowest and highest possible values, and the standard deviation both indicate that the exchange rate is significantly more volatile, which is corroborated by the standard deviation. It can be seen that the value of the standard deviation is greater than the mean. Nonetheless, despite the fact that this value is not particularly near to zero, the skewness indicates that the exchange rate has a positive skew. Kurtosis is higher than three a leptokurtic pattern indicating that the majority of the observations are concentrated close to the mean. Because the p-value is lower than 0.1, the findings of the Jarque-Bera test suggest that it is possible to conclude that the null hypothesis stating that the series follows a normal distribution cannot be accepted.

Given that the average value of Pakistan's external debt is close to one, it can be deduced that the country's foreign debt is growing by an average of one percent per month. The value of the average exports of goods and services is close to 0.35, which indicates that the value of the average monthly exports is growing by 0.35 percent. The mean imports indicates that monthly imports on average are growing by 0.62 percent. The interest rate's average value is close to 5.24, while the large scale manufacturing scale has an average value of approximately 0.22 per cent. It can be deduced from the fact that the average monthly remittances are growing by 1.9 per cent. Remittances plays an important role in shaping the economic indicators not only at the household level but also at macro level (Shair & Majeed, 2020; Shair & Anwar, 2023).

Table 2. Descriptive statistics

	EPU	ER	EXPORT	EXTDEBTS	IMP	IR	LSMS	REMS
Mean	88.97	0.55	0.35	0.99	0.62	5.24	0.22	1.88
Median	83.61	0.14	-0.15	0.78	1.49	5.22	-0.69	2.03
Maximum	226.83	6.35	39.91	13.37	27.54	9.29	22.48	38.66
Minimum	29.82	-4.96	-37.62	-9.73	-21.92	2.87	-38.83	-34.38
Std. Dev.	34.65	1.50	12.92	2.81	10.93	1.62	8.54	14.03
Skewness	0.95	0.55	0.02	0.64	0.15	0.21	-0.53	-0.05
Kurtosis	4.23	5.55	2.96	7.23	2.68	1.86	5.96	3.24
Jarque-Bera	28.32	42.25	0.02	107.72	1.03	8.17	54.39	0.37
Probability	0.00	0.00	0.99	0.00	0.59	0.02	0.00	0.83
Sum	11744.15	72.68	46.56	131.96	82.29	692.33	29.24	248.85
Sum Sq. Dev.	157283.00	296.66	21854.66	1037.44	15642.71	345.35	9554.27	25788.62
Observations	144	144	144	144	144	144	144	144

3.2. Correlation Analysis

In table 3, we present a representation of the correlation matrices of the variables that were employed in the analysis. This procedure's goal is to verify that there is a correlation between the dependent variable and the independent variable when they are considered separately. In addition, the association between the two independent variables may be of use in determining whether or not there is a potential issue with multicollinearity.

There is a positive correlation between the economic policy uncertainty and Pakistan's currency exchange rate. When we look at the magnitude of the correlation coefficient, we see that this link is not particularly robust in magnitude. Because of this positive correlation, it can be deduced that the exchange rate will be higher and the value of the local currency will decrease as economic policy uncertainty increases. The other variables depicting the positive association with exchange rate are imports, interest rate and remittances. On the other hand, variable negatively associated with the exchange rate are exports, external debt, and large scale manufacturing scale.

Given the correlation of the independent variables, the higher correlation is observe in the imports and exports; exports and large scale manufacturing; exports and remittances; remittances and imports. The magnitude of the coefficient is in the range of 0.35 to 0.60. The prior level of correlation is not indicating the presence of multicollinearity.

Table 3: Correlation matrix

	EPU	ERS	EXPORT	EXTDEBTS	IMP	IR	LSMS	REMS
EPU	1.000	0.209	0.069	0.039	-0.002	0.154	-0.029	0.045
ERS	0.209	1.000	-0.004	-0.130	0.093	0.071	-0.055	0.051
EXPORT	0.069	-0.004	1.000	-0.023	0.465	-0.048	0.355	0.604
EXTDEBTS	0.039	-0.130	-0.023	1.000	0.136	-0.092	0.021	0.141
IMP	-0.002	0.093	0.465	0.136	1.000	-0.107	0.266	0.574
IR	0.154	0.071	-0.048	-0.092	-0.107	1.000	-0.048	0.011
LSMS	-0.029	-0.055	0.355	0.021	0.266	-0.048	1.000	0.304
REMS	0.045	0.051	0.604	0.141	0.574	0.011	0.304	1.000

3.3. Scatter plot

The scatter plot of the variable that was utilized in the analysis was presented in figure 3. A visualization of the dependent variable and the independent variable can be seen in the form of a scatter plot. The scatter plot is depicting the positive relationship between economic policy uncertainty and exchange rate. This description is in line with the findings of the correlation analysis, which showed a positive link between the economic policy uncertainty and exchange rate. The exports of

goods and services and exchange rate is not depicting certain relationship between the exports and exchange rate of Pakistan. This description is not consistent with the outcome of the correlation analysis depicting the negative association between the exports and exchange rate. On the other hand, foreign debt and large scale manufacturing scale depicting negative association with the exchange rate. On contrary, the positive association of the imports, interest rate, and remittances with the exchange rate is visible. Given the scatter plot of the exchange rate with independent variables, almost all the variables' scatter plot is consistent with the correlation analysis. However, exception to the exports of goods and services which is not depicting any positive or negative relationship which confirmed from the horizontal regression line.

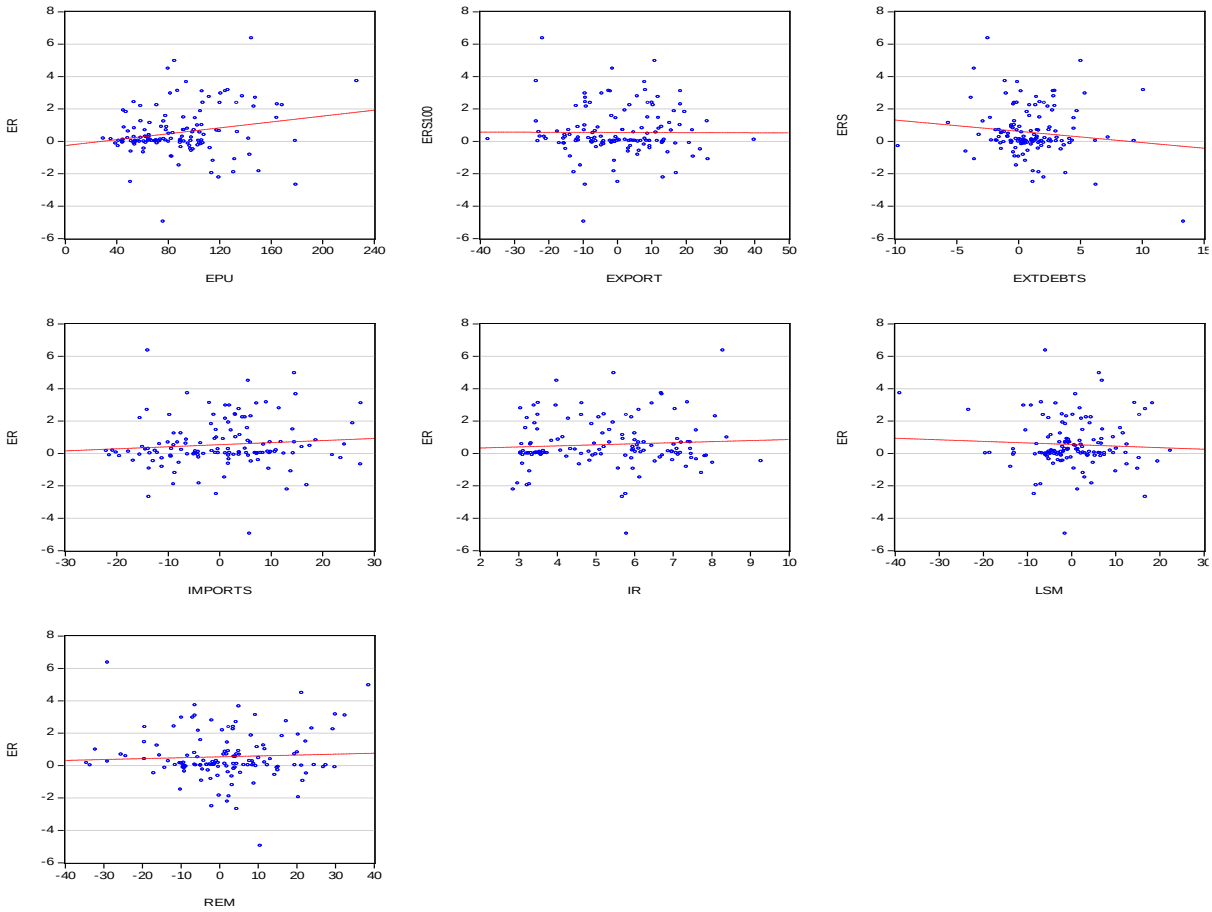

Figure 3: Scatter plot of exchange rate with variables used in analysis

4. Regression Analysis

4.1. Pre-estimation test

4.1.1. Unit root test

Table 4 contains the results of the unit roots test that we conducted. We tested the stationarity of the series at level with constant term as well as constant with time trend. Apart from the level, we also applied it with first difference. We used Augmented Dickey Fuller (ADF) test under the null hypothesis that series is unit/not stationarity. The results of the ADF test are displayed in panel A of table 4. They show that economic policy uncertainty (EPU), the exchange rate (ER), exports (EXPORTS), foreign debt (EXTDEBT), imports (IMPORTS), and large scale manufacturing (LSM) are stationary at level. Moreover, these variables are also stationary at the constant term with time trend. The variable interest rate (IR) is non-stationary at level with constant term.

The results of the ADF test are displayed in the panel B of table 4. These results show that all of the variables, including economic policy uncertainty (EPU), the exchange rate (ER), exports (EXPORTS), foreign debt (EXTDEBT), imports (IMPORTS), large scale manufacturing (LSM), remittances (REM), and interest rate, are stationary. Finally, if all variables are non-stationarity, it did not affect the choice of the EGARCH model. However, a stationary series can good predict the series with lesser error for the future purpose.

4.1.2. ARCH effect Test

We presented the autoregressive moving average (ARMA) of the series to test the presence of the volatility in the series in table 5. We tested the autocorrelation and partial autocorrelation for the choice of AR 'q' and MA 'p' order. The autocorrelation and partial autocorrelation suggest the AR (1) and MA (1) for the best fit of the ARMA process to test the presence of ARCH effect. We presented the ARIMA (1,0,1) model in the table 5.

We presented the pre-estimation test of the ARCH effect presence in the table 6. The p-value of the F-test is 0.0871 which indicates the rejection of the null hypothesis of 'there is no ARCH effect in the series'. Finally we can conclude that presence of the ARCH effect in the series which in turn support the objective of our study related to estimate the effect on the exchange rate volatility.

Table 4: Unit root test

	Level			
Variables	Intercept		Tend and Intercept	
	t-statistic	p-values	t-statistic	p- values
EPU	-4.141602***	0.0012	-6.869324***	0.0000
ER	-7.551967***	0.0000	-7.625929***	0.0000
EXPORTS	-12.72817***	0.0000	-12.73460***	0.0000
EXTDEBT	-9.958300***	0.0000	-10.52388***	0.0000
IMPORTS	-11.76835***	0.0000	-11.74621***	0.0000
IR	-1.866927	0.3470	-1.724302	0.7349
LSM	-4.915004***	0.0001	-4.900498***	0.0006
REM	-7.988411***	0.0000	-8.085614***	0.0000
	1st Difference			
	Intercept		Tend and Intercept	
	t-statistic	p-values	t-statistic	p-values
EPU	-17.77213***	0.0000	-17.71603***	0.0000
ER	-12.53106***	0.0000	-12.48241***	0.0000
EXPORTS	-6.727118***	0.0000	-6.706057***	0.0000
EXTDEBT	-9.943748***	0.0000	-9.910376***	0.0000
IMPORTS	-7.315318***	0.0000	-7.296194***	0.0000
IR	-7.006260***	0.0000	-7.011724***	0.0000
LSM	-11.82289***	0.0000	-11.73748***	0.0000
REM	-7.203598***	0.0000	-7.163093***	0.0000

*, ** and *** show 10%, 5% and 1% level of significance respectively

Table 5: Estimates of the ARMA model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.556329	0.190673	2.917706	0.0042
AR(1)	0.244253	0.172854	1.413053	0.1601
MA(1)	0.155492	0.174306	0.892062	0.3740
SIGMASQ	1.920275	0.153384	12.51942	0.0000

Table 6: ARCH effect test

Heteroskedasticity Test: ARCH				
F-statistic	2.972366	Prob. F(1,129)		0.0871
Obs*R-squared	2.950466	Prob. Chi-Square(1)		0.0859
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.646526	0.409341	4.022381	0.0001
RESID^2(-1)	0.150045	0.087031	1.724055	0.0871

4.2. EGARCH model results

In table 7, we offered some estimations regarding the impact of Pakistan's economic policy uncertainty on the country's exchange rate. We presented the conditional variance and standard deviation of the exchange rate in figure 4. While actual and fitted value of the series also presented in the figure 5 along with residuals of the fitted model. The R-square value shows the degree of explanatory power regarding the variation in the exchange rate that is caused by the covariates. The Durbin-Watson test suggests that there is no autocorrelation present in the model.

The estimates of the mean equation suggest that economic policy uncertainty has positive effect on the exchange rate of Pakistan. For example, an increase in economic policy uncertainty scale by one unit scale increase the exchange rate by 0.005 per cent. It implies that higher level of economic policy uncertainty is lead to depreciation of the local currency of Pakistan. The major economic policy of Pakistan are the monetary, fiscal, and trade policies. These policies manage the demand and maintain the demand stability in the economy by channelizing the savings and investment. However, the lack of economic policy certainty is an indicator of the risk and urged the investors to avoid the risk by diversify the portfolio investments. In the period of uncertainty, the most desirable portfolio choice is holding the foreign currency. The higher demand of foreign exchange increase the price of the foreign currency and depreciate the local currency.

The coefficient of the economic policy uncertainty in the variance equation is significantly positive. It indicates that an increase in the economic policy uncertainty scale increase the volatility in the exchange rate of Pakistan. The volatile exchange rate is a

source of unstable position of the nominal and real variable as well as worst performance of the money, capital, and forex market. The increase in EPU by one scale increase the volatility of exchange rate by 0.008 variance point. It implies that in the period of higher economic policy uncertainty investor use forex as hedge against the risk which made the forex market unpredictable and unstable.

The estimates of the mean equation suggest that foreign debt has significantly negative effect on the exchange rate of Pakistan. For example, an increase in foreign debt by one percentage point decrease the exchange rate by 0.03 per cent. It implies that higher level of foreign debt is lead to appreciation of the local currency of Pakistan. The foreign debt is a major source of forex inflow in Pakistan, and higher level of foreign debt is associates with higher level of forex inflow which can be used in the managed floating exchange rate regime. The higher foreign debt is also associated with higher supply of forex which in turn lower the price of foreign currency and allowed the local currency to be appreciate.

The coefficient of the foreign debt in the variance equation is significantly positive. It indicates that an increase in the foreign debt increase the volatility in the exchange rate of Pakistan. The volatile exchange rate is a source of unstable position of the nominal and real variable as well as worst performance of the money, capital, and forex market. The increase in foreign debt by one percentage point increase the volatility of exchange rate by 0.23 variance point. It implies that loan sanction from international agencies effects the expectations of the financial player and time involve in the inflow of forex through debt has an impact on market sentiments which ultimately volatile the forex market.

The estimates of the mean equation suggest that remittances has positive effect on the exchange rate of Pakistan. For example, an increase in remittances by one percentage point increase the exchange rate by 0.003 per cent, but this effect is statistically insignificant. The effect of remittances in a shorter period of time on the exchange rate is questionable because remittance is a source of forex inflow.

The coefficient of the remittances in the variance equation is significantly positive. It indicates that an increase in the remittances increase the volatility in the exchange rate of Pakistan. The volatile exchange rate is a source of unstable position of the nominal and real variable as well as worst performance of the money, capital, and forex market. The increase in remittances by one percentage point increase the volatility of exchange rate by 0.041 variance point. It implies that at one side remittance is a source of forex inflow, while it also contribute to volatile the forex market of Pakistan. The descriptive statistics of the remittances show that growth of remittance is extremely unpredictable, not a followed the stable upward trend. The presence of positive and negative growth of remittances made the forex market more volatile.

The estimates of the mean equation suggest that exports has negative effect on the exchange rate of Pakistan. For example, an increase in exports by one percentage point decrease the exchange rate by 0.002 per cent. The effect of exports on exchange rate is as expected but it is but this effect is statistically insignificant. The effect of exports in a shorter period of time on the exchange rate is insignificant due to unstable growth of exports as well as negative and positive mix of growth.

The coefficient of the exports in the variance equation is positive. It indicates that an increase in the exports increase the volatility in the exchange rate of Pakistan. The increase in exports by one percentage point increase the volatility of exchange rate by 0.007 variance point, but this effect is statistically insignificant. It implies that at one side export is a source of forex inflow, while it also does not contribute to volatile the forex market of Pakistan.

The estimates of the mean equation suggest that interest rate has significantly negative effect on the exchange rate of Pakistan. For example, an increase in interest rate by one percentage point decrease the exchange rate by 0.11 per cent. It implies that higher level of interest rate is lead to appreciation of the local currency of Pakistan. The relatively higher interest rate is a major source of forex inflow in Pakistan, and higher level of interest rate is associates with higher level of forex inflow which can be used in the managed floating exchange rate regime. The higher interest rate attracts the foreign investor to hold money in the money market of Pakistan in the forex currency which is also associated with higher supply of forex which in turn lower the price of foreign currency and allowed the local currency to be appreciate.

The coefficient of the interest rate in the variance equation is significantly positive. It indicates that an increase in the interest rate increase the volatility in the exchange rate of Pakistan. The volatile exchange rate is a source of unstable position of the nominal and real variable as well as worst performance of the money, capital, and forex market. The increase in interest rate by one percentage point increase the volatility of exchange rate by 0.11 variance point. It implies that higher interest rate attracts the hot money from the foreign investors who inject the money in money market of Pakistan for the shorter period. However, at the time of hot money inflow forex supply increase which appreciate the currency, while at the time of outflow of hot money, the demand of foreign currency increase which depreciate the currency and made the forex market more volatile.

The estimates of the mean equation suggest that imports of goods and services has positive effect on the exchange rate of Pakistan. For example, an increase in imports by one percentage point increase the exchange rate by 0.014 per cent. It implies that higher level of imports is lead to depreciation of the local currency of Pakistan. The higher import of goods and services is associated with the outflow of forex and outflow of forex is associated with higher demand of forex. The higher demand of foreign exchange increase the price of the foreign currency and depreciate the local currency.

The coefficient of the imports in the variance equation is negative, but it is statistically insignificant. It implies that growth of imports did not create volatility in the exchange rate of Pakistan. The unaffected nature of the imports on the volatility can be explained with fact that imports are stable source of forex outflow and pressure on the forex market can be reduce by designing the trade policy related to tariff, quota or restrict the letter of credit to avoid the volatility of the forex market.

The estimates of the mean equation suggest that large scale manufacturing has positive effect on the exchange rate of Pakistan, but this effect is statistically insignificantly. The unaffected nature of large scale manufacturing suggest that if we take the proxy of economic growth it implies economic growth is associated with income growth of the people and income growth does not affect the exchange rate due to lower level of saving among the people of Pakistan. Moreover, economic growth does not affect the volatility of the exchange rate.

Table 7: Regression results of the EGARCH model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.636647	0.267133	-2.383259	0.0172
EPU	0.004551	0.001299	3.504458	0.0005
EXTDEBTS	-0.034067	0.017641	-1.931100	0.0535
REM	0.003065	0.004179	0.733436	0.4633
EXPORT	-0.002182	0.004873	-0.447772	0.6543
IR	-0.114585	0.051977	-2.204544	0.0275
IMP	0.014936	0.005018	2.983527	0.0032
LSM	0.000717	0.005405	0.132733	0.8944
AR(1)	0.363767	0.090182	4.033716	0.0001
	Variance Equation			
ω	2.203221	0.589710	-3.736109	0.0002
α	-0.812347	0.222364	3.653225	0.0003
γ	-0.035008	0.181441	0.192945	0.8470
δ	0.816471	0.070341	11.60731	0.0000
EPU	0.007691	0.004444	1.730484	0.0835
EXTDEBTS	0.229865	0.046105	4.985676	0.0000
REM	0.041406	0.015461	2.678075	0.0074
EXPORT	0.006569	0.021270	0.308833	0.7574
IR	0.110580	0.048514	2.279351	0.0226
IMP	-0.006083	0.015256	-0.398757	0.6901
LSM	-0.016555	0.020992	-0.788612	0.4303
R-squared	0.178925			
Adjusted R-squared	0.125522			
Durbin-Watson stat	1.879490			

The EGARCH model suggest that negative innovations posses higher effect than the good news following the same level of magnitude. In this regard, $\gamma < 0$ suggest the presence of leverage effect. Moreover, it also implies that bad innovations hold 1.08 time more effect than the good news of same intensity (calculated by $|-1 + \gamma|/(1 + \gamma)$. Moreover, one lag coefficient of the GARCH model is ($\delta = 0.816471$), it quantify the time period for a shock to reduce to one half-life (HL). It is about 3.03 days (calculated by $\ln(0.5)/\ln(\delta)$) (Fakhfekh et al., 2016). It implies that shock remain for the lower time span create relatively more volatility on the conditional variance. The evidence can be confirmed from the conditional variance of the error terms.

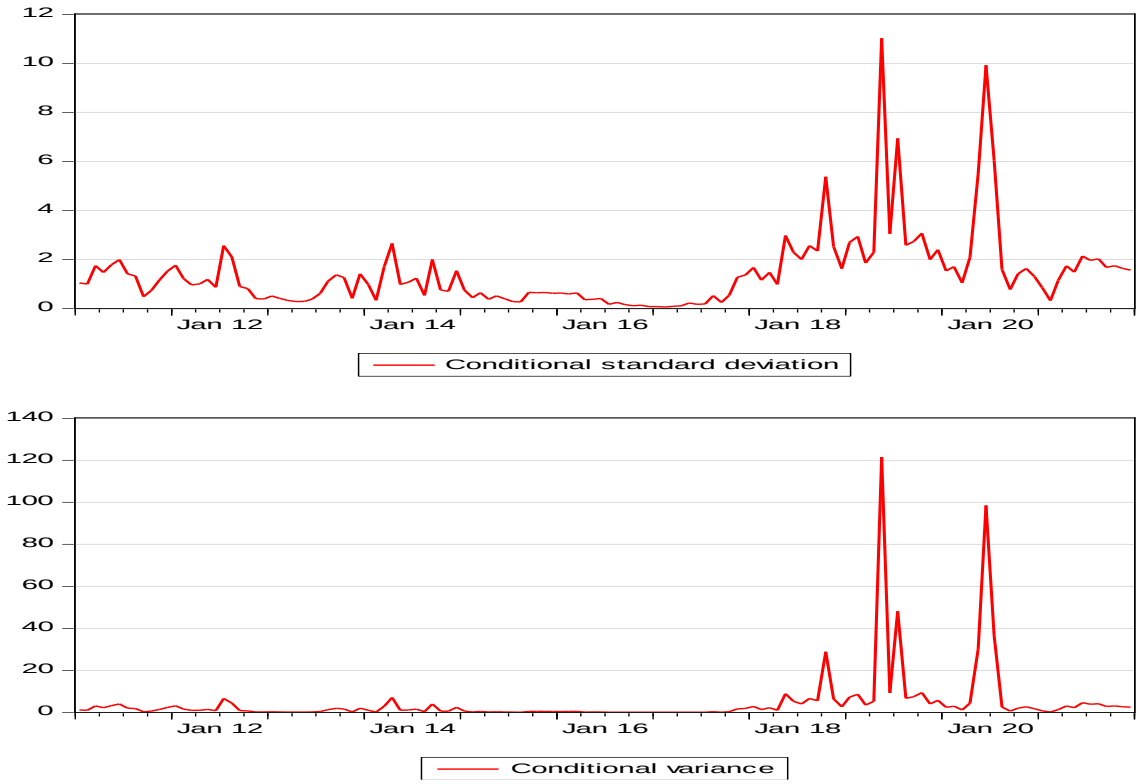

Figure 4: Conditional variance and standard deviation of the series

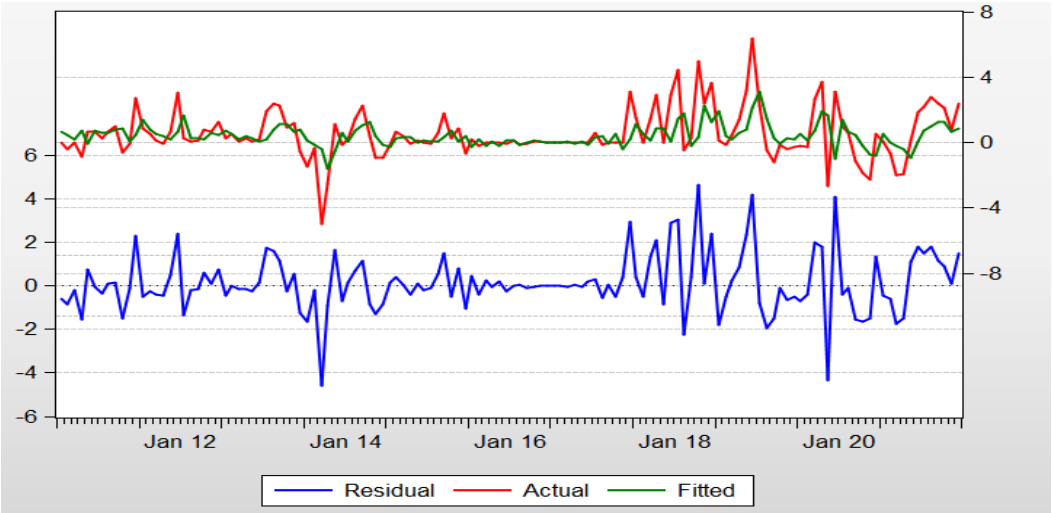

Figure 5: Actual, fitted and residual of the series

4.3. Post-estimation test

We presented the post estimation test to check the presence of heteroskedasticity in the estimated EGARCH model in table 8. The p-value of the test suggest that we are unable to reject the null hypothesis of 'there is no heteroskedasticity'. In addition, the serial correlation in the error terms is also tested, and despite our best efforts, we are unable to prove that there is not a serial correlation in the series and hence cannot reject the null hypothesis. We can also confirm from the figure 6 that error terms are stationary and did not follow any time trend.

Table 8: Post estimation test of Heteroskedasticity in the error terms

Heteroskedasticity Test: ARCH				
F-statistic	0.054955	Prob. F(1,129)		0.8150
Obs*R-squared	0.055784	Prob. Chi-Square(1)		0.8133
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.020708	0.163681	6.235941	0.0000
WGT_RESID^2(-1)	-0.020623	0.087971	-0.234426	0.8150

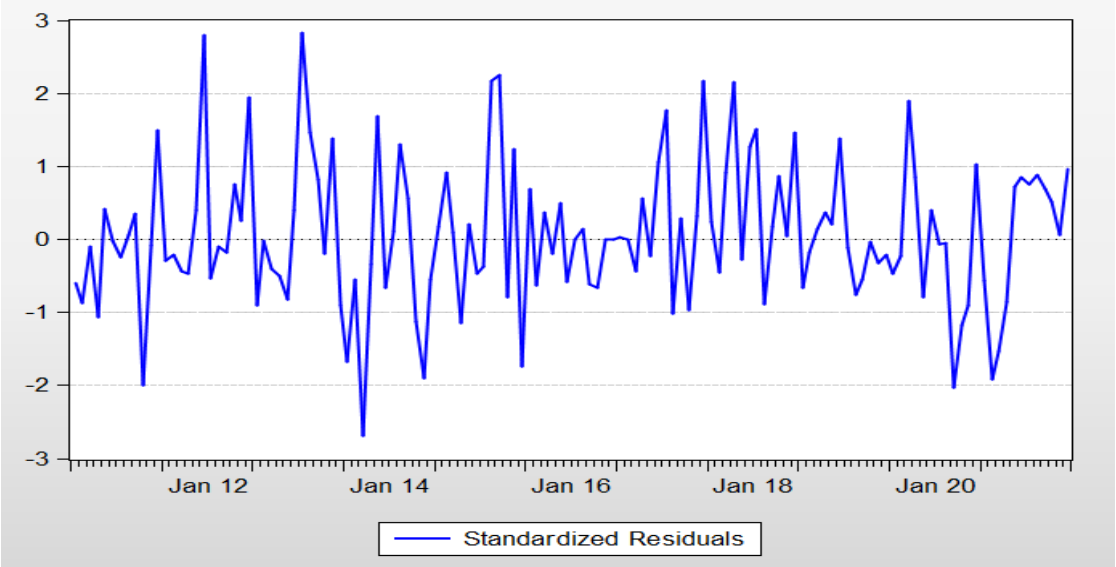

Figure 6: Error terms of the EGARCH model

5. Conclusion

The estimates of the mean equation of EGARCH model suggest that economic policy uncertainty has positive effect on the exchange rate of Pakistan. It implies that higher level of economic policy uncertainty is lead to depreciation of the local currency of Pakistan. The major economic policy of Pakistan are the monetary, fiscal, and trade policies. These policies manage the demand and maintain the demand stability in the economy by channelizing the savings and investment. However, the lack of economic policy certainty is an indicator of the risk and urged the investors to avoid the risk by diversify the portfolio investments. In the period of uncertainty, the most desirable portfolio choice is holding the foreign currency. The higher demand of foreign exchange increase the price of the foreign currency and depreciate the local currency. Moreover, the coefficient of the economic policy uncertainty in the variance equation is significantly positive. It indicates that an increase in the economic policy uncertainty scale increase the volatility in the exchange rate of Pakistan. The volatile exchange rate is a source of unstable

position of the nominal and real variable as well as worst performance of the money, capital, and forex market. It implies that in the period of higher economic policy uncertainty investor use forex as hedge against the risk which made the forex market unpredictable and unstable.

We also quantify that two major source of forex inflow named foreign debt and interest rate has a negative effect on the exchange rate of Pakistan. On the other hand, major source of forex outflow name imports has positive effect on the exchange rate of Pakistan. While remittances, exports, and large scale manufacturing has insignificant effect on the exchange rate of Pakistan. We found that economic policy uncertainty is a major source of exchange rate volatility. Moreover, foreign debt, remittances, and interest rate is also a major source of exchange rate volatility because it increase the volatility in the forex market. Amongst the said source of volatility, the effect of foreign debt on the exchange rate volatility is relatively more prominent than the other variables. Moreover, exports, imports and large scale manufacturing did not affect the exchange rate volatility. It implies that nominal variables are the major source of exchange rate volatility, while real variable did not affect the volatility. The summary of regression analysis for mean and variance equation presented in the table 9.

Table 9: Summary of the mean and variance equation results

Variable	Mean equation	Variation equation
Economic policy uncertainty	Positive & significant	Positive & significant
External debt	Negative & significant	Positive & significant
Remittances	Insignificant	Positive & significant
Interest rate	Negative & significant	Positive & significant
Exports	Insignificant	Insignificant
Imports	Positive & significant	Insignificant
Large scale manufacturing	Insignificant	Insignificant

This paper provides some policy recommendations, based on estimates, with the goals of stabilizing Pakistan's exchange rate and reducing the country's exchange rate volatility. Economic policy uncertainty is a major source of exchange rate volatility. Therefore, it need to be implement the policy consistency and stability required from by the fiscal and monetary policy developer to better the economic policy outlook. Although nominal and real variables effect the exchange rate of Pakistan. But major source of volatility is come from the nominal variables. Therefore, steps need to manage the nominal variables to reduce the exchange rate volatility. For this purpose, there is a need to stabilize the remittances, interest rate, and external debt. Steps need to undertake by the government to commence the policies to increase the inflow of forex which will ultimately lower the exchange rate volatility. Moreover, it is also required to align the inflow and outflow of the forex which is a potential source of exchange rate volatility.

References

Aghion, P., P. Bacchett, R. Ranciere, and K. Rogoff (2009), Exchange rate volatility and productivity growth: The role of financial development. *Journal of Monetary Economics, 56*(4), 494–513.

Ali, M., Shair, W., ur Rahman, F., & Naeem, S. (2021). The Relationship between Cash Flow Volatility and Dividend Payout Ratio: Evidence from Pakistan's Non-Financial Firms. *Empirical Economic Review, 4*(2), 32-48.

Ali, A, Khokhar, B. Sulehri, F. A. (2023). Financial Dimensions of Inflationary Pressure in Developing Countries: An In-depth Analysis of Policy Mix. *Journal of Asian Development Studies,* 12 (3), 1313-1327.

Arouri, M., & Roubaud, D. (2016). On the determinants of stock market dynamics in emerging countries: the role of economic policy uncertainty in China and India. *Economics Bulletin, 36*(2), 760-770.

Audi, M., Sulehri, F. A., Ali, A., & Al-Masri, R. (2022). An Event Based Analysis of Stock Return and Political Uncertainty in Pakistan: Revisited. *International Journal of Economics and Financial Issues*, 12 (5), 39-56.

Audi, M., Sulehri, F. A., Ali, A., & Al-Masri, R. (2023). The Role of Terrorist Events in Determining Stock Returns in Pakistan: Covering Most Vibrant Era 2003-2013. *Empirical Economics Letters*, 22 (7), 153-164.

Baker, S.R., Bloom, N., Davis, S.J., (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics, 131*(4), 1593–1636.

Baum, C. F., & Caglayan, M. (2010). On the sensitivity of the volume and volatility of bilateral trade flows to exchange rate uncertainty. *Journal of International Money and Finance, 29*(1), 79-93.

Beckmann, J., & Czudaj, R. (2017). Exchange rate expectations and economic policy uncertainty. *European Journal of Political Economy, 47*, 148–162.

Brogaard, J., & Detzel, A. (2015). The asset-pricing implications of government economic policy uncertainty. *Management Science, 61*(1), 3-18.

Chen, L., Du, Z., & Hu, Z. (2020). Impact of economic policy uncertainty on exchange rate volatility of China. *Finance Research Letters*, 32.

Chit, M. M., Rizov, M., & Willenbockel, D. (2010). Exchange rate volatility and exports: New empirical evidence from the emerging East Asian economies. *The World Economy, 33*(2), 239–263.

Choudhary, M. A., Pasha, F., & Waheed, M. (2020). Measuring economic policy uncertainty in Pakistan. *MPRA Paper*, pp. 1–21.

Devereux, M. B., & Lane, P. R. (2003). Understanding bilateral exchange rate volatility. *Journal of International Economics, 60*(1), 109–132.

Dong, H., Liu, Y., Chang, J., (2019). The heterogeneous linkage of economic policy uncertainty and oil return risks. *Green Finance, 1*(1), 46–66.

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, *50*(4), 987.

Grier, R., and K. Grier (2006), On the real effects of inflation and inflation uncertainty in Mexico. *Journal of Development Economics, 80*(2), 478–500

Leblang, D., & Bernhard, W. (2006). Parliamentary politics and foreign exchange markets: The world according to GARCH. *International Studies Quarterly*, *50*(1), 69-92.

Nelson, D. B. (1991). Conditional heteroskedasticity in asset returns: A new approach. *Econometrica*, *59*(2), 347. https://doi.org/10.2307/2938260

Nor, M. I. (2015). *The volatility of Somalia's unregulated exchange rates.* Universiti Sains Malaysia.

Shahzad, S.J.H., Raza, N., Balcilar, M., Ali, S., Shahbaz, M., (2017). Can economic policy uncertainty and investors sentiment predict commodities returns and volatility? *Resource Policy, 53*, 208–218.

Shair, W., & Anwar, M. (2023). Effect of internal and external remittances on expenditure inequality in Pakistan. *Cogent Economics & Finance*, *11*(1), 2178121.

Shair, W., & Majeed, M. T. (2020). Labor market outcomes of non-migrant members in response to remittances: Evidence from provincial capital of Punjab and Khyber Pakhtunkhawa (KPK). *Review of Socio-Economic Perspectives*, *5*(1), 1-22.

Shair, W., Majeed, M. T., & Ali, A. (2023). Labor participation decision and preferences towards different employment status in response to remittances in Pakistan. *Iranian Economic Review*, *27*(1), 135-152.

Shair, W., Naeem, S., & Rasul, F. (2021). Nexus Of Covid-19 News With Stock Market Returns And Volatility In Pakistan. *Bulletin of Business and Economics (BBE)*, *10*(2), 92-99.

Sulehri, F. A., & Ali, A. (2020). Impact of political uncertainty on Pakistan stock exchange: An event study approach. *Journal of Advanced Studies in Finance*, *11*(2), 194-207.

Wang, R., Morley, B., (2018). Forecasting the Taylor rule exchange rate model using directional change tests. *Quant. Finance Econ., 2*(4), 931–951.