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Research Paper

Exchange Rate Pass-Through to Consumer Prices in Pakistan: New Evidence from a VAR Analysis (2013-2023)

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Executive Summary

Exchange Rate Pass-Through (ERPT) refers to the degree to which changes in the exchange rate (ER) affect domestic prices of an economy. Since Pakistan's economy has a considerable level of openness to international trade, the domestic price level is sensitive to external price shocks. A change in the ER can lead to either the appreciation or depreciation of the Pakistani Rupee (PKR). This shift, in turn, affects the prices of imported goods and consequently influences domestic prices in Pakistan.

Globally, the relationship between ER and the inflation rate remains a topic of debate. ERPT is low in developing countries but high in developed ones. Despite a considerable openness to international trade, there is limited empirical literature on how ER fluctuations affect domestic prices in Pakistan.

This Paper employs McCarthy's (2000) recursive VAR to investigate the degree of ERPT in Pakistan. The impulse response functions (IRFs) were generated to quantify the degree of an ER shock on domestic prices. The IRFs indicate that:

(i) The ER movements affect domestic prices, or, in other words, ERPT exists.

(ii) The pass-through to domestic prices exists over a year. However, it is low in the first four months.

Recommendations

The SBP may

Design and implement a formal ERPT monitoring framework that distinguishes between inflation from ER movements and domestic supply or demand shocks.

Utilise forward-looking macro-risk VAR models to regularly provide ERPT statistics and insights that inform policy responses and market expectations, while enhancing transparency and improving the effectiveness of monetary policy.

Maintain a monetary policy that allows the economy to absorb short-term ER shocks, serving as a buffer against external volatility and preventing excessive distortions in trade and investment flows.

1. Introduction

Exchange rate (ER) fluctuations play a significant role in shaping domestic price dynamics, particularly in economies with a high degree of openness to foreign trade[1]. In such economies, small changes in ER can lead to subsequent shifts in the prices of imported goods. As a result, these fluctuations can have a cascading effect on inflation and the cost of production.

Since Pakistan Economy also has a considerable level of openness to international trade, the domestic price level cannot remain immune to any external price shock. A significant change in the ER can lead to either the appreciation or depreciation of the PKR. This subsequently causes fluctuations in the ER and, therefore, results (both directly and indirectly) in variations in the prices of imported finished products or inputs (see Figure 1).

Despite considerable openness to international trade, there is limited empirical literature on the degree or extent to which ER fluctuations affect domestic prices within the country. Globally, the relationship between ER and the inflation rate remains debated. The ERPT is low in developing countries, while it is high in developed countries. In this context, exploring the ERPT becomes critical.

This Paper assesses the magnitude of the ER changes affecting domestic prices or the ER pass-through (ERPT) to domestic prices in Pakistan. Specifically, this Paper focuses on CPI inflation by analysing data from January 2013 (2013:M1) to December 2023 (2023:M12). The paper employs McCarthy's (2000)[2] recursive VAR methodology, which provides a standard for tracking the ERPT. After estimating the VAR model, we generated impulse response functions (IRFs) to assess the impact of an exchange rate (ER) shock on domestic prices. Subsequently, this paper analysed domestic price fluctuations. The IRFs reveal that: (i) ER movements influence domestic prices, indicating the existence of ERPT; (ii) although the effects of this pass-through persist for over a year, they are minimal during the initial four months.

[1] *Meraj (2024). The impact-ER-fluctuations on Pakistan's economic landscape. Journal of Development and Social Sciences,5(1), 211-223.*

[2] McCarthy (2000). Pass-Through of ER & Import Prices to Domestic Inflation, FED of New York. Report No. 111.

ERPT: Conceptual Understanding

In general, when depreciation occurs, i.e., the cost of imported goods rises, businesses/firms might choose not to immediately raise their prices in the expectation that the depreciation is temporary. They absorb the cost increase by reducing their profit margins and avoiding the hassle and cost of changing prices. They do this because they expect the currency to recover soon (a temporary depreciation).

But if firms anticipate that the depreciation is going to last a long time (i.e., it's permanent), then they raise prices to cover their higher costs. In countries with high inflation, these kinds of persistent shocks are more common, hence their firms are quicker to pass cost increases onto This phenomenon is known as "exchange rate pass-through" or ERPT. Therefore, higher inflation makes firms more likely to raise prices in response to currency depreciation because they expect those cost increases to stick around.

Likewise, when the PKR depreciates, it results in higher imported prices. Since Pakistan is primarily dependent on imports, potentially higher costs of imported raw materials/capital goods are related to consistent depreciation of the PKR. This increases the costs and leads to higher prices for domestic produced goods. In the case of direct channels, ER movements influence domestic prices when there are such changes in the price of imported finished goods and imported inputs. ER depreciation indirectly affects net exports, which increases aggregate demand and causes an upward shift in domestic prices. Moreover, as the prices of imported goods rise, local manufacturers raise their prices for their profit margins. Nevertheless, besides the impact of ER depreciation, this effect on ERs is influenced by multiple factors viz. market structure, pricing strategies, the overall inflation, the involvement of non-tradable goods in the distribution of tradables, and the relative proportional share of imports within the WPI/CPI baskets.

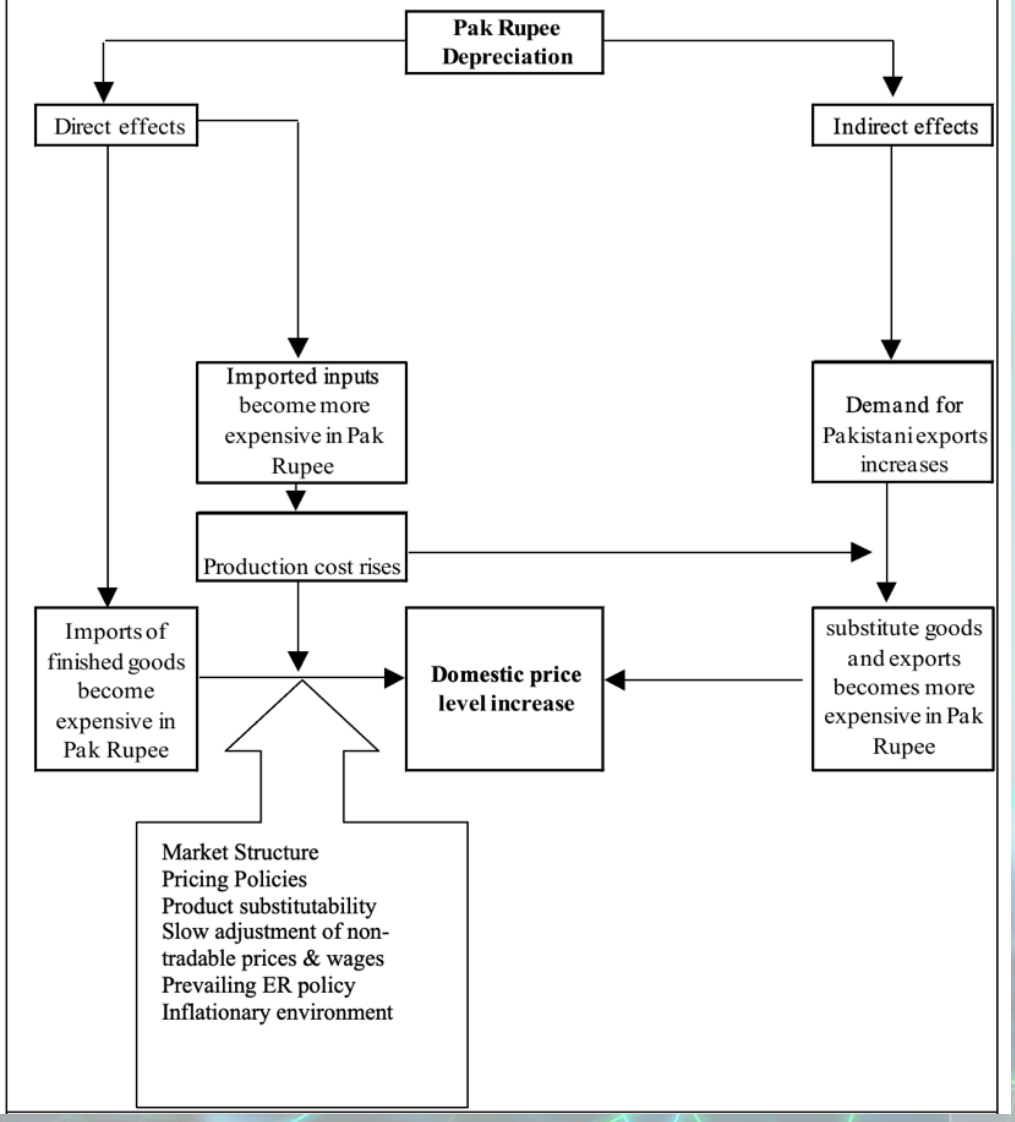

Figure 1: ERPT Conceptual Understanding

Source: Hyder (2004) [3]

Rest of this Paper is structured as follows. The next-section reviews the ERPT literature/studies. Section 3 discusses the VAR methodology used, the data coverage, as well as its sources. The results of the impulse responses or IRFs are presented in Section 4. Section 5, finally, concludes the Paper.

[3] Hyder (2004). Exchange Rate Pass-Through to Consumer Prices in Pakistan. State Bank of Pakistan.

2. Review of Literature

There exists an ample amount of theoretical as well as empirical literature on ER Pass-Through or ERPT to domestic prices. However, much of the literature is in regard to advanced economies. There is a dearth of literature on ERPT in developing countries like Pakistan.

The existing literature on ERPT can be categorised into multiple groups. The first category includes studies that analyse ERPT in import prices across some particular industries [e.g., (Goldberg, 1995) (Feinberg,1989)]. The second group consists of research investigating ERPT into cumulative import prices (e.g., Hooper (1989), Campa (2002)). Finally, the third category examines ERPT in micro or WPI & CPI. Examples includes, McCarthy (2000), Kim (1998), Papell (1994), Heng (1999), and Villavicencio (2019).

Rehana and Naeem (1999) explored the impact of imported inflation on changes in monetary variables from 1972 to 1998. They use the Johanson cointegration test to assess the causal relationships between ERs and domestic prices. However, their study does not reveal any significant unidirectional/bidirectional causal impacts.

Likewise, Etzaz (1999) analyses the correlation between domestic price levels and nominal ER in pakistan. The study focuses on multiple economic indicators using quarterly data from the second quarter (Q2) of 1982 to the fourth quarter (Q4) of 1996. The cointegration method was used to evaluate how the multiple variables adjust in response to multiple price shocks.

Nasim (1997), likewise, analyses data from 1974 to 1994 to explore the significant factors affecting inflation in Pakistan. The price equation used for estimation is based on a general AR framework that illustrates the overall price level as a weighted average of tradable and non-tradable prices. The study finds that M2 and the rise in foreign prices are the key determinants of inflation in Pakistan. It shows that an increase in foreign prices results in increase in price level in the SR. In the LR the effect is meagre.

Hasan (1995) also analyses the significant factors affecting WPI inflation in Pakistan. However, the study estimates separate VAR equations for food, raw materials, and manufactured goods. The findings suggest that the leading factors contributing to

inflation in Pakistan are increases in the procurement price of wheat, administered prices, and external prices viz. oil.

Villavicencio (2019) estimated the effects of inflation targeting (IT) in the ERPT for a large sample (or panel) of countries. It finds that older regimes, adopting a range or point with a tolerance/acceptance band and keeping the inflation rate close to the target, outperform IT regimes of other countries. It also shows that IT is effective even with a relatively high inflation target/low central bank/state/fed independence.

Shahzad (2019) contributes to the literature on ERPT using monthly inflation data in Pakistan, covering the period from June 2007 (2002:M5) to June 2018 (2018:M5). The study uses a new PBS-based base year of 07-08. The empirical findings of Shahzad (2019) illustrate that factors like ER fluctuations, output gap, global energy inflation, and lagged inflation have a significant effect on monthly IR in Pakistan. Specifically, the study quantifies the short-run and long-run ERPT rates at 0.16 and 0.42, respectively. It shows that a 1% depreciation of the PKR against the US dollar results in an increase of 0.16% in monthly inflation in the SR and 0.42 % in the LR.

However, according to Shah (2025), the effect of ER is dynamic and evolves with changes in a country's economic fundamentals. The literature also suggests that it depends on multiple factors, such as market structure, pricing policies, and the overall inflationary environment. This impact fluctuates over time and across different contexts. This Paper investigates the degree of ER changes that affect domestic prices, known as ERPT, in Pakistan. Since the current economic landscape with rising inflation, shifts in fiscal policies, and fluctuations in foreign investment have a likely impact on the ERPT.

3. Methodology

To examine the ER pass-through (ERPT) to domestic prices, this Policy Paper employs a recursive VAR (Vector Autoregressive) model developed by McCarthy in 2000. A mathematical depiction of the VAR model is provided hereunder:

$Y_t = B_1 Y_{t-1} + \ldots + B_k Y_{t-k} + \varepsilon_t$ (1)

Y_t **:** endogenous variables.

B_1 **:** coefficient matrices for lag *i*

ε : a white noise error term (means it is random and not affected by past error terms).

t : time period (from 2013-2023).

A relationship in a VAR system can be estimated using the usual OLS (Ordinary-Least-Squares) method. For the VAR model of this Paper, the selected variables are oil Imports, CPI, PMP, and Exchange Rate (ERD).

In a VAR model, a lag represents the time delay between a change in one variable and its impact on another. This time delay highlights that economic variable, like inflation or ER, do not react immediately. Their effects unfold over time. The duration of this delay is often expressed in terms of months, years, or quarters or in simple lags.

Moreover, statistical significance and shock patterns in a VAR model are observed through Impulse Response Functions (IRFs). IRF is used to show how one variable impacts the other if there is a shock in a variable. The IRFs are derived using Cholesky decomposition. Cholesky decomposition essentially breaks down the collective movements of variables into distinct, individual shocks sequentially. This method is based on a recursive assumption that enforces zero restrictions on the simultaneous correlation of residuals. This shows that in such movements, certain variables cannot affect others. For instance, a change in local prices in Pakistan cannot impact international oil prices. This objective can also be achieved using the SVAR model. In the SVAR model, restrictions (a change in one variable cannot impact other variables) are imposed on such relationships.

However, in the recursive VAR system, the ordering of the variable performs a similar purpose. That is to say, a shock on the last ordered variable (for instance, CPI) does not contemporaneously affect the previous variables (consider the example of the

world oil prices). This also makes the ordering of the variables crucial in a recursive VAR system[4]. A recursive VAR can be estimated with multiple orders of variables.

The IRF, however, demonstrates this effect over time/months (or as stated over lags). In order to determine the respective IRFs, the following ordering for the IRF is used in this Paper:

Π oil $\rightarrow$ Δy $\rightarrow$ Δe $\rightarrow$ ΠCPI

It is worth noting that McCarthy (2000) and others employed a different ordering, presuming a reactive behaviour of the economy. Nevertheless, based on the monetary school of thought, this Paper argues that the position of ER is prior to prices. Considering the long and variable lags in the effects of monetary policy in Pakistan, the CPI typically responds to earlier variables rather than the opposite. In this regard, it is logical to take into account ER, oil prices, and production before considering prices. However, this Paper does not identify any significant changes in its results when a VAR model with a different ordering of variables was employed.

In a VAR model, the Schwarz Bayesian Criterion (SBC) is used to select the lower or minimum lag length of variables. The Akaike Information Criterion (AIC) is used to select the upper or maximum lag length of variables. For instance, a lower AIC value at lag 2 indicates that, with the addition of one more lag, the model's fitness remains unchanged and vice versa. This determines the model's reliability. If SBC favours the selection of lag 1, it means that employing just one lag does not outweigh the improvements in the model's fitness.

The intuition behind the selection of the optimal lag length of the recursive VAR model is that the lag length should be long enough such that there is no autocorrelation in the errors; they are white noise, and long enough to allow VAR estimation. Based on the AIC and SBIC lag length criteria, 3 lag lengths are chosen for this study. The autocorrelation LM test is used to test the autocorrelation. Ideally, the autocorrelation LM test, with a p-value greater than 0.05, is used to assess the overall goodness of the model.

[4] Ordering tells about which variable impact what variable–that is, a shock or change on the last putted variable does not necessarily/contemporaneously affect the other or previous variables.

A potential critical issue with ER and inflation analysis is that reverse causation may influence some of the associations between ER and economic variables. ER can influence and be influenced by fluctuations in ER's lagged/past values and other financial variables. However, multiple empirical studies employed CLRMs (such as weighted OLS and instrumental variables). Nonetheless, the validity of such regression models is often debated (see Mankiw, 1995). The use of VAR and additional limitations of traditional models are discussed in Asteriou, D., & Hall, S. G. (2021).

This paper focuses on overall ER movements–that is, the aggregate inflation rather than micro-level or commodity-specific ERPT. The aim is to capture broader macroeconomic trends relevant for policy, ER in particular. It does not focuses on the volatile item-level price fluctuations.

Data Description

The Data that is used in the study is monthly and ranges from January 2013 (2013:M1) to December 2023 (2023:M12), giving a total of 132 observations. 132 observations are enough to estimate a VAR model since they are more than the number of parameters required in this study. The number of observations should be greater than the number of coefficients. Having more observations means that there are more reliable estimates–that is, having enough equations to solve for all the unknown parameters. The source of the data for all variables is the SBP Statistical Bulletin and the IFS.

Nevertheless, in multivariate models, stationarity is an essential/prerequisite characteristic. However, Christopher A. Sims (1980) argues that stationarity is not a strict requirement when the primary objective is not forecasting. This paper does not aim to forecast the ER series or any other[5]. Hence, it doesn't examine the stationarity characteristics of the data or discuss differencing of the data–that is, it is I(0) or I(1).

4. Empirical Results

This section provides the results of the Paper. The following Figure 2 shows the results

[5] This discussion and the rest of the VAR model discussions are based on Christopher A. Sims (1980). https://www.jstor.org/stable/pdf/1912017.pdf?refreqid=fastly-default%3A9e4494f1965d89c32033284a26ccc743&ab_segments=&initiator=&acceptTC=1

of the VAR model using IRF. Table 2 reports the Impulse Responses of ER to One SD Innovations in the VAR System (Cholesky Decomposition). A detailed cumulative pass-through of long-term inflationary effects is presented below to explore the cumulative pass-through and capture the total and lagged (delayed) impact of ER shocks on CPI over time (Table 1).

Table 1: Cumulative response of CPI to structural one SD innovations to ER

Period	CPI Response	Cumulative CPI Response
1	0.000	0.000
2	1.006	1.006
3	0.705	1.711
4	0.621	2.332
5	0.744	3.076
6	0.689	3.765
7	1.143	4.908
8	1.069	5.977
9	0.553	6.530
10	0.630	7.160
11	0.539	7.699
12	0.521	8.220
13	0.827	9.047
14	0.586	9.633

Source: Author's

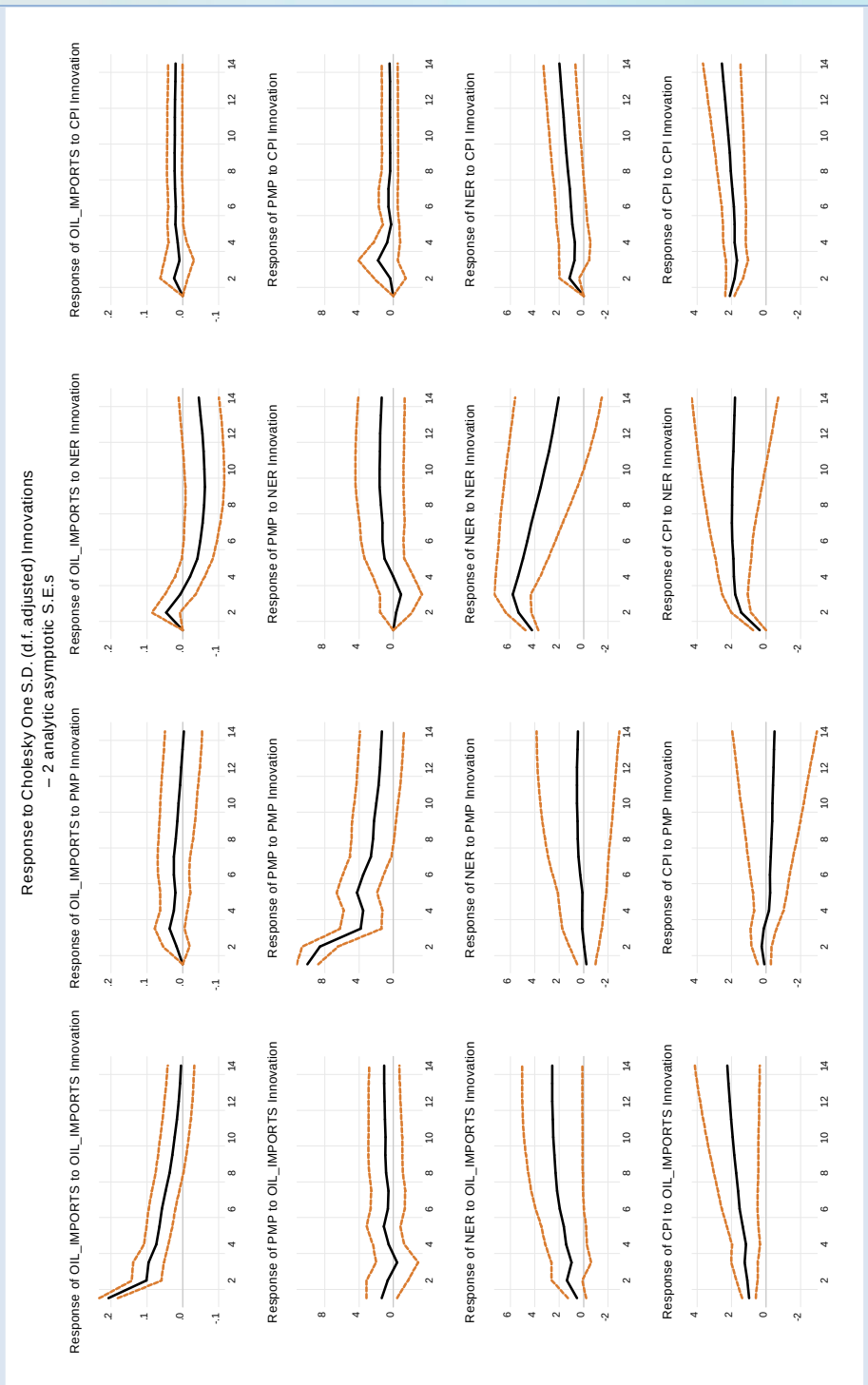

Figure 2: Impulse Responses of Domestic Prices to One Standard Deviation Shock in ER ±2*S.E.

Source: ***Author's, based on the VAR model***

Table 2: Impulse Responses of Exchange Rateto One SD Innovations in the VAR System (Cholesky Decomposition)*				
Period	**OIL_IMPORT**	**PMP**	**ER**	**CPI**
1	0.544	-0.222	4.23	0
	[0.374]	[0.128]	[1.020]	[0.000]
2	1.367	-0.041	2.552	1.006
	[0.627]	[0.302]	[0.596]	[0.399]
3	0.95	0.186	0.576	0.705
	[0.966]	[0.560]	[0.363]	[0.373]
4	1.44	1.82	0.319	0.621
	[1.084]	[1.035]	[0.377]	[0.724]
5	0.685	0.496	0.571	0.744
	[1.307]	[1.103]	[0.524]	[0.829]
6	0.918	0.128	1.614	0.689
	[0.952]	[0.295]	[0.500]	[0.613]
7	0.168	0.224	2.048	1.143
	[1.158]	[0.481]	[0.581]	[0.621]
8	2.299	-0.143	1.894	1.069
	[0.594]	[0.740]	[0.469]	[0.659]
9	1.153	0.149	1.263	0.553
	[0.824]	[0.307]	[0.396]	[0.626]
10	0.217	-0.43	1.57	0.63
	[1.169]	[0.480]	[0.509]	[0.533]
11	2.182	0.158	1.916	0.539
	[1.146]	[0.458]	[0.539]	[0.604]
12	1.708	0.168	1.755	0.521
	[1.232]	[0.511]	[0.647]	[0.692]
13	2.291	1.551	2.226	0.827
	[1.253]	[1.659]	[0.797]	[0.719]
14	2.563	1.465	2.568	0.586
Source: Author's				
***The brackets show the standard errors (S.E)**				

5. Discussion:

Figure 2, Table 1, and Table 2 show that the effect of an ER shock exists in Pakistan. It does not die out. However, the significance of these results is important to show that the results are reliable and not due to chance or error. A common rule of thumb for

assessing the statistical significance of impulse response (IRF) results is that the estimated response/coefficient should be greater than two times its SE (in absolute value).

Likewise, in graphical representations, the confidence band should not intersect the zero line. In both cases, the responses are considered significantly different from zero at the 95% confidence level, or the results are considered reliable (Hamilton, 1994)[6].

The results of this paper are consistent with Choudhri & Hakura (2021) and Eatzaz (1999). However, the responses are more pronounced because the Pakistan economy has a significantly greater level of openness to international trade compared to its past. The ERPT in Pakistan has historically been low in the short term due to rigid pricing behaviour, delayed adjustment mechanisms in wholesale and retail markets, and limited integration with global value chains compared to more open economies.

Prices in Pakistan respond to price shocks that come from outside Pakistan. A change in the ER result in the appreciation or depreciation of the PKR, which consequently leads to fluctuations in the ER and, hence, results (both directly and indirectly) in variations in the prices of imported final/finished products and imported inputs. This, as a result, influences the cost of the finished goods. Specifically, the ER trends affect domestic-prices.

In Pakistan, the initial response of the CPI to ER shocks is limited. The ERPT to domestic prices happens with a delay of at least one month due to the significant portion of locally traded goods in the CPI basket, such as wheat, sugarcane, cotton, and energy. Government procurement and administrative pricing strategies often control the prices of these goods. In the CPI basket, these goods play a more significant role and have a greater weight in determining the value of the overall index. These goods include food, transport, and housing. Hence, they are less affected by changes in the ER. As a result, a depreciation of the currency does not instantly pass through to consumer prices.

The impact of oil imports (a key exogenous factor) on CPI and PMP is more pronounced. Oil price shocks generate cost-push inflationary pressures, driving up consumer prices while simultaneously exerting downward pressure on manufacturing activity. This shows Pakistan's vulnerability to global commodity prices. It emphasises the need for energy

[6] James Douglas Hamilton (1994). Time Series Analysis. Princeton University.

diversification to stabilise both inflation/CPI. The effect of domestic demand (proxied by PMP) on inflation is present; however, it is moderate, suggesting that while demand-pull inflation exists, cost-push factors, particularly those linked to energy imports, remain more dominant. This is due to energy contracts that reduce immediate ERPT.

The government often implements price control mechanisms, or there exists an administrative price system in Pakistan, which initially keeps the ERPT meagre. However, these measures act as temporary buffers and only last for some months (often for a quarter only), suppressing inflationary pressures that would otherwise arise from currency depreciation.

Apart from the government role, the SBP's policy responses, such as FX interventions or adjustments in policy rates, also delay the inflationary effects of ER shocks. After a few months, the ER starts impacting the domestic prices. In essence, the short-run pass-through is low; it starts impacting after a lag, however, it does not exist over longer horizons. It is important to note that this delayed adjustment often results in a cumulative inflationary buildup in the medium term.

6. Conclusion and Policy Implications

This Paper employed a VAR model to analyse monthly data from January 2013 to December 2023. It identified the key factors that significantly affect prices in Pakistan. The ERPT to domestic inflation has significant implications for monetary policy implementation. Various shock channels at different pricing stages, alongside the CPI's strong response to ER shocks, likely contribute to high domestic price inflation in developing countries like Pakistan. Furthermore, the paper validates ERPT evidence showing that the ERPT to import prices, particularly oil imports, is higher and more immediate compared to consumer prices. However, a delayed effect of ERPT on CPI suggests a low and gradual ERPT.

Additionally, Pakistan is increasingly reliant on imports, leading to a high import share in its consumption-based economy. Even domestically produced agricultural products, which once buffered against ER shocks, are diminishing. This shows a more gradual ERPT in Pakistan. Currently, ERPT occurs with a lag of up to one month, meaning its

effects are more pronounced as compared to the early lag period of 3 to 4 months. The lag is attributed to the proportion of locally traded goods in the CPI, such as wheat, sugarcane, cotton, and energy, that are influenced by government-defined procurement and administered prices. The dynamics of ERPT have also shifted due to the free float of the PKR in July 2000 and the subsequent structural changes in the economy.

Policy Implications:

The SBP may maintain a monetary policy that allows the economy to absorb short-term ER shocks, serving as a buffer against external volatility and preventing excessive distortions in trade and investment flows. In doing so, it may:

- Establish and strengthen strategic buffer stocks for key CPI-sensitive commodities such as edibles and petroleum products. A well-managed buffer stock system allows the government to release supplies during periods of ER-induced price hikes and procure during surplus phases to stabilise domestic prices.
- Design and operationalise a formal ERPT monitoring framework. A framework that is able to distinguish between inflation caused by ER movements and that driven by domestic supply or demand shocks.
- Provide regular ERPT statistics and insights to guide policy responses and market expectations, enhancing transparency and the effectiveness of monetary policy. Meanwhile, utilising forward-looking macro-risk models
- Utilise forward-looking macro-risk models and analytical tools to anticipate vulnerabilities and guide proactive policy. Shift the focus of ER policy toward addressing fundamental macroeconomic challenges: fiscal discipline, structural inefficiencies, and productivity enhancement, rather than concentrating solely on administrative prices.
- Reduce long-term import dependency through strategic industrial and energy diversification policies that can provide long-term resilience against international oil price supply shocks. It may also scale up solarisation, invest in renewable energy, and implement industrial energy policy reforms.

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