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Regime-Dependent Exchange Rate Pass-Through to Inflation: Evidence from Pakistan, 2016 to 2026

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Abstract

This paper examines whether Pakistani rupee depreciation transmits to consumer price inflation, and whether workers' remittances play an intermediating role, using ten years of monthly data (July 2016 to July 2026) from the State Bank of Pakistan. Using Augmented Dickey Fuller stationarity tests, Granger causality analysis, a two lag Vector Autoregression model, and impulse response analysis, the study finds no statistically significant relationship between workers' remittances and either the exchange rate or inflation at any tested lag. A baseline regression across the full sample suggests exchange rate depreciation explains approximately twelve percent of monthly inflation variation (R squared = 0.116, $p < 0.001$); however, this result does not survive removal of the 2022 to 2023 devaluation episode (R squared = 0.005, $p = 0.496$). Splitting the sample by exchange rate regime confirms that the relationship is negligible under Pakistan's pre 2022 managed exchange rate (R squared = 0.002, $p = 0.714$) and substantially stronger under the post 2022 market determined regime (R squared = 0.221, $p < 0.001$). These findings indicate that exchange rate pass through in Pakistan is regime dependent rather than constant, consistent with the broader emerging market literature on inflation environments and pass through intensity.

Author's note on generative artificial intelligence: generative AI tools (Anthropic's Claude) were used to assist with statistical code execution, data processing, and drafting portions of this manuscript under the author's direction and review. All research questions, data sourcing decisions, model specifications, interpretation of results, and conclusions are the author's own.

Disclosure of Generative AI Use

In accordance with disclosure requirements for research submissions, the author confirms that generative artificial intelligence tools were used during the preparation of this paper. Specifically, Anthropic's Claude was used to: (i) assist in writing and debugging Python code for data cleaning, statistical testing, and model estimation; (ii) assist in drafting and editing manuscript prose based on the author's own analysis and results; and (iii) assist in organising the paper according to standard quantitative research reporting conventions. The research question, choice of data sources, model specification decisions, statistical interpretation, and substantive conclusions were determined by the author. No data, results, or citations in this paper were generated or fabricated by the AI tool; all statistical outputs reported herein were produced by executing the author's specified econometric procedures on real data obtained from the State Bank of Pakistan.

JEL Classification: E31, F31, C32

Keywords: Exchange Rate Pass-Through, Inflation, Pakistan, Vector Autoregression, Granger Causality, Regime Dependence, Workers' Remittances

1. Introduction

A persistent assumption in Pakistani economic commentary holds that depreciation of the Pakistani rupee against the United States dollar directly and reliably raises the domestic price level. This assumption underlies much public discussion of monetary and exchange rate policy, yet it is rarely subjected to formal statistical testing using Pakistan specific data. This paper investigates whether the assumption holds, and whether it holds uniformly across time, using ten years of monthly macroeconomic data published by the State Bank of Pakistan.

The research addresses three questions. First, is there a statistically significant relationship between the PKR/USD exchange rate and consumer price inflation in Pakistan, and if so, at what time horizon does it operate. Second, do workers' remittances, a major source of foreign exchange inflow for Pakistan, exhibit a measurable relationship with either the exchange rate or inflation. Third, and most centrally, is any observed exchange rate to inflation relationship stable across time, or does it depend on the prevailing exchange rate regime, given that Pakistan moved from a heavily managed exchange rate toward a more market determined rate around 2022.

The paper contributes to the literature in two respects. First, it provides Pakistan specific empirical evidence on exchange rate pass through, a country for which country specific peer reviewed econometric evidence remains comparatively limited relative to other emerging markets. Second, it demonstrates, through an explicit robustness exercise, that a seemingly robust full sample statistical relationship can be substantially an artefact of one structural break period, and that splitting the sample by policy regime materially changes the empirical conclusion. This methodological point, that pass through estimates are sensitive to regime classification, has direct relevance for how the finding should be interpreted and used.

2. Literature Review

Exchange rate pass through (ERPT), the extent to which changes in the nominal exchange rate transmit into domestic prices, has been extensively studied in international macroeconomics. Taylor (2000) proposed that the degree of pass through is not a structural constant but depends positively on the prevailing inflation environment, on the reasoning that firms are more willing to adjust prices in response to cost shocks when inflation is already high and price adjustment is expected to be persistent. This hypothesis implies that pass through should vary with the macroeconomic regime rather than remain fixed across time, a proposition directly relevant to the present study [1].

Cross country empirical work has generally supported the view that pass through is markedly higher and more variable in emerging market economies than in advanced economies. Ca'Zorzi, Hahn and Sanchez (2007), using a vector autoregression framework across a panel of emerging markets, find substantial heterogeneity in pass through magnitudes and note a positive association between pass through and the inflationary environment, consistent with Taylor's hypothesis once high volatility outlier economies are accounted for [2]. Choudhri and Hakura (2006) similarly report that countries with a history of high and volatile inflation display materially higher pass through than low inflation countries [3]. Frankel, Parsley and Wei (2005) and Campa and Goldberg (2005) extend this literature using import price and consumer price data across broader country samples, generally finding that pass through, while positive and significant, is incomplete and varies by sector and by country [4,5].

More recent work has emphasised that pass through is not merely heterogeneous across countries but can change within a single country over time as its monetary and exchange rate regime evolves. Ha, Stocker and Yilmazkuday (2020) document a general decline in aggregate pass through globally over recent decades and attribute part of this decline to the adoption of more credible, rules based monetary frameworks [6]. Nasir and Vo (2020) examine structural change in pass through intensity around the adoption of inflation targeting regimes, providing direct precedent for the regime split methodology adopted in this paper [7]. Taken together, this literature motivates the central empirical strategy pursued here: rather than assuming a single, time invariant pass through coefficient for Pakistan, the paper explicitly tests whether the coefficient differs before and after Pakistan's 2022 shift toward a more market determined exchange rate.

The role of workers' remittances in this relationship has received comparatively less direct econometric attention in the Pakistan specific literature, despite remittances constituting a substantial share of Pakistan's current account receipts. This paper treats the possible remittance channel as an open empirical question rather than assuming its relevance a priori.

3. Research Methodology

3.1. Data Sources and Sample

Monthly data were obtained from the State Bank of Pakistan's Easy Data portal (easydata.sbp.org.pk) for the period July 2016 to July 2026 (n = 121 monthly observations before differencing) [8]. Three series were used: (i) the National Consumer Price Index, year on year percentage change, compiled by the Pakistan Bureau of Statistics on the 2015 to 2016 base and republished by the State Bank; (ii) the PKR/USD exchange rate, measured as the bank floating average exchange rate; and (iii) total monthly workers' remittance inflows, drawn from the country wise workers' remittances series.

3.2. Variable Construction

All three series were tested for stationarity prior to any causal or regression analysis, since regression on non stationary time series can produce spurious statistical significance. CPI inflation was transformed via first differencing. The PKR/USD exchange rate and workers' remittances were transformed via log first differencing to approximate percentage changes while stabilising variance; remittances required an additional second difference to achieve stationarity, consistent with the series exhibiting residual seasonal or trend structure after a single differencing pass.

3.3. Stationarity Testing

Stationarity was assessed using the Augmented Dickey Fuller (ADF) test, which tests the null hypothesis that a time series contains a unit root against the alternative of stationarity [9].

3.4. Granger Causality Testing

Granger causality tests were used to assess whether past values of one variable improve the statistical prediction of another variable, beyond what is achieved using the second variable's own past values alone [10]. Tests were conducted in both directions for each pair of variables, across lag lengths of one to six months.

3.5. Cointegration Testing

Prior to selecting between a Vector Autoregression (VAR) specification in differenced variables and a Vector Error Correction Model (VECM) in levels, the Johansen (1991) trace test for cointegration was applied to the three variables in levels. The trace statistic for the null hypothesis of no cointegrating relationship (28.00) did not exceed the 95 percent critical value (29.80), indicating no statistically supported long run cointegrating relationship among the three series. A VAR specification in stationary, differenced variables was therefore adopted rather than a VECM [11].

3.6. Vector Autoregression Model and Lag Selection

A VAR model (Sims, 1980) was estimated treating differenced CPI inflation, differenced PKR/USD, and differenced remittances as a jointly determined system, in which each variable is modelled as a function of its own lags and the lags of the other two variables [12]. Lag order selection using the Bayesian Information Criterion and Hannan Quinn Information Criterion both indicated an optimal lag length of two months; this lag order was adopted in preference to the Akaike Information Criterion's suggestion of a longer lag, given the comparatively small sample size and the greater parameter penalty imposed by BIC and HQIC in such settings.

3.7. Impulse Response Analysis

Orthogonalised impulse response functions were computed from the estimated VAR to trace the dynamic response of each variable to a one time shock in each of the other variables over a twelve month horizon.

3.8. Robustness: Regime Subsample Analysis

To assess whether the baseline exchange rate to inflation relationship was stable over the sample period, the single equation regression of differenced CPI inflation on the one month lag of differenced PKR/USD was re estimated on three subsamples: the full sample; the full sample excluding the January 2022 to December 2023 devaluation window; and the sample split into a pre 2022 subsample, corresponding to Pakistan's more heavily managed exchange rate period, and a post 2022 subsample, corresponding to the more market determined float.

4. Results and Data Analysis

4.1. Stationarity Test Results

Variable	Level ADF stat	Level p-value	Transformatio n	Transformed ADF stat	Transformed p- value
CPI (YoY)	-2.2611	0.1848	First difference	-3.1185	0.0252
Workers' Remittances	-0.1192	0.9475	Second logdifference	-6.8866	<0.0001
PKR/USD Exchange Rate	-1.2589	0.6478	Log first difference	-7.6230	<0.0001

Table 1: Augmented Dickey Fuller Stationarity Test Results, Levels and Transformed Series

4.2. Granger Causality Results

Direction	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Remittances > PKR/USD	0.812	0.802	0.489	0.664	0.636	0.811
PKR/USD -> Remittances	0.707	0.064	0.184	0.093	0.056	0.116
Remittances > CPI	0.495	0.832	0.844	0.861	0.945	0.955
PKR/USD - > CPI	0.0004	0.0033	0.0049	0.0017	0.0041	0.0026

Table 2: Granger Causality F-test p-values by Lag Length (Months). The PKR/USD to CPI Direction is Significant at Every Lag Tested ($p < 0.005$).

4.3. Vector Autoregression Estimates (Selected Coefficients)

Equation	Regressor	Coefficient	Std. Error	p-value
CPI	L1.PKR_USD	0.2964	0.0859	0.001
CPI	L2.CPI	0.1764	0.0920	0.055
PKR_USD	L1.PKR_USD	0.3028	0.0958	0.002
Remittances	L1.Remittances	-1.1017	0.0782	<0.001
Remittances	L2.PKR_USD	-1.5378	0.6469	0.017
Remittances	L2.Remittances	-0.5310	0.0783	<0.001

Table 3: Var (2) Coefficient Estimates, Statistically Significant Regressors Only (p < 0.10). Full Estimation Output Available on Request

4.4. Baseline Regression and Regime Robustness

Sample	N	PKR/USD coefficient	R-squared	p-value
Full sample (20162026)	119	0.3079	0.1158	0.0002
Excluding 20222023	n/a	0.0703	0.0050	0.4958
Pre-2022 (managed regime)	64	-0.0292	0.0022	0.7139
Post-2022 (market regime)	55	0.4766	0.2209	0.0003

Table 4: OLS Regression of One-Month-Ahead CPI Change on Lagged PKR/USD Change, by Sample Period

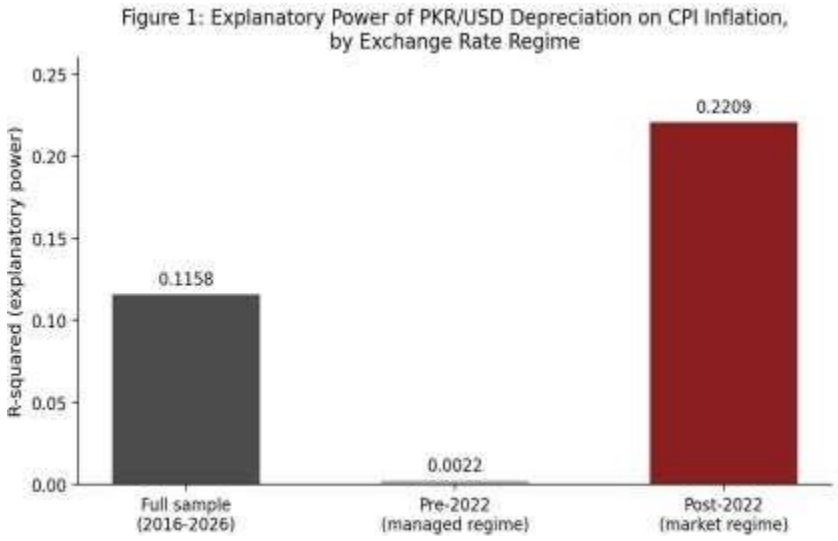


Figure 1: Explanatory Power (R-squared) of PKR/USD Depreciation on CPI Inflation, by Exchange Rate Regime

The stationarity results in Table 1 confirm that all three series required transformation before valid causal or regression analysis could proceed. Table 2 shows that workers' remittances exhibited no statistically significant Granger causal relationship with either the exchange rate or inflation at any lag tested, while the PKR/USD exchange rate showed a Granger causal relationship with CPI inflation that was significant at the 1 percent level or better at every lag from one to six months. Table 3 confirms this pattern within the joint VAR system: the one month lag of PKR/USD depreciation is a significant positive predictor of CPI inflation, while remittances show significant own persistence (negative, indicating mean reversion) and a significant negative relationship with the two month lag of PKR/USD, a result that warrants further investigation but does not indicate a stabilising effect of remittances on inflation. Table 4 and Figure 1 present the central robustness finding: the exchange rate to inflation relationship, while significant across the full sample, is driven almost entirely by the 2022 to 2023 devaluation episode, and is statistically indistinguishable from

zero during Pakistan's pre 2022 managed exchange rate period.

5. Discussion

5.1. Interpretation of Results

The results provide a qualified answer to the paper's central research question. Exchange rate depreciation is significantly associated with subsequent consumer price inflation in Pakistan, but this relationship is not a stable structural constant. It is effectively absent during the pre 2022 period, when the exchange rate was held within narrow, administratively managed bands, and becomes substantial and highly significant during the post 2022 period, when the exchange rate has been permitted to move in closer alignment with market conditions.

5.2. Relation to Existing Literature

This finding is consistent with Taylor's (2000) proposition that pass through intensity is not fixed but varies with the macroeconomic and policy environment, and it echoes the regime sensitive findings of Nasir and Vo (2020) in the context of inflation targeting adoption elsewhere [1,7]. The interpretation offered here is that, under a managed exchange rate, the observed exchange rate series carries comparatively little information about underlying market pressure, since its movements are constrained administratively rather than being determined by supply and demand; inflation during this period is more likely driven by other channels, such as international commodity prices, fiscal policy, and administered domestic prices, that are not captured by the exchange rate series itself. Once the exchange rate is permitted to float, its movements more closely reflect genuine market pressure, and the statistical relationship with inflation strengthens accordingly.

5.3. Policy Implications

For policymakers, the practical implication is that the inflationary cost of a given percentage depreciation is not a fixed parameter but is conditional on the prevailing exchange rate regime. This has direct relevance for Pakistan's ongoing engagement with the International Monetary Fund, where exchange rate flexibility and price stability are frequently discussed as competing policy objectives; the present findings suggest that the inflation cost of flexibility, while real, should be assessed with reference to the specific regime in place rather than assumed to be constant across regimes.

5.4. Limitations

Several limitations should be noted. First, workers' remittances as recorded by the State Bank capture only formally channelled transfers; informal channels are unobserved, and the null finding for remittances should be interpreted as applying to the observed, formal component only. Second, the post 2022 and pre 2022 subsamples are of modest size (n = 55 and n = 64 respectively), which limits statistical power relative to the full sample and warrants some caution in over interpreting subsample coefficient magnitudes. Third, the analysis does not explicitly control for global commodity and energy prices, which plausibly influence Pakistani inflation independently of the exchange rate and could partially confound the estimated relationship, particularly during the 2022 to 2023 period, which coincided with elevated global energy prices. Fourth, the Jarque-Bera test on the full sample baseline regression residuals rejects normality, indicating the full sample result is influenced by a small number of extreme observations consistent with the regime break identified; this reinforces, rather than undermines, the paper's central conclusion. Finally, this is a single country study; whether the regime dependence pattern generalises to other emerging markets undergoing similar exchange rate liberalisation is left to future research.

6. Conclusion

This paper set out to test, rather than assume, whether Pakistani rupee depreciation causes consumer price inflation, and whether workers' remittances play an intermediating role. The evidence indicates that workers' remittances, at least through formally recorded channels, show no measurable relationship with either the exchange rate or inflation over the sample period. The exchange rate to inflation relationship, by contrast, is real but not constant: it is negligible under a managed exchange rate regime and substantial under a market determined regime. The core conclusion is accordingly that exchange rate pass through in Pakistan is regime dependent rather than fixed, a result consistent with the broader international literature and one with direct relevance for how currency depreciation should be interpreted by policymakers, market participants, and households under Pakistan's current, more market determined exchange rate arrangement.

Future research could usefully extend this analysis by incorporating global commodity price controls, by testing whether the regime dependence pattern holds using higher frequency (weekly) data around the 2022 devaluation episode specifically, and by applying the same regime split methodology to other emerging markets that have transitioned from managed to floating exchange rate regimes, to assess whether the pattern identified here for Pakistan generalises more broadly.

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Appendix A: Data Dictionary

Variable	Source series	Unit	Frequency
CPI (YoY)	Inflation Snapshot (New Base 2015-16), National CPI, Year-on-Year basis	Percent	Monthly
Monthly	Country-wise Workers' Remittances, Total inflow of Workers' Remittances in Pakistan	Million USD	Monthly
PKR/USD	Bank Floating Average Exchange Rates, USD series	PKR per 1 USD	Monthly

All series sourced from the State Bank of Pakistan Easy Data portal, July 2016 to July 2026.

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