Original Article

Inflation Dynamics in India During the Twin Shocks of COVID-19 and Ukraine War*

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Abstract

The COVID-19 pandemic, described as a 'once in a century' shock, caused India to experience one of the deepest economic contractions globally. As the economy began to recover through various fiscal stimulus measures, significant public capital expenditure, and traditional and unconventional fiscal and monetary policies, the outbreak of the Ukraine war disrupted the recovery and altered the global economic trajectory. International commodity prices, particularly crude oil, surged dramatically. This, coupled with heightened supply chain pressures, both globally and domestically, led to rising input costs and increased consumer price index (CPI) inflation. In this rapidly shifting macroeconomic landscape, we analyse whether the inflation dynamics have changed course. First, we examine the empirical patterns of CPI inflation by examining structural changes in the inflation process and its potential drivers before and after the pandemic and war periods. Next, we attempt to explain the evolving nature of inflation using a small open economy New Keynesian dynamic stochastic general equilibrium model. Our results reveal that (a) real and nominal frictions, as well as structural shocks, have become more pronounced and (b) inflation is now being driven

* The views expressed in this article are of the authors and do not represent the view of Reserve Bank of India and NIPFP.

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more significantly by cost-push and demand shocks in the aftermath of the pandemic and the war.

Keywords

Inflation, New Keynesian DSGE model, cost-push shock, pandemic, Ukraine war, Indian economy, monetary policy

JEL Classification: C32, E10, E12, E31

Introduction

During the last decade of 2011–2020, global inflation was stable at 2.5% (IMF).[1] The unprecedented COVID-19 pandemic created massive disruptions in economic activities worldwide since the beginning of the current decade. While the global inflation rate was modest at 1.9% in 2020 owing to a negative crude oil price shock for low demand, it surged in the subsequent years due to supply chain disruptions, fluctuations in commodity prices, and shifts in demand patterns caused by the pandemic. The wake of the Ukraine war at the beginning of 2022 further intensified the impact of supply chain pressure on inflation. Consequently, it peaked at 8% in 2022 before showing some moderation due to monetary tightening by central banks worldwide. The average global inflation increased to 6.4% from 2021 to 2023.

India has not been immune to these global trends. Inflation has become a central concern as the country navigates through the post-pandemic recovery phase. Before the pandemic, India experienced relatively stable inflation rates, influenced by demand- and supply-side factors. The COVID-19 pandemic and the Ukraine war had profound and multifaceted impacts on the Indian economy, leading to significant shifts in the inflationary process. This article examines the trajectory of inflation in India, focusing on the drivers of inflationary pressure and the structural factors causing its evolving dynamics in the backdrop of the pandemic and the war.

India adopted the flexible inflation targeting (FIT) monetary policy framework in February 2015 through an agreement between the Reserve

[1] https://www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD

Bank of India (RBI) and the Ministry of Finance (MOF). This framework was finally implemented in October 2016. Under this framework, the central bank is committed to stabilizing the headline consumer price index (CPI) inflation at 4% in the medium to long run, allowing for deviations within a band of ±2%. Since 2011, before the adoption of FIT in 2015, the average inflation rate was high at 8.7%. Following the adoption of FIT, the inflation rate remained stable at 4.1%, well within RBI's tolerance band, till the pandemic broke out. In the post-pandemic period, however, the average headline inflation rate increased to 5.9%.

To explore the changing dynamics of inflation and the contributing factors in India during pre- and post-pandemic periods, we rely on a prototype small open economy New Keynesian dynamic stochastic general equilibrium (SOE-NK-DSGE) model and estimate it with the macroeconomic data for the sample period of 2011:Q3 to 2023:Q4. We split the sample period into three segments: (a) the pre-pandemic period spanning from 2011:Q3 to 2019:Q4, (b) the post-pandemic period 2011:Q3 to 2021:Q4 and (c) the post-pandemic period with Ukraine war which considers the full sample. Exploiting the theoretical framework, we investigate the changing patterns of the shocks driving the inflationary pressure and the structural factors which can potentially explain the dynamics of inflation across the periods.

The body of literature examining the factors behind global inflation in the post-pandemic era highlights extensively the role of supply-side disruptions via trade channel and/or domestic capacity constraints (Ascari et al., 2024; Comin et al., 2024; Diaz et al., 2024; Giovanni et al., 2022; Meier & Pinto, 2024). While most studies concentrate on advanced countries, limited research on emerging markets and developing economies is done, offering similar evidence (Andriantomanga et al., 2023; Ye et al., 2023; Yousuf & Chowdhury, 2024). Our study contributes to the aforesaid literature by underscoring the relative importance of various shocks, drawing evidence from the inflation experience of an emerging market economy like India during pre- and post-pandemic years.[2] In our analysis, the role of global and domestic supply-side disturbances is captured distinctively via shocks to world prices and domestic input costs. Moreover, the model environment features a variety of economic factors that play a pivotal role in shaping the inflationary momentum.

[2] Recent studies in the context of post-COVID inflation in India includes Patra et al. (2024) on the spillovers of cost-push shock, Patra et al. (2023) on structural break and inflation properties and Patra et al. (2021) on the dynamics of the Phillips curve.

The key findings from the model estimation underscore significant changes in the nominal frictions, the elasticity of substitution between domestically produced and imported goods and the time-series behaviour of the economic drivers, suggesting a greater magnitude of the pass-through of shocks and responsiveness of CPI inflation to them. We observe that the variance of shocks related to domestic demand and external demand (i.e., related to foreign output) rose stupendously during the COVID period. After the outbreak of war, the cost-push shock and shock to foreign inflation joined the rally of increasing uncertainties. Through the lens of our SOE-NK-DSGE model, we find that the relative strength of these shocks to inflation has altered in the post-pandemic period. The role of productivity and policy shocks has diminished, while the domestic cost-push shock and demand shock have become predominant drivers of inflation after the outbreak of COVID-19 and the Ukraine war. Moreover, with the combined effect of the changing structural parameters and uncertainties, the sensitivity of CPI inflation to its key drivers has been amplified.

The rest of the article is organized as follows. The second section documents the changing patterns of the inflation dynamics and its drivers, spanning from 2011 to 2020, as well as the years after the COVID-19 and the Ukraine war. The third section describes the theoretical framework. The fourth section discusses the estimation results and key findings. The fifth section concludes the study.

Changing Dynamics of Inflation in India During Pre- and Post-pandemic and War Periods

Trends of Inflation Indicators

In the aftermath of the global financial crisis, the economic recovery witnessed a near double-digit CPI inflation (9.7% during 2012:Q1–2013:Q4) caused by adverse supply-side shocks and lagged demand-pull effects from the fiscal stimulus. Inflation remained strongly persistent despite the tightening of the policy rate. To tackle such stubborn price pressure sustainably, India transitioned to the FIT regime in 2015 through an agreement between the MOF and RBI.[3] By adopting the FIT monetary policy regime, RBI set its mandate to achieve the CPI inflation of 4% with a band

[3] Inflation in the headline CPI published by the Ministry of Statistics and Programme Implementation (MOSPI) was considered as the target indicator.

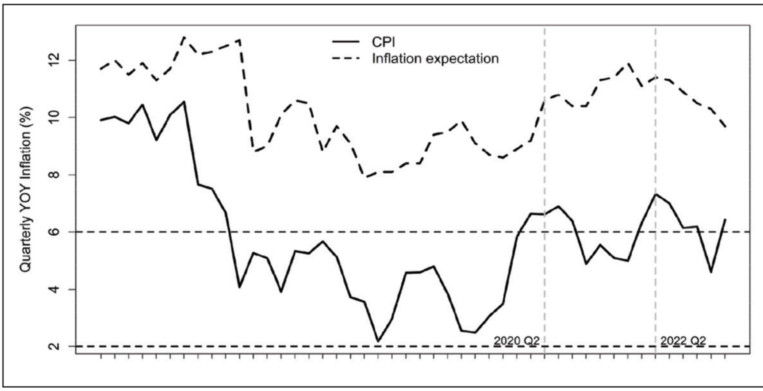

Figure 1. Headline CPI Inflation and Inflation Expectation.

Source: Central Statistical Organization, MOSPI, RBI.

of ±2% in the medium term.[4] Before the FIT, the average headline CPI inflation rate was 8.7%, while the inflation expectation measured by RBI's household survey-based expectations data was as high as 12.1% (Figure 1). After the commencement of FIT, headline inflation was stable at an average rate of 4.1%, well within RBI's tolerance band. Inflation expectations also declined to an average of 9.6% in this period.

From the end of 2019–2020, inflation started rising and stayed above the upper limit of RBI's tolerance band (2%–6%) during 2020–2021 (Figure 1). The surge in headline inflation was mainly due to supply chain disruption during the pandemic and high food inflation caused by weather shocks. The inflationary pressure eased in 2021 with the arrival of winter crops but remained sticky at above 5% due to sticky core inflation and rising energy inflation (Figure 2, Table 1). The Russia-Ukraine war started in February 2022, causing global food inflation to soar. Disruptions of wheat supplies from Ukraine led to a rise in demand for Indian wheat, adding to the price pressure. Global food and oil shocks, along with domestic weather shocks drove, the headline inflation above the 6% mark in 2022–2023. Given this series of changes in the domestic and external macroeconomic conditions, the headline CPI inflation has undergone significant variations which can be observed from the shifts in its level, persistence and volatility.

We perform a battery of statistical tests to examine if the inflation process has undergone a structural change and estimate a multivariate

[4] The first meeting of the Monetary Policy Committee was held in the second half of 2016.

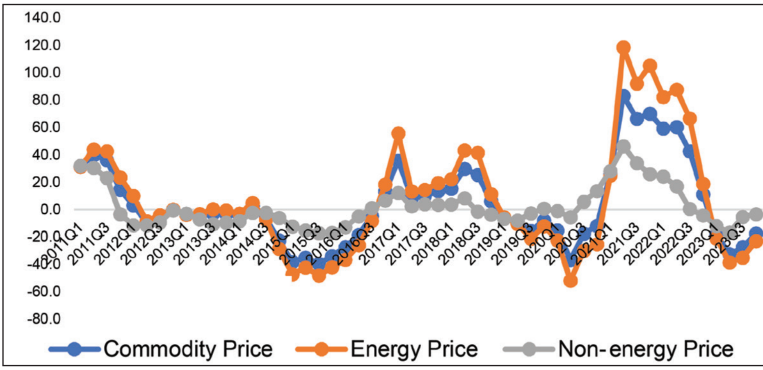

Figure 2. Commodity Price Inflation (in YOY %) in Global Market.

Source: Pink Data, World Bank.

Table 1. Global Commodity Price Inflation (in YOY %).

	Mean			Standard Deviation		
Period	Commodity Price	Energy Price	Non-energy Price	Commodity Price	Energy Price	Non-energy Price
2011–2019	–0.3	1.1	–1.6	21.0	27.1	11.6
2020–2023	15.2	21.9	9.2	42.2	60.2	18.3
2011–2023	4.5	7.5	1.7	29.7	40.8	14.7

Source: Pink Data, World Bank.

time-series model to identify the potential drivers or shocks which can explain the changing dynamics of inflation. For the first set of analyses, we use Bai and Perron's (1998, 2003) method of structural break tests in mean inflation, persistence of inflation and volatility of inflation. Next, applying a time-varying parameter vector autoregression (TVP-VAR) model, as in Casas et al. (2021), we explore how various drivers have contributed to the inflation process during pre- and post-COVID periods.

Dissecting Change in Inflation Through the Structural Break Test

Data and Methodology

At the outset, we construct the series of time-varying mean, persistence and volatility of headline CPI inflation. We take an eight-quarter window to construct the rolling mean and rolling standard deviation of the quarterly year-on-year (YOY) inflation rate in CPI. To capture the time-varying pattern in persistence, an AR(1) specification is estimated for five-year rolling windows. The persistence in the CPI quarterly YOY inflation rate is estimated using an AR(1) model:

$$\pi_t = c + \phi\pi_{t-1} + \varepsilon_t, \tag{2.2.1}$$

where the parameter ϕ defines persistence, interpreted as how much the past shocks matter for the current period value of a variable. The closer the ϕ is to 1, the higher the persistence is. The model for estimating persistence in CPI quarterly YOY inflation is optimally chosen using the auto.arima() programme of R software. The auto.arima() programme follows the steps in the Hyndman–Khandakar algorithm (Hyndman & Khandakar, 2008).[5,6]

Following Bai and Perron (1998, 2003), we use the endogenous structural break test to determine the presence of structural breaks in the rolling mean, persistence and volatility of inflation. In principle, the test assesses deviations from stability in a classical linear regression model with m breaks for (m + 1) regimes:

$$y_t = x_t^{'}\beta + z_t^{'}\delta_j, \left(T_{j-1}+1,\ldots..,T_j,\ j=1,\ldots.,m+1\right), \tag{2.2.2}$$

where j is the segment index; y_t is the dependent variable at time t; x_t $(p\times1)$ and z_t $(q\times1)$ are the vectors of explanatory variables. The parameters β and δ_j (j = 1, …, m + 1) are the corresponding vectors of coefficients. Here the coefficients δ_j associated with explanatory variables z_t are subject to structural breaks, while the other set of regression coefficients is assumed to be constant over the entire sample period. The disturbances are denoted by u_t, and the indices T_1, ... T_m; T_0= 0; T_{m+1} = T

[5] First, the algorithm starts a step-wise search for order of integration up to two fitting alternative autoregressive integrated moving average specification restricting the values of p and q up to 2. Second, it chooses the order of differencing using minimum Akaike information criteria (AIC). Third, it re-estimates the model using maximum likelihood and estimation with varying values for p and q. Finally, the optimal model is chosen based on minimum AIC, Bayesian Information criteria and Akaike information criteria.

[6] The estimated parameters of the optimally chosen AR(1) specification for CPI inflation are: c = 6.47 and ϕ = 0.89. The estimated values of ϕ are statistically significant at a 5% level.

are the unknown breakpoints to be estimated along with the unknown regression coefficients using the T observations on (y_t, x_t, z_t).

For each m segment of $(T_1, \dots T_m)$, the associated least-square estimates of β and δ_j are obtained by minimizing the sum of residual squares. The regression coefficients for each segment and the unknown breakpoints are simultaneously estimated using the algorithm described in Bai and Perron (2003). In our context, the structural breaks in each of the average inflation, persistence and volatility of the inflation series are estimated in a single-variable regression framework, where the covariate is a constant. This framework helps us understand possible level shifts in the basic parameters capturing changes in inflation dynamics over time.

Results

The univariate time-series analysis of the structural break test yields three observations. These are as follows.

First, there are three structural breaks in the rolling mean inflation rate (Figure 3). The first structural break appeared in 2015:Q2. This date corresponds to the quarter following the agreement between RBI and the MOF on adopting the FIT monetary policy regime. Earlier, the average inflation rate remained high at 8.8%. The next break appeared in 2017:Q1, two quarters after the implementation of the FIT policy via the first meeting of the Monetary Policy Committee on demonetization in 2016:Q3, and one quarter before the rolling out of the Goods and

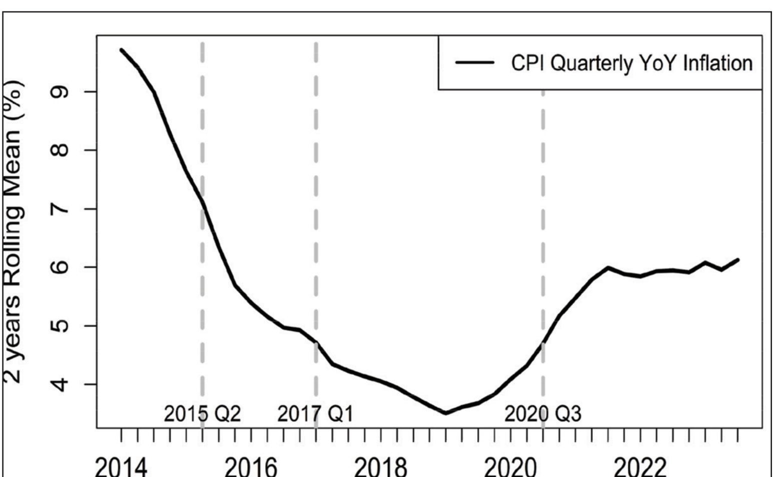

Figure 3. Structural Changes in Mean CPI Inflation Rate.

Services Tax (GST) system in the country. Following the adoption of FIT, the mean inflation rate moderated to 5.7% between 2015:Q2 and 2017:Q1. The third break date was found in 2020:Q3, during the first wave of the pandemic. During 2017:Q1 and 2020:Q3, the average inflation rate further moderated to 4%. However, with the advent of the pandemic, the mean inflation rate rebounded to 6%, the upper limit of RBI's tolerance band.

Second, the estimated AR(1) specification for five-year rolling windows fairly tracks the time-varying pattern in the degree of persistence. The persistence in y-o-y inflation was as high as 0.94 in 2017:Q1, and overall it was on a declining path till the pandemic hit the economy (Figure 4). During the year 2017, the average persistence in CPI y-o-y inflation was 0.87. It significantly declined to 0.64 in the period between 2018:Q1, identified as a structural break period, and 2019:Q4, immediately ahead of the pandemic, also identified as a structural break period. Since the pandemic, the persistence further increased by 22% to 0.78.

Third, three structural breaks were found in the volatility series (Figure 5) appearing in 2015:Q4, 2019:Q4 and 2021:Q1. Till 2015:Q4, the average volatility in headline inflation was at 1.8%. Following the adoption and implementation of IT, inflation volatility was significantly stabilized at 1%, till the beginning of the pandemic in 2020. The volatility again rose to 1.7% during the first wave of the pandemic but declined to 0.9% since the beginning of the second wave.

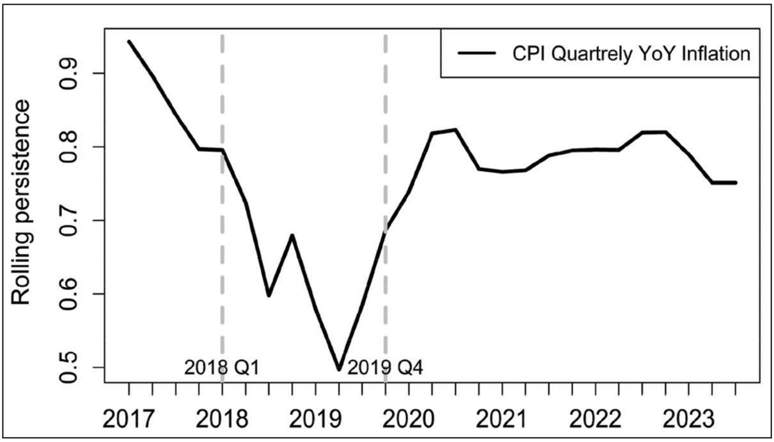

Figure 4. Structural Changes in Inflation Persistence.

Note: Persistence is estimated over a rolling window of 20 quarters.

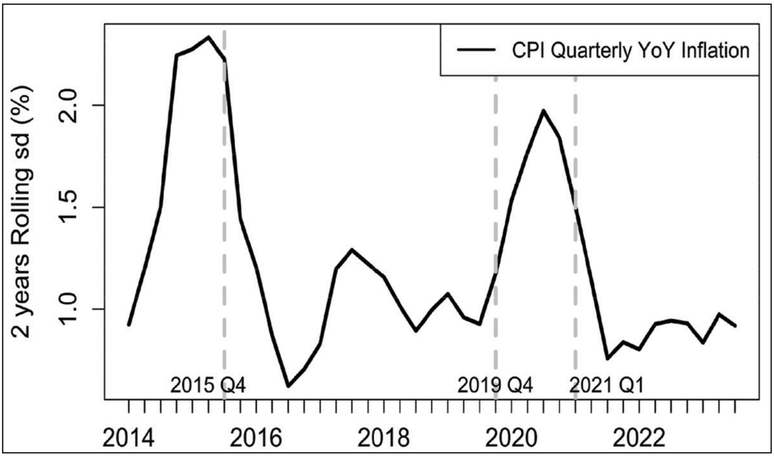

Figure 5. Structural Changes in Inflation Volatility.

Exploring the Drivers of Inflation Through TVP-VAR Model Estimation

Data and Methodology

We explore how various drivers contributed to inflation during pre- and post-COVID periods using a TVP-VAR model following Casas et al. (2021). The current inflation rate is assumed to be driven by shocks to the following variables: (a) global food inflation, since food constitutes the largest share (39%) in the CPI basket, (b) domestic input cost, (c) economic activities at the monthly frequency captured by real non-food credit growth, (d) repo rate capturing the monetary policy stance, (e) expected inflation and (f) exchange rate. Hence, the data matrix, denoted by Y_t, consists of the aforesaid six variables along with CPI month-on-month (m-o-m) inflation seasonally adjusted annualized rate (SAAR) in our analysis. The choice of variables is motivated by the existing empirical literature (Bhattacharya, 2025; Bhattacharya & Kapoor, 2020; Bhattacharya et al., 2019).[7]

[7] The data on CPI (2011–2012 base) are sourced from Central Statistical Organization, and MOSPI, while data on non-food credit, repo rate, ₹/dollar exchange rate and expected inflation rate are sourced from the RBI. The average three-month-ahead inflation expectation from RBI's household survey proxies expected inflation in the analysis. Global food price data are sourced from the World Bank Pink sheet. Finally, the domestic input

The stationary properties of the variables are tested using the Zivot–Andrews structural break versus the unit root test. The null hypothesis of the test is that the series is stationary with a structural break. The alternative hypothesis is that the series contains a unit root. Indian CPI, global food prices,[8] ₹/dollar exchange rate and real non-food credit are found to be the $I(1)$ process, while the input cost, repo rate and expected inflation are stationary with a structural break. We do not find evidence for cointegration among the $I(1)$ variables.[9] Hence, we estimate our model in a VAR framework, including CPI inflation (m-o-m SAAR), real non-food credit growth (m-o-m SAAR), global food inflation and rate of change in the exchange rate (m-o-m AR), input cost index, repo rate and expected inflation. We examine the effects of shocks to these different drivers of CPI inflation at different points in time using the TVP-VAR model as specified in Equation (2.3.1):

$$Y_t = A_t + \sum_{i=1}^{P} \beta_{it} Y_{t-i} + u_t, \tag{2.3.1}$$

where $Y_t = (y_{1t}, y_{2t}, \ldots, y_{Mt})'$; M is the number of endogenous variables in the VAR system; $A_t = (\alpha_{1t}, \alpha_{2t}, \ldots, \alpha_{mt})'$; and $\beta_{mt} = (\beta_{m1t}, \beta_{m2t}, \ldots, \beta_{mpt})'$, $M = 1,2, \ldots, M$ is the vector of coefficients for the mth endogenous variable; P is the number of lags in Y_t; and T is the total number of observations. The error term u_t is a random process, with a diagonal variance-covariance matrix. The time-varying coefficients for the mth equation are rescaled as a function of time as follows: $a_{mt} = a_m\left(\frac{t}{T}\right); \beta_{mit} = \beta_{mi}\left(\frac{t}{T}\right)$. The model is estimated using the kernel smoothing estimation technique.

Results

The TVP-VAR model estimation shows that the effect of input cost pressure on CPI inflation has been accentuated in the post-pandemic and post-war periods compared to the pre-pandemic period (Figure 6). Although the nature of impulse response remains transitory across the periods, the peak effect of a 1% standard deviation of shock to input cost

cost is captured by the input cost index of HSBC's composite Purchasing Managers Index for India, also sourced from RBI.

[8] Domestic CPI prices and real non-food credit are adjusted for seasonality to address the possibility of seasonal unit roots. Global food prices do not feature any seasonality.

[9] For brevity, we do not provide the detailed results of the unit root and cointegration tests. The results are available upon request to the authors.

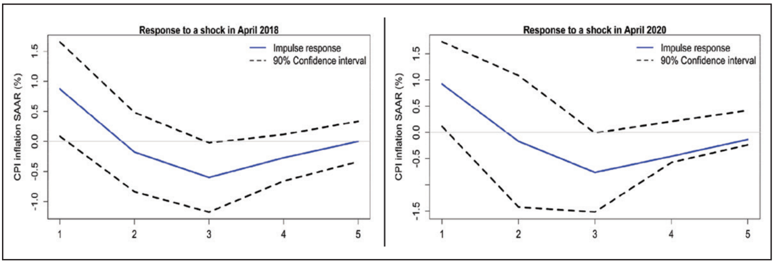

Figure 6. Impulse Response of CPI Inflation to Shocks to Input Costs. (A) Pre-pandemic Scenario. (B) Post-pandemic Scenario.

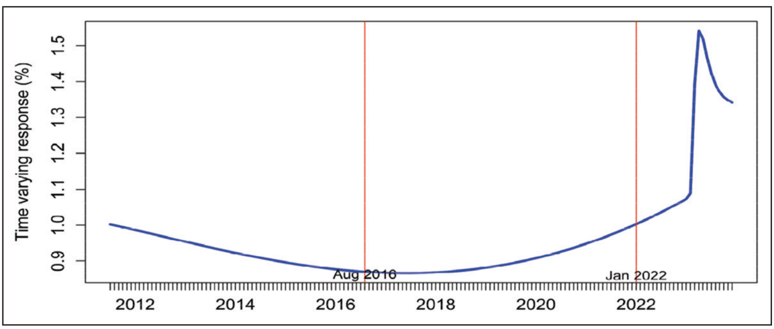

Figure 7. Time-Varying Impulse Response of CPI (M-O-M SAAR) to Shock to Input Cost.

increased from 0.87% in the pre-pandemic period to 0.92% in the later period. The robustness of the rise in the responsiveness of CPI inflation to input cost after the pandemic and war is checked from the plot of time-varying impulse response (after one-quarter of the shock) as shown in Figure 7. Figure 7 shows that the input cost shock is a significant driver of CPI inflation from August 2016 to January 2022. During this period, the extent of the impact increased from 0.87% to 1%. The impact further peaked at 1.54% in April 2023, before declining to 1.34% in December 2023.

Overall, the inflation in India during the post-pandemic period has been characterized by an uneven rise in the level, persistence and volatility. The evolving nature of the inflation trajectory can be attributed to factors such as supply chain disruption, input cost and commodity price pressures, demand–supply imbalances and exchange rate volatility. While the initial recovery phase in post-COVID saw a rise in the inflation rate influenced by supply chain disorders and pent-up demand with the reopening of the economy, the surge of commodity prices escalated the consumer prices further after the outbreak of Ukraine's war with the worldwide financial tightening. To address the ramifications of the twin shocks on inflation, we use a DSGE model with New Keynesian elements and small open economy features in the following section.

Theoretical Framework

Model Environment

We use a SOE-NK-DSGE model as suggested in Gupta and Steinbach (2013).[10] The model is premised on the representative agent framework with four building blocks, namely households, firms, external sector and policy authority.[11] The key features of the model are as follows. First, nominal rigidities are incorporated through a staggered wage and price-setting framework (Calvo, 1983) along with partial indexation of prices to their past consumer price inflation and wage inflation. Second, real rigidities are included in the form of external habit formation in consumption and trade friction due to home bias. Third, there is an incomplete pass-through of the exchange rate influencing the short-run fluctuations via the law of one price gap. Finally, the assumption of a small open economy implies that the relative size of the foreign economy, that is, the rest of the world in the context of this model, is so large that it is not affected by the developments in the domestic conditions of the home economy, and therefore, it approximates to a closed economy. We consider that the condition of the foreign economy is evolving exogenously. The description of the model variables is given in Table 2, and the list of behavioural equations is presented in Table 3.

[10] Such theoretical framework is extensively used in the literature to explain various structural issues including incomplete pass-through of the exchange rate (Adolfson, 2007; Adolfson et al., 2007; Adolfson, Lindé, & Villani, 2007; Christiano et al., 2005; Gali & Monacelli, 2005; Justiniano & Preston, 2004, 2010b; Smets & Wouters, 2007), macroeconomic forecasting (Ca'zorzi et al., 2017) and optimal monetary policy (Dmitriev & Hoddenbagh, 2021; Justiniano & Preston, 2010b).

[11] The details of the microfoundation of the model are available in Justiniano and Preston (2010a).

Table 2. List of Variables.

Variables	Description	Variables	Description
c_t	Real private consumption	l_t	Labour
i_t	Nominal interest rate	y_t	Real output
π_t	CPI inflation	$\pi_{4,t+1}$	CPI inflation y-o-y
π_t^h	Domestic inflation	a_t	Net foreign assets
π_t^f	Imported inflation	ca_t	Current account
mc_t	Real marginal cost	y_t^*	Foreign output
ψ_t	Gap variable in LOOP	π_t^h	Foreign CPI inflation
Δe_t	Change in nominal exchange rate	i_t^*	Foreign policy rate
q_t	Real exchange rate	ε_t^d	Demand shock
π_t^w	Wage inflation	ε_t^x	Risk premium shock
rw_t	Real wage	ε_t^p	Domestic price mark-up shock
μ_t^w	Wage mark-up	ε_t^a	Productivity shock
s_t	Terms of trade	ε_t^i	Monetary policy shock

Table 3. List of Model Equations.

1. Consumption Euler condition:

$$c_t = \left(\frac{1}{1+\gamma_h}\right)E_t c_{t+1} + \left(\frac{\gamma_h}{1+\gamma_h}\right)c_{t-1} - \left(\frac{1-\gamma_h}{1+\gamma_h}\right)\left(\frac{1}{\sigma}\right)\left[i_t - E_t\pi_{t+1}\right] + \left(\frac{1-\gamma_h}{1+\gamma_h}\right)\left(\frac{1}{\sigma}\right)\left\{\varepsilon_t^d - E_t\varepsilon_{t+1}^d\right\}$$

2. Domestic New Keynesian Phillips curve:

$$\pi_t^h = \left(\frac{\delta_h}{1+\delta_h\beta}\right)\pi_{t-1}^h + \left(\frac{\beta}{1+\delta_h\beta}\right)E_t\pi_{t+1}^h + \left\{\frac{(1-\theta_h)(1-\beta\theta_h)}{\theta_h(1+\delta_h\beta)}\right\}mc_t$$

3. Imported inflation:

$$\pi_t^f = \left(\frac{\delta_f}{1+\delta_f\beta}\right)\pi_{t-1}^f + \left(\frac{\beta}{1+\delta_f\beta}\right)E_t\pi_{t+1}^f + \left\{\frac{(1-\theta_f)(1-\beta\theta_f)}{\theta_f(1+\delta_f\beta)}\right\}\psi_t$$

4. Real marginal cost of domestic production:

$$mc_t = rw_t - a_t + \alpha s_t + \varepsilon_t^p$$

5. Wage inflation:

$$\pi_t^w = \gamma_w\pi_{t-1} + \beta E_t\pi_{t+1}^w - \beta\gamma_w\pi_t + \left\{\frac{(1-\theta_w)(1-\beta\theta_w)}{\theta_w(1+\varphi\xi_w)}\right\}\mu_t^w$$

(Table 3 continued)

(Table 3 continued)

6. Wage mark-up:

$$\mu_t^w = \left(\frac{\sigma}{1-\gamma_h}\right)(c_t - \gamma_h c_{t-1}) + \varphi\left(y_t - \varepsilon_t^a\right) - rw_t$$

7. CPI inflation:

$$\pi_t = (1-\alpha)\pi_t^h + \alpha\pi_t^f$$

8. Technology of production:

$$y_t = \varepsilon_t^a + l_t$$

9. Dynamics of real exchange rate:

$$q_t = q_{t-1} + \Delta e_t + \pi_t^* - \pi_t$$

10. UIP condition:

$$E_t q_{t+1} - q_t - \chi a_t - \varepsilon_t^\phi = (i_t - E_t\pi_{t+1}) - (i_t^* - E_t\pi_{t+1}^*)$$

11. Law of one price gap:

$$\psi_t = q_t - (1-\alpha)s_t$$

12. Dynamics of terms of trade:

$$s_t - s_{t-1} = \pi_t^f - \pi_t^h$$

13. Goods market clearing condition:

$$y_t = (1-\alpha)c_t + \alpha\eta(2-\alpha)s_t + \alpha y_t^* + \alpha\eta\psi_t$$

14. Current account:

$$ca_t = -\alpha(s_t + \psi_t) + y_t - c_t + \left(\frac{1-\beta}{\beta}\right)a_{t-1}$$

15. Net foreign assets:

$$a_t = a_{t-1} + ca_t$$

16. Interest rate rule:

$$i_t = \rho i_{t-1} + (1-\rho)\left[\phi_\pi E_t\pi_{4,t+1} + \phi_y y_t\right] + \varepsilon_t^i$$

17. Exogenous shocks:

$$x_t = \rho_x x_{t-1} + \zeta_t^x, \text{ where } x_t = \varepsilon_t^a, \varepsilon_t^d, \varepsilon_t^p, \varepsilon_t^\phi, \varepsilon_t^i, y_t^*, \pi_t^*, i_t^*$$

Log-linearized Equations

Consumption Euler Condition of Households

In Table 3, Equation (1) represents the consumption (c_t), a Euler condition, which is determined by the past values of consumption (c_{t-1}), expectations about future consumption (c_{t+1}), and the expected real rate of interest. The Euler equation balances marginal utilities from intertemporal consumption–savings decisions. The sensitivity of current consumption to its lagged values, future values and the ex-ante real interest rate depends on the degree of habit formation in consumption (γ_h) and the inverse of the intertemporal elasticity of substitution for consumption (σ). In addition, the shock to time preference for present consumption comes as the demand shock (ε_t^d) and appears in the equation from the intertemporal optimization of the household.

Expectation Augmented New Keynesian Phillips Curves for Price and Wage Inflation

Domestic inflation (π_t^h) is represented by a New Keynesian Phillips curve as in Equation (2). It is a function of its own lagged values (π_{t-1}^h) due to indexation of past inflation, expected domestic inflation (π_{t+1}^h) sourced from the forward-looking behaviour of the firms and the real marginal cost (mc_t) capturing the business cycle condition. Similarly, the dynamics of imported inflation are specified in Equation (3). However, unlike domestic inflation, the inflationary pressure builds from the degree of imperfect exchange rate pass-through, captured by the variable of the law of one price gap (ψ_t).[12] The responsiveness of the current inflation (i.e., domestic/imported) to its past values, expected values and the cost of production critically depends on the three structural attributes, namely (a) the discount factor (β), (b) the degree of indexation to past inflation (δ_h, δ_f) and (c) the degree of price stickiness reflected by the Calvo (1983) parameters (θ_h, θ_f). In Equation (4), the real marginal cost is expressed as a function of the real wage (rw_t), gains from productivity (ε_t^a), terms of trade (s_t) and price mark-up shock (ε_t^p).

For nominal wage inflation in Equation (5), we observe a Phillips curve relation that connects current-period wage inflation (π_t^w) to time-varying wage mark-up (μ_t^w), partially indexed to last period consumer price inflation and expected wage inflation. The wage markup in Equation (6) is defined as a wedge between the real wage and the marginal rate of substitution between labour and consumption, arising from wage stickiness. The nature of the parameters that shape the dynamics of wage inflation is similar to price inflation equations, such as γ_w arises

[12] An imperfect exchange rate pass-through is reflected by deviations from the law of one price.

from the degree of indexation to past consumer price inflation and θ_w reflects the degree of wage stickiness. In addition, since φ is the inverted labour supply elasticity, $\varphi\xi_w$ represents the ratio of the labour demand and supply elasticities.

Headline CPI Inflation of Home Economy

Equation (7) provides the home CPI inflation (π_t) as the weighted average of domestic and import inflation where the weight is assigned according to home bias, that is ($1-\alpha$) for domestic inflation and trade openness, which is α.

Real Exchange Rate Determination

In Equation (9), the dynamics of the real exchange rate are defined using the change in the nominal exchange rate (Δe_t), foreign CPI inflation (π_t^*) and home CPI inflation. In Equation (10), we specify the uncovered interest rate parity (UIP) condition incorporating the shock to country risk premium (ε_t^{ϕ}). In Equations (11) and (12), we define the law of one price gap variable[13] and the dynamics of the terms of trade.

Monetary Policy Reaction of the Central Bank

Monetary policy is conducted according to a Taylor-type interest rate rule as given in Equation (16). The central bank changes the policy rate via a policy shock, responding partly to the previous interest rate as policy inertia (i_{t-1}), and partly responding to the expected y-o-y consumer price inflation ($E_i\pi_{4,t+1}$) and current demand pressure captured in output gap (y_i).

Closing the Model

Equation (8) provides the linearized production technology which shows that output depends on the labour (l_t) input and productivity shock. Exploiting the national income identity, goods market clearing condition and consumption risk-sharing condition, Equation (13) is obtained. Equations (14) and (15) define current and capital account dynamics. We consider eight exogenous shocks which are presented in Equation (17) in a generic form for all the shock variables and are assumed to follow AR(1) time-series processes.

[13] The specification assumes that importing retailers pay the world market price in domestic currency to procure the importable at the dock. But as they face a downward-sloping demand curve in the domestic economy, they are unable to fully pass on the changes in domestic currency-denominated world prices to consumers in the short run. Nevertheless, complete exchange rate pass-through takes place in the long run.

Quantitative Analysis

Model Estimation

We take the model to the data and estimate the structural and policy parameters and the shock processes to isolate the key drivers and factors contributing to the changing dynamics of inflation. To capture the parametric shifts in the economy, we calibrate a minimal number of model parameters and estimate the rest of them with the quarterly macroeconomic indicators using the Bayesian methodology.

Given the size and nature of the shocks like COVID-19, followed by the outbreak of the Russia–Ukraine War, we investigate the temporal changes in the estimable parameters of the model with the subsamples. Our sample period spans from 2011:Q3 to 2023:Q3, in which we consider (a) the pre-pandemic period (2011:Q3 to 2019:Q4), (b) the post-pandemic period (2011:Q3 to 2021:Q4) and the post-pandemic and war period (2011:Q3 to 2023:Q3). Assuming the model estimated for the pre-pandemic period as the baseline model, we compare the changes in the key parameters between the baseline and post-pandemic estimates, and baseline and post-pandemic and war period estimates.

To perform the aforesaid exercise, first, we calibrate the discount factor and adjustment cost of foreign bond holding at 0.98 and 0.01, respectively, as in Banerjee and Basu (2019). Next, we set the priors for the estimable parameters and used the observables to find out the posteriors. We estimate the log-linearized system of equations with seven data indicators of our sample, namely output gap (SAAR), CPI inflation (SAAR), repo rate (annualized rate), change in the nominal exchange rate (SAAR), world output growth rate (y-o-y), world CPI inflation rate (y-o-y) and the US Fed funds rate (annualized rate).

In the estimation, we include the following parameters: (a) degree of trade openness and substitutability between domestic and imported goods, (b) (inverse) elasticity of labour supply and the elasticity of labour demand, (c) (inverse) elasticity of substitution between current and future consumption and the degree of habit formation, (d) price stickiness and past inflation indexation for domestic and imported goods, (e) stickiness of nominal wage and indexation of past inflation, (f) coefficients of the Taylor-type policy rule, (g) first-order persistence coefficients which indicate how long a shock to the system lasts and (h) the standard error of the shocks, which measures the degree of uncertainty the economy is facing. The selection of priors and probability density functions are broadly in line with Banerjee et al. (2023) and Banerjee and Basu (2019).

Our estimation routine follows a two-step procedure. In the first step, probable values of estimable parameters of the model are set up on the basis of a priori knowledge and proximate guidance in the literature as initial starting points or 'priors' with theoretically plausible probability density functions.[14] In the second step, we find the posterior estimates of estimable parameters. Exploiting the Markov Chain Monte Carlo–Metropolis–Hastings (MCMC-MH) algorithm, the posterior means are obtained, including their 90% confidence intervals (Table 4).[15] From the baseline model, we present the plots of key impulse response functions (IRFs), namely shocks to total factor productivity (TFP), demand, domestic cost-push and policy interest (Figures 8–11). We focus on the aforementioned shocks as they are found to be the primary drivers of CPI inflation based on the forecast error variance decomposition (FEVD) results (Table 5).

Key Findings

Changes in Structural Factors and Responsiveness of Inflation

The set of structural parameters including the elasticity of labour supply, elasticity of demand for labour, degree of relative risk aversion, degree of openness, indexation of past inflation to wage and price setting are found to remain stable across the periods. However, significant changes are observed for the real and nominal frictions and the elasticity of substitution between domestically produced and imported goods. The elasticity of substitution between domestically produced and imported goods has increased (8.6%), while the habit formation in consumption has declined (38%) substantially. The degree of nominal rigidities in wage and domestic prices have risen (24% and 13.5%, respectively), infusing

[14] For instance, the beta distribution is used for the degree of price stickiness, while the inverse gamma distribution is specified for the standard errors of the shocks because they take only positive values.

[15] We take 50,000 replications to implement the MH algorithm in which the first 45% of the 'burn-in' observations are discarded to reduce the importance of starting values. Two parallel chains are used in the MCMC-MH algorithm with an acceptance rate of 26%. The univariate and multivariate diagnostic statistics show convergence when comparing between and within moments of multiple chains (Brooks & Gelman, 1998). The algorithm simulates the smoothed histogram that approximates the posterior distributions of parameters.

Table 4. Estimated Parameters: Pre-COVID vis-à-vis Post-COVID and Post-COVID and Ukraine War.

Parameters	Prior Mean	Prior	Std. Dev.	Posterior Mean: Pre-COVID	Posterior Mean: Post-COVID	Posterior Mean: Post-COVID and Ukraine War
Trade openness (α)	0.15	Beta	0.02	0.140	0.147	0.147
Elasticity of substitution between domestic and imported goods (η)	0.70	Gamm	0.10	0.687	0.737	0.746
Habit formation in consumption (γ_h)	0.50	Beta	0.10	0.432	0.282	0.288
Inverse elasticity of inter-temporal substitution (σ)	2.00	Norm	0.10	1.981	1.978	1.977
Inverse elasticity of Frisch labour supply (ϕ)	3.00	Gamm	0.10	3.001	3.006	3.002
Elasticity of labour demand (ξ_w)	1.00	Gamm	0.10	1.015	1.034	1.029
Past inflation indexation in wage setting (γ_w)	0.40	Beta	0.10	0.356	0.363	0.362
Size of nominal wage stickiness (θ_w)	0.50	Beta	0.10	0.618	0.780	0.768
Past inflation indexation in domestic goods (δ_H)	0.40	Beta	0.10	0.314	0.319	0.305
Size of price stickiness in domestic goods (θ_H)	0.50	Beta	0.10	0.422	0.461	0.479
Past inflation indexation in imported goods (δ_F)	0.20	Beta	0.10	0.201	0.192	0.203
Size of price stickiness in imported goods (θ_F)	0.50	Beta	0.10	0.557	0.512	0.529
Size of interest rate smoothing (ρ)	0.80	Beta	0.10	0.932	0.943	0.930

(Table 4 continued)

(Table 4 continued)

Parameters	Prior Mean	Prior	Std. Dev.	Posterior Mean: Pre-COVID	Post-COVID	Post-COVID and Ukraine War
Output stabilizing coefficient in policy rule (φ_y)	0.50	Norm	0.10	0.434	0.138	0.105
Inflation stabilizing coefficient in policy rule (φ_π)	1.50	Norm	0.10	1.532	1.534	1.540
Long-run level of output gap ($\overline{yg}$)	3.00	Gamm	1.00	3.171	2.978	3.026
Long-run level of inflation ($\overline{\pi^{yoy}}$)	4.00	Gamm	0.40	4.024	3.991	3.991
Long-run level of policy rate ($\overline{i^{rr}}$)	7.00	Gamm	0.20	6.953	6.932	6.935
Long-run level of change in nominal exchange rate ($\overline{\Delta^{ner}}$)	1.00	Gamm	0.30	0.933	0.945	0.911
AR(1) coefficient of TFP shock (ρ^a)	0.80	Beta	0.10	0.794	0.823	0.786
AR(1) coefficient of demand shock (ρ^d)	0.80	Beta	0.10	0.655	0.438	0.423
AR(1) coefficient of monetary policy shock (ρ_m)	0.60	Beta	0.10	0.499	0.429	0.461
AR(1) coefficient of cost-push shock (ρ_{cp})	0.80	Beta	0.10	0.791	0.799	0.787
AR(1) coefficient of external risk premium (ρ_φ)	0.80	Beta	0.10	0.838	0.861	0.863
AR(1) coefficient of global output (ρ_{y*})	0.60	Norm	0.10	0.943	0.869	0.906
AR(1) coefficient of global inflation ($\rho_{\pi*}$)	0.60	Norm	0.10	0.503	0.586	0.650
AR(1) coefficient of global interest rate (ρ_{i*})	0.60	Norm	0.10	0.714	0.715	0.880
Std. error of productivity shock (ε^a)	0.10	Invg	Inf	0.0095	0.0120	0.0134
Std. error of demand shock (ε^d)	0.10	Invg	Inf	0.0454	0.1735	0.1551

(Table 4 continued)

(Table 4 continued)

Parameters	Prior Mean	Prior	Std. Dev.	Posterior Mean: Pre-COVID	Post-COVID	Post-COVID and Ukraine War
Std. error of cost-push shock (ε^{cp})	0.10	Invg	Inf	0.0116	0.0154	0.0174
Std. error of external risk premium shock (ε^{φ})	0.10	Invg	Inf	0.0071	0.0061	0.0056
Std. error of monetary policy shock (ε^{i})	0.01	Invg	Inf	0.0034	0.0033	0.0034
Std. error of global output shock (ε^{y*})	0.01	Invg	Inf	0.0065	0.0160	0.0148
Std. error of global inflation shock ($\varepsilon^{\pi*}$)	0.01	Invg	Inf	0.0028	0.0037	0.0037
Std. error of global monetary policy shock (ε^{i*})	0.01	Invg	Inf	0.0016	0.0016	0.0017

Note: TFP = total factor productivity.

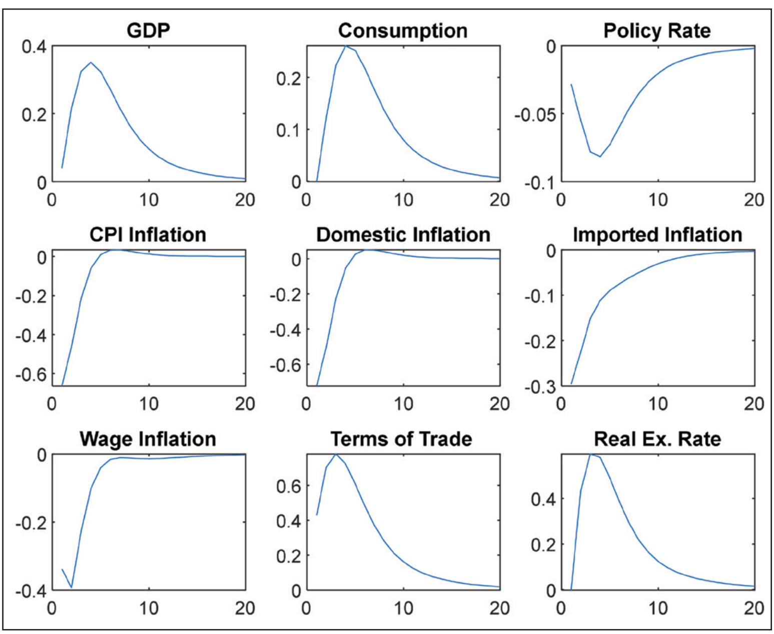

Figure 8. Impulse Responses of Productivity Shock.

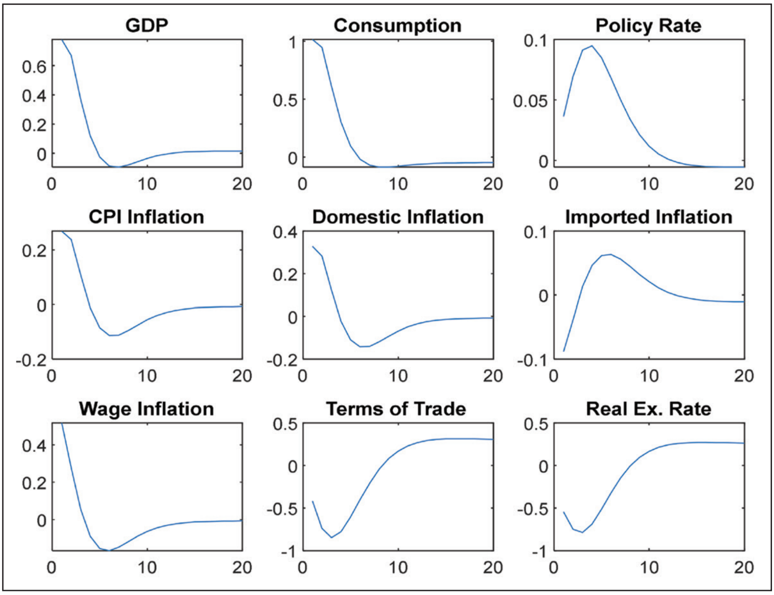

Figure 9. Impulse Responses of Demand Shock.

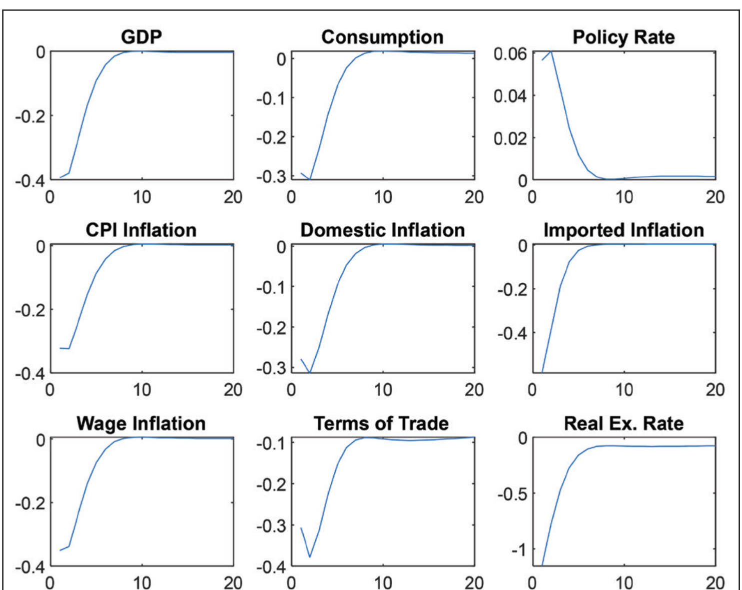

Figure 10. Impulse Responses of Monetary Policy Shock.

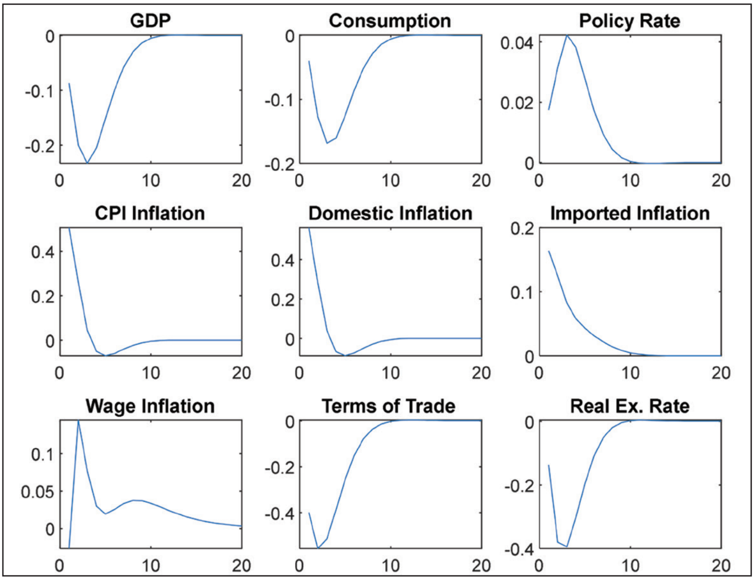

Figure 11. Impulse Responses of Domestic Cost-Push Shock.

Table 5. FEVD Results (in %) of Inflation Across Sub-periods.

Sample Period	ε_t^a	ε_t^d	ε_t^i	ε_t^p	ε_t^ϕ	ε_t^{y*}	$\varepsilon_t^{\pi*}$	ε_t^{i*}
Pre-COVID	43.16	12.05	18.28	20.69	5.19	0.55	0.01	0.07
Post-COVID	32.66	16.13	13.05	31.55	6.39	0.08	0.06	0.08
Post-COVID and Ukraine War	32.55	15.19	11.84	34.22	5.37	0.09	0.11	0.63

greater persistence in the inflation process. In contrast, the decline in nominal rigidity in the import prices (5%) indicates a higher pass-through of exchange rate pressure and foreign prices. Regarding the policy parameters of the interest rate rule, the interest rate inertia and inflation stabilizing coefficients do not exhibit any significant change across the sample periods. In the case of the output gap stabilizing parameter, the size of the coefficient is found to decrease considerably. Despite the accommodative stance of monetary policy on a large scale to tackle severe slacks in the economy, this coefficient has dropped on account of the rise in amplitudes of the output gap in the negative terrain.

Considering the time-series properties of the exogenous shocks, we find that the first-order persistence coefficients and variance of the shocks have undergone significant changes for most of the shocks as compared to their baseline estimates. The degree of persistence has declined for the demand shock (33.1%) and monetary policy shock (14.2%) in the post-COVID period, while the same has increased for the foreign inflation shock (16.5%). After the Ukraine war, the persistence of shock to foreign inflation increased further (10.8%) along with a considerable rise in the persistence of the shock to the foreign policy rate (23.3%). The standard errors of the shocks to demand and foreign output have increased by 2.8 times and 1.5 times, respectively, during the COVID period. The size of the cost-push shock and the shock to foreign CPI inflation have increased by 32.8% and 32.1%, respectively. The variance of productivity rose by 26.3%. Such changes in the degree of uncertainties, however, did not rise much during the post-Ukraine war period, except for the ones sourced from productivity, cost-push and the US policy rate. After the outbreak of war, the size of productivity shock, cost-push shock and the foreign interest rate shock have risen by 11.7%, 13% and 6.3%, respectively. The changing pattern of the shocks indicates that the uncertainties during the pandemic were primarily sourced from the domestic demand and global demand situation, whereas during the war period, the same was accentuated from the supply-side adversities. As the drivers, however, not all the shocks are equally relevant to shape the dynamics of inflation. To understand their relevance, we inspect the contribution of the different shocks in the FEVD results of inflation.

Drivers of Inflation

The FEVD results indicate that the shocks emerging from the domestic condition are occupying a central role in shaping the movement of CPI inflation. In contrast, the foreign sources of disturbances, like the shocks to the world GDP growth rate, world CPI inflation rate and the Fed funds rate, appear to be negligible. Shocks to the exchange rate remain in place but play a limited role in explaining the variations in inflation. In the pre-pandemic period, among the domestic sources of shocks, TFP was the main driver of inflation explaining 43% of the variations, followed by the cost-push shock (20.7%), monetary policy shock (18.3%) and demand shock (12%). However, the relative strength of these shocks has altered in the post-pandemic period.

While the roles of productivity and policy shocks have declined modestly, domestic cost-push shock and demand shock have gradually gained prominence as the drivers of inflation after the outbreak of COVID and the Ukraine war. In particular, the magnitude of the decline in the share of productivity shocks in the inflation process is taken over by the prevalence of the cost-push shock during the post-pandemic period. Given the predominance of domestic shocks as the key drivers of inflation, we document their general equilibrium effects using the IRFs and analyse the behaviour of inflation.

Properties of Key Impulse Response Functions

Effects of a Positive Productivity Shock

A positive shock to the level of productivity reduces the real marginal cost of production of the domestic intermediate goods and brings down domestic inflation. As the domestic intermediate goods become cheaper relative to foreign-produced intermediate goods, the relative demand moves in favour of the domestic goods vis-à-vis foreign goods, leading to some respite from the imported inflation. The fall in domestic and import inflation together pacifies inflationary pressure. Since the fall in domestic inflation is greater than that of imported inflation, we observe a rise in the terms of trade. Improvement in the factors' productivity lowers the demand for labour causing a decrease in wage inflation. Given the inflation-targeting policy rule, the policy rate goes through an easing and raises demand for consumption. As the domestic interest rate falls, the home currency depreciates, making the home-produced exportable more competitive in the international market. The improvement in domestic demand and external demand, in sum, leads to an expansion of the aggregate output.

Effects of a Positive Demand-Side Shock

A positive shock to current consumption increases the domestic demand, incentivises production, raises the domestic price level and CPI inflation, and demand for labour and thereby builds upward pressure on the wages. As the CPI inflation rises, the policy rate goes up, and the home currency is appreciated through modified UIP conditions. Due to the appreciation of the home currency, the import inflation remains subdued at the impact effect. However, with the rise in demand for imported intermediate goods, relative to expensive domestic goods, import inflation sets in. Overall, the terms of trade rise after an initial decline in their course of mean reversion.

Effects of a Positive Interest Rate Shock

A positive shock to the policy rate engenders the standard results of contractionary policy intervention. With the interest rate tightening, current consumption falls via intertemporal substitution, and domestic demand declines, followed by a decline in the derived demand for labour, leading to a contraction of aggregate output, a drop in price inflation and wage inflation. The rise in the domestic interest rate entails the appreciation of the home currency causing the decline in import inflation more than that of the domestic inflation, hence the terms of trade fall.

Effects of a Positive Cost-Push Shock

A positive cost-push shock to the real marginal cost of domestic intermediate goods production increases domestic inflation and CPI inflation. Inflation for importable is fuelled due to higher demand for the same to substitute the domestic goods. The rising cost of the production results in the cut-down of production, demand for labour and contraction of consumption demand. Parallel to this, the pressure of cost-push shock translates to wage inflation. The dynamics of wage inflation are shaped by the change in real wage and CPI inflation. The falling demand for labour induces a decline in the real wage, while the CPI inflation elevates the pressure on nominal wage. The combination of the offsetting effects of the falling real wage and rising CPI inflation determines the impulse response of wage inflation. On the impact, real wage falls faster than the CPI inflation, so we observe a negative effect. Later, the pace of rising inflation supersedes declining real wages, leading to a sharp hike in wage inflation. To curb the inflationary pressure, the policy rate is increased, which causes an appreciation of the domestic currency via interest parity condition. As the domestic prices rise more than the rise of import prices, the terms of trade decline.

Change in Responsiveness of CPI Inflation to Key Drivers

While considering the impulse response properties of the macroeconomic variables, we examine if there is any change in the responsiveness of inflation to the shocks in the post-pandemic period. A quantitative change in the impact effect and the qualitative change in the pattern of mean reversion of the CPI inflation are observed for the structural shocks to productivity, consumption demand and cost-push (Figure 12 A–C).

In the case of the monetary policy shock, the responsiveness of inflation remains unchanged. For all three structural shocks, the sensitivity of inflation to the shocks on the impact effect has increased. The impact effects have elevated by 0.17 and 0.26 percentage points for the TFP and cost-push shock, respectively. However, the same has shot up more than double for the demand-side disturbance. It can be attributed to the increased level of uncertainty from the pent-up demand and the drop in the price stickiness of the import sector. Regarding the qualitative pattern of the impulse response, the degree of persistence of shocks such as productivity and

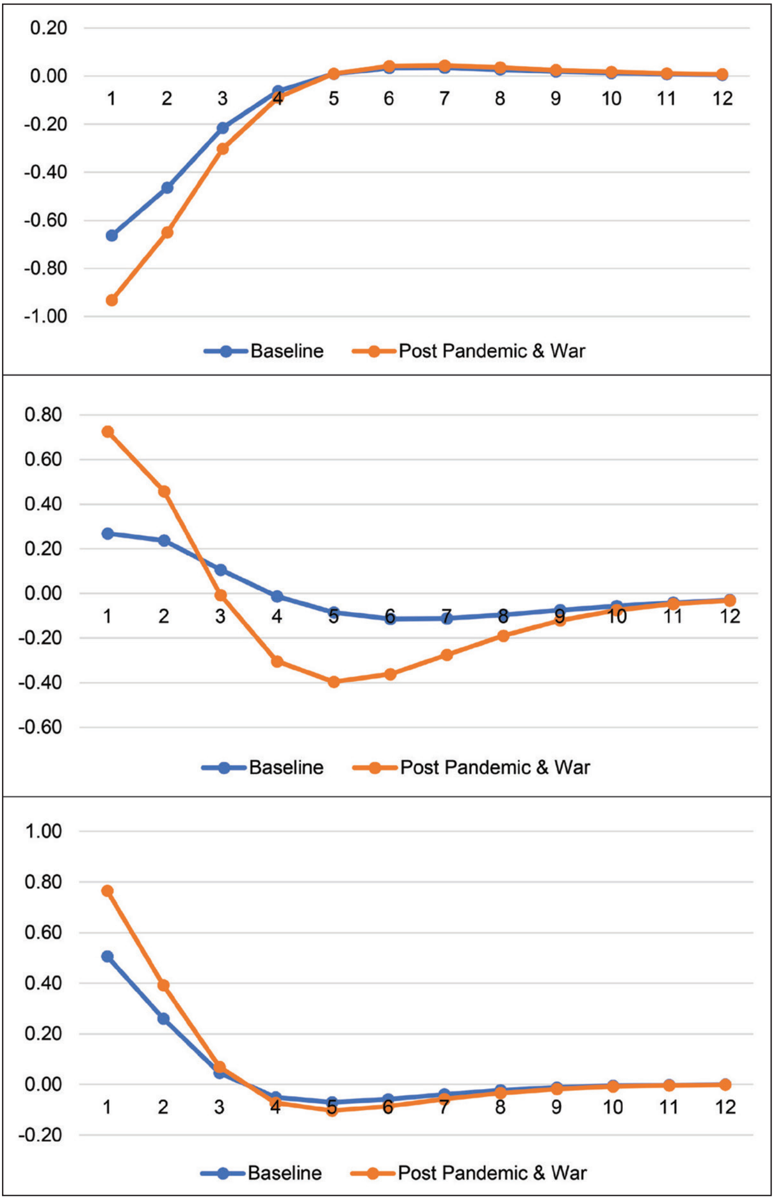

Figure 12. Change in Impulse Response of Inflation (in %) to Structural Shocks: Baseline vis-à-vis Post-pandemic and War Period. (A) Effect of Positive TFP Shock. (B) Effect of Positive Demand Shock. (C) Effect of Positive Cost-Pust Shock.

cost-push has augmented, taking four to five quarters to dissipate. In contrast, the demand shock-induced impulse response appears less persistent but more pronounced in its mean reversion process, showing relatively faster adjustment within three quarters. In sum, the change in responsiveness of inflation to the shocks underscores a gradual shift in the transmission process of the shocks to consumer prices.

To check the robustness of our inference drawn based on the evidence from FEVD results, we perform counterfactual experiments with the parameters which have changed in size from the pre-COVID period to the post-COVID and war period (Table 6). We consider those parameters that exhibit at least a 5% change in magnitude. Considering the pre-COVID

Table 6. FEVD Results (in %) from Counterfactual Experiments.

Parameters	ε_t^a	ε_t^d	ε_t^i	ε_t^p	ε_t^ϕ	ε_t^{y*}	$\varepsilon_t^{\pi*}$	ε_t^{i*}
Baseline	43.16	12.05	18.28	20.69	5.19	0.55	0.01	0.07
Elasticity of substitution between domestic and imported goods (η)	43.13	11.98	18.46	20.70	5.32	0.33	0.01	0.07
Habit formation in consumption (γ_h)	43.24	11.97	18.29	20.75	5.10	0.56	0.01	0.07
Size of nominal wage stickiness (θ_w)	42.96	3.18	11.46	35.04	6.59	0.68	0.02	0.09
Size of price stickiness in domestic goods (θ_H)	42.82	11.91	19.75	19.09	5.71	0.63	0.01	0.08
Size of price stickiness in imported goods (θ_F)	42.92	11.84	18.34	20.56	5.69	0.54	0.01	0.08
AR(1) coefficient of demand shock (ρ_g)	46.25	5.74	19.59	22.17	5.56	0.59	0.01	0.08
AR(1) coefficient of global inflation ($\rho_{\pi*}$)	43.14	12.05	18.27	20.68	5.18	0.55	0.06	0.07
AR(1) coefficient of global interest rate (ρ_{i*})	42.98	12.01	18.20	20.60	5.16	0.55	0.01	0.48

(Table 6 continued)

(Table 6 continued)

Parameters	ε_t^a	ε_t^d	ε_t^i	ε_t^p	ε_t^ϕ	ε_t^{y*}	$\varepsilon_t^{\pi*}$	ε_t^{i*}
Std. error of Productivity shock (ε_z)	60.17	8.45	12.81	14.50	3.63	0.39	0.01	0.05
Std. error of Demand shock (ε_g)	18.88	61.53	7.99	9.05	2.27	0.24	0.01	0.03
Std. error of cost-push shock (ε_{cp})	34.29	9.58	14.52	36.98	4.12	0.44	0.01	0.06
Std. error of global output shock(ε_{y*})	42.18	11.78	17.86	20.22	5.07	2.80	0.01	0.07
Std. error of global inflation shock ($\varepsilon_{\pi*}$)	43.15	12.05	18.28	20.69	5.19	0.55	0.02	0.07

state as the baseline, we replace the relevant parameters one at a time and note the subsequent change in the FEVD results. Except for the nominal wage rigidity, none of the structural parameters has influenced the relative importance of the shocks in explaining the inflation dynamics. However, the higher values of the standard errors of the TFP shock, demand shock and cost-push shock are the potential factors which can alter the relative contribution of the drivers of the inflation process.

Conclusion

The Indian economy had weathered several domestic and global macroeconomic policy shocks before being hit by the unprecedented pandemic of COVID-19 at the onset of the current decade. The pandemic has disrupted economies worldwide, and India has experienced substantial economic loss. As the country navigates through the post-pandemic recovery phase, the face-off between Ukraine and Russia started at the beginning of 2022 and caused soaring commodity prices in the international market. Consequently, the inflation dynamics become the central concern for the policy authorities across the jurisdictions. Before the pandemic, India experienced relatively stable inflation rates, influenced by demand- and supply-side factors. However, after the pandemic and the outbreak of war, the economy faces new challenges, including supply chain disruptions, volatile commodity prices, input cost pressures and shifts in demand patterns. This article examines how inflation in India has evolved since the onset of the pandemic and provides a structural interpretation of the underlying causes for the same.

The COVID-19 pandemic and the Ukraine war had profound and multifaceted impacts on the Indian economy, leading to significant shifts in the inflationary process. Considering the sample period over the last one and half decades, we observe that inflation was more volatile during the pandemic, while it has become more persistent after the Ukraine war. Using a New Keynesian dynamic stochastic general equilibrium model, we explore the changing dynamics of inflation and the factors contributing to it. To this end, we estimate the model with macroeconomic indicators across three subsamples: the pre-pandemic period, post-pandemic period and post-pandemic period with the Ukraine war. Using the relevant macroeconomic indicators and a theoretical framework, we investigate the changing patterns of the shocks driving the inflationary pressure and the structural factors which can explain the dynamics of inflation across the periods.

The results from the estimation reveal substantial changes in the structural parameters characterizing the responsiveness of inflation and the magnitude of pass-through from the shocks to consumer prices. In addition, it shows the change in the behavioural patterns of the economic drivers and their relative strengths in explaining the inflationary process that has altered in the post-pandemic and war periods. In particular, it identifies the greater prominence of the domestic cost-push and demand shock in shaping inflation. The combination of the changing structural parameters and uncertainties has increased the sensitivity of CPI inflation to its key drivers. Given the transmission of cost pressures to inflation, in the future, the cost of disinflation would be higher for monetary policy than in the pre-pandemic period. It can narrow down the policy space for monetary authority and make the trade-off between the choice of inflation stabilization and sustainability of economic growth steeper.

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