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**Price Pass-Through from Producer to Consumer Prices in Bangladesh: Evidence and Policy
Options for Managing Inflation**

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Price Pass-Through from Producer to Consumer Prices in Bangladesh: Evidence and Policy Options for Managing Inflation

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Executive Summary

This paper primarily aims to suggest some policy options for managing inflation by examining both the symmetric and asymmetric impacts of producer prices and central bank policy rates on consumer prices. The study utilizes ARDL and NARDL methodologies to estimate the model equation, drawing on monthly data from July 2016 to April 2026 obtained from the Bangladesh Bureau of Statistics and Bangladesh Bank. Producer prices naturally have a nonlinear pass-through effect on consumer prices. The central bank policy rate and wage rate exhibit asymmetric influences on consumer prices, necessitating the use of the NARDL approach in this paper. The study identified significant symmetric and asymmetric pass-through effects from producer prices to consumer prices in both the long and short run. An increase in producer prices results in higher consumer prices, whereas a decrease does not significantly lower consumer prices. Central bank policy rate and wage rate asymmetrically contribute to ongoing inflationary pressure. This paper provides new insights into the analysis of linear and nonlinear pass-through effects from producer prices to consumer prices using the ARDL and NARDL approaches within a single study. It enhances policy implications for monetary authorities by simultaneously examining the effects of producer prices, central bank policy rate, and wage rate index within a unified linear and nonlinear framework. The findings assist in exploring the underlying causes of persistent inflationary pressure in Bangladesh. They provide predictive insights for policymakers, indicating that while an increase in producer prices leads to inflationary pressure on consumer prices, negative changes in producer prices do not result in disinflationary effects. Policymakers should focus on stabilizing the transmission channel by addressing market dynamics.

Keywords: CPI, PPI, Inflation, ARDL, NARDL

JEL Classification: E31, C32, E52

1. Introduction & Context

Consumer Price Index (CPI) and Producer Price Index (PPI) are the two crucial indicators of the inflation levels of a country. The economists proposed that the present PPI can significantly influence the path of the potential CPI inflation of the country (Caporale et al., 2002; Dorestani & Arjomand, 2022). Producer prices reflected in initial productions costs are usually expected to impact the CPI after a time lag (Blomberg & Harris, 2007). This mechanism of cost-push transmission proposed that the change in inflation at producer level may act as an early indication of inflation at consumer level. Particularly in developing country like Bangladesh, maintaining price level stability is a core objective of the macroeconomic policy. Instability in price level has a direct impact on the economic growth and household welfare. Thus, it is important to explicate the path by which price changes pass through different stages of the supply chain to grasp the inflation dynamics. The inflationary pressures transmission from producer to consumer prices shows a key channel (Clark, 1995; McCarthy, 2007). It is crucial to understand the rate of interaction between CPI and PPI. This understanding is very important to assess inflation accurately and to investigate its movement through the economy. This assists the monetary authority to navigate the uncertainties associated with price stability and to smoothen the economic analysis and decision-making (Tiwari et al., 2013).

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This paper examines both the symmetric and asymmetric effects of producer prices on consumer prices in Bangladesh employing ARDL and NARDL approaches to assess the linear and nonlinear relationship between CPI and PPI. Consumer prices are usually considered as an ancestor to producer prices. Different macroeconomic indicators in practical terms are built using producer prices (Tiwari, 2012; Khan et al., 2018). The PPI offers information about cost scenario at production stage while CPI reveals the price differences incurred by the final consumers. Grasping the extent and nature of transmitting price from PPI to CPI is important to attain insights into inflation dynamics, market structures, and effectiveness of monetary policy. A dynamic relationship exists between producer and consumer prices and changes in producer prices has an impact on consumer prices in a single direction (Alemu, 2012; Morlin, 2025; Ahlander et al., 2023; Sidaoui et al., 2009; Murdipi & Law, 2016; Ghazali et al., 2009). The demand-side factors more significantly affect the producer prices than supply-side factors and they are also shaped by consumer prices (Fan et al., 2009; Clark, 1995). The economic literature finds a long-run bidirectional causal relation between CPI and PPI, exerting a stronger impact from PPI to CPI (Shahbaz et al., 2009). In certain nations, like France and Germany, producer prices solely drive consumer prices, whereas a two-way causality is noted in the United Kingdom, Italy, Japan, and the USA (Caporale et al., 2002). There exists a dynamic and bidirectional relationship between consumer and producer prices, where consumer prices lead producer prices in the short term, but the opposite is true in the long term (Tiwari et al., 2014). Additionally, various studies have concluded that there is no enduring relationship between producer and consumer prices (Dorestani & Arjomand, 2022; Ghazali et al., 2009; Akdi et al., 2006; Clark, 1999). In global context, empirical studies show that the degrees of pass-through between CPI and PPI vary across countries depending on supply chain mechanism, market dynamics and monetary policy stances. The empirical evidences document that a positive long run exists in both developed economies and emerging economies, though the short run relationship can differ due to different shocks and policy intervention (Nishimura & Koibuchi, 2016). To understand this relationship remains still more important for the developing economies because inflation in developing economies is frequently affected by supply-side disruptions. The inflation dynamics in Bangladesh are progressively being shaped by supply-side shocks. The changes in producers' pricing are not steadily reflected in consumers' prices due to some factors like rising input cost, exchange rate fluctuations, supply chain disruptions, and market rigidities. The motion in which the increases in producer prices are transmitted to consumer prices can differ from how decreases are transferred to. These phenomena are referred to as asymmetric price transmission. These symmetries can be caused by the factors like adjustment costs, downward price rigidities, imperfect competition, inflation expectations (Meyer & von Cramon-Taubadel, 2004; Peltzman, 2000). Therefore, assuming the asymmetric pass-through mechanism could conceal significant nonlinear dynamics and leads to skewed empirical findings. In this context, recent events of surged inflation underscore the necessity of more comprehensive investigation of the mechanisms underlying price transmission.

Despite asymmetric price transmission being an important research matter, the existing empirical literature of Bangladesh lacks studies that examine the nonlinear relationship between PPI and CPI. A few studies have to some extent investigated the effects of the supply-side factors on consumer prices, usually assuming symmetric price dynamics. Nevertheless, evidence observed in both developing and developed nations suggests that the price pass-through from producer to consumer prices are inherently nonlinear (Enders & Granger, 1998). Particularly, upward changes in producer prices can differently influence the consumer prices than the downward changes in both short and long run. Understanding these nonlinearities is crucial for accurately measuring inflationary risks and formulating timely policy responses.

In Bangladesh context, inflation is still a concern for the economists. The inflation is persistently driven by together the demand-pull inflation and the supply-side factors. Earlier studies on inflation in Bangladesh perspective have mostly considered the monetary shocks, exchange rate, food prices (Aziz & Ahmed, 2017; Uddin et al., 2014; Mahmud & Mondal, 2024). However, limited consideration has been given to examine the direct relationship between CPI and PPI though the producer-level prices has been persistently influencing the consumer-level inflation through increasing production costs, supply chain disruptions, and rising import costs. Bangladesh has been grappling with ongoing inflation, though there has been a slight easing of inflationary pressures recently. Despite this, inflation remains significantly above the target level. The BBS reports that in June 2026, Bangladesh experienced a CPI-based headline inflation rate of 9.16%, up from 8.48% in June 2025, marking the highest inflation in the South Asian region. Throughout FY2025-26, the average inflation rate stood at 8.68%. In response, Bangladesh Bank increased the policy rate to 10% in

October 2024 and has kept it there as part of a tightening monetary policy strategy to manage inflation within the desired range.

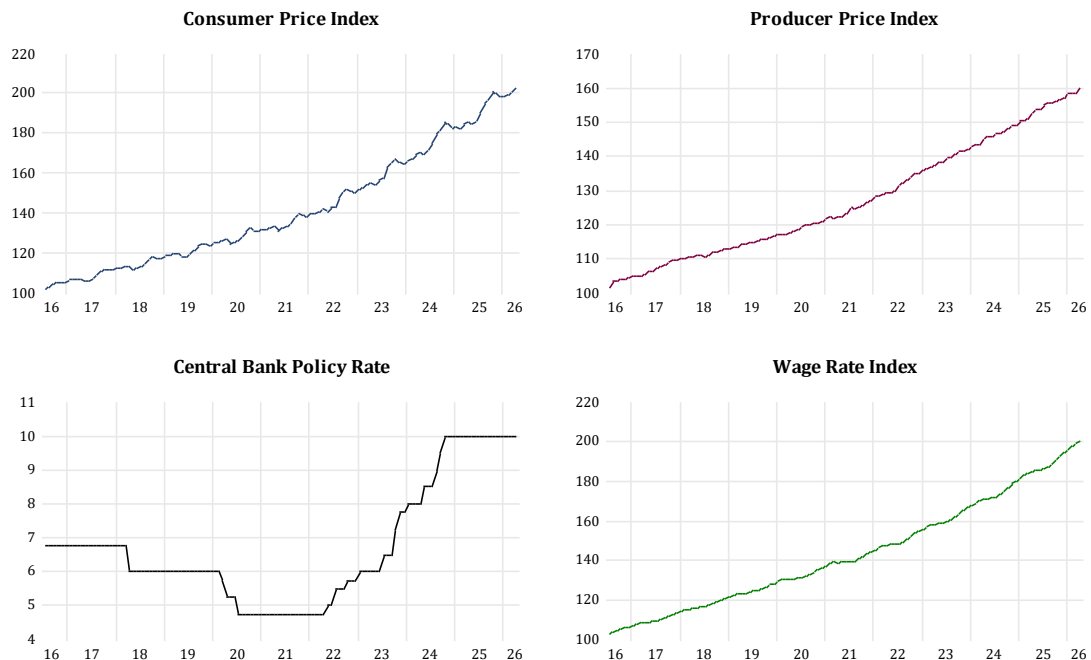


Figure 1: Historical Trends of Selected Variables

Figure 1 depicts the historical patterns of Bangladesh's CPI, PPI, Central Bank Policy Rate, and WRI throughout the observation period. Both the CPI and PPI showed a consistent upward trend, reflecting ongoing inflationary pressures. The rate of increase of CPI surpasses that of the PPI, indicating a partial pass-through from the PPI to the CPI. The central bank actively adjusts monetary policy in response to inflationary shocks by tightening or loosening it. In summary, Figure 1 implies that persistent inflation is primarily driven by producer costs, a tight monetary policy response, and ongoing market imperfections. In this context, this paper aims to address the current policy gap by examining how producer prices affect consumer prices in Bangladesh, focusing on both symmetric and asymmetric pass-through effects using the ARDL and NARDL models. The NARDL approach, developed by [Shin et al. \(2014\)](#), permits for the parting of producer price changes into positive and negative shares and enables the estimation of asymmetries in both the short and long term within a cointegration framework. This method is especially suitable for analyzing inflation dynamics in economies characterized by structural rigidities and adjustment frictions.

This paper provides some policy suggestions based on empirical findings. First, this paper offers empirical insights into whether fluctuations in producer prices are symmetrically and asymmetrically transmitted to consumer prices in Bangladesh. It provides new evidence for policymakers by examining the nonlinear effects of pass-through from producer to consumer prices through the NARDL method. Second, it contributes to the policymakers' decision making in the field of limited previous research by investigating the symmetric and asymmetric effects of producer prices, the central bank policy rate, and the wage rate index simultaneously in a unified nonlinear framework. Hence, this paper provides policy suggestions on whether policymakers should give more importance to demand-side policy instruments or supply side stabilization. Third, this paper offers significant policy recommendations for monetary authorities, supporting in the improvement of inflation estimation and the adjustment of policy measures to stabilize inflation expectations. Finally, the empirical results of this study contribute to understanding the intrinsic causes of ongoing inflationary pressure in Bangladesh. It provides policymakers with predictive insights, indicating that while an increase in producer prices leads to inflationary pressure by being transmitted to consumer prices, a decrease in producer prices does not result in disinflationary effects. Policymakers should focus more on stabilizing the transmission channel by addressing market dynamics.

2. Rationale of the Study

a. Why Does PPI Matter for Monetary Authority?

PPI acts as a key early indicator for inflationary condition. It reflects the changes in producer prices as a predictive means of forecasting CPI based inflation (IMF, 2004; Lee & Scott, 1996). Investigating the relationship between PPI and CPI is crucial for the monetary authority effective forecasting of inflation and formulation of policies (IMF, 2004). The cost of production transmitted finally to the consumers. The increase in production cost can ultimately lead to higher CPI through supply chain. Examination of PPI helps the central bank to detect the potential risk associated with inflation before it finally appears in CPI (Lee & Scott, 1996). PPI offers crucial insights into core inflation dynamics in the developing economies like Bangladesh. Several factors like exchange rate volatility, imported input prices, energy prices, and supply side constraints etc. significantly affect the production costs in these economies (Forbes et al., 2018; IMF, 2004). A closely understanding of the PPI–CPI transmission process allows monetary authorities to implement timely measures and differentiate between inflation pressures driven by demand and those caused by cost-push pressures (IMF, 2004; Lee & Scott, 1996)

b. Contemporary Challenges

Of late, Bangladesh has been passing through substantial inflationary challenges driven by diversified internal and external influences such as global commodity price hike, exchange rate depreciation, rising import costs, supply chain disruptions, and increased production costs (IMF, 2004; Forbes et al., 2018). These factors have resulted in higher costs for producers and persistent pressures on the consumer prices (IMF, 2004; Lee & Scott, 1996). Nevertheless, the transmission in inflation dynamics is not usually immediate or symmetric in real terms. An increase in producer prices can immediately rise the consumer prices while a decrease in production costs might not lead to a corresponding drop in consumer prices due to market rigidities, adjustment costs, and imperfect competition (Meyer & von Cramon-Taubadel, 2004; Peltzman, 2000). However, determination of whether the positive and negative changes in PPI influence CPI differently is essential to enhance the inflation management strategies (Meyer & von Cramon-Taubadel, 2004). Moreover, traditional symmetric approaches might not sufficiently capture these nonlinear price-adjustment processes. Therefore, employing a nonlinear method like NARDL approach provides a more profound insight whether the inflationary shocks exert greater influence than disinflationary ones (Shin et al., 2014).

c. Policy Gap

Though controlling inflation is the key policy focus in Bangladesh, existing policy frameworks mostly emphasize movement of CPI and demand-side tools of monetary policy. The policy frameworks less emphasize on the dynamics of inflation from producer's perspective. Limited empirical research prevails on how changes in producer prices influence consumer prices and whether the transmission is asymmetric. The past research usually employs linear approach for estimation which assumes that both increases and decreases in producer prices influence consumer prices equally. This assumption might not consider the significant market characteristics such as downward price rigidity and incomplete pass-through of cost reductions. Therefore, this paper offers to fill the policy gap by using ARDL and NARDL approaches to explore symmetric and asymmetric transmission mechanism from PPI to CPI in Bangladesh. The findings offer some valuable insights for the monetary authority to improve inflation forecasting, effective policy formulation, and manage the cost-push inflationary more effectively.

3. Evidence from Previous Studies

While many researchers have explored the causal relationship between the CPI and PPI from their own viewpoints, there has been no examination of the asymmetric relationship between these indices in Bangladesh. This study focuses on the cost-push inflation theory, which suggests that changes in production costs are transmitted through the supply chain, eventually affecting consumer prices (Blinder, 1981; Gordon, 1981). However, the evidence supporting the cost-push inflation theory is still uncertain and lacks precise measurement (Williams, 2023). To address this issue, this study employs nonlinear regression analysis. The PPI acts as a measure of upstream cost pressures and is anticipated to influence the CPI. Nonetheless, this transmission might not be uniform. Theories concerning price rigidity and menu costs suggest that firms are more inclined to raise prices than lower them due to adjustment costs and downward nominal rigidities,

resulting in a more pronounced pass-through of positive cost shocks, especially in the short term (Ball & Mankiw, 1994; Mankiw, 1985). Firms adjust their prices in response to supply shocks and impose higher markups during disinflationary shocks, which diminishes the pass-through of disinflationary supply shocks (Kharroubi et al., 2023). Market power and imperfect competition further contribute to this asymmetry, as firms in concentrated markets often pass on cost increases to preserve profit margins while absorbing cost reductions as increased markups (Peltzman, 2000; Rotemberg & Saloner, 1986). Additionally, asymmetric information and consumer search costs imply weaker downward price adjustments, as consumers are generally more responsive to price increases than decreases (Stiglitz, 1987; Tappata, 2009). Together, these frameworks indicate that the transmission of prices from producers to consumers is inherently nonlinear, with different reactions to positive and negative shocks, rendering linear symmetric models inadequate. This theoretical basis supports the application of the Nonlinear Autoregressive Distributed Lag (NARDL) approach by Shin et al. (2014) to capture asymmetric short-run and long-run pass-through effects from producer prices to consumer prices. Research in the field acknowledges that macroeconomic indicators often exhibit asymmetric responses to various types of shocks. Traditional linear models assume that both positive and negative shocks from explanatory variables have the same or symmetric impact on the dependent variable. Shin et al. (2014), building on the work of Shin & Pesaran (1999), introduced the Nonlinear Autoregressive Distributed Lag (NARDL) method. This approach captures both long-term and short-term asymmetric relationships within a unified cointegration framework. By breaking down variables into positive and negative partial sums, the NARDL method assesses their influence on the dependent variable within the ARDL framework. Numerous studies have shown that price levels respond differently to shocks from supply-side pressures or demand-side elements, such as changes in the central bank's policy rate.

Ibrahim (2015) observes that increases in producer prices generally exert a more substantial influence on consumer prices compared to decreases. This indicates an asymmetric transmission of prices from producers to consumers. Long & Liang (2018) investigated the differential effects of global crude oil price changes on China's PPI and CPI inflation. Their findings reveal that oil price shocks have long-term asymmetric effects on China's PPI and CPI, with oil price hikes having a more pronounced impact than reductions. Makinde et al. (2025) examined the nonlinear effects of global oil price variations on Hong Kong's food prices using the NARDL method. Their study shows that while rising oil prices significantly elevate food prices, declining oil prices do not lead to a significant reduction in food prices. Chou & Lin (2019) identify asymmetric price transmission between retail prices and farm costs, demonstrating that retail prices react more swiftly and intensely to increases in farm costs than to decreases. Liu et al. (2022) examined the uneven transmission of prices from the wholesale sector to the retail market over varying timeframes. Their findings indicate that wholesale and retail carp prices are nonlinearly cointegrated, with asymmetric price transmission occurring in both short and long terms. Wholesale prices generally exhibit quicker and more significant changes compared to retail prices. Xia (2009) investigated the movement of prices from the farm level to retail markets within agricultural sectors. This research emphasizes that price transmission in these markets is uneven, with increases in farm prices being more readily reflected in retail prices than decreases. Meyer & von Cramon-Taubadel (2004) offer an extensive analysis of the literature concerning asymmetric price transmission. They observed that the transmission of price changes from producers to consumers often differs when prices increase compared to when they decrease. Their critique highlights the prevalence of method-driven results and calls for more empirically robust methods to directly capture nonlinear adjustments, which serves as a key motivation for this study. Anderl & Caporale (2023) present compelling evidence that inflation reacts asymmetrically to economic shocks, contingent on whether these shocks are positive or negative. They demonstrated that nonlinear ARDL models are superior to linear models in capturing both short-term and long-term adjustment dynamics effectively. Their research underscores that ignoring these asymmetries can result in an underestimation of pass-through effects. Alemu (2012) explored the dynamic interaction between producer and consumer prices, noting a one-way causality from producer to consumer price inflation. Consumer inflation reacts differently to increases and decreases in producer inflation, with consumer prices tending to rise more rapidly than they fall. Although Gómez et al. (2010) identified short-run asymmetries with notable differences across countries, they did not find evidence of long-run asymmetric price transmission. Albahouth (2025), Bala & Chin (2018), and Lacheheb & Sirag (2019) report asymmetric cointegration between oil prices and inflation. Their findings indicate that rising oil prices lead to increased inflation rates in both the short and long term. In contrast, a decline in oil prices does not result in reduced inflation, nor do lower oil prices alleviate inflationary pressures on consumer prices. Demir (2022) identified a long-run positive asymmetry between producer and consumer prices, with demand-side

effects being dominant, while short-run asymmetric transmission occurs from producer prices to consumer prices. Peltzman (2000) explored the uneven dynamics between output and input prices within consumer and producer goods markets. The study revealed that, in most of these markets, output prices adjust to cost increases at a rate that is at least double that of their response to cost decreases. Asık (2023) examined the irregular relationship between exchange rates and price indices in Turkey, finding a positive correlation between the PPI and CPI over both short and long periods, with the PPI having an asymmetric effect on the CPI. In 2024, Aşık expanded on this by analyzing the asymmetric influence of producer prices on consumer prices and investigating the cointegration between these indices in Turkey's economy. The PPI positively affects the CPI in both short and long terms, with positive PPI changes leading to CPI increases, while negative changes lack statistical significance on the CPI. Yu et al. (2013) studied interest rate pass-through in several Asian countries, discovering incomplete pass-through in nations like Indonesia, Hong Kong, Thailand, and the Philippines, with Japan experiencing limited pass-through. Korea exhibited over pass-through, with positive long-term asymmetric pass-through in Korea and Hong Kong, but negative in Thailand and Indonesia. Singapore and Malaysia showed no significant interest rate pass-through. Empirical studies by Akbar et al. (2015), Yu et al. (2013), and Zhang et al. (2017) demonstrate that an increase in the policy rate has a stronger contractionary impact on price levels and output than the expansionary effect of a policy rate decrease.

Although extensive research has been undertaken on the uneven transmission of prices from producers to consumers, there are still some gaps in the existing literature. Most of the previous studies focus largely on oil prices or the price relationship between farm and retail. No study examines the combined asymmetric influences of producer prices, monetary policy rate, and wage rate on consumer prices within a single nonlinear framework. Additionally, empirical studies on developing economies in South Asia such as Bangladesh are scarce and incoherent. Those studies usually utilize linear or partially nonlinear models. Besides, the existing research hardly incorporates cost-push inflation, monetary transmission and wage dynamics into one empirical framework. These studies inadequately explore the interaction between supply-side and demand-side shocks derived from policy actions. Therefore, the scope and determination of asymmetric pass-through effects across different macroeconomic channels remain mostly unquantified. Existing gaps are addressed and the current policy landscape is enhanced by this study. It extends the asymmetric price transmission framework by examining the nonlinear effects of producer prices, policy rate, and wage rate on consumer prices concurrently using NARDL method in the Bangladeshi context. In addition, this study provides strong empirical evidence of asymmetries in both the short and long term, contributing a more comprehensive insight into inflation dynamics than conventional linear approaches. Moreover, the study offers a consistent theoretical and empirical explanation of inflationary pressures in a developing economy. Last of all, the findings suggest policy-relevant insights and show that positive shocks exert stronger and more lasting impacts than negative shocks, highlighting the necessity of taking into consideration of asymmetries in macroeconomic stabilization and inflation management strategies.

4. Data and Research Methods

a. Data Sources and Explanation

This research examines the most recent monthly secondary data spanning from July 2016 to April 2026, sourced from the Bangladesh Bureau of Statistics (BBS) and Bangladesh Bank. The analysis starts in July 2016 due to the unavailability of Producer Price Index (PPI) data from the BBS before this date. In this study, the focus is on analyzing both the long-run and short-run relationships between the dependent variable and the regressors. Additionally, it assesses how the producer price index, central bank policy rate, and wage rate index asymmetrically affect the consumer price index in Bangladesh. The research further explores the directional relationship between the CPI and PPI to identify the primary factor driving inflation in Bangladesh.

The study focuses on several key variables: the consumer price index, which measures prices at the consumer level; the producer price index, reflecting prices at the production level; the central bank policy rate, a monetary tool used to control inflation from the demand side; and the wage rate index. A crisis dummy variable is incorporated to account for the impact of the COVID-19 era. In analyzing inflation patterns, it is essential to consider structural breaks, particularly those associated with the COVID-19 pandemic. The pandemic caused substantial disruptions in economic activity, labor markets, supply chains, and policy

responses. In Bangladesh, the COVID-19 shock affected both supply-side and demand-side factors, leading to changes in the mechanisms of inflation transmission.

Table 1 Explanation of the Variables

Variable	Base/Unit of Measurement	Symbol	Source
Consumer Price Index	2015-16=100	CPI	BBS
Producer Price Index	2015-16=100	PPI	BBS
Central Bank Policy Rate	In percent	CBPR	Bangladesh Bank
Wage Rate Index	2015-16=100	WRI	BBS

b. Model Framework

The primary goal of this research is to explore both the long-term and short-term symmetric and asymmetric relationship between the Consumer Price Index (CPI) and the explanatory variables, namely the Producer Price Index (PPI), Central Bank Policy Rate (CBPR), and Wage Rate Index (WRI). Additionally, it seeks to assess how PPI, CBPR, and WRI asymmetrically impact the CPI in Bangladesh. The model is grounded in macroeconomic inflation theories, which suggest that consumer prices are affected by production costs (Blinder, 1981; Gordon, 1981), monetary policy (Blanchard, 2017; Friedman, 1968), and wage dynamics (Ball & Mankiw, 1994; Blanchard, 2017; Friedman, 1968; Gordon, 1981; Phillips, 1958). Specifically, it is anticipated that producer prices will pass on cost pressures to consumer prices, policy interest rates will influence inflation via the monetary transmission mechanism, and wage dynamics will alter producer prices by affecting production costs. The econometric model for this study has been formulated as follows:

$$\ln CPI_t = \alpha_0 + \beta_1 \ln PPI_t + \beta_2 CBPR_t + \beta_3 \ln WRI_t + \varepsilon_t \quad (1)$$

This model demonstrates the influence of PPI, CBPR, and WRI on CPI and the shaping of policy decisions in Bangladesh. The coefficients associated with the explanatory variables reveal how CPI reacts to these variables. Except for CBPR, all variables are expressed in a natural logarithmic form. The terms α_0 and ε_t represent the intercept and the white-noise error, respectively. The ADF test is widely regarded as the leading method for assessing stationarity. While it reduces the degrees of freedom, the ADF test enhances the basic DF test by including lagged difference terms to manage autocorrelation. Dickey & Fuller (1979) and Dickey & Fuller (1981) noted that such terms are employed to handle serial correlations. Dickey and Fuller (1979) and Dickey and Fuller (1981) pointed out that terms like $\Delta \ln CPI_{t-i}$ are used to deal with serial correlation. Taking null hypothesis ($H_0: \lambda = 0$) and alternative hypothesis ($H_1: \lambda < 0$), the general ADF test, including the intercept, can be specified as follows:

$$\Delta Y_t = \alpha_0 + \lambda Y_{t-1} + \sum_{i=1}^n \beta_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

The variable under consideration is denoted by Y_t , while represents the first difference operator. The optimal number of lags is indicated by n , and the white noise error term is represented by ε_t . According to Shin et al. (2014), the partial sums retain the integration order of the original variable. The ADF test is formulated in a way that resembles the Phillips & Perron (1988) approach for assessing unit roots in asymmetric time series. Unlike the ADF test, the PP test manages heteroscedasticity and serial correlation by incorporating a nonparametric modification to the test statistics, which eliminates the need for lag difference terms.

c. Model specification

Specification for ARDL Model:

When variables are found to be integrated at level $I(0)$, first difference $I(1)$, or a combination of both, the Autoregressive Distributed Lag (ARDL) approach can be applied for subsequent analysis, including cointegration testing through the ARDL Bounds testing procedure introduced by Pesaran and Shin (1999) and later extended by Pesaran et al. (2001). This method enables the evaluation of both short-term and long-term connections between the dependent variable and the model's explanatory variables. The ARDL Bounds

testing method also permits the inclusion of dummy variables without compromising the validity of critical values. Additionally, it helps in identifying autocorrelation and omitted variables by simultaneously analyzing the model's short-run and long-run dynamics. The ARDL model employed in this research to assess the symmetric relationship for Bangladesh is defined using equation (1).

$$\begin{aligned}\Delta \ln CPI_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta \ln CPI_{t-i} + \sum_{i=0}^q \alpha_{2i} \Delta \ln PPI_{t-i} + \sum_{i=0}^r \alpha_{3i} \Delta CBPR_{t-i} \\ & + \sum_{i=0}^s \alpha_{4i} \Delta \ln WRI_{t-i} + \lambda_1 \ln CPI_{t-1} + \lambda_2 \ln PPI_{t-1} + \lambda_3 CBPR_{t-1} \\ & + \lambda_4 \ln WRI_{t-1} + \varepsilon_t\end{aligned}\quad (3)$$

The maximum lag lengths are represented by p , q , r , and s , while Δ denotes the first-difference operator. In the ARDL Bounds testing procedure, the model is initially estimated using the Ordinary Least Squares (OLS) method, after which a Wald test or F-test is applied to examine the joint significance of the lagged level coefficients. Once the presence of cointegration is confirmed, the corresponding long-run ARDL cointegrating model is subsequently estimated.

$$\ln CPI_t = \alpha_0 + \delta_1 \ln PPI_t + \delta_2 CBPR_t + \delta_3 \ln WRI_t + \varepsilon_t \quad (4)$$

An Error Correction Model (ECM) can finally be developed to represent the short-term dynamics within the ARDL framework.

$$ECT_{t-1} = \ln CPI_{t-1} - \delta_1 \ln PPI_{t-1} - \delta_2 CBPR_{t-1} - \delta_3 \ln WRI_{t-1} \quad (5)$$

where ECT_{t-1} is the error correction term. By integrating ECT_{t-1} into equation (5), the ARDL model can be specified as

$$\begin{aligned}\ln CPI_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta \ln CPI_{t-i} + \sum_{i=0}^q \alpha_{2i} \Delta \ln PPI_{t-i} + \sum_{i=0}^r \alpha_{3i} \Delta CBPR_{t-i} \\ & + \sum_{i=0}^s \alpha_{4i} \Delta \ln WRI_{t-i} + \mu ECT_{t-1} + \varepsilon_t\end{aligned}\quad (6)$$

All coefficients in equation (6) represent the short-term behavioral patterns that influence the system's return to equilibrium, with μ the speed of adjustment being a key factor.

Specification for NARDL Model:

The NARDL method, initially introduced by [Shin et al. \(2014\)](#), assesses the impact of variables on the dependent variable within the ARDL framework by decomposing them into positive and negative partial sums. In line with the approaches of [Shin et al. \(2014\)](#), the asymmetric components of the PPI, CBPR, and WRI are constructed as cumulative sums.

$$\begin{aligned}\ln PPI_t^+ &= \sum_{i=1}^t \Delta \ln PPI_t^+ = \sum_{i=1}^t \max(\Delta \ln PPI_i, 0); \text{ and } \ln PPI_t^- = \sum_{i=1}^t \Delta \ln PPI_t^- \\ &= \sum_{i=1}^t \min(\Delta \ln PPI_i, 0)\end{aligned}\quad (7)$$

$$\begin{aligned}CBPR_t^+ &= \sum_{i=1}^t \Delta CBPR_t^+ = \sum_{i=1}^t \max(\Delta CBPR_i, 0); \text{ and } CBPR_t^- = \sum_{i=1}^t \Delta CBPR_t^- \\ &= \sum_{i=1}^t \min(\Delta CBPR_i, 0)\end{aligned}\quad (8)$$

$$\begin{aligned} \ln WRI_t^+ &= \sum_{i=1}^t \Delta \ln WRI_t^+ = \sum_{i=1}^t \max(\Delta \ln WRI_i, 0); \text{ and } \ln WRI_t^- = \sum_{i=1}^t \Delta \ln WRI_t^- \\ &= \sum_{i=1}^t \min(\Delta \ln WRI_i, 0) \end{aligned} \quad (9)$$

When the coefficients for the positive and negative elements of a variable differ, an asymmetric relationship is present. With this method, the long-term nonlinear ARDL model for this research can be expressed in the following system:

$$\ln CPI_t = \alpha_0 + \alpha_1^+ \ln PPI_t^+ + \alpha_1^- \ln PPI_t^- + \alpha_2^+ CBPR_t^+ + \alpha_2^- CBPR_t^- + \alpha_3^+ \ln WRI_t^+ + \alpha_3^- \ln WRI_t^- + \varepsilon_t \quad (10)$$

In this formulation, $\ln PPI_t^+$, $\ln PPI_t^-$, $CBPR_t^+$, $CBPR_t^-$, $\ln WRI_t^+$, and $\ln WRI_t^-$ represent the partial sums of positive and negative variations in PPI, CBPR, and WRI, respectively. These decompositions enable the model to distinguish between the effects of inflationary and deflationary shocks on CPI. The coefficients α_1^+ , α_1^- , α_2^+ , α_2^- , α_3^+ , and α_3^- capture the long-run asymmetric impacts of positive and negative changes in PPI, CBPR, and WRI on CPI. The long-run parameters associated with PPI (α_1), CBPR (α_2), and WRI (α_3) are considered distinct, reflecting the possibility that positive and negative movements in these variables may exert unequal effects on CPI. Accordingly, the conventional ARDL framework can be extended into the Nonlinear ARDL (NARDL) model by incorporating the asymmetric positive and negative components of PPI and CBPR, as expressed in Equation (11).

$$\begin{aligned} \Delta CPI_t &= \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta \ln CPI_{t-i} + \sum_{i=0}^q \alpha_{2i}^+ \Delta \ln PPI_{t-i}^+ + \sum_{i=0}^r \alpha_{2i}^- \Delta \ln PPI_{t-i}^- + \sum_{i=0}^s \alpha_{3i}^+ \Delta CBPR_{t-i}^+ \\ &\quad + \sum_{i=0}^t \alpha_{3i}^- \Delta CBPR_{t-i}^- + \sum_{i=0}^u \alpha_{4i}^+ \Delta \ln WRI_{t-i}^+ + \sum_{i=0}^v \alpha_{4i}^- \Delta \ln WRI_{t-i}^- + \lambda_1 \ln CPI_{t-1} \\ &\quad + \lambda_2^+ \ln PPI_{t-1}^+ + \lambda_2^- \ln PPI_{t-1}^- + \lambda_3^+ CBPR_{t-1}^+ + \lambda_3^- CBPR_{t-1}^- + \lambda_4^+ \ln WRI_{t-1}^+ \\ &\quad + \lambda_4^- \ln WRI_{t-1}^- + \varepsilon_t \end{aligned} \quad (11)$$

Where α_{2i}^+ and α_{2i}^- capture short-run asymmetric responses of CPI to positive and negative changes in PPI. λ_2^+ and λ_2^- are the long-run level coefficients of the partial-sum series. Normalizing the level coefficients of decomposed explanatory variables by the coefficient of lagged dependent variable yields long-run asymmetric effects in the NARDL framework. The long-run multipliers for positive and negative changes in each explanatory variable are calculated as like $\ln PPI_{long-run}^+ = -\frac{\lambda_2^+}{\lambda_1}$ and $\ln PPI_{long-run}^- = -\frac{\lambda_2^-}{\lambda_1}$, given $\lambda_1 \neq 0$.

These provide the long-term impact of a unit cumulative positive or negative change in the PPI on CPI. An error-correction method can be used to depict long-term equilibrium relationships and short-term dynamics inside the NARDL framework. The following is the definition of the error correcting term:

$$\begin{aligned} ECT_{t-1} &= \ln CPI_{t-1} - \delta_2^+ \ln PPI_{t-1}^+ - \delta_2^- \ln PPI_{t-1}^- - \delta_3^+ CBPR_{t-1}^+ - \delta_3^- CBPR_{t-1}^- \\ &\quad - \delta_4^+ \ln WRI_{t-1}^+ - \delta_4^- \ln WRI_{t-1}^- \end{aligned} \quad (12)$$

The NARDL model is expressed in its error-correction form by incorporating these terms. This form accounts for both short-term asymmetric dynamics and the speed at which equilibrium is restored. By incorporating the long-term parameters and the error correction term, the NARDL error correction representation is restructured as follows:

$$\begin{aligned}
\Delta \ln CPI_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta \ln CPI_{t-i} + \sum_{i=0}^q \alpha_{2i}^+ \Delta \ln PPI_{t-i}^+ + \sum_{i=0}^r \alpha_{2i}^- \Delta \ln PPI_{t-i}^- \\
& + \sum_{i=0}^s \alpha_{3i}^+ \Delta CBPR_{t-i}^+ + \sum_{i=0}^t \alpha_{3i}^- \Delta CBPR_{t-i}^- + \sum_{i=0}^u \alpha_{4i}^+ \Delta \ln WRI_{t-i}^+ \\
& + \sum_{i=0}^v \alpha_{4i}^- \Delta \ln WRI_{t-i}^- + \psi ECT_{t-1} + \varepsilon_t
\end{aligned} \tag{13}$$

The adjustment speed is indicated by ψ in this context. The negative value, which is statistically significant, verifies the presence of long-term cointegration by demonstrating the pace at which deviations from the long-term equilibrium are corrected.

5. Empirical Results and Analysis

a. Empirical Results

The key findings of the study are outlined in the Empirical Results section. It is advised that the author emphasize the most significant findings rather than merely displaying the research data tables. These results should be thoroughly discussed with clear explanations and compared with the findings of other studies. Descriptive statistics provides a descriptive summary of the variables analyzed in this study, including the number of observations, mean, median, minimum and maximum values, standard deviation, skewness, kurtosis, and the Jarque–Bera statistic. The statistics indicate that the means for CPI, PPI, and WRI are 142.01, 127.24, and 143.57, respectively, showing distinct monthly variations among the indices. The CPI's minimum and maximum values were 101.94 and 202.73, respectively. Both CPI and PPI demonstrate moderate variability, with standard deviations of 29.39 and 16.89, and exhibit positive skewness. Largely, the descriptive statistics imply that CPI and PPI reveal a smooth trend all the way through the sample period (Appendix: Table 1).

The estimation of the model requires to the confirmation about the order of integration of the variables. Different methods like ADF, PP, and KPSS are used for testing unit root characteristics of time series. This study utilized the ADF and PP tests to examine the unit root. The results indicate that none of the variables are integrated at I(2); instead, they are all integrated at I(1) (Appendix: Table 2). Consequently, the ARDL and NARDL models were employed for estimation in this this study. Several techniques, such as the Johansen and Juselius tests, the Engle-Granger test, and the ARDL bounds test, are available for assessing cointegration. These approaches, however, are based on the assumption that there is a symmetric relationship between the dependent and independent variables. Consequently, the ARDL bounds test is applied to linear models, while the NARDL bounds test is utilized for nonlinear models to examine cointegration. Table 2 presents the results of the bounds test. When considering CPI as the dependent variable, the test results indicate that the F-statistics exceed the critical values of the upper bounds at both the 1% and 5% significance levels for the ARDL and NARDL models. This finding implies a long-term symmetric and asymmetric relationship exists among CPI, PPI, CBPR, and WRI.

Table 2: Bounds Test Results for Cointegration

H ₀ : No long-run relationship exists						
Model	Selected Model	F-Statistic	Critical values			
			At 5% level		At 1% level	
			Lower	Upper	Lower	Upper
Model1: ARDL	(3,4,2,4,0)	7.598541	2.86	4.01	3.74	5.06
Model2: NARDL	(3,4,0,1,0,4,2,0)	6.664033	2.32	3.50	2.96	4.26

* Lower and upper bound are respectively the stationary and non-stationary bounds.

Table 3 presents the long-run estimation outcomes for both the linear and nonlinear relationship between CPI and the explanatory variable. The ARDL model estimation results illustrate CPI's symmetrical response to variations in PPI, CBPR, and WRI over the long run. Conversely, the NARDL model estimation

results demonstrate CPI's asymmetrical reaction to both positive and negative shocks in PPI, CBPR, and WRI in the long run. The model selection is determined using the AIC lag selection criteria ([Appendix: Figure 1](#)).

Table 3: ARDL & NARDL Long-run Results

Model1: ARDL				Model2: NARDL			
Variable	Coefficient	Standard Error	P-value	Variable	Coefficient	Standard Error	P-value
$\ln PPI_{t-1}$	0.756562	0.184482	0.000079	$\ln PPI_{t-1}^+$	0.636849	0.258263	0.015271
$CBPR_{t-1}$	0.008892	0.000977	0.000000	$\ln PPI_{t-1}^-$	1.898635	1.322994	0.154201
$\ln WRI_{t-1}$	0.494955	0.124845	0.000131	$CBPR_{t-1}^+$	0.010165	0.002185	0.000010
C_D	0.005196	0.003907	0.186353	$CBPR_{t-1}^-$	0.004460	0.006228	0.475522
$CE = \ln CPI_{t-1} - 0.756562 * \ln PPI_{t-1} - 0.008892 * CBPR_{t-1} - 0.494955 * \ln WRI_{t-1} - 0.005196 * C_D$				$\ln WRI_{t-1}^+$	0.569236	0.179607	0.001997
				$\ln WRI_{t-1}^-$	-7.715054	13.673686	0.573792
				C_D	0.000054	0.006397	0.993309
				$CE = \ln CPI_{t-1} - 0.636849 * \ln PPI_{t-1}^+ - 1.898635 * \ln PPI_{t-1}^- - 0.010165 * CBPR_{t-1}^+ - 0.004460 * CBPR_{t-1}^- - 0.569236 * \ln WRI_{t-1}^+ + 7.715054 * \ln WRI_{t-1}^- - 0.000054 * C_D$			

Table 4 presents the short-run estimation outcomes for both the linear and nonlinear relationship between CPI and the explanatory variable. The ARDL findings illustrate CPI's symmetrical reaction to variations in PPI, CBPR, and WRI over the short run. The negative and significant ECT of ARDL short-run result shows that approximate 67% deviation in short-run is adjusted in every month. The NARDL short-run findings show the responses of CPI to the positive and negative changes in PPI, CBPR, and WRI in the short run. The negative and significant ECT of NARDL short-run result shows that about 62% of short-run deviation is adjusted in each month which suggests a stable long-run asymmetric relationship among CPI, PPI, CBPR, and WRI.

Table 4: ARDL and NARDL Short-run Results

Model1: ARDL				Model2: NARDL			
Variable	Coefficient	Std. Error	P-value	Variable	Coefficient	Std. Error	P-value
ECT*	-0.673885	0.107120	0.000000	ECT*	-0.619898	0.099223	0.000000
$\Delta \ln CPI_{t-1}$	0.254548	0.092631	0.007115	$\Delta \ln CPI_{t-1}$	0.226109	0.088054	0.011744
$\Delta \ln CPI_{t-2}$	0.161048	0.100168	0.111037	$\Delta \ln CPI_{t-2}$	0.171046	0.092199	0.066577
$\Delta \ln PPI_t$	0.038777	0.222309	0.861881	$\Delta \ln PPI_t^+$	-0.074035	0.229428	0.747614
$\Delta \ln PPI_{t-1}$	-0.435604	0.233276	0.064784	$\Delta \ln PPI_{t-1}^+$	-0.440100	0.231738	0.060489
$\Delta \ln PPI_{t-2}$	-0.176844	0.221558	0.426655	$\Delta \ln PPI_{t-2}^+$	-0.243616	0.221662	0.274442
$\Delta \ln PPI_{t-3}$	0.374616	0.204512	0.069965	$\Delta \ln PPI_{t-3}^+$	0.436040	0.213750	0.044046
$\Delta CBPR_t$	-0.001114	0.004037	0.783188	$\Delta CBPR_t^+$	-0.001495	0.004587	0.745134
$\Delta CBPR_{t-1}$	0.007403	0.003992	0.066649	$\Delta \ln WRI_t^+$	1.652442	0.318924	0.000001
$\Delta \ln WRI_t$	1.510983	0.330883	0.000014	$\Delta \ln WRI_{t-1}^+$	-0.672657	0.336613	0.048454
$\Delta \ln WRI_{t-1}$	-0.481347	0.343553	0.164285	$\Delta \ln WRI_{t-2}^+$	-0.005646	0.345076	0.986980
$\Delta \ln WRI_{t-2}$	0.168456	0.355810	0.636929	$\Delta \ln WRI_{t-3}^+$	-1.352834	0.312475	0.000036
$\Delta \ln WRI_{t-3}$	-1.378497	0.313870	0.000028	$\Delta \ln WRI_t^-$	-32.537848	15.425999	0.037468
C	-0.827238	0.133519	0.000000	$\Delta \ln WRI_{t-1}^-$	47.373587	15.624494	0.003108
				C	2.869011	0.457194	0.000000

[Appendix: Table 3](#) presents the outcomes of the diagnostic tests conducted to evaluate the ARDL and NARDL models' validity and reliability. These findings indicate that the residuals follow a normal distribution and exhibit consistent variance across the measured values. Furthermore, the model does not suffer from issues related to serial correlation or specification errors.

b. Analysis

This study confirms that both long-run equilibrium symmetric and asymmetric significant relationships exist among CPI, PPI, CBPR, and WRI aligning with [Naseem et al.\(2010\)](#) and [Shahbaz, Awan, & Nasir\(2009\)](#). The findings of the ARDL model reveal that PPI and WRI strongly and persistently affect CPI, implying that a 1% increase in PPI and WRI increases CPI by approximately 0.75% and 0.49% in the long run, respectively, with a period lag. CBPR also positively affects CPI in the long run, but more weakly than PPI and WRI. These findings are consistent with [Morlin \(2025\)](#), [Caporale et al. \(2002\)](#), [Ahlander et al. \(2023\)](#), and [Akter & Rahman \(2025\)](#). The ARDL short-run results show that the inflation dynamics in Bangladesh has past inertia. The ARDL short-run coefficients of PPI suggest that pass-throughs are both delayed and partial in the long term. The CBPR begins to have a notable impact on the CPI after a delay of several months. According to the Granger Causality Test, there is a one-way Granger causality from PPI to CPI at a 5% significance level, meaning that PPI significantly drives changes in CPI, aligning with [Caporale et al. \(2002\)](#) & [Sidaoui et al. \(2010\)](#), while CPI does not affect PPI. Additionally, WRI Granger causes CPI. Both CPI and PPI Granger cause CBPR, indicating that CBPR is adjusted in reaction to changes in CPI and PPI, rather than CBPR causing changes in CPI and PPI.

The NARDL long-run analysis indicates that PPI exerts an asymmetric influence on CPI in Bangladesh over the long run. The positive and significant coefficient of PPI's positive component suggests that a 1% rise in PPI eventually leads to a 0.64% increase in CPI. This finding supports the cost-push theory of [Blinder, \(1981\)](#) and [Gordon, \(1981\)](#), which posits that sustained increases in production costs are ultimately reflected in consumer prices. Conversely, the negative PPI component's insignificant coefficient suggests that a reduction in PPI does not lead to a long-run decrease in CPI. This observation is consistent with the concepts of price rigidity and menu cost theories of [Blinder et al. \(1998\)](#), [Hall & Hitch \(1939\)](#), [Stiglitz, \(1987\)](#), [Rotemberg & Saloner \(1986\)](#), [Peltzman \(2000\)](#). Thus, the NARDL long-run findings of this research indicate that while an increase in PPI uplifts CPI over time, a decrease in PPI does not have the same effect. In the short run, the NARDL results reveal that PPI has an asymmetric impact on CPI. Short-run inertia influences Bangladesh's inflation dynamics, indicating that past fluctuations affect current price levels. This aligns with the theories of inflation persistence and adaptive expectations of [Friedman \(1968\)](#), [Fuhrer & Moore \(1995\)](#), [Galí & Gertler \(1999\)](#), [Nerlove \(1958\)](#), [Taylor \(1980\)](#). Despite the distributed and nonlinear adjustment process, the lagged positive and significant coefficient indicates that increases in PPI are transmitted to CPI in the short term. However, the negative components' coefficients are mostly insignificant, indicating incomplete transmission to CPI. In the short run, CPI is more responsive to PPI increases than to decreases. These findings are compatible with [Ball & Mankiw \(1994\)](#), [Mankiw \(1985\)](#), [Peltzman \(2000\)](#), [Meyer & Von Cramon-Taubadel \(2004\)](#). The results of this paper indicate that PPI influences CPI in an asymmetric transmission over both long and short periods, achieving the study's primary goal. An upward shift in PPI results in a rise in CPI, whereas a downward shift does not significantly affect CPI statistically. This finding is consistent with the studies by [Ibrahim \(2015\)](#), [Long & Liang \(2018\)](#), [Makinde et al. \(2025\)](#), [Chou & Lin \(2019\)](#), [Liu et al. \(2022\)](#), [Xia \(2009\)](#), [Meyer & Von Cramon-Taubadel \(2004\)](#), [Anderl & Caporale \(2023\)](#), [Alemu \(2012\)](#), [Albahouth \(2025\)](#), [Bala & Chin \(2018\)](#), [Lacheheb & Sirag \(2019\)](#), [Demir \(2022\)](#), [Peltzman \(2000\)](#), and [Aşık \(2024\)](#). The positive and significant coefficient of CBPR indicates that the central bank policy rate has a notable yet smaller effect on CPI in the long run via the cost channel. An increase in interest rates raises firms' borrowing costs, which are eventually transferred to CPI, aligning with the cost channel of monetary policy ([Ravenna & Walsh, 2006](#)). In the long run, CPI is surged by approximately 0.01% in response of 1% increase in CBPR. The statistically insignificant negative component of CBPR suggests that CPI does not reduce in response of the decrease of CBPR in the long run. Hence, the CPI is asymmetrically influenced by CBPR in the long and short run. Short-run findings show that the CPI is asymmetrically influenced by the CBPR with some period lag and fluctuations. The impact of the positive component is stronger than the negative component. The effects of monetary tightening have weak and delayed interest rate pass-through in developing countries though the cost channel. This is aligned with the findings of [Patnaik et al. \(2011\)](#), [Taylor \(2000\)](#), and [Tillmann \(2008\)](#). The positive and significant coefficient of the positive component of WRI indicates that the CPI surges by approximate 0.57% in response of 1% increase in WRI in the long run. This finding is aligned with the wage-push theories of inflation by [Phillips \(1958\)](#), [Schumpeter \(1936\)](#), and [Gordon \(1981\)](#). However, the insignificant coefficient of the negative CBPR component suggests that a reduction in WRI does not lower CPI in the long term, consistent with downward nominal wage rigidity by [Dickens et al. \(2007\)](#). The short-run nonlinear estimation coefficients imply that an increase in WRI leads to an immediate and sustained rise in CPI, while a decrease in WRI does not significantly cause disinflationary effects.

6. Policy Implications

The empirical findings of this study and the evidences from the previous studies suggest some important policy implications for the monetary authorities of Bangladesh.

Policy option 1: Formulating Model-based Integrated Monetary Policy Framework (MBIMPF)

This study strongly suggests that the inflation controlling requires an integration of monetary and supply-side policies. The monetary authorities should formulate a Model-based Integrated Monetary Policy Framework employing general equilibrium between monetary sector and real sector variables along with the external sector. Inflation dynamics of Bangladesh is influenced by both demand-side and supply-side factors; the supply-side impact is stronger than the demand-side. Policymakers need to pay more attention to producer prices, monetary conditions, and wage movements, as these elements have a substantial impact on consumer prices.

Policy option 2: Strengthening market monitoring and producer-side interventions

The significant positive impact of PPI on CPI suggests that rise in producer prices are directly transmitted to consumer prices. Consequently, it is important for the policymakers to enhance the monitoring of producer prices and to adopt strategies aimed at minimizing unnecessary production costs and improving supply chain effectively. The NARDL model's findings of asymmetric effects highlight that upward shocks necessitate more robust policy actions compared to downward adjustments. Thus, policymakers should focus on inflationary shocks and initiate early intervention strategies during the times of increasing input costs, exchange rate volatility, or credit expansion.

Policy option 3: Avoid excessive cost-push effects from monetary tightening

The asymmetric effects analysis from the findings of this paper shows that rise in CBPR increases CPI through cost channel. Hence, this paper suggests that the monetary authorities should avoid excessive cost-push effects from monetary tightening.

7. Conclusion

Analyzing the nonlinear relationship helps policymakers in making effective decisions regarding macroeconomic indicators for the price stability. This study primarily aims to examine the symmetric and asymmetric pass-through effects from producer prices to consumer prices in Bangladesh, utilizing both ARDL and nonlinear ARDL methods. Additionally, it examines the linear and nonlinear impacts of central bank monetary policy and wage rates on consumer prices in Bangladesh. The empirical findings reveal substantial evidence of both short-term and long-term asymmetries in the dynamics of consumer prices. Positive changes in producer prices, central bank policy rates, and wage rates exercise significant and more lasting effects on consumer prices compared to negative changes. This highlights the existence of the asymmetric price transmission in Bangladesh. An increase in the producer prices leads to higher consumer prices but a decrease does not. The inflationary condition is also asymmetrically influenced by the central bank policy rate and wage rate which indicate presence of price and wage rigidity and market imperfections. The findings of this paper suggest that PPI strongly influences the persistent inflationary condition of Bangladesh. The inflation dynamics are driven not only by the central bank policy rate but also by the production cost and market rigidities. Hence, the findings of this paper entail the necessity of using nonlinear approaches for managing inflation in Bangladesh. Therefore, the policymakers should adopt a proactive and nonlinear approach for managing inflation. Production cost requires stabilization to address the upward pressure on price level. This can be achieved through the enhancement of supply chain efficiency and productivity. The asymmetric impact of central bank policy rate suggests that the monetary authority should avoid the excessive cost push effect of monetary policy. The authority should give more attention to increase productivity keeping the policy rate at a permissive level. Accordingly, the central bank should make timely and credible policy rate adjustments while strengthening monetary transmission mechanisms. Aligning wage growth with productivity gains is also necessary to prevent persistent cost-push inflation. This highlights the importance of coordination of labor market and macroeconomic policies. Finally, Prior intervention and necessary initiatives are crucial to reduce the inertia of inflation and maintaining price stability considering the positive shocks and downward adjustments. The effectiveness of inflation management strategies should

be enhanced by integrating the analysis of asymmetric inflation dynamics into the macroeconomic policy formulation. This will contribute to maintain a sustainable economic stability of Bangladesh.

Declaration of using AI in the writing process

The authors declare that the research ideas, contents, and analyses are authors' own. No AI tools have been used in this study for analyzing, interpreting, or generating any of the part of this paper. The authors have used AI tool (Paperpal) for solely reviewing and improving grammar, paraphrasing, and language clarity. The authors confirm that the manuscript has been reviewed carefully and compiled with the standards of originality.

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Appendix

Figure 1: ARDL and NARDL Model Selection Criteria

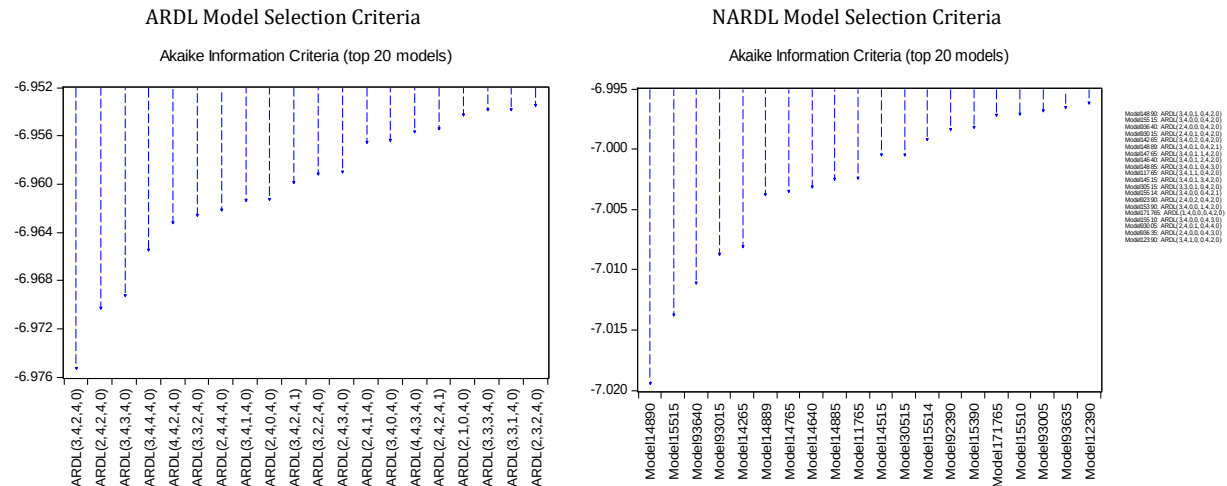


Figure 2: Normality Tests for ARDL and NARDL Model

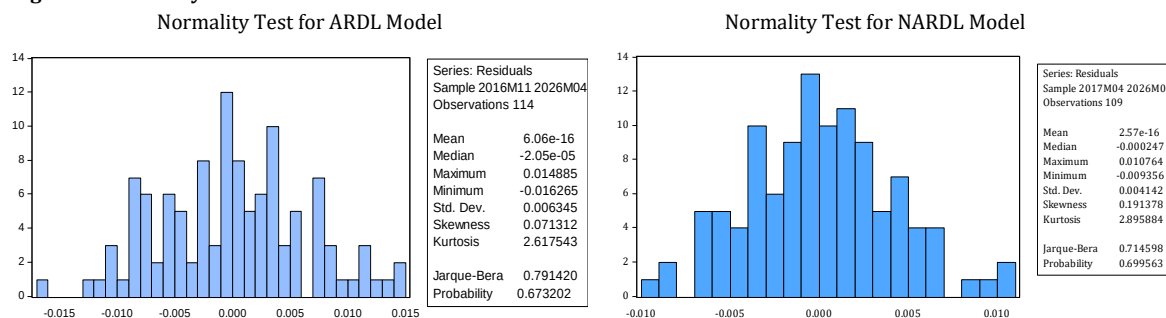


Table 1: Descriptive Statistic Results

Statistic	CPI	PPI	PR	WRI
Mean	142.01	127.24	6.73	143.57
Median	133.07	122.81	6.00	139.08
Maximum	202.73	160.36	10.00	199.75
Minimum	101.94	101.82	4.75	102.69
Std. Dev.	29.39	16.89	1.75	27.29
Skewness	0.57	0.37	0.83	0.38
Kurtosis	2.11	1.87	2.50	2.03
Jarque-Bera	10.27	8.94	14.85	7.56
Probability	0.01	0.01	0.00	0.02
Observations	118	118	118	118

Table 2: Unit Root Test Results

Variable	At Level		At 1st Difference		Order of Integration
	t-Statistic	Critical Value	t-Statistic	Critical Value	
ADF Test					
<i>lnCPI</i>	1.240515	-3.488585	-8.300978	-3.489117*	I(1)

<i>lnPPI</i>	2.097295	-3.488063	-6.131838	-3.488585*	I(1)
<i>CBPR</i>	-0.174922	-3.488585	-3.854058	-3.488585*	I(1)
<i>lnWRI</i>	1.668176	-3.489117	-7.662349	-3.489659*	I(1)
PP Test					
<i>lnCPI</i>	3.716188	-3.487046	-8.538868	-3.487550*	I(1)
<i>lnPPI</i>	1.491025	-3.487046	-13.329770	-3.487550*	I(1)
<i>CBPR</i>	0.292429	-3.487046	-8.812661	-3.487550*	I(1)
<i>lnWRI</i>	1.544849	-3.487046	-5.699326	-3.487550*	I(1)
* represents 1% level of significance, respectively. Appropriate lags are selected using AIC.					

Table 3: Results of Diagnostic Tests

Tests	Null Hypothesis (H_0)	Model1: ARDL		Model2: NARDL		Decision
		F-Statistic	P-value	F-Statistic	P-value	
Ramsey Test	No specification error	1.539154	0.1271	1.368236	0.1746	Do not reject H_0
Breusch-Pagan-Godfrey Test	No heteroscedasticity	1.119317	0.3374	0.902498	0.6316	Do not reject H_0
LM Test	No serial correlation	0.452720	0.6373	0.638980	0.5311	Do not reject H_0
Jarque-Bera Test	Normally distributed	0.791420	0.6732	0.714598	0.6996	Do not reject H_0

Table 4: Pairwise Granger Causality Tests

Null Hypothesis	F-Statistic	P-value
LNPPPI does not Granger Cause LNCPI	12.462669	0.000013
LNCPI does not Granger Cause LNPPPI	1.449222	0.239160
CBPR does not Granger Cause LNCPI	1.828913	0.165394
LNCPI does not Granger Cause CBPR	5.275656	0.006475
LNWRI does not Granger Cause LNCPI	4.967286	0.008588
LNCPI does not Granger Cause LNWRI	17.435860	0.000000
CBPR does not Granger Cause LNPPPI	0.553206	0.576680
LNPPPI does not Granger Cause CBPR	3.659247	0.028907
LNWRI does not Granger Cause LNPPPI	1.775887	0.174110
LNPPPI does not Granger Cause LNWRI	13.075916	0.000008
LNWRI does not Granger Cause CBPR	2.952720	0.056312
CBPR does not Granger Cause LNWRI	4.753896	0.010449