Evidence on Inflation Persistence in India

Swapnil Bhardwaj

Assistant Professor, Department of Economics, University of Rajasthan, JLN Marg, Jaipur – 302004, Rajasthan, India; swapn25@gmail.com

Abstract

The paper focuses on understanding the concept of inflation persistence in detail and analyzing it in the Indian economy context for the period 1991-2019 using monthly data. The study employs the univariate approach which is the most conventional method of estimating persistence as the sum of estimated autoregressive coefficients. The study estimates the persistence coefficient for the WPI and CPI measures of inflation, and it is found that the WPI measure of inflation is more persistent than the CPI for the period under study. The higher degree of persistence in the WPI inflation can be plausibly credited to higher persistence in the "manufacturing' and "non-food" categories of overall WPI inflation.

Keywords: Inflation, Indian Economy, Inflation Persistence

1. Introduction

Inflation is one of the most popular and widely used terms in economics; broadly speaking, it is a persistent rise in the general price levels of goods and services. Simply put, it measures the relative dearness of goods and services over a period of time. Inflation poses a serious threat to economic stability and efficiency and harms economic growth and welfare. It affects the real value of goods and assets in the economy, negatively influencing consumption and investment and lowering economic welfare.

In his earliest work, Indian Currency and Finance (1913), Keynes contended that gains from inflation are transitory and occur at the cost of vulnerable sections of society, and the benefits do not accrue to an economy as a whole. Keynes believed that inflation systematically erodes the income and savings of the citizens of a nation and reinforces the wealth of a few. According to him, inflation had much devastating and far-reaching impact on capitalist economies. He was convinced that inflation distorts the social harmony of society and weakens the spirit of free-market capitalist economies. High levels of inflation work against the justice in distribution principle

and reallocate wealth in favour of riches. He also argued that high inflation breeds anti-business sentiments in society and weakens the support for the business class. In the early 1920s, the post-war situation led to a steep rise in inflation which posed a grave danger to the British economy. Keynes was clear that the policy of gradually tackling and controlling inflation must be rejected, and the policy of swift attack through monetary shock must be adopted.

Keynes was quite vocal about the detrimental impacts of inflation in his book *A Tract on Monetary Reform (1923)*. He was most intimidated by the disincentivizing implications of inflation on savings and capital formation in the economy. He was concerned that inflation reduces the willingness to save and invest and eventually hampers economic growth in the long run. Since inflation erodes people's confidence and, in turn, their willingness to save; lower saving and investment slows down the process of capital formation. According to Keynes, capital growth must be proportional to the growth in labour supply to maintain the quality of life. Keynes, in his book, also discussed that inflation leads to the business class making profits in the form of windfall gains which work against them and weaken the support of society for its business

class. In addition, Keynes talked about inflation as a tax on real money holdings. According to him, inflation is as good as any other tax where the government secures its control over real resources just as obtained through taxation. He emphasized that it is the easiest form of taxation to be enforced and the hardest to be evaded, the burden of which falls on cash holders.

Understanding inflation dynamics is crucial; firstly, inflation causes prices to change, resulting in the firms' price adjustment costs. Such expenses though imprudent, alter the distribution of relative prices in the economy. Secondly, inflation affects the "real value of nominal assets and the value of money, which governs society's response to consumption and investment" (Dossche, 2009). In short, inflation through its effect on real goods prices and asset prices is very closely linked to humans' social and economic well-being. In simple words, comprehending inflation dynamics means discerning the process of inflation through the knowledge about drivers of inflation and its consequential effect on the allocation of resources.

Over the last decade, inflation dynamics and their relationship with other key economic variables seem to have altered. Following the Great Financial Crisis (GFC), the central banks (particularly advanced countries) have had a bold, unconventional and systematic response. Inflation in advanced economies appears to be not taking a conventional path. The inflation rates have remained significantly low, especially in the presence of all-time low-interest rates and a huge liquidity boost (Central Bank of Chile, 2018). The post-crisis period has witnessed lower average headline and core inflation rates and a fall in unemployment figures, particularly in advanced economies and some emerging nations. It is referred to as a "twin puzzle" in inflation dynamics and has left economists and policymakers perturbed. Many explanations have been put forward explaining this change in inflation dynamics, one of which is structural changes brought about by globalization, such as lowering wage rates and technological innovations leading to changes in the industrial setup. Many central bankers believe that this flattening of the Phillips curve may be due to the successful inflation targeting by central banks. Challenges in measuring price fluctuations may also be a plausible explanation for the twin puzzle with the ever-evolving goods and services market.

An exploration into the process and mechanisms of inflation includes understanding the persistence of inflation. Inflation persistence is defined as the speed with which inflation converges back to its equilibrium level following a shock. A high level of inflation persistence would keep inflation at higher levels for a greater duration, and low persistence brings inflation down to its underlying trend relatively sooner. Section 2 discusses inflation persistence in detail; section 3 thoroughly reviews the relevant literature, data source and methodology presented in section 4 while section 5 offers the findings and conclusions of the study.

2. Inflation Persistence

Several definitions of inflation persistence have been proposed in the literature. Batini and Nelson (2001) discuss three types of inflation persistence, first as positive serial correlation in inflation, secondly as lags between monetary policy actions and their impact on inflation, and lastly as lags between the response of inflation to policy shocks or non-systematic policy actions. Willis (2003) defines persistence in the context of the speed with which inflation returns to its baseline following a shock. Pivetta and Reis (2004) explain persistence as the lags taken by inflation to return to their previous level after a shock. Inflation persistence has been broadly discussed in the literature under two contexts. First, as a univariate representation of inflation, and second as the multivariate approach using econometric models explaining the behaviour of inflation. Under the univariate approach, the shocks affecting inflation are collectively assessed and measured as white noise in the autoregressive process. Hence, they cannot be separated as monetary policy shocks or external shocks *per se*. Under the multivariate approach using structural VAR, separate shocks affecting inflation are identified, and a shock-specific analysis is possible.

Following the definition of the first type of inflation persistence, studies were carried out in the post-war period for the US (Fuhrer and Moore, 1995) and other industrialized countries where inflation was highly persistent. Cogley and Sargent (2001) and Taylor (2000) carried out the regressions for the US and UK**.** They confirm the decline in persistence through a fall in AR (1) coefficient for both countries. The UK witnessed a significant fall in persistence in its adoption of IT, which was confirmed by Kuttner and Posen (2001). The measure of persistence as lags taken by the monetary policy actions

to impact inflation is widely covered in the literature. Friedman (1972), using monthly data for the US (1953-70), concludes that money growth and CPI inflation display the highest correlation. The study on lags for monetary actions to impact inflation was repeated for the UK and extended to the US by Friedman and Schwartz (1982). It concludes that monetary changes affect output with a lag of six to nine months for both the US and the UK, and it took around fifteen to twenty months for monetary policy to affect prices in both nations.

Inflation persistence is an important characteristic that needs to be monitored. It is instrumental in better predictability of future inflation rates. Moreover, knowledge about the lags taken by the monetary policy change to have its peak effect on inflation is vital to the monetary authorities. India experienced several episodes of persistently high inflation. In the 1950s and 60s, it was mainly because of droughts and wars. In the 1970s, high inflation was due to the supply shocks resulting from Oil Price Crisis. A huge fiscal deficit and fiscal mismanagement were responsible for elevated price levels during the 1980s, which led to the balance of payment crisis in the early 90s and kept inflation at higher levels. The shift to a flexible exchange rate regime and the opening of the economy led to a massive capital inflow and skyrocketing prices in the mid-90s. Price levels cooled down, and inflation was in the comfort zone in the 2000s, after which the Global Financial Crisis hit in 2008, from which India recovered. However, the coming period witnessed massive price surges due to weather adversity, rising oil prices, massive capital inflows, and other factors. High food prices kept headline inflation above the comfort zone and remained there till 2013.

Several studies have been conducted in India examining the degree and source of inflation persistence. Khundrakpam (2008) estimates inflation persistence using monthly data at the aggregate and disaggregated level from 1982-2008. The persistence is estimated through the lags taken for monetary policy to impact prices and autoregressive properties. It was found that persistence remained lower when a break-in means was considered. The study also reported that money supply positively impacted various price indices, and the lags were longer when inflationary pressure was high. The negative impact of interest rates on prices with much longer lags was also observed. New age methodology has also been applied in various studies estimating inflation persistence in India. It involves developing a structural model relating inflation to its past and future path and deviation of the current price level from its required level, a new Keynesian-type Philips curve. This approach has been estimated in the Indian context to measure various sources of persistence such as intrinsic, extrinsic, and expectation-related persistence by Kapur and Patra (2003), Patra and Ray (2010), and many others. Patra *et al.*, (2014) investigate the source of inflation persistence in India using monthly and quarterly data for the period 1982-2013 and update the results obtained from Khundrakpam (2008) employing both univariate and multivariate approaches. The univariate approach confirms an increase in inflation persistence post the global crisis. Following the new Keynesian Phillips curve, the multivariate approach suggests that expectations are the main factor causing inflation persistence.

3. Review of Literature

The economic literature is swarmed with research works on varied dimensions of inflation. This study focuses on the literature associated with the concept and the measurement of inflation persistence.

Batini (2006) defines three types of inflation persistence: first as the positive serial correlation in inflation; second as the lags taken by the monetary policy to have its peak effect on inflation; third as the lags taken by inflation to respond to policy shocks. The study analyzes all three types of inflation persistence and presents new evidence for the Euro Area and individual countries: Germany, France, and Italy. The evidence from the analysis of the first type of persistence suggests that the degree of persistence for the euro area has not altered much over the three decades, and it indicates a sizeable shift in the mean inflation for Italy and France, which explains the fall in the mean inflation of the Euro Area. The overall analysis hints at the euro area inflation being persistent and has changed marginally over thirty years. The definition and measurement facets of inflation persistence are reviewed by Marques (2004). It is highlighted that the estimation of inflation persistence under the univariate approach is conditional on a constant mean. There is a trade-off between persistence and flexibility of the long-run level of inflation. That is, persistence is maximized when a constant level of long-run inflation is assumed. The study also conveys that the

standard approach of accounting for a structural break in the intercept does not solve the problem. A non-parametric measure of estimating inflation persistence for which specifying and estimating a model is not required is suggested. The inflation persistence for the US and the Euro Area is estimated, and the degree of persistence heavily relies on the type of mean assumed.

The concept of Inflation Persistence is further explored by Fuhrer (2010). The study assumes inflation persistence to be an economic analogy of inertia in physics. Reduced form inflation persistence is distinguished from structural persistence, and the sources of persistence are explored following the distinction between intrinsic and inherited persistence. A variety of measures to examine reduced form persistence are discussed. The data used in the analysis comprises three key inflation measures; the GDP deflator, CPI, and the personal consumption expenditures chain-type price index (PCE), core versions of CPI and PCE are also included. Each inflation measure is defined as four hundred times the log change in the corresponding price index. The study indicates that reduced-form persistence has changed, although there is not much clarity about the source that caused the change. The structural channels through which the persistence may have changed are discussed; changes in intrinsic and inherited persistence are indicated in the study. It is concluded that while improvement in the systematic component of monetary policy has led to low inflation persistence, the majority of the changes in persistence are attributed to changes in the intrinsic sources of inflation.

The duration in which monetary policy has the maximum impact on inflation in the US and the UK is examined by Batini and Nelson (2001). The empirical evidence reaffirms that it takes over a year for monetary policy actions to impact prices in both the US and the UK. The evidence also makes a case for a significant relationship between inflation and money growth after the lags involved are taken into consideration. The results also show that the financial market innovations and improvement in information processing have not significantly reduced lags between monetary policy actions and inflation reactions. The evidence on the sources of lags partly agrees with the ones identified by Friedman (1972). The study does not find persistent inflationary expectations as a significant source of lags. The long lags between monetary policy actions and inflation response exist even after a reduction in inflation's serial correlation, which implies a reduction in the persistence of inflationary expectations.

Khundrakapam (2008) uses monthly data for the period 1982:4 to 2008:3 to analyze inflation persistence in India in terms of autoregressive properties and the lag response of inflation to systematic monetary policy. The study utilizes various measures of prices in India such as WPI, CPI-IW, CPI-UNML and CPI-AL, along with the disaggregates of WPI and food components of CPI-IW. A structural break in the mean rate of inflation is tested employing the Quandt-Andrews unknown break-point test, and a statistically significant break is found in all the aggregate measures of WPI and CPIs. The first type of inflation persistence is measured using the auto-correlation properties of inflation, and it is measured as the sum of the AR coefficients. The results show that inflation persistence is on the lower side without a mean break, and CPI measures of inflation are more persistent than WPI. At the disaggregated level of WPI, the degree of persistence is the highest for manufacturing, while food and fuel exhibit a lower level of persistence. When the mean break is allowed, the persistence declines for all inflation series, including the components. The second type of inflation persistence is measured by estimating the lag at which the response of monthly year-on-year inflation to a corresponding growth in M3 and the monthly weighted average call rate is the maximum. The results suggest that change in money growth has a statistically significant impact on almost all the inflation series. On the other hand, the monthly weighted average call rate is found to have a statistically significant negative impact on all the inflation series. The results obtained from Khundrakapam (2008) are extended in a study by Patra, Khundrakpam, and George (2014). The study delves into sources of inflation persistence and estimates persistence through both univariate and multivariate analysis. The moments of inflation are investigated as it provides useful insight into the dynamics and persistence of inflation. The analysis of the first moment of inflation reveals that fuel prices have a short-lived impact on the mean rate of inflation, and food prices have a lasting effect on the mean rate and even spill to the non-food manufactured products. The analysis of the skewness of inflation in India comes out to be positive or right-skewed due to sharp movements in relative prices on account of supply-side shocks. The coefficient of kurtosis has remained more than three except for some periods implying the distribution of price changes to be fat-

tailed. The univariate analysis points to a higher degree of persistence in the post-crisis period, and the multivariate analysis suggests expectations to be the main cause of higher inflation persistence.

A link between inflation persistence and policy credibility in India is established by Kumar and Mitra (2012). The literature on credibility points out the negative relationship between inflation persistence and policy regime credibility. The evidence from India suggests a significant variation in the persistence coefficients over the sample period. The 80s were marked by a notable rise in persistence coefficients due to weak fiscal controls and huge fiscal deficits. The ever-rising deficits and the Gulf war resulting in the oil price hike further paved the way for higher inflation persistence in the early 90s. The crisis in 1991 presented an opportunity before India to adopt economic and fiscal reforms, which kept a check on persistence levels for the coming years. However, the deterioration of government finances in the late 90s again resulted in the drifting up of persistence levels. The global financial crisis of 2008 led to the deterioration of government finances. Thus the process of fiscal consolidation was kept on hold to cope with the crisis, and easy monetary and fiscal policies were adopted. However, the poor government finances and the lack of public confidence in the RBI's ability to stabilize inflation led to a rise in inflation persistence during this period.

4. Data and Methodology

This section measures inflation persistence using the univariate approach, estimating univariate Autoregressive (AR) time series. It is the most traditional method of measuring persistence as the sum of the estimated AR coefficients. The model looks as follows:

$$\Pi t = C + \sum_{j=1}^{k} \alpha_j \Pi_{t-j} + \varepsilon_t \tag{1}$$

Where Π is the inflation rate, α is the autoregressive coefficient, and ε is a serially uncorrelated but possibly heteroskedastic random error term. The measure of persistence is obtained by adding up the AR coefficients, $p \equiv \sum \alpha_j$ (Andrews and Chen, 1994). Equation (1) can be rewritten as:

$$\Pi_t = C + p\Pi_{t-1} \sum_{j=1}^{k-1} \beta_j \Delta\Pi_{t-j} + \varepsilon_t \tag{2}$$

Here p measures persistence, and β indicates transformations of autoregressive coefficients in (1), $\beta_{k-1} = -\alpha_k$. Suppose p is equal to unity or any value around one. In that case, it implies that inflation is non-stationary and has a unit root so that when due to any shock, inflation rises; it stays at an elevated level. Conversely, if the value of p is lower than unity, the shock has a transient impact on inflation and will soon converge to its original level. The two information criteria, Akaike Information Criteria (AIC) and Schwarz Bayesian Criteria (SBC), are used to decide the lag lengths. Perron (1989) suggested that the persistence parameter measured as the sum of AR coefficients will be over-estimated if the structural break in the inflation series is not taken into account. Therefore, Quandt-Andrews unknown breakpoint test and Bai-Perron breakpoint test are used to detect any structural break in the inflation series. If the two tests confirm the presence of a structural break in inflation, then the persistence measure recognizing a break in the mean is estimated through the following equation:

$$\Pi = C_0 + C_1 D_t + p\Pi_{t-1} \sum_{j=1}^{k-1} \beta_j \Delta\Pi_{t-j} + \varepsilon_t \tag{3}$$

$D_t = 0$ for t < T and 1 for t ≥ T.

For India year on year inflation data on monthly frequency is taken for the estimation of inflation persistence. The data for both the WPI and the CPI is considered for the period of January 1991-December 2019. The WPI and CPI measures plotted in Figure 1 show some episodes of peaks in both the inflation indices. The peak in the early 90s was due to the balance of payment crisis which eased in the mid-90s and followed a declining trend. CPI inflation went beyond the comfort zone and was above the WPI measure in 1998 due to food price fluctuations as CPI gives larger weight to food, and in the early 2000s, both WPI and CPI measures maintained low levels. In mid-2008, India encountered the global financial crisis, and in 2009-10 it experienced one of the highest food inflation rates. The prices breached the safety zone and reached double-digit levels.

In handling the time series data, the first step is to check for a unit root. This step is also crucial in getting an idea about the degree of persistence in the inflation measure. In various studies, the presence of unit roots in inflation confirms a high degree of persistence. The Augmented Dickey-Fuller test is employed to test for the
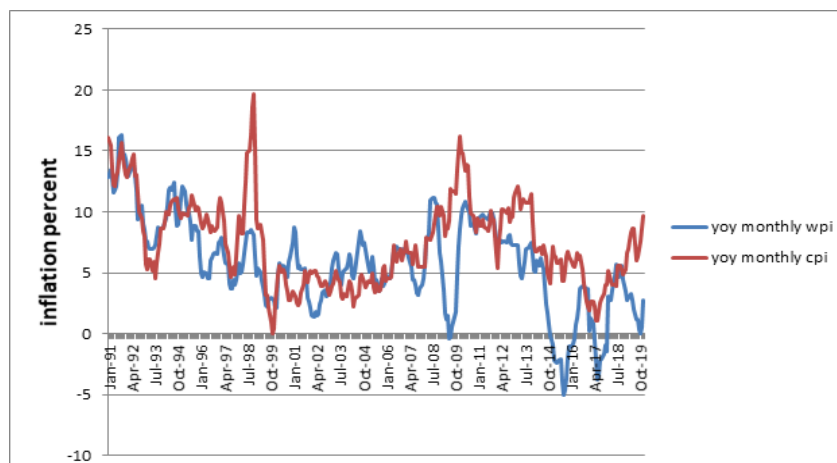
Figure 1. YoY monthly inflation rate of WPI and CPI Series

Table 1. Mean and Volatility of WPI and CPI (in per cent)

Variable	Mean Inflation	Standard deviation	Structural Break
WPI	6.22	v	1995:12
CPI	7.70	3.52	1999:06 & 2008:03

Source: Author's Calculation

Table 2. Persistence of WPI and CPI

Variable	Persistence Parameter	Structural Break	Lag length (selected by SBC)
WPI	0.40*	1995:12	1
CPI	0.34*	1999:06 & 2008:03	2

Source: Author's Calculation

stationarity in the WPI, and the CPI and both the inflation measures become stationary after differencing.

The mean and standard deviation of the WPI and the CPI are presented in Table 1. The break dates are obtained using the Quandt-Andrews unknown breakpoint test and Bai-Perron multiple breakpoint tests. The tests give a statistically significant break in December 1995 for the WPI and in June 1999 and March 2003 for the CPI. As expected, the mean of the CPI inflation rate is more than that of the WPI. In addition, the volatility in the WPI is slightly higher than in the CPI, maybe because of the higher weightage given to the manufactured goods in the wholesale basket. Frequent movements in manufactured goods cause the WPI to move more than the CPI.

The lag lengths are selected using the SBC information criteria, which chooses AR (1) process for the WPI and AR (2) process for the CPI. The persistence measure in Table 2 comes to around 0.34 for the CPI for the full sample period suggesting a lower degree of persistence in the presence of a structural break in the mean rate. A lower degree of persistence suggests that the deviation of the CPI inflation from its long-term trend would be corrected in a short period and that about 65 per cent of the deviation would be corrected. On the other hand, the

persistence for the WPI comes to 0.40 in the presence of the structural break. It is slightly higher than the CPI and implies that 60 per cent of its deviation from the long-term underlying trend would be corrected.

5. Conclusion

Inflation is the most used economic term in common parlance due to its impact on people's day-to-day lives. The biggest cost of inflation is the erosion of real income that it causes. When the nominal income of the households does not increase in proportion to the increase in prices, the purchasing power or the real income of the people falls. The level of real income determines the standard of living; when real income falls, so does people's standard of living in society. Economic stability and efficiency are also adversely affected by a sustained rise in prices along with growth and welfare. Inflation redistributes income between different sectors of the economy. It redistributes real purchasing power from those whose income rises slowly relative to the prices they pay to those whose income increases rapidly, which instils instability in the economic system and lowers the welfare of people, especially fixed-wage earners and pensioners. Inflation also affects the consumption and investment decisions of the people, which lowers economic activity and hence growth.

Persistence is one of the essential facets of inflation that needs to be monitored. With Price stability being one of the foremost priorities of central banks, an understanding of inflation persistence is crucial. Inflation persistence in both the WPI and CPI measures of inflation has been estimated in this study employing the univariate approach of estimating AR time series. It is the most conventional method of estimating persistence as the sum of AR coefficients. WPI and CPI are stationary at the first difference, and structural breaks are tested to prevent the exaggeration of the persistence parameter. A statistically significant break appears in December 1995 for WPI and in June 1999 and March 2003 for CPI. The mean CPI inflation rate is more than the mean WPI. However, the volatility in WPI appears to be higher than the CPI, probably because of the higher weightage of the manufactured goods in the wholesale basket. The frequent movement in the prices of manufactured goods makes WPI more volatile than the CPI. The persistence

parameter for the WPI and CPI comes to 0.40 and 0.34, respectively. Thus, the WPI emerges to be slightly more persistent than CPI for the period under study. In other words, CPI inflation would return to its long-term trend following a shock relatively sooner than WPI. The higher persistence in overall WPI can be explained by a higher degree of persistence of the 'manufacturing' and 'non-food' categories of WPI.

6. References

Andrews, D. W., & Chen, H. Y. (1994). Approximately median-unbiased estimation of autoregressive models. *Journal of Business & Economic Statistics*, *12*(2), 187-204. https://doi.org/10.1080/07350015.1994.10510007

Batini, N. (2006). euro area inflation persistence. *Empirical Economics*, *31*(4), 977-1002. https://doi.org/10.1007/s00181-006-0064-7

Batini, N., & Nelson, E. (2001). The lag from monetary policy actions to inflation: Friedman revisited. *International Finance*, *4*(3), 381-400. https://doi.org/10.1111/1468-2362.00079

Cogley, T., and Sargent, T.J. (2001). Evolving post-world war II US inflation dynamics. *NBER Macroeconomics Annual, 16,* 331-373. https://doi.org/10.1086/654451

Dossche, M. (2009). Understanding inflation dynamics: Where do we stand (National Bank of Belgium Working Paper No. 165). National Bank of Belgium. Available at: https://www.nbb.be/doc/ts/publications/wp/wp165en.pdf?language=de. https://doi.org/10.2139/ssrn.1684013

Friedman, M. (1972). Have monetary policies failed? *The American Economic Review, 62*(1/2), 11-18.

Friedman, M., & Schwartz, A. J. (1982). Monetary trends in the United States and the United Kingdom: their relations to income, prices, and interest rates. University of Chicago Press. https://doi.org/10.7208/chicago/9780226264257.001.0001

Fuhrer, J. C. (2010). Inflation Persistence. In B.M. Friedman and M. Woodford (Eds.), *Handbook of monetary economics*. San Diego: Elsevier. 3, 423-486. https://doi.org/10.1016/B978-0-444-53238-1.00009-0

Fuhrer, J., & Moore, G. (1995). Inflation persistence. *The Quarterly Journal of Economics, 110*(1), 127-159. https://doi.org/10.2307/2118513

Keynes, J. M. (1913). Indian Currency and Finance. London: Macmillan and Company.

Keynes, J. M. (1923). A Tract on Monetary Reform. London: Macmillan and Company.

Khundrakpam, J. K. (2008). How persistent is indian inflationary process, has it changed? *Reserve Bank of India Occasional Papers, 29*(2).

Kumar, P., & Mitra, P. (2012). Fiscal stance, credibility and inflation persistence in India (RBI Working Paper Series No. 13). Reserve Bank of India. Available at: https://rbidocs.rbi.org.in/rdocs/publications/pdfs/wp13fsc250712.pdf

Kuttner, K. N., & Posen A. S. (2001). Beyond Bipolar: A three-dimensional assessment of monetary frameworks. *International Journal of Finance and Economics, 6,* 369-87. https://doi.org/10.1002/ijfe.167

Marques, C. R. (2004). Inflation persistence: Facts or artefacts (ECB Working Paper No. 371). European Central Bank. Available at: https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp371.pdf.

Patra, M. D., & Ray, P. (2010). Inflation expectations and monetary policy in India: An empirical exploration (IMF Working Paper No. 10/84). International Monetary Fund. Available at: https://www.elibrary.imf.org/view/journals/001/2010/084/001.2010.issue-084-en.xml. https://doi.org/10.5089/9781451982640.001

Patra, M. D., Khundrakpam, J. K., & George, A. T. (2014). Post-global crisis inflation dynamics in India: what has changed. India Policy Forum. *National Council of Applied Economic Research, 10*(1), 117-203. Available at: https://www.ncaer.org/uploads/photogallery/files/1432105116India%20Policy%20Forum%202013-14,%20Volume%2010.pdf#page=142.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 1361-1401. https://doi.org/10.2307/1913712

Pivetta, F., & Reis, R. (2004). The persistence of inflation in the United States. Manuscript, Harvard University.

Taylor, John B. (2000). Low inflation, pass-through, and the pricing power of firms. *European Economic Review, 44,* 1389-1408. https://doi.org/10.1016/S0014-2921(00)00037-4

Willis, J. L. (2003). Implications of structural changes in the US economy for pricing behavior and inflation dynamics. *Economic Review-Federal Reserve Bank of Kansas City, 88*(1), 5-28.