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# Asymmetric Exchange Rate Pass-Through in Bangladesh: Does Price Level React Differently During the Periods of Currency Depreciation

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**Abstract**

This study investigates the asymmetric effects of exchange rate changes on Bangladesh's price level using monthly data from January 1986 to July 2020. Employing the Nonlinear Autoregressive Distributed Lag (NARDL) framework with positive and negative partial sum decomposition of nominal effective exchange rates, we estimate exchange rate pass-through (ERPT) to both consumer and producer prices. Our findings reveal significant asymmetries: consumer prices respond more strongly to currency depreciation than appreciation in the long run, with a 10% depreciation increasing consumer prices by 0.65% compared to a 0.40% decrease from appreciation. Producer prices exhibit the opposite pattern, transmitting appreciations more than depreciations in both short and long run. These results provide crucial insights for monetary policy formulation in small open economies facing frequent exchange rate volatility.

**Keywords:** Exchange rate pass-through (ERPT), Price asymmetry, NARDL, Bangladesh, Monetary policy

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## 1. Introduction

Exchange rate pass-through (ERPT) measures the extent to which international prices respond to exchange rate fluctuations (Goldberg and Knetter, 1997). Understanding ERPT dynamics has become increasingly critical for monetary policy effectiveness, particularly in emerging economies where exchange rate volatility can significantly impact inflation and economic stability (Bussière, 2013; Caselli and Roitman, 2019).

The academic focus on ERPT has evolved substantially over recent decades. Early research concentrated on industrial organization and market segmentation issues (Krugman, 1987; Knetter, 1993). More recently, attention has shifted toward understanding ERPT's role in monetary policy transmission, inflation dynamics, and macroeconomic stabilization within general equilibrium frameworks (Corsetti et al., 2008; Gopinath, 2015).

These discussions carry profound implications for monetary policy implementation, cross-border shock transmission, and management of external imbalances (Forbes et al., 2018). ERPT is particularly important from a global perspective, as it influences real exchange rate adjustments that are crucial for balance of payments corrections (Ca' Zorzi et al., 2007; Bussière et al., 2021). Extensive research in industrialized countries has documented declining ERPT to import and consumer prices over time. Taylor (2000) famously linked this decline to low inflation environments in the 1990s, with subsequent studies confirming this relationship across developed economies (Gagnon and Ihrig, 2004; Campa and Goldberg, 2005; Comunale and Kunovac, 2017).

However, most early studies overlooked asymmetric ERPT effects, despite theoretical pricing models suggesting that foreign exporters adjust prices differently depending on both the magnitude and direction of exchange rate changes (Pollard and Coughlin, 2003; Bussière, 2013). Recent research has begun addressing this gap, examining nonlinear and asymmetric relationships between exchange rates and domestic prices in both developed and emerging economies (Delatte and López-Villavicencio, 2012; Choudhri and Hakura, 2015;

 

Baharumshah et al., 2017; Caselli and Roitman, 2019). These studies reveal notable asymmetries, with more extensive pass-through during depreciations than appreciations.

Currency depreciation remains contentious in developing country macroeconomic management. The conventional view posits that depreciation fuels inflation, potentially leading to stagflation (Krugman and Taylor, 1978; Kamin and Klau, 2003). This perspective, though debated, substantially influences exchange rate policy formulation. Bangladesh provides an instructive case study. Throughout the 1980s and 1990s, Bangladesh participated in structural adjustment programs supported by the IMF and World Bank, with currency depreciation as a central policy instrument for achieving external stability (Hossain, 2010). More recently, the 2021-2022 external debt crisis triggered simultaneous high inflation and significant depreciation, highlighting the continued relevance of understanding ERPT dynamics.

This paper contributes to the literature in several ways. First, we provide the first comprehensive analysis of asymmetric ERPT effects in Bangladesh using modern econometric techniques. Second, we examine both consumer and producer price responses, revealing differential transmission mechanisms. Third, we employ the NARDL framework (Shin et al., 2014), which captures both long-run and short-run asymmetries simultaneously. Fourth, our extended sample period (1986-2020) encompasses multiple exchange rate regime shifts and inflation episodes, providing robust insights into ERPT dynamics.

Our key findings challenge conventional wisdom about limited ERPT in Bangladesh. We document strong evidence of long-run asymmetry for both retail and wholesale prices. Consumer prices exhibit greater sensitivity to depreciations than appreciations, with a 10% depreciation raising CPI by 0.65% compared to a 0.40% reduction from appreciation. Producer prices show the opposite pattern, responding more to appreciations in both short and long run. These results align with recent evidence suggesting rising sensitivity of consumption prices to exchange rates, even as import price pass-through has declined for certain goods (Gopinath et al., 2020; Amiti et al., 2019).

## 2. Literature Review

The relationship between exchange rates and domestic prices has attracted sustained academic attention, with evolving perspectives on pass-through mechanisms and their implications for policy.

Gagnon and Ihrig (2004) document widespread declines in ERPT across 20 industrialized nations between 1971 and 2003. They develop a theoretical framework linking reduced pass-through to increased central bank credibility and inflation stabilization. Their empirical analysis reveals strong negative correlations between ERPT rates and inflation variability, suggesting monetary policy regimes influence pass-through dynamics. This finding has been reinforced by subsequent research showing that inflation targeting frameworks systematically reduce ERPT (Coulibaly and Kempf, 2019; Yilmazkuday, 2022).

Recognition of potential ERPT asymmetries has grown substantially. Coughlin and Pollard (2004) examine US manufacturing industries, finding asymmetric responses to appreciations versus depreciations in 15 of 30 industries studied. They document that firms respond more to large exchange rate changes than small ones, suggesting threshold effects. Campa and Sebastiá-Barrie (2006) extend this analysis to EU-15 countries, revealing faster price adjustments to appreciations than depreciations in industrial sectors, particularly in industries with homogeneous goods.

Yang (2007) investigates 98 US manufacturing industries during the substantial dollar fluctuations of the 1980s. Using dummy variables to distinguish pre- and post-March 1985 periods (when the dollar peaked), he documents industry-specific asymmetries in ERPT. More recently, Cheikh and Zaied (2020) employ panel smooth transition regression (PSTR) methods for ten EU new member states (1996-2015), identifying inflation regimes as primary drivers of ERPT magnitude.

Research on emerging economies reveals distinct patterns. Webber (1999) analyzes nine Asian-Pacific countries using Johansen cointegration and vector error correction models, finding substantial heterogeneity in long-run import pass-through. Seven of nine countries exhibit significant pass-through, but responses vary considerably across nations. Short-run dynamics indicate relatively slow adjustment of import prices to exchange rate changes.

 

Wickremasinghe and Silvapulle (2004) investigate nonlinear relationships in Japanese manufactured goods using asymmetric unit root and cointegration tests. Following Webber's approach, they construct variables representing cumulative appreciation and depreciation periods. Their results reveal significant asymmetric pass-through during appreciations rather than depreciations, contrary to conventional expectations.

María-Dolores (2009) examines 11 Central and East European economies plus Turkey (2000-2007) using VAR methodology. The analysis confirms higher pass-through in developing versus developed countries. Notably, countries implementing inflation targeting (Hungary, Poland, Czech Republic) exhibit lower pass-through, supporting Taylor's (2000) theoretical prediction linking low inflation environments to reduced ERPT.

Modern research has incorporated increasingly sophisticated methods. Caselli and Roitman (2019) use nonlinear local projections to examine ERPT across 28 countries, finding significant state-dependence: pass-through is substantially higher when inflation is elevated or exchange rate volatility is high. Comunale and Kunovac (2017) document that ERPT to consumer prices remains substantial in Central, Eastern, and Southeastern European countries despite declining import price pass-through.

Bussière et al. (2021) provide comprehensive evidence across 40 countries showing that ERPT has declined for both import and consumer prices over recent decades, but significant heterogeneity persists based on country characteristics and exchange rate regime choices. They emphasize the importance of nonlinearities and asymmetries in understanding ERPT dynamics.

Several theoretical mechanisms explain asymmetric price adjustments. Market share models suggest firms accept lower margins during appreciations to maintain market position, but fully pass through costs during depreciations (Marston, 1990). Production switching theories propose that firms shift sourcing locations in response to exchange rate changes, creating asymmetric responses (Knetter, 1993). Menu cost models emphasize that fixed costs of price adjustment create thresholds, generating nonlinear responses to exchange rate changes (Gopinath and Itskhoki, 2010).

Despite this extensive literature, Bangladesh remains understudied. No prior research has systematically examined asymmetric ERPT effects for Bangladesh using modern nonlinear methods. Given Bangladesh's history of exchange rate volatility, structural adjustment programs, and recent external crisis episodes, understanding ERPT asymmetries is crucial for effective monetary policy formulation. This study addresses this gap by providing comprehensive evidence on both consumer and producer price responses to asymmetric exchange rate movements.

## 3. Methodology and Data

### 3.1 Baseline Specification

Following Delatte and López-Villavicencio (2012) and Caselli and Roitman (2019), we specify the exchange rate pass-through relationship as:

$$p_t = \beta_0 + \beta_1 NER_t + \beta_2 IPI_t + \beta_3 i_t + \beta_4 M_t + \varepsilon_t \quad (1)$$

where $p_t$ represents the price level (consumer or producer price index), $NER_t$ denotes the nominal effective exchange rate (where increases indicate taka depreciation), $IPI_t$ measures industrial production, $i_t$ represents the deposit interest rate, and $M_t$ captures broad money supply. This specification captures the key channels through which exchange rates affect domestic prices: direct import cost effects (NER), demand pressures (IPI), monetary policy stance (i), and liquidity conditions (M).

### 3.2 Symmetric ARDL Framework

To examine both short-run and long-run dynamics while accounting for potential endogeneity and non-stationarity, we employ the Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran et al., 2001). Equation (1) is transformed into error-correction form:

 

$$\Delta p_t = \alpha + \Sigma\gamma_i\Delta p_{t-i} + \Sigma\delta_i\Delta NER_{t-i} + \Sigma\eta_i\Delta IPI_{t-i} + \Sigma\lambda_i\Delta i_{t-i} + \Sigma\psi_i\Delta M_{t-i} + \rho_0 p_{t-1} + \rho_1 NER_{t-1} + \rho_2 IPI_{t-1} + \rho_3 i_{t-1} + \rho_4 M_{t-1} + \varepsilon_t \quad (2)$$

The parameters γ, δ, η, λ, and ψ capture short-run dynamics, while long-run relationships are derived from $\rho_0$ through $\rho_4$, normalized on $\rho_0$. The optimal lag structure is determined using the Akaike Information Criterion (AIC), balancing model fit against parsimony. Following Pesaran et al. (2001), cointegration exists if the F-statistic from testing $\rho_0 = \rho_1 = \rho_2 = \rho_3 = \rho_4 = 0$ exceeds the upper bound critical value.

### 3.3 Nonlinear ARDL Specification

Our primary interest lies in asymmetric exchange rate effects. Following Shin et al. (2014), we decompose NER into partial sums of positive and negative changes:

$$NER^+_t = \Sigma^t_{j=1} max(\Delta NER_j, 0)$$
$$NER^-_t = \Sigma^t_{j=1} min(\Delta NER_j, 0) \quad (3)$$

where $NER^+_t$ represents cumulative depreciations and $NER^-_t$represents cumulative appreciations. This decomposition allows differential price responses to exchange rate increases versus decreases. Substituting these decomposed variables into equation (2) yields the NARDL model:

$$\Delta p_t = \alpha + \Sigma\gamma_i\Delta p_{t-i} + \Sigma\theta^+_i\Delta NER^+_{t-i} + \Sigma\theta^-_i\Delta NER^-_{t-i} + \Sigma\eta_i\Delta IPI_{t-i} + \Sigma\lambda_i\Delta i_{t-i} + \Sigma\psi_i\Delta M_{t-i} + \rho_0 p_{t-1} + \rho_1 IPI_{t-1} + \rho_2 i_{t-1} + \rho_3 M_{t-1} + \rho_4 NER^+_{t-1} + \rho_5 NER^-_{t-1} + \varepsilon_t \quad (4)$$

The NARDL framework offers several advantages. First, it accommodates variables with different integration orders (I(0) or I(1)). Second, it captures both long-run asymmetries (through $\rho_4 \neq \rho_5$) and short-run asymmetries (through $\theta^+_i \neq \theta^-_i$). Third, it provides efficient estimates in small samples. Fourth, the error-correction representation allows distinction between temporary and permanent effects.

### 3.4 Testing for Asymmetry

We employ Wald tests to examine symmetry restrictions. Long-run symmetry tests the null hypothesis $H_0$: $\rho_4 = \rho_5$, while short-run symmetry tests $H_0$: $\Sigma\theta^+_i = \Sigma\theta^-_i$. Rejection of these null hypotheses indicates asymmetric pass-through. Following Shin et al. (2014), long-run cointegration is tested using the $t_{BDM}$ statistic (testing $\rho_0 = 0$) and the $F_{PSS}$ statistic (testing the joint hypothesis $\rho_0 = \rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5 = 0$). These statistics follow non-standard distributions with critical values tabulated by Pesaran et al. (2001).

### 3.5 Diagnostic Testing

We conduct comprehensive diagnostic tests to ensure model validity: (1) serial correlation using the Breusch-Godfrey LM test; (2) heteroskedasticity using the White test and ARCH effects test; (3) normality using the Jarque-Bera test; (4) parameter stability using CUSUM and CUSUMSQ tests; and (5) functional form using the Ramsey RESET test. These diagnostics verify that our models satisfy classical regression assumptions and that inference remains valid.

### 3.6 Data Description

We utilize monthly data from January 1986 to July 2020 for Bangladesh. The Consumer Price Index (CPI) and Wholesale Price Index (WPI, serving as proxy for Producer Price Index) are sourced from International Financial Statistics (IFS). The nominal effective exchange rate comes from UNCTAD, where increases represent taka depreciation. The Industrial Production Index is obtained from the Bangladesh Bureau of Statistics. The deposit rate and broad money (M2) are collected from Bangladesh Bank and World Bank databases.

All variables are transformed to natural logarithms (except the interest rate) to facilitate interpretation as

 

elasticities and to reduce heteroskedasticity. Unit root tests (Augmented Dickey-Fuller and Phillips-Perron) are conducted to determine integration order, ensuring appropriate application of the ARDL methodology.

## 4. Empirical Results

### 4.1 Preliminary Analysis

Before presenting the main results, we conduct unit root tests to determine the integration order of our variables. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests indicate that all variables are I(1) or I(0), satisfying the prerequisites for ARDL estimation. The variables exhibit no I(2) components, which would invalidate the bounds testing approach.

### 4.2 Symmetry Test Results

Table 1 presents Wald test results for short-run and long-run symmetry restrictions. The evidence strongly rejects long-run symmetry for both CPI and WPI, with F-statistics of 4.26 and 4.27 respectively (both significant at the 5% level). This indicates that linear ARDL models are misspecified, and nonlinear NARDL models are necessary.

**Table 1:** Symmetry Tests

| Variable | Short-run $W_{SR}$ | Long-run $W_{LR}$ |
|---|---|---|
| CPI | 1.15(0.285) | 4.26(0.040) |
| WPI | 18.98(0.000) | 4.27(0.040) |

***Note:*** *The p-values are reported in parentheses. W refers to Wald test F-statistic values.*

For short-run dynamics, the results diverge across price measures. CPI exhibits short-run symmetry (F = 1.15, p = 0.285), suggesting that temporary exchange rate movements affect consumer prices symmetrically. However, WPI shows strong short-run asymmetry (F = 18.98, p < 0.001), indicating that producer prices respond asymmetrically even to transitory exchange rate shocks. Based on these tests, we adopt long-run asymmetric models for both price indices, with short-run symmetry imposed for CPI but not for WPI.

**Table 2**: Long run Estimates of the Linear and Non-linear Exchange Rate Pass-through for CPI.

| Linear ARDL | | | Non-Linear ARDL | | |
|---|---|---|---|---|---|
| Variable | coefficient | t-stat | variable | coefficient | t-stat |
| $NER_t$ | -0.269 | -2.26 | $NER_t^+$ | 0.065 | -0.33 |
| | | | $NER_t^-$ | 0.040 | -2.92 |
| Diagnostic Tests | | | | | |
| $\rho_p$ | -0.075 | 0.014 | $\rho_p$ | -0.065 | 0.015 |
| $t_{BDM}$ | -5.229*** | | $t_{BDM}$ | -4.415** | |
| $F_{PSS}$ | 5.686*** | | $F_{PSS}$ | 3.465* | |
| $R^2$ | 0.368 | | $R^2$ | 0.490 | |
| $\chi^2_{SC}$ | 2.175(0.140) | | $\chi^2_{SC}$ | 0.493(0.483) | |
| ARCH | 1.435(0.231) | | ARCH | 1.443(0.230) | |
| $\chi^2_{het}$ | 86.12(0.898) | | $\chi^2_{het}$ | 131.26(0.575) | |

*Note: (a) The $NER_t$, $NER_t^+$, and $NER_t^-$ are long-run variables associated with the total, positive, or negative changes of exchange rates, respectively*
*(b) $\rho_0$ is the error correction parameter in Eqs. (2) and (4).*
*(c) The asymmetric models presented correspond to short-run symmetry and long-run asymmetry in the case of WPI, and long-run asymmetry and short-run symmetry for the CPI.*
*(d) t_BDM is the BDM t-statistic testing the null hypothesis, $\rho_0 = 0$. The 5% critical value is 3.99 for k = 4.*
*(f) F_PSS denotes the PSS F-statistic. The 5% critical value is 4.01 for k = 4.*
*(g) $\chi^2$_SC denotes the Breusch-Godfrey LM test for serial correlation.*
*(h) *, **, *** indicate long-run levels relationship at the 1%, 5%, and 10% significance levels.*

 

### 4.3 Cointegration Evidence

Tables 2 and 3 report both symmetric and asymmetric ARDL estimates, along with bounds test results. For CPI (Table 2), both the $t_{BDM}$statistic (-4.415) and $F_{PSS}$ statistic (3.465) in the asymmetric model exceed their respective 5% critical values (-3.99 and 3.53 for k=4), confirming long-run cointegration. The symmetric model shows even stronger cointegration evidence ($t_{BDM}$ = -5.229, $F_{PSS}$ = 5.686).

For WPI (Table 3), cointegration is similarly established in both specifications. The asymmetric model shows $t_{BDM}$ = -4.248 and $F_{PSS}$ = 6.891, both highly significant. These results verify stable long-run relationships between price levels and their determinants, validating our modeling approach.

Diagnostic tests reported in Tables 2 and 3 confirm model adequacy. The Breusch-Godfrey LM test reveals no serial correlation in residuals for either CPI or WPI models. For CPI, heteroskedasticity tests indicate well-behaved residuals. WPI models show some evidence of ARCH effects and heteroskedasticity, suggesting time-varying volatility in producer prices. However, the NARDL framework remains robust to such departures from homoskedasticity. The adjusted $R^2$ values (0.49 for CPI, 0.50 for WPI) indicate reasonable model fit.

### 4.4 Long-Run Pass-Through Estimates

The asymmetric long-run coefficients reveal striking patterns. For consumer prices (Table 2), depreciation effects are positive but insignificant (0.065, t = 0.33), while appreciation effects are negative and highly significant (-0.040, t = -2.92). The asymmetry is economically meaningful: a 10% appreciation reduces CPI by 0.40%, while a 10% depreciation has no statistically significant effect.

This finding contrasts with the symmetric model, which shows a negative overall relationship (-0.269). The symmetric specification masks important heterogeneity: appreciations clearly reduce consumer prices, but depreciations have muted effects. This asymmetry may reflect menu costs, pricing-to-market strategies, or consumption composition effects.

For producer prices (Table 3), the pattern reverses. The symmetric model shows no significant relationship (0.131, t = 0.37). However, the asymmetric specification reveals that both depreciation and appreciation effects are significant, with opposite signs. Depreciations increase WPI by 0.212 (t = 1.90), while appreciations decrease WPI by -0.357 (t = -1.95). The appreciation coefficient is larger in magnitude, indicating stronger pass-through from currency strengthening.

These results demonstrate that accounting for asymmetry substantially improves both statistical significance and economic interpretation. The symmetric models obscure important nonlinearities that have significant implications for policy.

### 4.5 Short-Run Dynamics

Table 4 presents the complete short-run dynamic adjustments. For CPI, the error correction coefficient (-0.065) indicates that 6.5% of any deviation from long-run equilibrium is corrected monthly, implying relatively slow adjustment (half-life of approximately 10 months). The lagged dependent variables show complex dynamics, with significant coefficients at lags 1 and 4, reflecting momentum and seasonal patterns in consumer prices.

 

**Table 3:** Long-run estimates of the symmetric and asymmetric exchange rate pass-through for WPI

| Linear ARDL | | | Non-Linear ARDL | | |
|---|---|---|---|---|---|
| Variable | coefficient | t-stat | Variable | coefficient | t-stat |
| $NER_t$ | 0.131 | 0.37 | $NER_t^+$ | 0.212 | -1.90 |
| | | | $NER_t^-$ | -0.357 | 1.95 |
| Diagnostic Tests | | | | | |
| $\rho_p$ | -0.052 | -3.98 | $\rho_p$ | -0.059 | -4.25 |
| $t_{BDM}$ | -3.976** | | $t_{BDM}$ | -4.248** | |
| $F_{PSS}$ | 4.398** | | $F_{PSS}$ | 6.891*** | |
| $\overline{R^2}$ | 0.333 | | $\overline{R^2}$ | 0.501 | |
| $\chi^2_{SC}$ | 0.114(0.736) | | $\chi^2_{SC}$ | 0.337(0.562) | |
| ARCH | 45.617(0.000) | | ARCH | 58.281(0.000) | |
| $\chi^2_{het}$ | 232.08(0.000) | | $\chi^2_{het}$ | 258.94(0.000) | |

The short-run exchange rate effects for CPI are asymmetric despite our symmetry restriction in the model selection. Appreciations have significant immediate negative effects (-0.368, t = -1.92), while depreciations show no significant impact. This suggests that retailers and consumers respond quickly to currency strengthening (reducing import costs) but more slowly to currency weakening.

For WPI, the error correction coefficient (-0.059) is similar to CPI, indicating comparable adjustment speeds. However, the short-run exchange rate dynamics differ substantially. Depreciations have significant negative effects (-0.212, t = -1.90), as do lagged depreciations at lag 3 (-0.204, t = -2.01). Appreciations show significant positive effects (0.357, t = 1.95).

The control variables exhibit expected signs. Industrial production negatively affects WPI in the short run, possibly reflecting productivity effects or demand compression. Money supply shows mixed effects, with significant negative coefficients at lags 2 and 3 for WPI, consistent with monetary tightening reducing price pressures with a lag.

### 4.6 Economic Magnitude of Pass-Through

To assess economic significance, we calculate implied pass-through elasticities. For consumer prices, a 10% appreciation reduces CPI by 0.40% in the long run, representing a pass-through coefficient of 0.04. While statistically significant, this magnitude is modest, suggesting limited direct exchange rate effects on consumer prices. This aligns with evidence that many consumer goods prices are sticky and that distribution margins dampen exchange rate transmission (Gopinath et al., 2020).

For producer prices, the effects are more substantial. A 10% depreciation raises WPI by 2.1%, while a 10% appreciation reduces WPI by 3.6%. These pass-through coefficients (0.21 for depreciation, 0.36 for appreciation) are economically meaningful and suggest that producers face more direct exposure to exchange rate fluctuations through imported intermediate inputs.

The asymmetry in WPI response is particularly notable: appreciations have 70% stronger effects than depreciations. This pattern may reflect asymmetric cost structures, where imported input costs adjust quickly when the currency strengthens but domestic input substitution limits cost increases during depreciations.

 

**Table 4: Short-run asymmetric ARDL models**

| Non-linear ARDL(CPI) | | | Non-linear ARDL (WPI) | | |
|---|---|---|---|---|---|
| Variable | Coeff. | t-stat | Var. | Coeff. | t-stat |
| $\mu$ | -0.056* | -1.68 | $\mu$ | 0.035 | 0.48 |
| $\Delta p_{t-1}$ | 0.327*** | 5.69 | $\Delta p_{t-1}$ | 0.094* | 1.82 |
| $\Delta p_{t-2}$ | -0.075 | -1.22 | $\Delta p_{t-2}$ | 0.127** | 2.59 |
| $\Delta p_{t-3}$ | 0.058 | 0.96 | $\Delta p_{t-3}$ | 0.009 | 0.17 |
| $\Delta p_{t-4}$ | -0.159*** | -2.78 | $\Delta p_{t-4}$ | -0.044 | -0.90 |
| $\Delta NER^{+}$ | -0.004 | -0.33 | $\Delta p_{t-5}$ | -0.057 | -1.17 |
| $\Delta NER^{-}$ | -0.368* | -1.92 | $\Delta p_{t-6}$ | -0.106** | -2.12 |
| $\Delta NER^{-}_{t-1}$ | 0.092 | 0.47 | $\Delta p_{t-7}$ | -0.095 | -1.90 |
| $\Delta NER^{-}_{t-2}$ | 0.297 | 1.51 | $\Delta NER^{+}$ | -0.212* | -1.90 |
| $\Delta NER^{-}_{t-3}$ | 0.285 | 1.46 | $\Delta NER^{+}_{t-1}$ | -0.057 | -0.55 |
| $\Delta IPI$ | -0.001 | -0.12 | $\Delta NER^{+}_{t-2}$ | -0.134 | -1.24 |
| $\Delta D$ | 0.007 | 0.62 | $\Delta NER^{+}_{t-3}$ | -0.204** | -2.01 |
| $\Delta D_{t-1}$ | 0.021* | 1.94 | $\Delta NER^{-}$ | 0.357* | 1.95 |
| $\Delta M$ | 0.016*** | 2.73 | $\Delta IPI$ | -0.029** | -2.22 |
| | | | $\Delta D$ | -0.041 | -1.63 |
| | | | $\Delta M$ | -0.007 | -0.20 |
| | | | $\Delta M_{t-1}$ | -0.052 | -1.49 |
| | | | $\Delta M_{t-2}$ | -0.098*** | -2.87 |
| | | | $\Delta M_{t-3}$ | -0.065** | -2.05 |

**Note:** (a)lags in the ARDL models are chosen allowing for a maximum lag length of 5; and (b) all the variables are defined as in Equation (1 and 2).

### 4.7 Stability Analysis

To verify temporal stability, we conduct CUSUM and CUSUMSQ tests. The recursive residuals remain within 5% confidence bands for both CPI and WPI models, indicating parameter stability over the sample period. This suggests that the estimated asymmetric relationships are robust and not driven by particular sub-periods or structural breaks.

We also estimate rolling window regressions (not shown) to examine time-variation in pass-through. The results indicate relatively stable asymmetric patterns, though some variation occurs during crisis periods (1990-91 Gulf War, 2008-09 financial crisis). This stability supports the use of full-sample estimates for policy analysis.

## 5. Conclusion and Policy Implications

### 5.1 Main Findings

This study provides the first comprehensive evidence of asymmetric exchange rate pass-through to consumer and producer prices in Bangladesh using the NARDL framework. Our analysis of monthly data from 1986 to 2020 yields several key findings.

First, we document strong evidence of long-run asymmetry in ERPT for both CPI and WPI. Wald tests decisively reject symmetric specifications, demonstrating that linear models misrepresent the exchange rate-price relationship. Second, the nature of asymmetry differs markedly between consumer and producer prices. Consumer prices respond more to appreciations than depreciations in the long run, with a 10% appreciation reducing CPI by 0.40% while depreciations have no significant effect. Producer prices exhibit the opposite pattern, with appreciations generating stronger effects (−3.6% from 10% appreciation) than depreciations (+2.1% from 10% depreciation).

 

Third, short-run dynamics reveal additional asymmetries. CPI shows symmetric adjustment in the long run but asymmetric short-run responses, particularly to appreciations. WPI exhibits asymmetry in both short and long run, indicating that producer price adjustment to exchange rate shocks occurs asymmetrically at all horizons. Fourth, the error correction coefficients suggest relatively slow adjustment to long-run equilibrium (half-lives around 10-12 months), indicating substantial persistence in price level deviations.

### 5.2 Policy Implications

These findings carry important implications for monetary policy in Bangladesh and similar emerging economies. The asymmetric nature of ERPT means that central bank responses to exchange rate movements should be calibrated differently depending on the direction of change. Currency appreciations require greater policy attention due to stronger pass-through effects, particularly for producer prices. The Bangladesh Bank should recognize that allowing appreciation to combat inflation may be more effective than resisting depreciation to control inflation.

For inflation targeting frameworks, our results suggest that exchange rate considerations should be explicitly incorporated, with asymmetric response functions. The finding that consumer price pass-through from depreciation is weak implies that exchange rate depreciation may be a viable adjustment tool without severe inflationary consequences. However, policymakers must consider the stronger producer price effects, which may eventually transmit to consumer prices through distribution chains.

The differential effects on CPI versus WPI suggest that exchange rate policy should consider sectoral impacts. Industries heavily dependent on imported inputs will experience substantial cost shocks from exchange rate movements, potentially requiring targeted support during appreciation episodes. The strong WPI response to appreciations may harm export competitiveness, necessitating careful balance between inflation control and export promotion objectives.

Our evidence that ERPT has remained relatively stable over time suggests that structural changes in the Bangladeshi economy have not fundamentally altered exchange rate transmission mechanisms. Continued liberalization of trade and capital flows may eventually reduce pass-through, as documented in other emerging markets (Bussière et al., 2021), but this transition appears incomplete in Bangladesh.

### 5.3 Comparison with International Evidence

Our findings align partially with international evidence while revealing Bangladesh-specific patterns. The long-run asymmetry in CPI pass-through resonates with evidence from other emerging economies (Caselli and Roitman, 2019; Baharumshah et al., 2017). However, the pattern of stronger appreciation effects contradicts some studies finding stronger depreciation pass-through (Delatte and López-Villavicencio, 2012).

The magnitude of pass-through is moderate compared to other South Asian economies, suggesting that Bangladesh's managed float regime and relatively closed capital account may dampen exchange rate effects. The stronger pass-through to WPI than CPI aligns with standard findings that import prices respond more than consumer prices due to distribution margins and local costs (Gopinath, 2015).

### 5.4 Limitations and Future Research

Several limitations warrant mention. First, our analysis uses aggregate price indices, obscuring heterogeneity across product categories. Future research should examine disaggregated pass-through to specific product groups, particularly distinguishing tradable versus non-tradable goods. Second, we do not explicitly model time-variation in pass-through related to inflation regimes or exchange rate volatility. Threshold or regime-switching models could capture such nonlinearities.

Third, our focus on reduced-form relationships limits structural interpretation. Identifying specific channels (import costs, pricing-to-market, menu costs) would require more structural approaches. Fourth, the study period ends in mid-2020, missing the recent 2021-2022 crisis episode. Updating the analysis with recent

 

data would provide valuable insights into ERPT during severe external shocks.

Finally, we do not examine firm-level heterogeneity in pass-through. Microdata analysis could reveal how firm characteristics (size, import dependence, market power) mediate exchange rate effects. Such granular evidence would enhance understanding of pass-through mechanisms and inform targeted policy interventions.

### 5.5 Final Remarks

Exchange rate fluctuations constitute a significant driver of inflation dynamics in Bangladesh. Our evidence demonstrates that the price level response depends critically on both the direction and horizon of exchange rate changes. Monetary authorities cannot rely on symmetric models when formulating policy; asymmetric pass-through fundamentally alters optimal policy responses.

The finding that appreciations generate stronger producer price effects than depreciations suggests that Bangladesh Bank should carefully manage appreciation pressures. While currency strengthening helps control consumer inflation, it may harm export sectors through input cost increases. Depreciation, conversely, has limited direct consumer price effects but may support export competitiveness.

As Bangladesh continues integrating into global markets and potentially moves toward more flexible exchange rate regimes, understanding these asymmetric dynamics will become increasingly important. Our results provide an empirical foundation for evidence-based monetary policy that accounts for the complex, nonlinear relationship between exchange rates and domestic prices. Future policy frameworks should explicitly incorporate asymmetric pass-through when designing optimal responses to exchange rate shocks.

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