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Exchange Rate Pass-Through to Consumer Prices in Pakistan: Using Vector Auto Regression (VAR) Approach

*Mustansar Aatizaz [*1], Shahzada Aatzaz [2], Ghazanfar Aatzaz[3] and Maliha Aitzaz[4]*

Abstract

This study attempts to examine the pass-through impact of exchange rates on consumer prices in the specific context of Pakistan. To completely assess this association, a thorough configuration of five variables was carefully picked. The dataset covers financial patterns spanning more than twenty years, from January 2000 to December 2021. With the utilization of multivariate analysis and a Vector Auto Regression (VAR) model, the analysis presents convincing fragments of the data. The data indicates that fluctuations in the exchange rate have a significant impact on the Consumer Price Index (CPI). The Impulse Response (IR) analysis incorporates this association, mirroring a positive relationship between the two variables. In like manner, Granger causality analysis reveals understanding into the sharp control of the CPI in wrapping up exchange rate shifts. Unendingly out, these revelations feature the squeezing position of the exchange rate in making feeling of expansion parts inside Pakistan's monetary scene.

Keywords

Exchange Rate Pass-Through, Consumer Price Index, Inflation, VAR.

1. Introduction

The association between exchange rates and their effect on consumer prices holds significant importance in molding powerful economic arrangements. Exchange rates decide a country's buying power, in this manner applying a direct impact on its development variables. The influence of exchange rates over homegrown prices of labor and products, which accordingly influences consumer buying power, highlights their importance. This transaction is especially obvious with regards to inflation evaluation, as stressed by A. Adeyemi (2013). The unpredictable elements of ERPT to CP are interwoven with factors like financial approach, money related strategy, and securities exchange execution, as Charles (2008) features.

* Corresponding author
[1] Department of Statistics, Allama Iqbal Open University, Islamabad, Pakistan.
Email: mustansar.aatizaz@aiou.edu.pk
[2] Department of Economics, The University of Punjab, Lahore, Pakistan.
Email: shahzadaaatzaz786@gmail.com
[3] Core Statistics Department, State Bank of Pakistan, Karachi, Pakistan.
Email: ghazanfar.aatzaz@sbp.org.pk
[4] Department of International Relations, Lahore College Women University, Lahore, Pakistan.
Email: maliha.aitzaz@lcwu.edu.pk

Understanding the significance of ERPT for a nation is fundamental in light of its extensive results across various viewpoints. ERPT gauges a country's inflation direction as well as guides choices with respect to cash supply and assesses the speed at which exchange rate impacts convert into prices. Besides, ERPT goes about as a gauge for surveying economic advancement inside an economy. In Pakistan's unique situation, the quick deterioration of its cash brings up issues about the degree to which exchange rate fluctuations influence consumer prices. Munir's exploration (2022) highlights that exchange rate appreciation will in general diminish long haul inflation, while devaluation makes the contrary difference a worry given Pakistan's ongoing situation of high inflation and significant money deterioration.

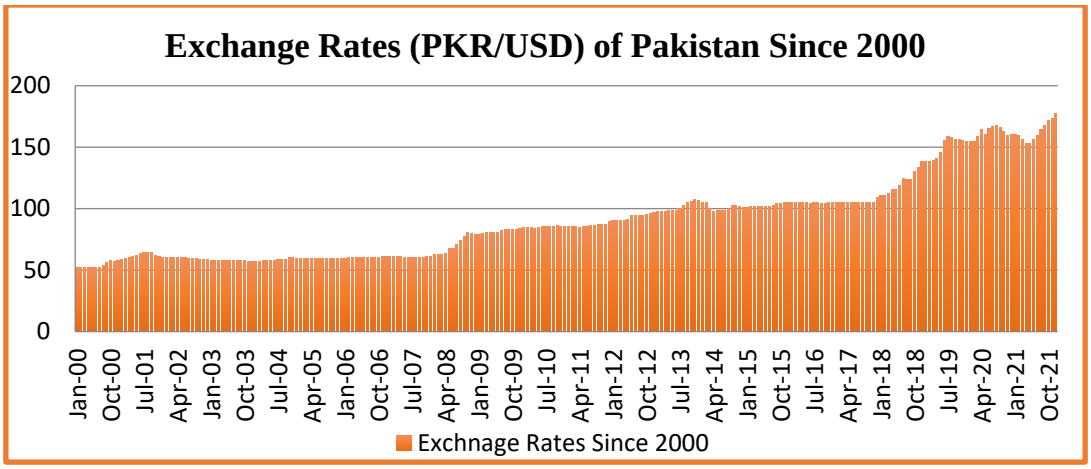

Figure 1: Pakistan's exchange rate (PKR/USD) since 2000.

As portrayed in Figure 1, the diagram illustrates the change in Pakistan's exchange rate (PKR/USD) beginning around 2000, demonstrating a noticeable pattern of deterioration over the long run. This visual brief is an investigation of the possible effect of exchange rate developments on consumer prices. Universally, an expansion in the expense of unfamiliar unrefined components affects homegrown prices, a peculiarity that the exchange rate can flag. Quiet, somewhere in the range of 1973 and 1979, unfamiliar inflation arose as an essential driver of changes in homegrown prices in a few immature Asian nations, as featured by Dowling (1983). This highlights the perplexing way one country's inflation rates can impact the homegrown valuing of another.

The current paper frames a system for breaking ERPT to CP from 2000 to 2021 utilizing the VAR model, as proposed by McCarthy (2000). As explained by Farhan Ahmed (2018), Fandamu et al. (2023) and Bhat. et.al., (2024), the linkages between exchange rates, cash supply, and markdown rates structure a complicated trap of causality forming evaluating. In Pakistan's context, these factors emerge as crucial determinants of consumer prices, rendering them integral to understanding the dynamics of the nation's exchange rate. The exchange rate's volatility over the years, particularly from 1980 to 2000, underscores its sensitivity to these factors.

To investigate the role of inflation in the developing countries, Taylor (2000) decreased the most affected factors which had a pass-through to the domestic prices of the firms. Different exchange rate factors are linked to domestic prices. It can be trade pattern, Balance of Payment (BOP) or current account balance. Although the depreciation in the

exchange rate of the country would be effective for an adjustment mechanism but it disturbs the inflation rate and other factors in the economy.

The purpose of this study is to check the impact of exchange rate on consumer prices in Pakistan, to find that which variables are affecting the exchange rate, to determine the response of variables by giving shock to the exchange rate and to investigate that which variables are helpful for the prediction of exchange rate.

2. Research methodology

To examine the ERPT to the CP, this study utilized the VAR model. The model uses a total of five variables, Exchange Rate (ER), Consumer Price Index (CPI), Foreign Exchange Stock (FOREX), Money Supply (M2), and Discount Rate (DR) respectively.

$$ER_t = \alpha_{10} + \sum_{k=1}^{k=7} \alpha_{11} logER_{t-k} + \sum_{m=1}^{m=7} \beta_{10} log_{CPI_{t-m}} + \sum_{n=1}^{n=7} \beta_{11} log_{FOREX_{t-n}} + \sum_{p=1}^{p=7} \beta_{12} log_{M2_{t-p}} + \sum_{u=1}^{u=7} \beta_{13} log_{DR_{t-u}} + \varepsilon_{1t}$$

$$CPI_t = \alpha_{10} + \sum_{k=1}^{k=7} \alpha_{21} logER_{t-k} + \sum_{m=1}^{m=7} \beta_{20} log_{CPI_{t-m}} + \sum_{n=1}^{n=7} \beta_{21} log_{FOREX_{t-n}} + \sum_{p=1}^{p=7} \beta_{22} log_{M2_{t-p}} + \sum_{u=1}^{u=7} \beta_{23} log_{DR_{t-u}} + \varepsilon_{2t}$$

$$FOREX_t = \alpha_{10} + \sum_{k=1}^{k=7} \alpha_{31} logER_{t-k} + \sum_{m=1}^{m=7} \beta_{30} log_{CPI_{t-m}} + \sum_{n=1}^{n=7} \beta_{31} log_{FOREX_{t-n}} + \sum_{p=1}^{p=7} \beta_{32} log_{M2_{t-p}} + \sum_{u=1}^{u=7} \beta_{33} log_{DR_{t-u}} + \varepsilon_{3t}$$

$$M2_t = \alpha_{10} + \sum_{k=1}^{k=7} \alpha_{41} logER_{t-k} + \sum_{m=1}^{m=7} \beta_{40} log_{CPI_{t-m}} + \sum_{n=1}^{n=7} \beta_{41} log_{FOREX_{t-n}} + \sum_{p=1}^{p=7} \beta_{42} log_{M2_{t-p}} + \sum_{u=1}^{u=7} \beta_{43} log_{DR_{t-u}} + \varepsilon_{4t}$$

$$DR_t = \alpha_{10} + \sum_{k=1}^{k=7} \alpha_{51} logER_{t-k} + \sum_{m=1}^{m=7} \beta_{50} log_{CPI_{t-m}} + \sum_{n=1}^{n=7} \beta_{51} log_{FOREX_{t-n}} + \sum_{p=1}^{p=7} \beta_{52} log_{M2_{t-p}} + \sum_{u=1}^{u=7} \beta_{53} log_{DR_{t-u}} + \varepsilon_{5t}$$

The above model specified that, how exchange rate is affecting due to the variability of the other variables and how this is impacting consumer prices. This model indicated that, which factors should be controlled for the appreciation of the exchange rate to control the increasing domestic prices. A total of seven lags and Log of the variables have taken to avoid the instability of the model.

3. Data sources and selection of variables

The data used in this study is monthly from January 2000 to December 2021. Thus, given us a total of 264 observations. The data were obtained from the website of State Bank of Pakistan (SBP) except CPI and DR while the data for the variables Consumer Price Index (CPI) and Discount Rate (DR) were obtained from the International Financial Statistics (IFS) of International Monetary Fund (IMF).

4. Empirical analysis

4.1 Descriptive statistics

Descriptive of Statistics are computed of 264 observations and results are summarized in Table 1. Mean shows the average values of the data set. The average value of the ER is 4.448054. The median of the ER and CPI is 4.44 and 4.56 respectively, which are very close to each other. The standard deviation 0.344 indicates the dispersion of ER with its mean. DR has a minimum standard deviation which is 0.2513. The skewness is a statistical measure which measures the asymmetry of the distribution. There will be exceptionally slanted conveyance on the off chance that the worth of the skewness is more noteworthy than 1 or not exactly - 1. It will be decently slanted assuming the worth of the skewness is somewhere in the range of 0.5 and 1 or - 0.5 and - 1. Also, it will be symmetric assuming that it is between - 0.5 and 0.5. As per the above expressive measurements the skewness worth of the trauma centre 0.388 shows that the circulation is symmetric. While the circulation of the CPI is respectably slanted.

Table 1: Smarmy statistics.

Variable	Mean	Median	St. dev.	Minimum	Maximum	Skewness	Obs.
LN ER	4.4480	4.4493	0.3457	3.9468	5.1771	0.3883	264
LN CPI	4.5680	4.6669	0.5262	3.7632	5.4551	-0.1214	264
LN FOREX	9.4767	9.5763	0.5460	7.7714	https://doi.org/10.196	-1.7532	264
LN M2	15.593	15.646	0.8568	14.089	17.048	-0.1297	264
LN DR	2.2547	2.2512	0.2513	1.8325	2.7080	-0.0238	264

5. Unit root test

To check the stationarity of the variables, both ADF and PP unit root tests (A. Farhan, 2013) were applied. The below unit root results are showing that all the variables ER, CPI, FOREX, M2 and DR are stationary at first difference and the order of integration is I(1).

Table 2: Results of Unit root test.

	LEVEL		FIRST DIFFERENCE		
Variable	ADF	PP	ADF	PP	Comment
LN ER	0.8336	0.7974	0.0000*	0.0000*	I(1)
LN CPI	0.7566	0.8150	0.0000*	0.0000*	I(1)
LN FOREX	0.3563	0.3118	0.0000*	0.0000*	I(1)
LN M2	0.4178	0.3118	0.0000*	0.0000*	I(1)
LN DR	0.3563	0.3118	0.0000*	0.0000*	I(1)

6. VAR stability test

It has observed from Figure 2 that the roots of AR process are inside the unit circle, which showed that the model is stationary.

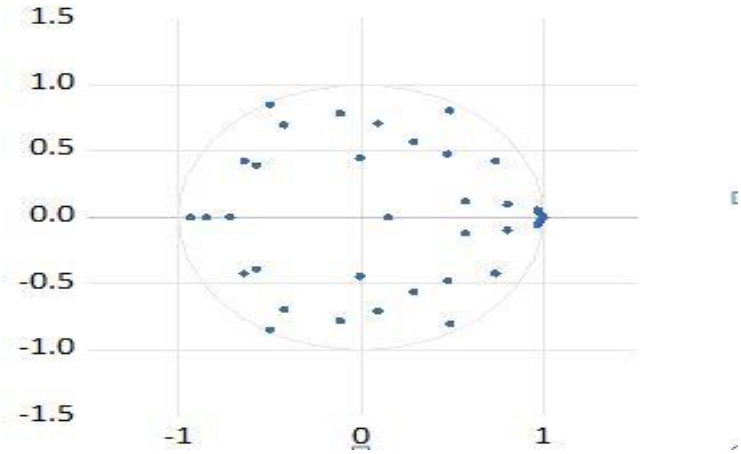

Figure 2: VAR stability condition.

7. VAR estimation results

The vector auto regression has estimated by Ordinary Least Square (OLS) method. There is total five equations of this method. The results are showing the values of coefficient, standard error, t - statistics and P-Values. The c values are showing the constants. The results of Table 3 shows that CPI has significance relation ER at 3rd lag, with FOREX at 3rd, 4th, and 7th lag and with M2 at 4th, 6th and 7th lag.

Table 4 reveals a significant relationship between the ER and CPI at the first lag. Furthermore, it indicates significant correlations between Foreign Exchange (FOREX) and ER at the 2nd, 3rd, and 5th lags. ER exhibits a positive relation with all variables across different lags, a trend supported by P-values below 5%.

Continuing to Table 5., it showcases relationship dynamics. Specifically, FOREX maintains a significant connection with ER at the 1st lag, with M2 at the 1st lag, and with DR at the 6th and 7th lags. The findings in Table 6. highlight that M2 shares a significant relation with FOREX at the 5th lag and with CPI at the 6th lag. Finally, Table 7. Underscores that DR has a noteworthy relationship with CPI at the 1st lag and with FOREX at the 6th lag.

Table 3: Dependent variable: CPI.

	Coefficient	Std. Error	t-Statistic	Prob.
LER(-3)	-0.006374	0.065006	-0.098049	0.0152
LFOREX(-3)	0.033897	0.010942	3.097762	0.0020
LFOREX(-4)	-0.030860	0.011138	-2.770613	0.0057
LM2(-4)	0.112282	0.040177	2.794679	0.0053
LFOREX(-7)	0.018067	0.008294	2.178246	0.0296
LM2(-7)	0.122483	0.041068	2.982428	0.0029

Table 4: Dependent variable: ER.

	Coefficient	Std. Error	t-Statistic	Prob.
LCPI(-1)	0.264003	0.113156	2.333082	0.0198
LFOREX(-2)	0.063725	0.018406	3.462213	0.0006
LFOREX(-3)	-0.023024	0.018910	-1.217559	0.2237
LM2(-4)	-0.114484	0.069432	-1.648855	0.0995
LDR(-4)	-0.065495	0.029620	-2.211196	0.0272
LFOREX(-5)	-0.038120	0.019352	-1.969796	0.0491

Table 5: Dependent Variable: FOREX.

	Coefficient	Std. Error	t-Statistic	Prob.
LER(-1)	-0.840992	0.347785	-2.418134	0.0158
LM2(-1)	-0.303153	0.335333	-0.904037	0.3662
LDR(-6)	0.306022	0.149995	2.040215	0.0416
LDR(-7)	-0.281394	0.104940	-2.681465	0.0074

Table 6: Dependent Variable: M2.

	Coefficient	Std. Error	t-Statistic	Prob.
LFOREX(-5)	0.036671	0.017130	2.140658	0.0325
LCPI(-6)	-0.425242	0.150795	-2.819994	0.0049

Table 7: Dependent Variable: DR.

	Coefficient	Std. Error	t-Statistic	Prob.
LCPI(-1)	1.649268	0.368408	4.476743	0.0000
LFOREX(-6)	0.156455	0.063168	2.476787	0.0134

8. Impulse response

The concept of impulse response is used to study the dynamic effects of shocks or changes in the economy. The impulse response function (IRF) helps economists and researchers understand how a particular economic variable responds to a one-time shock or change in another variable. Here's how impulse response is used in economics.

The black line displayed in Figure 3 represents the Impulse Response Functions (IRFs), offering insights into how various variables respond when subjected to a shock in the Exchange Rate (ER). Below, we delve into the specifics of these variable responses.

The visual depiction highlights a positive response in the Consumer Price Index (CPI) following an ER shock. Initially, CPI remains steady at 0.001, subsequently experiencing an increase up to 0.002 by the 4th period and maintaining stability through the 12th period. This pattern indicates that the CPI grows in response to a single impulse in the exchange rate. Notably, the Exchange Rate has a 100% positive impact on the Discount Rate (DR), leading to an increment from 0.01 to 0.05.

In contrast, the response of Money Supply (M2) reflects a decline in negative values. Triggered by the ER shock, M2 initially rises from 0.000 to 0.001, but then consistently decreases, reaching a negative value of -0.001 by the 4th period. Subsequent periods continue to exhibit fluctuating negative values. As for Foreign Exchange (FOREX), its response initiates with a descent from the first period, starting at 0.00 and continuing until the 6th period with a negative value of -0.04, followed by an upward shift.

Throughout these responses, it becomes evident that CPI is the most influential variable, displaying a consistent positive impact from the beginning to the end. This observation suggests a pronounced Exchange Rate Pass-Through (ERPT) effect on consumer prices, indicating a strong linkage between ER and CPI.

9. Variance decomposition

We can utilize change decay to investigate the general commitment of the shocks in making sense of Pakistan's shopper costs. Table 8 reveals that money supply shocks contribute relatively more than the discount rate of the country. While discount rate also more contributing than the foreign exchange stock with 3 percent. And the more contribution is happening due to the exchange rate than the other variable shocks. So, it's basically concluding that the consumer prices are prejudiced by the ER changes. And also here is need to adopt more efficient monetary policy as discount rate is also contributing more than the foreign exchange stock and money supply. Variance Decomposition will help to summarize our remarks that exchange rate has been considered major affecting factor. The graphical representation of the variance decomposition is shown in Figure 4.

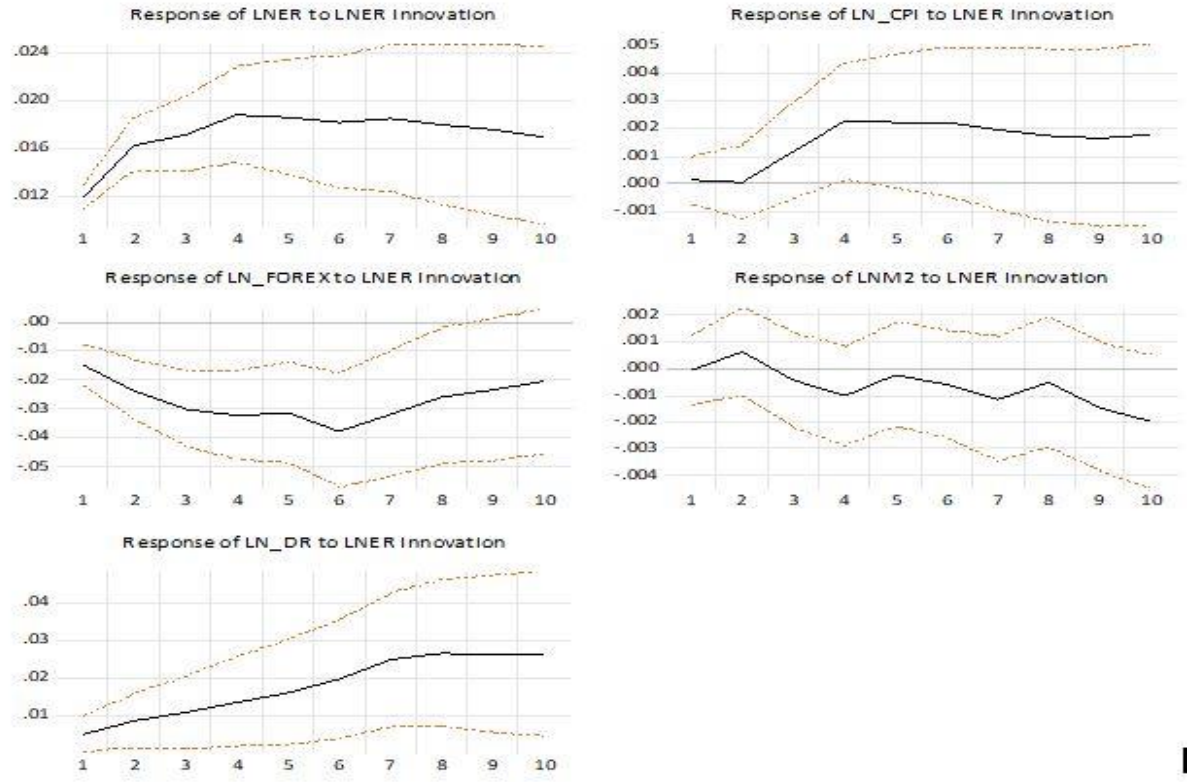

Figure 3: Response of the variables.

Table 8: Statistics of Variance decomposition.

Period	S.E	LN_CPI	LN_ER	LN_FOREX	LN_M2	LN_DR
1	0.0068	100.0000	0.0000	0.0000	0.0000	0.0000
2	0.0103	99.7426	0.0063	0.0050	0.0140	0.2318
3	0.0133	98.6293	0.5695	0.3175	0.0402	0.4432
4	0.0161	97.0347	2.0404	0.2257	0.0506	0.6483
5	0.0185	95.4576	2.8096	0.2254	0.5647	0.9425
6	0.0205	93.7188	3.3088	0.5534	1.2591	1.1596
7	0.0220	92.3874	3.5494	1.5859	1.1082	1.3688
8	0.0233	91.3654	3.6341	2.2029	1.0463	1.7510
9	0.0245	90.0622	3.6690	2.7588	0.9646	2.5452
10	0.0257	88.5171	3.7586	3.0691	0.8887	3.7663

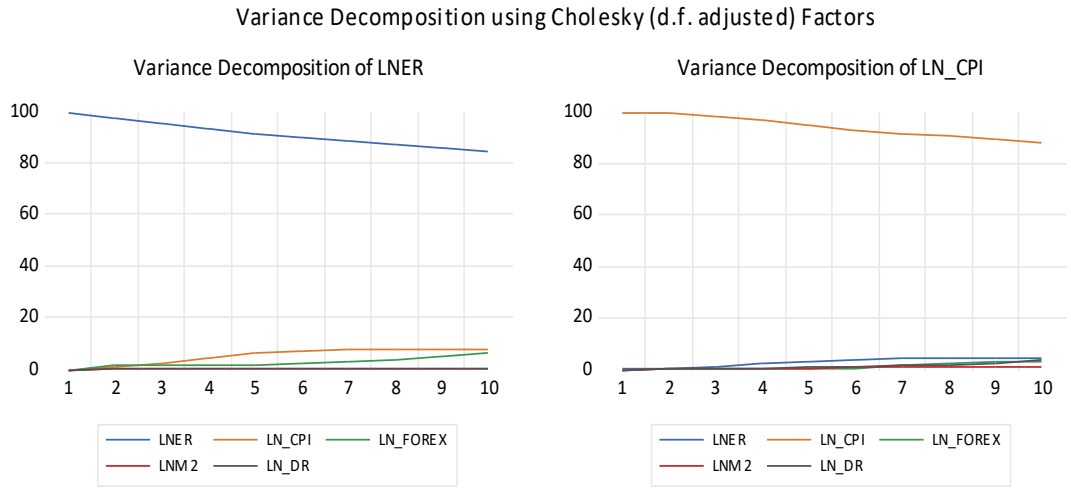

Figure 4: Variance decomposition.

10. Conclusion and policy recommendations

This study conducts a comprehensive analysis of Pakistan's exchange rate and its connection to key economic variables—Exchange Rate (ER), Consumer Price Index (CPI), Foreign Exchange (FOREX), Money Supply (M2), and Discount Rate (DR) covering the period from 2000 to 2021. Secondary data was sourced from the State Bank of Pakistan (SBP) and the International Financial Statistics (IFS) of the International Monetary Fund (IMF). The primary aim was to assess the impact of exchange rate fluctuations on consumer prices using a VAR approach, supported by graphical and tabular presentations.

The findings reveal a positive effect of ERPT changes on CP in Pakistan, in line with earlier research (Adeyemi et al., 2013). The study underscores the significant impact of ER shocks on the CPI, highlighting a consistent positive retort of CPI to ER impulses. Remarkably, cash deterioration will in general drive expansion inside the country. Furthermore, CPI arises as a prescient pointer for exchange rate developments, with FOREX and M2 being crucial givers. Granger causality tests insist that all factors can anticipate exchange rate vacillations. Variance Disintegration analysis further demonstrates the broad effect of exchange rate improvement on CPI fluctuation, while

M2 expects a basic part in exchange rate improvement. The audit uncovers understanding into the intertwined components of exchange rates and consumer prices, maintaining for strong cash related ways to deal with manage ER weakening and its inflationary outcomes.

11. Limitations

The VAR approach in analysing ERPT to CP in Pakistan faces imperatives due to assumptions of stationary time series data. It could ignore nonlinear associations and basic changes, reducing its ability to get complicated components definitively.

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