BARRY EICHENGREEN*
University of California, Berkeley

POONAM GUPTA†
World Bank

RISHABH CHOUDHARY‡
Indira Gandhi Institute of Development Research
World Bank

Inflation Targeting in India: An Interim Assessment§

ABSTRACT This paper provides an assessment of India's inflation targeting regime. It shows that the Reserve Bank of India (RBI) is best characterized as a flexible inflation targeter: contrary to criticism, it does not neglect changes in the output gap when setting policy rates. The paper does not find that the RBI became more hawkish following the transition to inflation targeting; on the contrary, adjusting for inflation and the output gap, policy rates became lower, not higher. Some evidence suggests that inflation has become better anchored: increases in actual inflation excite inflation expectations less, which is indicative of improved anti-inflation credibility. The question is whether the shift to inflation targeting has enhanced the credibility of monetary policy such that the RBI is in a position to take extraordinary action in response to the COVID-19 crisis. The paper argues that the rules and understandings governing inflation targeting regimes come with escape clauses, allowing central banks to suspend their inflation targets temporarily under specific circumstances such as those provided by the COVID-19 pandemic. The paper provides evidence that inflation targeting central banks were able to respond more forcefully to the COVID-19 crisis, consistent with the idea that inflation expectations were better anchored, providing more policy room for maneuver.

Keywords: *Inflation Targeting, Monetary Policy, India*

JEL Classification: *E5, E52*

* *eichengr@berkeley.edu*
† *pgupta@ncaer.org*
‡ *rchoudhary@worldbank.org*
§ We thank Kenneth Kletzer, Rakesh Mohan, Raghuram Rajan, Rajeswari Sengupta, Venkat Bhargav Sreedhara, and participants at the India Policy Forum, July 13–16, 2020, for helpful comments.

1. Introduction

Monetary policy in India has a checkered history. The Reserve Bank of India (RBI) has followed a variety of policy strategies over the years. Following a long period of fiscal dominance during which the central bank was expected to monetize budget deficits, the fiscal framework was reformed and strengthened in the early years of the current century, allowing the RBI to exert more independence and bring inflation down to levels characteristic of other low- and middle-income (LMI) countries. This transition culminated in the inflation-targeting (IT) agreement of February 2015 and an amended RBI Act in May 2016, which gave the central bank a statutory inflation target. At this point, the RBI adopted a full IT framework, emulating international best practice.

These changes being recent, their consequences have been the subject of little systematic analysis. Moreover, their efficacy is now being subjected to the mother of all stress tests in the form of the COVID-19 pandemic. We think that four years of experience is just enough for a preliminary analysis and that the challenge of the pandemic makes it important to extract lessons from that experience.

Some of the lessons we draw may be surprising. Contrary to conventional wisdom that the RBI should focus on core inflation and "look through" volatile and transient food price inflation, we find that food price inflation can de-anchor expectations and spill over into core inflation; by implication, monetary policy should respond. We show that the RBI is best characterized as a flexible inflation targeter: contrary to criticism, it does not neglect changes in the output gap when setting policy. We do not find that the RBI became more hawkish following the transition to IT; on the contrary, adjusting for inflation and the output gap, policy rates became lower, not higher. We find some evidence that inflation has become better anchored: increases in actual inflation do less to excite inflation expectations, indicative of improved anti-inflation credibility. Consistent with this conclusion, a number of inflation-related outcomes (the level and volatility of inflation, the stability of inflation expectations, and the behavior of ancillary variables such as the exchange rate and equity markets) are more stable than before.

Finally, we ask whether the RBI, having gained credibility with the shift to IT, is in a position to take extraordinary steps in response to COVID-19. We argue that this is the case, and that rules like those governing modern IT regimes come with implicit escape clauses allowing central banks credibly committed to those regimes to deviate, under exceptional circumstances,

without untoward consequences. Specifically, we argue that the better anchoring of inflation expectations has enhanced the scope for the RBI to respond to an exceptional shock like the COVID-19 pandemic—a shock that is (a) independently verifiable and (b) not of the authorities' own making—despite the fact that inflation was already running at the top of the target range and that COVID-19, as a negative supply shock, might be expected to raise inflation. We provide evidence that inflation-targeting central banks were able to respond more forcefully to the COVID-19 crisis, consistent with the idea that inflation expectations were better anchored, giving them more policy room for maneuver.

Section 2 starts with an overview of the evolution of India's monetary policy framework, placing the shift to IT within a broader historical context. Section 3 describes different measures of inflation for India with an eye toward determining which have the greatest utility for policy. Section 4 estimates reaction functions for the RBI that can be used to place its policy actions in an international comparative perspective. It asks whether and how the reaction functions changed with the shift to IT. Sections 5 and 6 look at how the behavior of macroeconomic and financial variables, including inflation expectations and pass-through, changed, if at all, with the shift to IT. Section 7 looks at the RBI's response to the COVID-19 pandemic, after which Section 8 concludes the paper.

2. India's Monetary Policy Framework[1]

India's monetary policy framework has evolved over recent decades (for a comprehensive summary, see Appendix Table A.1). In the first two decades following Independence, there was no formal framework for monetary policy. Policy regulated credit availability with an eye toward the needs of the current Five-Year Plan.[2] With enactment of the Banking Regulation Act in 1949, banks were required to maintain a Statutory Liquidity Ratio (SLR) in the form of gold, cash, and approved securities. Other policy instruments included the discount rate (bank rate), reserve requirements, and open market operations (OMOs).

1. This section draws on Mohan and Ray (2018), Das (2020), and Hutchison et al. (2013). See also Mohan and Kapur (2009) and Patra and Kapur (2012) for discussions of the evolution of monetary policy in India. Dua (2020) provides a discussion of the IT framework, and Patnaik and Pandey (2020) compare features of India's IT framework with that of other countries.

2. Monetization of the budget deficit by the RBI increased after the Second Five-Year Plan, leading to an increase in statutory liquidity ratio to 25 percent from 20 percent.

The monetary policy framework in place since the end of the 1960s (when the major banks were nationalized) through the mid-1980s is often described as one of "credit planning," during which policy operated via the SLR and the Cash Reserve Ratio (CRR), a specified minimum fraction of total customer deposits that commercial banks must hold in cash or as deposits with the central bank. The SLR was used to finance the budget deficit, the CRR to neutralize the effect of deficit financing on inflation.[3] Deposits at public sector banks and credit supplied by them expanded rapidly, resulting in a rapid increase in the broad money supply: the money stock increased by 17.5 percent a year during the 1970s and the first half of the 1980s, compared to less than 10 percent during the previous decade. Since the period featured modest economic growth (about 4 percent a year), this resulted in relatively high inflation (averaging 8.8 percent). Das (2020) contends that traditional monetary policy instruments, such as the bank rate and OMOs, proved inadequate for regulating credit growth, money supply, and inflation, owing to fiscal dominance.[4]

From the mid-1980s through the late 1990s, the RBI employed a "monetary targeting with feedback" framework in which the broad money supply was set in line with projected GDP growth and inflation. The move to this framework coincided with financial sector reforms and increasingly market-determined interest and exchange rates. Price stability was the central objective of monetary policy, with 5–7 percent as the target range for inflation. (This is different from saying that the central bank adopted a monetary policy strategy of inflation targeting, where such a framework involves additional elements, as described below.) Although the RBI introduced various money market instruments in the late 1980s, including commercial

3. The SLR was raised from 25 percent of the bank's Net Demand and Time Liabilities (NDTL) in 1969 to 37 percent by July 1985, while the CRR was raised from 3 percent of the bank's NDTL in 1969 to 9 percent by 1985.

4. Recall that the RBI was not independent and was expected to finance the budget deficit with no questions asked. As Ghate and Kletzer (2016) put it:

> Fiscal dominance and financial repression have been hallmarks of Indian monetary policy for decades. The Reserve Bank of India was designated as the banker for the government and authorized to grant advances to the Government of India in the Reserve Bank of India Act of 1934. These advances became *ad hoc* three-month Treasury Bills continuously held by the RBI in a process of automatic monetization of government debt. The RBI simply funded the public sector budget deficit through periods of rising public debt and inflation until the 1990s. In 1997, the authorization to issue such *ad hoc* Treasury Bills ended and was replaced by a system of Ways and Means advances. The RBI continues in its debt management role for the Government of India. In 2006, RBI's participation in the primary market for government debt ceased, and India completed the transition to market-determined yields on government bonds.

paper and certificates of deposit, the money market was thin and illiquid due to low volumes. Fiscal dominance in the form of significant automatic monetization of budget deficits by the central bank remained a monetary policy fact of life.

As the economy was further liberalized, the practice of automatic debt monetization through the central bank's purchases of treasury bills was eliminated.[5] This allowed the RBI to adopt a multiple indicator approach as of April 1998. In addition to taking into account trends in growth and inflation, the central bank now took into consideration additional macroeconomic variables such as credit growth, the exchange rate, the trade balance, unemployment, and the stance of fiscal policy. The decade that followed was also marked by greater fiscal discipline, enforced starting in 2003 through a newly enacted Fiscal Responsibility and Budget Management (FRBM) Act, which prohibited the RBI from purchasing government securities on the primary market, and by continued financial sector liberalization and interest rate deregulation.

As a result of these changes, interest rates gradually became the main instrument of monetary policy. From the late 1990s through the early 2000s, the bank rate was used to signal the policy stance. In April 1999, the RBI introduced an Interim Liquidity Adjustment Facility (ILAF) under which liquidity was injected at the bank rate and withdrawn at the reverse repo rate (the rate at which the RBI borrows from the banks). By November 2004, this had developed into a full-fledged Liquidity Adjustment Facility (LAF) in which the repo rate (the rate at which the banks borrow from the RBI) provided the upper bound of the policy interest rate corridor, while the reverse repo rate provided the lower bound. If liquidity was ample, the operative rate was the reverse repo rate; when it was scarce, it was the repo rate. From 2011, a revised corridor was redefined as a fixed width of 200 basis points. The repo rate was placed in the middle, with the reverse repo rate 100 basis

5. There were two kinds of treasury bills: "ordinary treasury bills" were placed with banks and retails investors at market rates as per a weekly schedule of borrowing, and "ad hoc bills" could be placed only with the RBI, at below market rates when required. "Ad hoc" connotes that there was no schedule for issuance. In 1994, the RBI and the government signed an agreement specifying limits on the automatic monetization of budget deficits. In March 1997, another agreement was then signed under which ad hoc treasury bills were replaced by Ways and Means Advances, through which the government could borrow from the RBI subject to limits. It was agreed that these advances would not be a regular source of deficit financing but only cover day-to-day mismatches in receipts and payments of the government. Note that as part of the COVID-19 policy response, the borrowing limits under Ways and Means Advances were increased for both Central and state governments, and the number of consecutive days for which government advances could be overdrawn was also increased.

points below it, and a Marginal Standing Facility (MSF) rate 100 basis points above it (at which commercial banks could borrow overnight up to 1 percent of their net demand and time liabilities to meet liquidity shocks).

Further changes were introduced in September 2014 to coincide with the move to formal inflation targeting (see Patra et al. 2016). An expert committee (Reserve Bank of India 2014) had recommended that the RBI should manage liquidity by offering term repos of different tenors. This led to the ending of unlimited accommodation of liquidity needs at the fixed LAF repo rate; providing most central bank liquidity through term repo auctions; fine-tuning operations through repo/reverse repo auctions of maturities ranging from intra-day to 28 days; allowing market participants to hold central bank liquidity for a longer period; and progressively reducing the SLR.

The government and the RBI then signed an inflation-targeting agreement in February 2015 and amended the RBI Act in May 2016.[6] The inflation target was set by the government in consultation with the RBI.[7] Accordingly, the government announced via the Official Gazette that 4 percent Consumer Price Index (CPI) inflation would be the target from August 5, 2016, with an upper tolerance limit of 6 percent and a lower limit of 2 percent. It further announced that the government would constitute a six-member Monetary Policy Committee (MPC), including three ex-officio members from the RBI: the Governor of the Bank (who would also be its Chairperson); the Deputy Governor in charge of monetary policy; and one officer to be nominated by its Central Board. The other three members would be appointed by the government. The members would hold office for four years and could not be reappointed.

The RBI was required to organize at least four meetings of the MPC annually, following a schedule published in advance.[8] It was asked to publish a Monetary Policy Report every six months explaining the sources of inflation. It was to provide forecasts of inflation for a period ranging from 6 to 18 months; the resolution adopted by the Committee; further details on the 14th day after every meeting of the MPC, including the minutes of the proceedings of the meeting; the vote and the statement of each member of the MPC; and a document explaining steps to be taken to implement the decisions of the MPC. Finally, if the inflation target was not met, the RBI was required to submit a report detailing the reasons for failure to achieve it; remedial actions; and the estimated time period within which the inflation

6. For details, see amendment to the RBI Act, 1934, inserted by the Finance Act, 2016, Chapter III F, Monetary Policy.

7. With the possibility of revisiting it after five years.

8. The first meeting of the MPC was held on October 3 and 4, 2016.

target could be achieved. The agreement specified that the RBI would be deemed to have missed its target if inflation exceeded 6 percent, or declined below 2 percent, for three straight quarters.

3. Measures of Inflation

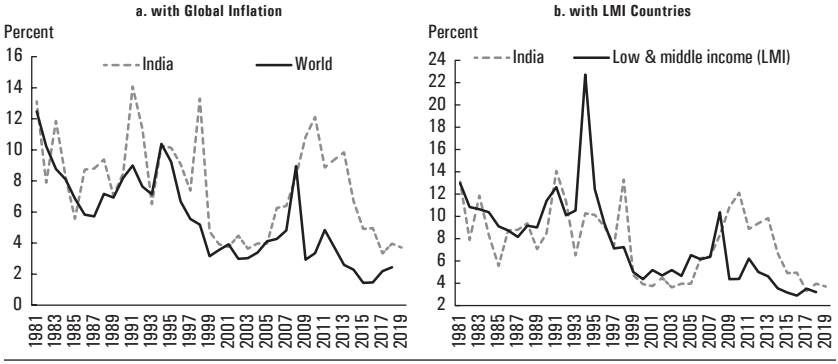
Inflation in India has averaged 8 percent or more since the 1980s, except in the early 2000s, when it averaged 4 percent and, more recently, when inflation fell with the move to inflation targeting (see Table 1). Inflation rates have exceeded average global inflation for the most part (Figure 1), while fluctuations have broadly tracked those in other LMI countries aside from 2009–2015. Basu et al. (2015) attribute India's relatively high inflation during this period to budget deficits and monetary policy accommodation in the years that coincided with national elections.

TABLE 1. Average Inflation Rates in India, the World, and in Low- and Middle-Income Countries (%)

	1981–85	*1986–90*	*1991–95*	*1996–2000*	*2001–05*	*2006–10*	*2011–15*	*2016–19*
India	9.3	8.5	10.5	7.7	4.0	8.8	7.9	4.0
LMI	10.8	9.3	13.7	6.6	5.3	6.3	4.5	3.2
World	9.3	6.8	8.7	4.8	3.5	4.9	3.0	2.0

Source: World Bank's World Development Indicators (WDI) for LMI countries and the world, Ministry of Statistics and Programme Implementation, CEIC for India, authors' calculations.

FIGURE 1. Long-term Inflation Rate (Consumer Prices) in India and Its Co-movement with Global and LMI Inflation



Source: WDI, Authors' calculations.

On the basis of correlations like these, some authors (e.g., Chhibber 2020) have argued that Indian inflation is heavily influenced by global developments, reducing the effectiveness of monetary policy. We analyzed the correlation of global inflation and Indian headline, food, and fuel inflation series at monthly, quarterly, and annual frequencies. It turns out that Indian inflation is *not* highly correlated with global inflation. For the most part, there is no systematic time pattern in these correlations.[9]

3.1. Alternative Measures

A challenge for monetary policy generally is the measurement of inflation. This is true for India, where there was no composite Cost of Living Index before 2011. Instead, there existed separate CPI series for industrial workers, agricultural workers, and nonagricultural rural workers. The CPI for industrial workers (CPI-IW) was commonly used as a proxy for the composite CPI.[10]

A unified CPI series has been available since January 2011. It can be used to calculate monthly year-over-year inflation starting in January 2012. While the RBI used the Wholesale Price Index (WPI) in monetary policy analysis until about March 2014, it now utilizes the headline CPI.[11] The WPI consists of the prices of bulk transactions of goods in the domestic market. It includes manufacturing and commodities but not services (see Table 2).

CPI inflation has been higher than WPI inflation on average. While the average difference between CPI and WPI inflation was 0.4 percent between 1997 and 2009, it widened to 3.2 percent in 2009–2019. Divergences between the two series can be attributed to both food inflation (which has a higher weight in the CPI) and manufacturing inflation (which has a larger weight in the WPI).

The question is: Which series should the RBI target? The WPI may not be the best for two reasons. First, it places a large weight on oil and commodity prices, which are volatile; second, it does not include services. Headline CPI inflation is also affected by volatile commodity prices, albeit

9. Results available on request. These findings are not surprising: food prices in India have been much more stable than global prices because they are administered, while energy prices were similarly more stable than global prices until about 2015, and co-move more strongly with global prices after they became more market-based.

10. There have been five different CPI series: CPI-Combined, CPI–IW, CPI Agricultural Labor (CPI–AL), CPI Rural Labor (CPI–RL), and the CPI Urban Non-Manual Employees (CPIUNME). The last one of these has been discontinued. The weights of different components in the baskets for CPI-Combined and CPI–IW are similar, whereas the CPI–AL and CPI–RL have a larger weight on food, nearly 70 percent. See Mohan and Ray (2018) for a discussion of the composition and dynamics of different inflation series.

11. When estimating reaction functions, we follow this practice, using the CPI inflation starting 2012 and WPI inflation before that.

TABLE 2. Composition of the Wholesale Price Index and the Headline Consumer Price Index

	WPI		*CPI*
Primary products/food	22.6	Food, beverages, and tobacco	48.2
Fuel	13.2	Fuel and light	6.8
Manufactured	64.2	Housing	10.1
		Miscellaneous	28.3
		Clothing and footwear	6.5

Source: CEIC, Ministry of Statistics and Programme Implementation.

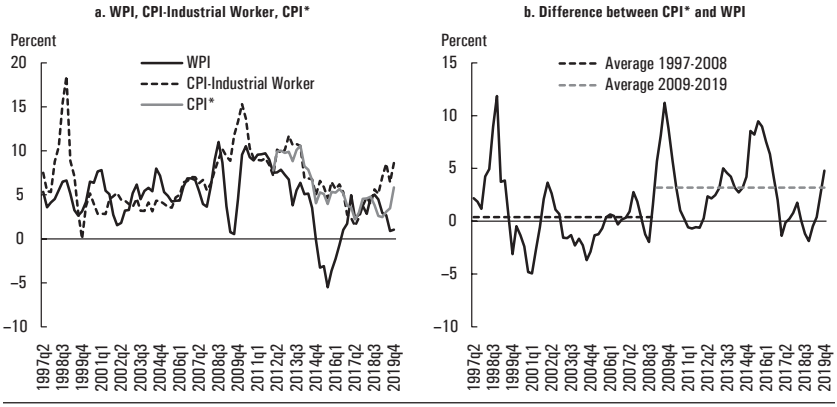
to a lesser extent than the WPI. More importantly, food prices account for nearly half of the CPI, and food prices are often heavily affected by sector-specific, non-monetary factors such as weather and harvests. Insofar as shocks to food prices are transient, there is an argument that the RBI should look through them.[12] Such arguments favor a core (non-food, non-fuel) CPI. The counterarguments favoring headline inflation are that (a) it is easier to explain to the public and thus more effective in anchoring expectations and (b) food inflation feeds back into core inflation and hence needs to be tamed lest it becomes structural and strongly entrenched.[13]

The choice of WPI or CPI is inconsequential if the two series co-move closely. But this is not generally the case, as shown in Figure 2. In the period 2014 Q3 to 2016 Q4, for example, WPI inflation (headline) averaged –1.2 a quarter, while CPI inflation (headline) averaged more than 5 percent a quarter.

12. It has been argued (by Banerjee 2020 and others) that IT has led to a worsening of the agricultural terms of trade and declining rural/agricultural incomes. Variants of this argument are that the government has grown more reluctant to raise support prices for agricultural products because it wishes to help the RBI to lower inflation, or that it has grown more reluctant because it fears the wider repercussions on the economy of the RBI raising interest rates in response. We find the first variant implausible (helping the RBI hit its inflation target is not a government priority). The second variant amounts to the statement that government support for the rural sector costs the economy as a whole through either higher inflation or higher interest rates. The 2015 IT agreement reflected a consensus that paying these costs in the form of inflation was more costly than paying them in the form of interest rates. We do not see what has changed.

13. Cecchetti (2007) and Mohanty (2014) recommend targeting headline inflation. JPMorgan (2018) uses a modified version of core inflation, which besides food and fuel further excludes elements that may be impacted by fuel prices. They term this measure "core-core CPI" and suggest that India should target core or core-core inflation. The argument runs that instead of core inflation converging to food/headline inflation, it is food/headline inflation that converges to core inflation in India. Hence, an elevated core inflation can be undesirable and ought to be monitored and targeted directly. As we show below, we do not find evidence to support the argument.

FIGURE 2. Consumer and Wholesale Price Inflation



Source: Ministry of Statistics and Programme Implementation, CEIC.
Note: *CPI inflation series consists of CPI-Industrial Workers until 2011, and CPI-Combined from 2012 onward.

The correlation between WPI headline and CPI headline inflation has not been very high, though it rose in the last decade and is significantly greater than zero at the 95 percent confidence level (see Table 3). Given the relative composition of their baskets, it is unsurprising that WPI headline inflation is correlated more strongly with WPI core inflation, and that CPI headline inflation is correlated more strongly with food inflation. Their respective food and core inflation series are correlated more strongly than their respective headline inflation series.[14]

3.2. Persistence

Contrary to popular presumption, food price inflation has not been higher than core and headline inflation (Table 4).[15] Neither is it more persistent. We estimate first-order autocorrelation coefficients for rolling windows of 20, 30, and 40 quarters. The coefficients for core and headline inflation are higher than that for food price inflation.[16] Nor has inflation persistence declined over time (in contrast to evidence for the US, e.g., Fuhrer 2010).

14. These patterns have not changed in the last decade.

15. See Appendix B for details.

16. Unit root tests conducted on all inflation measures provide mixed results. While we cannot reject the null of unit root for core inflation at the 5 percent level using both ADF and PP tests (implying high persistence), but for food, fuel, and headline inflation, we reject the null of unit root when the lag length considered for ADF and PP tests is less than 4.

TABLE 3. Correlation Matrix of Inflation Measures

A: 1997 Q2–2008 Q4						
Inflation Measure	*WPI Headline*	*WPI Food*	*WPI Core*	*CPI Headline*	*CPI Food*	*CPI Core*
WPI Headline	1					
WPI Food	0.34*	1				
WPI Core	0.82*	0.20	1			
CPI Headline	0.32*	0.90*	0.09	1		
CPI Food	0.41*	0.93*	0.26	0.94*	1	
CPI Core	–0.04	0.63*	–0.32*	0.81*	0.58*	1
B: 2009 Q1–2019 Q4						
Inflation Measure	*WPI Headline*	*WPI Food*	*WPI Core*	*CPI Headline*	*CPI Food*	*CPI Core*
WPI Headline	1					
WPI Food	0.55*	1				
WPI Core	0.93*	0.27	1			
CPI Headline	0.58*	0.91*	0.39*	1		
CPI Food	0.34*	0.89*	0.10	0.92*	1	
CPI Core	0.77*	0.74*	0.67*	0.86*	0.61*	1

Source: Authors' calculations.
Note: *denotes significance at the 5% level.

TABLE 4. Level and Volatility of CPI Inflation and Its Components (Quarterly Data from 1997 Q2–2019 Q4)

	Mean	*Standard Deviation*	*Coefficient of Variation*
CPI	6.41	3.31	0.52
CPI Food	6.29	5.01	0.80
CPI Fuel	6.96	4.96	0.71
CPI Core	6.47	2.76	0.43

Source: Authors' calculations.

We also calculate the largest autoregressive root or dominant root in the univariate autoregressive process for each inflation series. In the long run, the effect of a shock will be dominated by this largest root. The dominant roots confirm that core and headline inflation are more persistent than food price inflation. The sum of autoregressive coefficients gives a similar result: high persistence across inflation series and higher persistence of core inflation.

Yet another measure of persistence is the impulse half-life, that is, the number of periods it takes for the impulse response to fall below 0.5 following a unit shock. This measure also confirms the higher persistence of core inflation (see Appendix B). The half-life for headline inflation is estimated at around four quarters, and for core inflation at around five quarters. These findings are consistent with the earlier results of Ball et al. (2016), who similarly document the shorter duration of food price shocks.

We estimate a vector autoregression (VAR) model to identify the timing relationship between food price inflation and core inflation.[17] We treat food and core inflation as endogenous and fuel inflation as exogenous (as given largely by global economic conditions).[18] We estimate specifications with 2, 4, and 8 lags. Food price inflation has a larger and more consistent impact on core inflation than vice versa. The impact is significant for two quarters. Fuel inflation does not impact food or core inflation at a quarterly frequency. Granger causality tests in Table 5 further suggest that food inflation Granger-causes core inflation. This result is robust to different lag lengths. In contrast, there is no evidence that core inflation Granger-causes

TABLE 5. Granger Causality Wald Tests (VAR Model)

Dependent Variable (y)	*Explanatory Variable (x)*	*F*	*df*	*df_r*	*Prob > F*	*Does x Granger-cause y?*
Lag length 2						
Food inflation	Core inflation	2.4129	2	81	0.0960	No
Core inflation	Food inflation	3.4081	2	81	0.0379	Yes
Lag length 4						
Food inflation	Core inflation	3.3246	4	73	0.0147	Yes
Core inflation	Food inflation	3.3435	4	73	0.0143	Yes
Lag length 8						
Food inflation	Core inflation	0.6982	8	61	0.6917	No
Core inflation	Food inflation	2.9597	8	61	0.0073	Yes

Source: Authors' calculations.
Notes: Granger causality is based on a 5% significance level; "No" indicates that we fail to reject the null hypothesis: *x* does not Granger-cause *y*.

17. Data is from 1997 Q1 to 2019 Q4. We use the standard splicing method to expand our CPI 2011–12 inflation series, which starts from 2012 onwards. Prior to 2012, CPI–IW inflation has been used for each component—food, fuel, and core.

18. India being a net importer of fuel, its base price is determined globally, and retail prices by the base price and taxes. During the earlier period in the analysis, the retail price was administered.

food inflation. Put differently, past values of food inflation help predict core inflation, but past values of core inflation do not help predict food inflation.

Contrary to popular perception, we do not find food price inflation to be higher, more volatile, or persistent than core inflation. There is evidence, however, that the changes in food inflation lead to subsequent changes in core inflation, but not the other way around. This reinforces a finding of Mishra and Roy (2012).[19] We confirm that this relationship has not changed post IT.

Other authors (e.g., Chhibber 2020) have suggested that the RBI should "look through" (i.e., disregard) movements in food price inflation on the grounds that food prices are volatile, and that focusing on them distorts the conduct of policy. In responding to food price inflation, the central bank will be focusing on the transitory inflation threat and neglecting other more important objectives of policy. We find, on the contrary, that food price inflation feeds through to core inflation as producers mark up the prices of other products. Central banks in advanced economies have been able to look through fluctuations in food and fuel price inflation without consequences for core inflation and therefore, without jeopardizing their inflation targets. In India, where food is a much more important component of consumption baskets, this may not be the case. This is not an argument that the central bank should react to each and every movement in headline and food inflation. But it does suggest that neglecting food price inflation that diverges from the target for an extended period of time can have negative consequences.

4. Reaction Functions

We now ask whether monetary policy decisions are influenced more by the output gap or inflation, whether the reaction function has changed with the adoption of inflation targeting, whether the output gap and inflation carry different weights in the reaction function at high and low values, and whether the reaction function is different for headline and core inflation.[20]

19. This is consistent with Ball et al. (2016), who show that changes in headline inflation feed into expected inflation and future core inflation. Raj et al. (2020) evaluate several possible measures of core inflation and similarly find that headline inflation does not converge to core inflation.

20. Rangarajan (2020) suggests that IT in India is flexible in the sense that "what inflation targeting demands is that when inflation goes beyond the comfort zone, the exclusive concern of monetary policy must be to bring it back to the target level. When inflation is within the comfort zone, authorities can look to other objectives."

All estimated reaction functions include the output gap and inflation but, in an augmented version, we also include the lagged policy rate, the percentage change in the exchange rate, and the budget deficit or government borrowing.

A number of earlier papers have estimated reaction functions for the RBI (see Appendix Table A.4). These studies find that the output gap is important (Hutchison et al. 2013; Mohanty and Klau 2004) and that the exchange rate also matters, especially from the late 1990s when it became more flexible. Inflation, in general, has a much smaller coefficient, both absolutely and relative to the Taylor rule benchmark of 1.5.

These analyses typically use quarterly data, since quarterly GDP growth is available from 1997; we follow this standard practice.[21] For inflation, we use the WPI inflation until 2013 and the CPI inflation thereafter, since these are the inflation rates monitored by the RBI.

For the policy rate, we adopt two approaches. First, we construct a composite policy rate series in the manner of Patra and Kapur (2012).[22] This is based on the series that was used by the RBI at the time for monetary policy purposes, as detailed in Table 6 and Figure 3a. In the second approach, we use the bank rate for the period 1997–2001 and the repo rate from 2002 onwards[23] (See Figure 3b). The exchange rate is calculated as quarter-over-quarter percentage change in the nominal exchange rate with respect to the US dollar. The budget deficit and market borrowing variables are highly seasonal at a quarterly frequency, so we adjust them

TABLE 6. Effective Policy Rates

	Duration	
Instrument	*Month*	*Quarter*
Bank rate	January 1996–February 2002	1996 Q1–2002 Q1
Reverse repo rate	March 2002–June 2006	2002 Q2–2006 Q2
Repo rate	July 2006–November 2008	2006 Q3–2008 Q4
Reverse repo rate	December 2008–May 2010	2009 Q1–2010 Q2
Repo rate	June 2010–present	2010 Q3–present

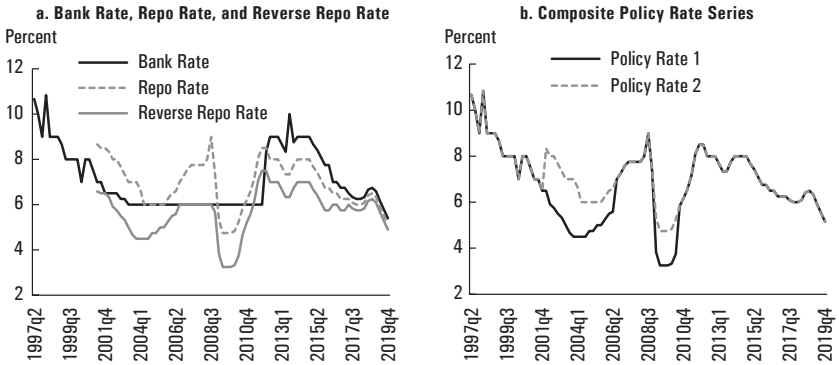
Source: Based on information in Patra and Kapur (2012).

21. Papers estimating reaction functions at a monthly frequency use the Index of Industrial Production as a proxy for output, which we regard as unreliable.

22. The bank rate, the repo rate, and the reverse repo rate are available as monthly averages and end-of-the-month values. The results are insensitive to the two series. In the results reported here, we have used monthly averages.

23. The two series are highly correlated, as is evident in Figure 4.

FIGURE 3. Policy Rates



Source: RBI, CEIC. Source: Authors' calculations.

Note: The first composite policy rate series is based on the policy rates at different points in time, as per Table 6. In the second composite policy rate series, the bank rate is used for the period 1996–2001 and the repo rate from 2002 onwards. The correlation between the two policy rate series is 0.93.

for seasonality and express them as a percentage of the seasonally-adjusted nominal GDP.[24]

The output gap is measured as the difference between the seasonally adjusted real GDP and its trend obtained via the Hodrick-Prescott filter (as in Patra and Kapur 2012) and expressed as a percentage of seasonally adjusted real GDP.[25] Summary statistics and correlations for these variables are presented in the Appendix Table A.4.[26] The policy rate is positively and significantly correlated with the output gap and exchange rate depreciation. It is also positively correlated with inflation, though the correlation is weaker and significant only at the 10 percent level.

We estimate the following baseline specification of the reaction function using OLS:

$$\text{epr}_t = \alpha_0 + \alpha_1 \text{gap}_t + \alpha_2 \text{inflation}_t + \epsilon_t \tag{1}$$

where, epr_t is the effective policy rate; gap_t denotes the output gap expressed as a percentage of GDP; and inflation_t denotes the inflation measure as targeted by the RBI. We assess if the policy rate is different after

24. We use both X-11 and X-13 ARIMA SEATS to seasonally adjust these series. The choice of filter does not seem to matter in the results.

25. The quarterly real GDP series is seasonally adjusted using the X-11 algorithm (of the US Department of Commerce).

26. The policy rate is most persistent (or inertial), followed by inflation. The output gap and exchange rate are least persistent, as per their AR(1) coefficients.

TABLE 7. Monetary Policy Reaction Functions (Dependent Variable is the Effective Policy Rate)

	I	*II*	*III*	*IV*
Inflation	0.11	0.06	0.08***	0.08***
	(1.25)	(0.62)	(3.23)	(2.86)
Output gap (% of GDP)	0.36***	0.40***	0.20***	0.21***
	(4.43)	(4.96)	(2.65)	(2.64)
Inflation targeting		–0.82***		–0.07
		(2.98)		(0.75)
Lagged effective policy rate			0.85***	0.85***
			(18.00)	(17.85)
Constant	6.17***	6.56***	0.48*	0.53*
	(13.27)	(11.29)	(1.73)	(1.80)
Observations	91	91	90	90
Adjusted R^2	0.11	0.13	0.89	0.89

Source: Authors' calculations.

Notes: Robust *t* statistics in parentheses. *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

controlling for the output gap and inflation once the country moved to IT by including a dummy for the period since IT in the regression.

In all variants in Table 7, the output gap has a positive and significant coefficient, as anticipated. Inflation also has a positive coefficient.[27] When we add the lagged policy rate as an explanatory variable (Woodford's version of the Taylor Rule, Woodford 2011), its coefficient indicates significant inertia. The output gap and inflation remain positive as before.

We also include a dummy variable for the IT period to address the concern that interest rates have been higher post IT. On the contrary, we find that rates have been lower once one accounts for inflation and the output gap, though not always significantly so.[28]

27. It is significantly less than the standard Taylor rule benchmark of 1.5. The coefficients on the output gap and inflation are similar to those in other papers estimating the reaction function for India, including Hutchison et al. (2013); Patra and Kapur (2012); Singh (2010); and Mohanty and Klau (2004). Bhoi et al. (2019) estimate a reaction function for 2000–18, using the weighted average call money rate as the policy rate and similarly find the coefficient on the output gap to be larger post IT.

28. We also included two additional terms interacting inflation and the output gap with this same IT dummy. The coefficient on the output gap was consistently positive, and that on inflation consistently negative, though a dozen or so quarterly observations for the IT period do not give us sufficient variation and degrees of freedom to estimate these coefficients reliably and precisely.

Policy rates were lowered dramatically during the Global Financial Crisis. Was this reaction unusual, given that growth slowed sharply between 2007 and 2008? When we add a dummy for the Global Financial Crisis, its coefficient is negative and significant, confirming that the RBI moved more quickly than predicted by its standard reaction function. Another question is whether policy rates react to the inflation series that the RBI tracks formally or to one or more of the CPI inflation series. When we include different inflation series in the reaction function, the results suggest that monetary policy responds to headline and core inflation but not to food inflation.

We also ask if the weights on the output gap and inflation are different in periods when these variables take on unusually high or low values. Contrary to previous suggestions, we do not find evidence of such threshold effects.[29]

While there is evidence of autocorrelation in our OLS estimates, when we correct the standard errors using Newey–West correction, the significance levels are unaffected. Previous studies have used GMM for estimating the reaction function on the grounds that OLS coefficients may suffer from endogeneity and simultaneity bias. When we do so, the coefficients of inflation and output gap are similar to the OLS estimates obtained when we include the lagged policy rate. When we do not include the lagged policy rates, the GMM estimates of the coefficients for both inflation and the output gap are larger and more significant than the OLS estimates (see Appendix D).

Some scholars believe that even though India formally moved to inflation targeting in September 2016, it had de facto started paying more attention to the level of inflation and had announced a glide path for inflation starting in 2014.[30] In lieu of the formal inflation targeting, we define another dummy

29. Specifically, we define dummies for very high values of inflation as when it exceeds 9 percent; for a very large output gap as when it exceeds 1.5; for very low levels of inflation as when inflation is below 3 percent; and for a low output gap as when it is below –1.5. The cutoffs have been selected at about top 10 percent or bottom 10 percent of the observations for inflation and the output gap. We include one of these dummy variables at a time in the regressions. The only coefficient that is significant at a 10 percent level is for a high output gap. This coefficient is negative, indicating that at a very high GDP growth rate (and output gap), the policy rate does not increase proportionately.

30. Mohan and Ray (2018) note that while IT was formally adopted in 2016, the monetary policy framework of the RBI had started tilting towards IT from 2014, and after Raghuram Rajan joined the RBI as governor. The RBI started publishing a biannual Monetary Policy Report to provide an assessment of the overall macroeconomic conditions as well as forecasts of inflation and growth. It also put forth the objective to lower CPI inflation to below 8 percent by January 2015, and below 6 percent by January 2016.

that takes a value 1 from 2014 Q1 onwards. This variable does not show up as significant or impact our other results. When we add the budget deficit or the government's market borrowings (both as a percentage of GDP), their coefficients are insignificant.

5. Outcomes Pre- and Post-Inflation Targeting

Studies of the impact of inflation targeting have reached different conclusions depending, inter alia, on the countries, the period, and the measures considered. We tabulate these studies in Appendix F (Table F.1). For emerging market economies, there is evidence of lower inflation under IT, but the results for inflation volatility are less consistent.[31] There is no clear consensus on the effects of IT on output growth—Brito and Bystedt (2010) find a significant negative effect on growth while other studies (Gemayel et al. 2011; Naqvi and Rizvi 2009) find insignificant effects of IT on growth. Gonçalves and Salles (2008) find that IT reduces output volatility, whereas Batini and Laxton (2007) find no such evidence.

We now compare the behavior of a range of economic and financial variables before and after the adoption of IT in India. We compare percentage changes and, where appropriate, volatility. Unless noted otherwise, the data are again quarterly and extend from 1997 through 2019. Our baseline specification is of the form:

$$y_t = \alpha_0 + \alpha_1 \mathrm{IT}_t + \alpha_2 \mathrm{GFC}_t + \alpha_3 \text{Post-GFC}_t + \epsilon_t^y \qquad (2)$$

where, y_t denotes the outcome variable; IT_t, GFC_t, and Post-GFC_t denote the inflation targeting dummy (Q3 2016–Q4 2019), the Global Financial Crisis (GFC) dummy (Q3 2008–Q1 2009), and a post-GFC dummy (Q2 2009–Q4 2019), respectively.[32] CPI headline, core and food inflation are all lower in the IT period, as shown in Table 8.[33] While CPI inflation increased after the GFC, all measures of CPI inflation declined after the shift to IT. CPI headline inflation declined by 4.9 percentage points relative to the post-GFC average, and food inflation declined even more sharply by 6.9 percentage

31. Vega and Winkelried (2005), Batini and Laxton (2007), Lin and Ye (2007), and Gemayel et al. (2011) conclude that inflation volatility is significantly lower after IT, whereas Gonçalves and Salles (2008) and Brito and Bysted (2010) find any difference to be insignificant.

32. We acknowledge that this framework cannot strictly establish any causal effects of IT, since we have not controlled for confounding factors and developments.

33. In an alternative specification, we control for the output gap and see an even sharper decline in headline inflation.

TABLE 8. Inflation is Lower after Inflation Targeting

	WPI Inflation	*CPI Headline Inflation*	*CPI Core Inflation*	*CPI Food Inflation*
Inflation Targeting	−1.53	−4.91***	−3.29***	−6.91***
	(1.56)	(8.23)	(5.76)	(6.12)
Global Financial Crisis dummy	2.65	3.98***	0.26	7.79***
	(1.46)	(7.14)	(0.61)	(7.81)
Post Global Financial Crisis dummy	−0.66	3.14***	2.31***	4.20***
	(0.70)	(4.43)	(3.46)	(4.05)
Constant	5.13***	5.55***	5.87***	5.11***
	(20.50)	(11.63)	(14.60)	(7.12)
Observations	91	91	91	91
Adjusted R^2	0.06	0.29	0.17	0.27

Source: Authors' calculations.

Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

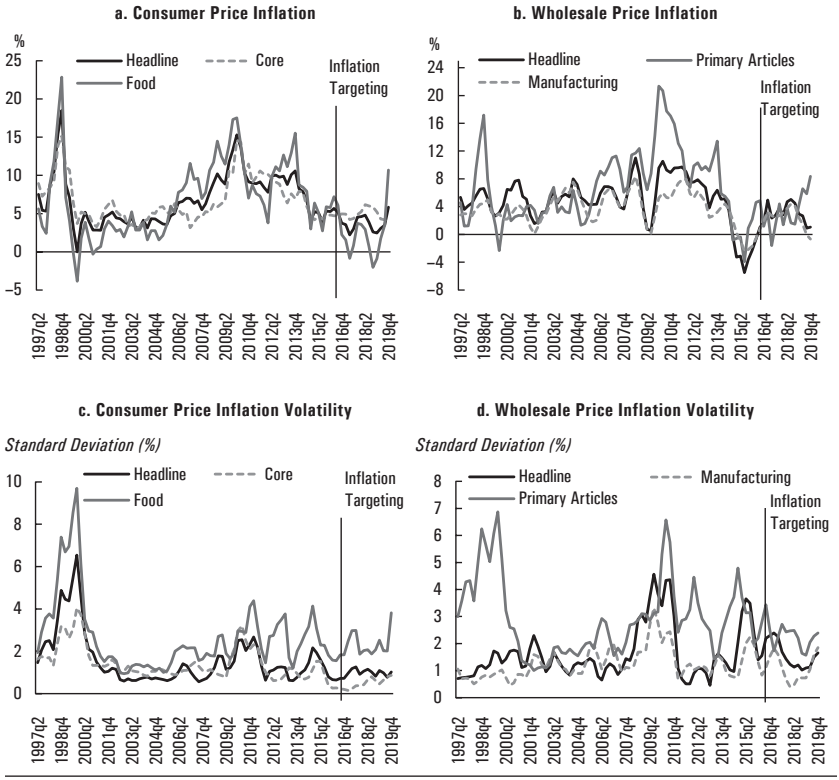
points. WPI inflation also declined by 1.5 percent, though the change is not statistically significant.

The same analysis for inflation volatility, calculated as the quarterly average of the 15-month rolling standard deviation of monthly inflation series, shows lower inflation volatility after the adoption of IT, except in the case of food price inflation, over which the central bank arguably has less control. Plotting this volatility measure (Figure 4) indicates that, except for food price inflation, volatility is lower after the shift to IT relative to the preceding decade. This is borne out in Table 9 where, except for food price inflation, the volatility of all measures of inflation has declined.

Figure 5 and Table 10 indicate no change in exchange rate depreciation or appreciation (computed as an average of daily changes), foreign exchange reserves, or portfolio debt flows. However, portfolio equity flows are somewhat smaller (as a percentage of GDP) under the IT regime. Yields on government debt are smaller, on average, by about 90 basis points, after the adoption of IT.

We measure the exchange rate and equity market volatility by the standard deviation of percentage changes in the daily value of the rupee to the dollar exchange rate and equity markets, respectively. Table 11 suggests that the exchange rate and equity markets have become less volatile under IT. Measuring the volatility of portfolio flows as the standard deviation of daily flows (measured in USD billions) within a quarter, we note that their average volatility has increased since the GFC, but it has not changed with the shift to IT, relative to the post-GFC period average.

FIGURE 4. Inflation and Its Volatility



Source: CEIC, Author's calculations.

Note: Inflation volatility is computed as a 15-month rolling standard deviation of the monthly inflation series, which is then averaged at a quarterly frequency.

The weighted average call rate (WACR), the interest rate at which banks lend overnight money to one another, is the RBI's operating target under its IT framework. Table 11 suggests that its volatility has declined under IT relative to the post-GFC period.

In sum, the exchange rate, the stock market, and the call money rate all became less volatile following the adoption of inflation targeting. In contrast, the volatility of portfolio capital flows has not changed (Figure 6).

In Table 12, we ask whether IT impacted output growth and its volatility. We use year-on-year percentage changes in the Index of Industrial Production (IIP) as a proxy for output growth.[34] Volatility is defined as the

34. We use the IIP instead of GDP growth as the IIP is available at a monthly frequency.

TABLE 9. Inflation Volatility under IT

	Volatility of CPI Inflation			*Volatility of WPI Inflation*		
	Headline	*Core*	*Food*	*Headline*	*Primary Articles*	*Manufacturing*
Inflation Targeting	–0.42***	–0.80***	–0.28	–0.48*	–0.99***	–0.41**
	(3.32)	(5.01)	(1.26)	(1.69)	(3.92)	(2.17)
Global Financial Crisis dummy	–0.12	–0.65***	–0.31	1.65***	0.33	0.62***
	(0.43)	(5.15)	(0.73)	(18.80)	(1.34)	(9.95)
Post Global Financial Crisis dummy	–0.31	–0.27	–0.13	0.80***	0.59*	0.42***
	(1.23)	(1.44)	(0.36)	(3.12)	(1.84)	(2.86)
Constant	1.71***	1.57***	2.73***	1.26***	2.69***	1.09***
	(7.53)	(13.03)	(8.37)	(22.43)	(11.49)	(18.38)
Observations	91	91	91	91	91	91
Adjusted R^2	0.02	0.19	–0.03	0.19	0.04	0.11

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

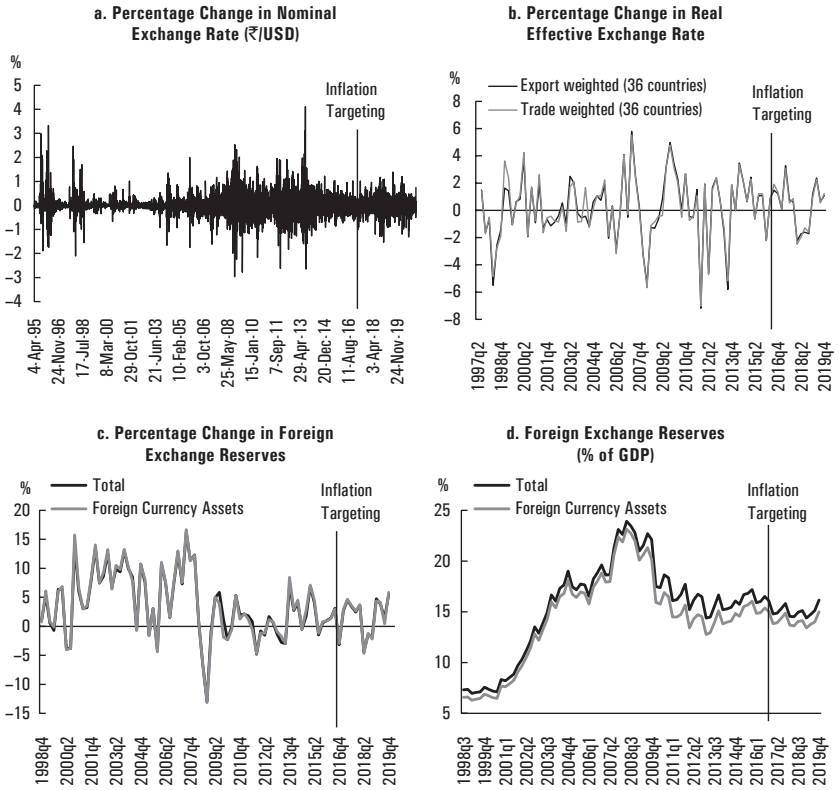
15-month rolling standard deviation of the year-on-year percentage changes (which is then averaged at a quarterly frequency). There is no evidence of a change in the rate of growth, but volatility is lower under IT relative to the post-GFC average.

We do not find changes in the rate of growth of the government total, revenue (operating and recurrent), or capital spending under the IT regime. The rate of growth of interest payments is somewhat smaller, which is probably a reflection of lower bond yields.

Finally, we looked for evidence that the transmission of policy impulses to banking and financial markets improved with the adoption of IT. Historically, evaluations of transmission in India have been mixed. Mishra et al. (2016) examined the strength of transmission using a structural VAR methodology. They found that a tightening of policy is associated with a significant increase in bank lending rates. Although pass-through to the lending rates is only partial, they conclude that their result for India compares favorably with the results for other developing countries. Consistent with these findings, Acharya (2017) and Dua (2020) argue that transmission to the money market and long-term interest rates is rapid and relatively complete, but that bank deposit and lending rates adjust more slowly and less completely.

We collated monthly data on government bonds yields of 1-, 2-, 5-, and 10-year maturities, treasury bill rates, and average lending rates on

FIGURE 5. Exchange Rates and Reserves



Source: Authors' calculations. Source: Authors' calculations.

Note: Foreign exchange reserves are expressed as a percentage of annual (calendar year) GDP in panel d.

new and outstanding loans. We used the repo rate as the relevant policy rate. Table 13 confirms that transmission is greater for treasury bill and short-tenure bonds. Transmission to government bonds yields and bill rates improved somewhat following the adoption of IT. Transmission to bank lending rates is relatively weak, as other authors have shown, and has not improved with the adoption of IT.

6. Are Expectations Better Anchored?

Kose et al. (2019) find that long-term inflation expectations have declined in the past two decades in both advanced economies, and emerging markets

TABLE 10. Exchange Rates, Reserves and Portfolio Flows

	Nominal Exchange Rate (% Change)	*Trade Weighted REER (% Change)*	*% Change in Reserves (q-o-q)*	*Portfolio Equity Flows (% of GDP)*	*Portfolio Debt (% of GDP)*	*G-Sec Secondary Market 10-Year Maximum Yield*
Inflation Targeting	−0.63 (0.66)	−0.08 (0.13)	0.47 (0.47)	−0.74*** (3.06)	−0.23 (1.03)	−0.91*** (5.69)
Global Financial Crisis dummy	5.83*** (2.75)	−0.87** (2.25)	−13.12*** (4.34)	−1.56*** (6.95)	0.06 (0.24)	−0.56 (0.90)
Post Global Financial Crisis dummy	0.70 (0.83)	0.39 (0.64)	−5.08*** (4.89)	0.18 (0.80)	0.34*** (2.70)	−0.15 (0.41)
Constant	0.38 (1.02)	0.09 (0.26)	6.37*** (7.28)	0.75*** (5.29)	0.05 (1.60)	8.49*** (24.87)
Observations	91	91	85	84	84	86
Adjusted R^2	0.08	−0.02	0.32	0.14	0.05	0.03

Source: Authors' calculations.

Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

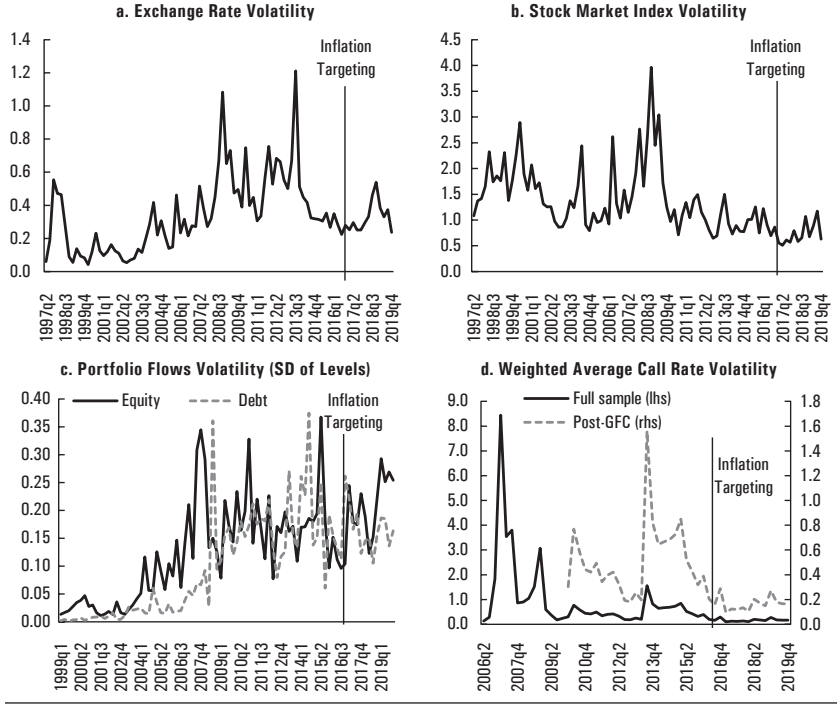
and developing economies (EMDEs). Although inflation expectations are less well anchored in EMDEs, their sensitivity to domestic and global shocks has declined. They suggest that an IT regime and greater central bank transparency are associated with better anchoring.[35]

Studies of India similarly suggest that expectations have become better anchored in recent years. For example, Asnani et al. (2019) analyze the inflation expectations of households and find that inflation expectations have become better anchored during the IT period; in particular, there is only limited spillover from food inflation to food and non-food inflation expectations in the IT period.[36]

35. Lower public debt and greater trade openness are also associated with better anchoring of expectations. Using monthly survey data from Consensus Economics for a sample of 22 EMDEs and 14 advanced economies in a structural VAR model, Davis and Presno (2014) similarly find that the introduction of IT is associated with a statistically significant reduction in the response of inflation expectations (12 months ahead) to shocks in oil prices and observed inflation.

36. Benes et al. (2017) and Patra and Ray (2010) similarly found that lagged inflation, as well as current and lagged changes in fuel and food prices, significantly affected inflation expectations prior to IT.

FIGURE 6. Volatility of Macrofinancial Indicators



Source: Authors' calculations, CEIC, RBI.
Note: "lhs" is left-hand-side axis, and "rhs" is right-hand-side axis.

TABLE 11. Volatility of Financial Variables

	Exchange Rate Volatility	*SENSEX Volatility*	*WACR Volatility*	*Portfolio Equity Volatility*	*Portfolio Debt Volatility*
Inflation Targeting	–0.17***	–0.38***	–0.31***	0.02	–0.01
	(3.84)	(3.82)	(5.51)	(0.99)	(0.50)
Global Financial Crisis dummy	0.58***	1.47***	–0.59	0.04*	0.17**
	(4.89)	(3.62)	(0.55)	(1.77)	(2.30)
Post Global Financial Crisis dummy	0.28***	–0.42***	–1.84**	0.10***	0.15***
	(6.36)	(3.58)	(2.12)	(5.58)	(12.33)
Constant	0.22***	1.54***	2.32***	0.08***	0.02***
	(10.18)	(19.02)	(2.68)	(5.64)	(6.28)
Observations	91	91	55	84	84
Adjusted R^2	0.45	0.43	0.30	0.33	0.69

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively. WACR = weighted average call rate.

TABLE 12. Industrial Production and Government Expenditure

	IIP (% Change)	*Volatility of IIP*	*Total Government Expenditure (% Change)*	*Revenue Expenditure (% Change)*	*Capital Expenditure (% Change)*	*Interest Payments (% Change)*
Inflation Targeting	−0.88	−0.99***	−1.58	−1.43	9.31	−5.45
	(1.02)	(3.36)	(0.42)	(0.44)	(0.41)	(1.39)
Global Financial Crisis dummy	−6.98**	3.28***	23.95**	26.23**	−6.80	2.52
	(2.15)	(5.60)	(2.42)	(2.27)	(0.42)	(0.30)
Post Global Financial Crisis dummy	−3.68***	1.22***	−0.90	−2.63	−0.55	2.08
	(4.24)	(4.17)	(0.30)	(1.11)	(0.03)	(0.63)
Constant	7.85***	2.19***	12.54***	13.61***	22.35	11.60***
	(13.11)	(17.49)	(5.39)	(8.66)	(1.52)	(4.95)
Observations	91	91	87	87	87	87
Adjusted R^2	0.24	0.33	0.08	0.19	−0.03	−0.02

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

TABLE 13. Transmission of the Policy Rate

	One-year Government Bond Yield	*91-Day Treasury Bill Rate*	*Bank Lending Rate on Outstanding Loans*	*Bank Lending Rate on New Loans*
Repo rate	0.94***	1.15***	0.61***	0.64***
	(20.25)	(20.23)	(12.56)	(17.77)
IT	−1.35***	−0.41	0.87**	−0.12
	(2.99)	(0.89)	(1.99)	(0.34)
Repo rate × IT	0.33***	0.18**	−0.23***	−0.06
	(4.59)	(2.59)	(3.38)	(1.03)
Constant	0.12	−1.52***	7.30***	6.31***
	(0.38)	(3.93)	(19.49)	(23.00)
Observations	232	233	102	71
Adjusted R^2	0.59	0.59	0.91	0.91

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

The RBI has been conducting its Inflation Expectations Survey of Households since 2005, recording survey respondents' perceptions of current inflation and expectations of inflation three months, and one year ahead. The survey records both qualitative and quantitative responses. It was conducted

quarterly (in March, June, September, and December) until March 2014. At that point, two additional rounds in May and November were added to align it with the bimonthly monetary policy review cycle.

The RBI has also been conducting a survey of professional forecasters since the second quarter of 2007–08, drawing responses from forecasters with both financial and non-financial institutions. Initially, the survey was conducted at a quarterly frequency, but this was changed to bi-monthly in 2014–15. The survey collects annual quantitative forecasts for two financial years (the current year and next year) and quarterly forecasts for five quarters (the current quarter and next four quarters). We analyze how the inflation expectation series for India has changed since the implementation of IT. For the analysis below, we use both the household and professional forecaster series averaged at quarterly frequencies.[37] We use the CPI inflation expectations of professional forecasters and compare household and professional forecasts with CPI inflation.[38]

Both professional forecasts and households' expectations of inflation declined with the shift to IT (Table 14). Even so, household expectations of inflation consistently exceed actual inflation, and the deviation has not declined. Figure 7 shows that the average of professional forecasts has been

TABLE 14. Inflation Expectations Declined after Inflation Targeting

	Households' Expectations			*Professional Forecasters' Expectations*			
	Current	*1 Quarter Ahead*	*1 Year Ahead*	*1 Quarter Ahead*	*2 Quarters Ahead*	*3 Quarters Ahead*	*4 Quarters Ahead*
Inflation Targeting	−1.22***	−0.94**	−1.27**	−4.08***	−3.39***	−2.89***	−2.74***
	(2.70)	(2.06)	(2.59)	(9.50)	(9.13)	(9.46)	(8.16)
Constant	9.47***	9.82***	10.52***	8.29***	7.83***	7.44***	7.26***
	(22.48)	(22.98)	(23.95)	(20.90)	(22.10)	(26.04)	(26.42)
Observations	54	54	54	45	45	45	30
Adjusted R^2	0.03	0.01	0.03	0.51	0.47	0.50	0.44

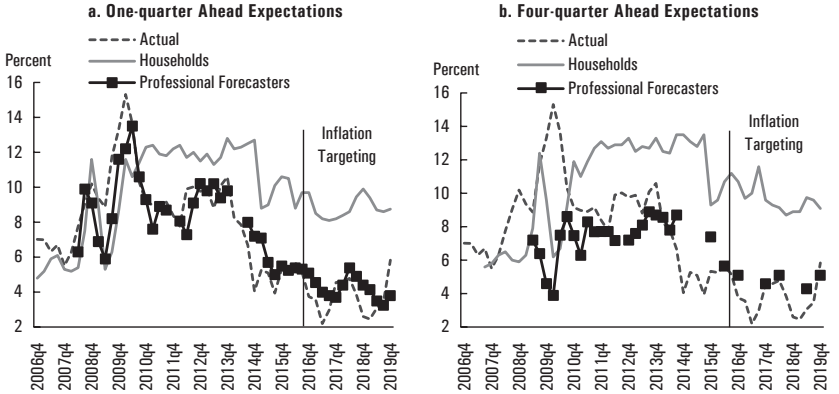
Source: Authors' calculations.

Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

37. We restrict our analysis to a quarterly frequency in order to have comparable results across sectors.

38. We use the CPI combined inflation series from 2012 onwards and prior to that, the CPI–IW. Professional forecasters' expectations are for the CPI–IW prior to 2014, and for the combined series from 2014 onwards.

FIGURE 7. CPI Inflation and Household and Professional, One-quarter and Four-quarter Ahead Inflation Expectations



Source: CEIC, RBI.

Note: Data for One-quarter and Four-quarter ahead expectations for professional forecasters is not available for some quarters. We report mean expectations for both the household and professional forecasters' series.

close to actual inflation, while household expectations have often exceeded actual inflation. In the last few years, and particularly since the shift to IT, expected inflation has declined, in line with the decline in actual inflation. However, households' expectations have declined less than actual inflation and continue to be higher (by about 3 percentage points).

In addition, while household inflation expectations continue to display considerable variation around their mean and median, professional forecaster expectations show a smaller range since the shift to IT, consistent with firmer anchoring (see Figure 8).

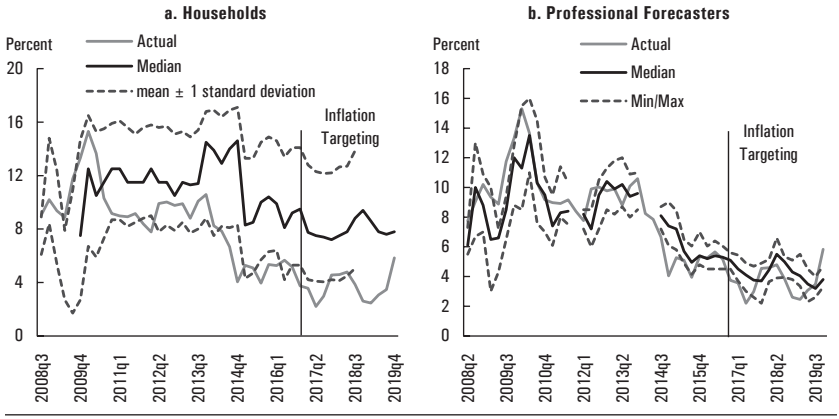
6.1. Do Shocks to Current Inflation Influence Expectations about Future Inflation?

To assess whether shocks to current inflation influence expectations about future inflation, we regress expected inflation q quarters ahead on current inflation. Our baseline specification is:

$$E_t\pi_{t+q} = \beta_0 + \beta_1\pi_t + \epsilon_t \tag{3}$$

$E_t\pi_{t+q}$ denotes expectations at time t of inflation in period $t+q$ and π_t denotes CPI inflation in period t. The coefficient β_1 captures the extent to which current inflation exerts an influence on current expectations about inflation in period $t+q$. If inflation expectations are well-anchored, then one

FIGURE 8. Inflation Expectations (One Quarter Ahead) before and after IT



Source: CEIC, RBI, Authors' calculations.
Note: Prior to 2014, professional forecasters' expectations are for CPI–IW, and from 2014 onwards for the combined series.

would expect β_1 to be small and insignificant.[39] Since our goal is to assess whether inflation expectations have become better anchored under IT, we also estimate:

$$E_t\pi_{t+q} = \beta_0 + \beta_1\pi_t + \beta_2 \mathrm{IT}_t + \beta_3\pi_t \times \mathrm{IT}_t + \epsilon_t \tag{4}$$

For household expectations, we find that, for a 1 percentage point increase in current inflation, expectations about one-quarter and one-year ahead inflation increase by about 40 basis points (Table 15). The magnitude of this pass-through has remained the same since the shift to IT (β_3 is insignificant). For the professional forecasters, the pass-through from inflation to expectations has declined significantly since the shift to IT.

6.2. Do Inflation Expectations Feed into Actual Inflation?

To assess whether inflation expectations feed into actual inflation, we estimate the following specification:

$$\pi_t = \beta_0 + \underbrace{\beta_1\pi_{t-1}}_{\text{persistence}} + \underbrace{\beta_2 E_{t-1}\pi_t}_{\text{expectations}} + \underbrace{\beta_3 \text{output gap}_t}_{\text{supply-side shock}} + \epsilon_t \tag{5}$$

39. For households, we use three-month and one-year ahead mean inflation expectations and for professional forecasters, we use one- to four-quarter ahead mean (CPI) inflation expectations.

TABLE 15. Do Shocks to Current Inflation Affect Inflation Expectations?

	Households' Expectations		*Professional Forecasters' Expectations*			
	1 Quarter Ahead	*1 Year Ahead*	*1 Quarter Ahead*	*2 Quarters Ahead*	*3 Quarters Ahead*	*4 Quarters Ahead*
CPI Inflation	0.40***	0.41***	0.70***	0.50***	0.30***	0.13
	(3.17)	(3.09)	(10.26)	(5.74)	(3.56)	(1.23)
IT	1.18	0.42	0.50	0.34	–0.06	–0.43
	(0.91)	(0.29)	(0.62)	(0.39)	(0.08)	(0.42)
CPI Inflation × IT	–0.08	0.05	–0.32*	–0.35**	–0.36***	–0.42***
	(0.48)	(0.20)	(1.95)	(2.31)	(2.83)	(3.57)
Constant	6.50***	7.10***	2.31***	3.52***	4.83***	6.06***
	(5.34)	(5.71)	(3.80)	(4.86)	(7.15)	(6.12)
Observations	54	54	45	45	45	30
Adjusted R^2	0.12	0.15	0.87	0.72	0.62	0.45

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

The expectation term is the expectation of current inflation in the previous quarter. Lagged inflation captures the persistent nature of inflation, and the output gap controls for supply-side shocks. As before, the output gap is defined as the difference between seasonally adjusted GDP and potential GDP, expressed as a percentage of seasonally adjusted GDP. β_1 captures the magnitude of pass-through from inflation expectations to actual inflation. To compare the strength of any feedback from expectations to actual inflation pre- and post-IT, we interact the expectations term with an IT dummy.

The estimated results are presented in Table 16. Pre-IT, there is no pass-through from households' expectations to actual inflation. However, a 1 percentage point increase in professional forecaster's expectations about the next quarter's inflation implies, on an average, an increase in inflation in the next quarter by about 40 basis points. This impact of inflation expectations on inflation has become muted under IT, again consistent with better anchoring.

7. COVID-19 and Credibility

The question of the day is how an inflation-targeting central bank should respond to an exceptional shock like the COVID-19 pandemic. In practice, we have seen central banks around the world, including those in EMDEs, cut

TABLE 16. Do Inflation Expectations Feed into Actual Inflation?

Dependent Variable: CPI Inflation (%)				
	Households' Expectations		*Professional Forecasters' Expectations*	
Lagged inflation	0.90***	0.90***	0.62***	0.61***
	(8.36)	(8.46)	(4.46)	(4.38)
Inflation Expectations	–0.10	–0.11	0.39**	0.41**
	(1.14)	(1.34)	(2.66)	(2.66)
IT	6.14*	5.85	2.77	2.75
	(1.79)	(1.64)	(1.51)	(1.48)
Inflation Expectations × IT	–0.75**	–0.71*	–0.73**	–0.70*
	(2.09)	(1.90)	(2.09)	(1.97)
Output gap (% of GDP)		–0.12		–0.09
		(0.93)		(0.81)
Constant	1.72**	1.91**	0.13	0.03
	(2.04)	(2.25)	(0.14)	(0.04)
Observations	53	53	44	44
Adjusted R^2	0.84	0.84	0.86	0.86

Source: Authors' calculations.

Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

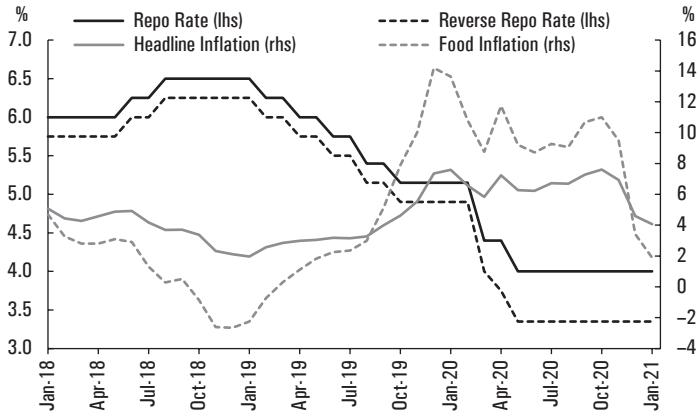
interest rates sharply and engage in a wide range of credit-market operations. This response contrasts with the response to past external crises affecting EMDEs when central banks were reluctant to cut interest rates significantly for fear of fanning inflation expectations. That inflation expectations in a number of EMDEs are now better anchored than before, we would argue, is part of the explanation for why they have been able to do more.[40]

This is the case for India. On March 27, 2020, the RBI cut the repo rate by 75 basis points, the reverse repo rate by 90 basis points, and the CRR by 1 percent.[41] It followed this by another 25 basis points reduction in the reverse repo rate and lowered the liquidity coverage ratio required of banks to 80 percent of the previous requirement. The RBI then further reduced the repo rate by 40 basis points on May 22, for a total reduction of 115 basis points

40. We would not deny that there is also a role for Federal Reserve (and advanced country central bank policy in general) in the contrast. That the Fed responded so aggressively to the crisis opened up space for central banks, including in EMDEs, to do more.

41. In addition, the requirement of minimum daily CRR balance maintenance was also reduced from 90 percent to 80 percent for three months, while the borrowing limit for the marginal standing facility was increased from 2 percent to 3 percent of the SLR.

FIGURE 9. Inflation and Monetary Policy during the Pandemic



Source: RBI, CEIC.
Note: "lhs" is left-hand-side axis, and "rhs" is right-hand-side axis.

between March and May 2020. The reverse repo rate was also decreased by 40 basis points on May 22, 2020.

The RBI took these steps despite the fact that consumer price inflation in March (according to figures published in mid-April) was running at 5.91 percent, at the top of the RBI's 2–6 percent target range and down only slightly from 6.58 percent in February (Figure 9). It did so despite the possibility that CPI inflation might accelerate further, given the impact of the lockdown and other supply-side disruptions on food prices and of exchange rate depreciation on the cost of imports. Thus, the fact that inflation expectations had become better anchored allowed the RBI to temporarily disregard the fact that inflation was already at the top of the Bank's target range and to respond to this exceptional shock.

Three further literatures speak of the consequences of such actions. One is concerned with how an inflation-targeting central bank should respond to supply shocks, COVID-19 related lockdowns, and disruptions to supply chains and production, that is, a negative supply shock. Monetary policy is an awkward instrument for dealing with the consequences of supply shocks, since it operates mainly on aggregate demand rather than aggregate supply.[42] The dilemma for MPC members is that raising the policy rate

42. Other non-monetary policies of central banks designed to buttress the liquidity and stability of specific financial assets and even institutions can be thought of as supply-side interventions insofar as they prevent credit-market disruptions from interfering with supply.

in response to the inflationary consequences of a negative supply shock will only worsen the output shortfall, but reducing rates will only worsen the inflation overshoot.[43]

Thus, the standard advice for an inflation-targeting central bank is to cut rates—or at least to refrain from raising them—if the negative supply shock is temporary. If the shock is temporary, there will be higher prices and inflation now but lower prices and less inflation, or even deflation, in the future. The central bank should therefore be able to "look through" today's inflation when setting rates. For an economy frequently subject to supply shocks, this is an argument for the central bank to adopt a relatively long horizon when formulating its inflation forecast. When supply shocks, both positive and negative, tend to fall disproportionately on food and fuel prices, this is an argument for focusing not on headline CPI, which includes them, but core CPI, which does not.

There are three caveats to these points. First, the COVID-19 pandemic has elements of both a negative supply shock and a negative demand shock, as firms halt investment projects and households increase their precautionary saving and see their incomes fall. The negative demand shock may only materialize with a lag, and it may be smaller in India than elsewhere insofar as households living close to the margin of subsistence have little scope for reducing spending. But demand-side considerations point in the direction of interest rate cuts, insofar as they imply weaker inflation going forward.

Second, this logic assumes that the negative supply shock from COVID-19 is temporary. Unfortunately, there is also a scenario in which the shock, if not permanent, is at least very persistent—that it will require continuous or repeated lockdowns and distancing, with associated disruptions to trade and production, until a vaccine is successfully identified, manufactured and distributed, or until herd immunity develops. A permanent shock of this sort, which is inflationary, ceteris paribus, suggests raising rates.

Third, even if the shock is transient, there is the danger that allowing inflation to stray above the top of the target range may un-anchor inflation expectations. Agents may see current inflation above target as evidence that the central bank has lost control of the inflation process, igniting a wage–price spiral. Thus, if monetary policy lacks credibility, the costs of monetary accommodation of the shock will be greater. This is something that, in principle, can be inferred from observed measures of inflation expectations.

43. Especially since a classic negative supply shock will not increase the output gap—it will only reduce actual output, since potential output has fallen, while increasing unemployment.

This last observation is taken up in the second relevant literature, that on escape clauses for inflation-targeting central banks. The question here is whether an inflation-targeting central bank can invoke an exceptional event—unavoidable circumstances that provide a temporary reprieve from performing its obligations under a contract, which is the definition of *force majeure*—and depart from its inflation target without damaging its credibility. *Force majeure* clauses are included in a variety of private contracts in both civil law and common law countries. Few central banks include them in descriptions of their IT regimes. The Czech National Bank is a rare case of a central bank that, when establishing its inflation target in 1998 and revising it in 2001, specified escape clauses. These included major changes in the world prices of raw materials and energy, major changes in the exchange rate not due to domestic economic fundamentals, major changes in regulated prices, step changes in indirect taxes, and natural disasters. Heenan et al. (2006) report that, at the time of their writing, only five inflation-targeting central banks specified exceptions in their target definitions; most of these pertained to administered prices and indirect taxes.[44] Some central banks have added escape clauses to their monetary policy statements in exceptional circumstances. Thus, the MPC of the Bank of England added an explicit financial stability escape clause to their bank rate forward guidance in 2013.

Heenan et al. (2006) argue that the advantages of explicit escape clauses are likely to be limited. As they note, the central bank would have to identify the shock, explain the impact, detail its policy response, and forecast the inflation path whether or not there was a formal escape clause. They worry that formal escape clauses are overly legalistic and may divert the public communications of the central bank from the underlying macroeconomic issues toward the technical details of the escape clause itself.

In addition, there is a closely related literature on exchange rate escape clauses concerned with the circumstance under which an exchange-rate targeting central bank can alter the target. Obstfeld (1997) warns that exchange rate escape clauses can be destabilizing. If the escape clause permits or requires the policymaker to alter or suspend the target when certain economic and financial conditions obtain, investors anticipating the possibility that the escape clause will be invoked may take actions that produce those very conditions.

Grossman and van Huyck (1988) specify the conditions under which invoking an escape clause will not result in reputational damage (under

44. They do not specify these, but the three we are aware of are New Zealand, the Philippines, and the Czech Republic.

which it will not diminish the credibility of the policy regime or be destabilizing). First, the shock must be independently verifiable. Second, the shock must not be of the central bank's own making. COVID-19 clearly satisfies these conditions. These conclusions suggest that central banks, including the RBI, may be able to temporarily exceed their inflation targets without damaging their credibility—assuming, that is, that the other preconditions discussed above are met.

Third, and finally, there is a literature on the optimal degree of discretion in monetary policy (e.g., Athey et al. 2005). It may be that the full extent of the shock is not independently verifiable, so the Grossman–van Huyck conditions are not satisfied. But the central bank may know better—it may have private information about the severity of the shock. This is plausibly the case of the Coronavirus pandemic, when estimating its effects requires epidemiological modeling and estimates of the behavioral response. Knowing that a major negative shock is coming, the central bank may then have good reason to cut rates even though inflation is currently running above target.

The question is whether it can do so without damaging its credibility. The main threat to credibility, Athey et al. (2005) argue, is that the central bank may abuse those same discretionary powers in the future, for example, by overly stimulating the economy in the manner of the classic time inconsistency problem. The solution, they show, is a cap on the target rate of inflation that penalizes the central bank when that target is exceeded. This kind of reputational or political penalty is precisely what IT is designed to apply. This, in turn, suggests that an inflation-targeting central bank should have more room than other central banks to cut rates in this situation because it is granted more discretion and invites less damage to its credibility.

So did IT give central banks, in general, and the RBI in particular, more room for maneuver? In Table 17, we show policy rate changes between December 2019 and May 2020, together with the 2019 rate of inflation, for 70 emerging and developing countries, distinguishing between IT and non-IT central banks and India. The cut in policy rates is larger for IT than non-IT central banks, despite the fact that IT central banks had less "space" (their policy rates started out closer to zero). The contrast is suggestive of greater anti-inflation credibility that makes for more policy room for maneuver.

In Table 18, we regress the change in the policy rate over the same period on a dummy variable for IT central banks, the lagged policy rate, and the lagged rate of inflation. The resulting estimates confirm that IT central banks lowered their policy rates by more, even after controlling

TABLE 17. Policy Response to COVID-19 by IT and Non-IT Central Banks

	IT	*Non-IT*	*India*
Number of countries	27	43	
Average policy rate at end-2019	4.70	5.27	5.15
Average policy rate change between December 2019 and May 2020 (percentage points)	–1.31	–0.90	–1.15
Average inflation rate during 2019	3.13	3.19	3.7

Source: Data from Haver Analytics and Authors' calculations. Inflation is the monthly average during 2019.

TABLE 18. Change in Policy Rate during the COVID Crisis

	Change in Policy Rate		
Dependent Variable	*I*	*II*	*III*
Inflation targeting dummy	–0.41 (1.57)	–0.48** (2.04)	–0.47* (1.96)
Policy rate at end-2019		–0.12*** (2.82)	–0.09* (1.97)
Inflation at end-2019			–0.06 (0.94)
Constant	–0.90*** (5.74)	–0.25 (1.18)	–0.23 (1.02)
Observations	70	70	70
Adjusted R^2	0.02	0.23	0.22

Source: Authors' calculations.
Notes: Robust *t* statistics in parentheses; *, **, and *** indicate significance at 10, 5, and 1 percent, respectively.

for inflation and the level of the policy rate.[45] This suggests that inflation targeting, or more accurately the complex of institutional arrangements associated with it, had a payoff in terms of greater policy credibility and room for maneuver in the COVID-19 crisis.[46]

45. We find the same thing when we construct the dependent variable as the change in policy rate as a percentage of lagged rate.

46. IT frameworks are not assigned randomly, of course. The literature suggests several approaches to instrumenting IT status. Virtually, all of them produced negative coefficients on the IT specification in Table 18, although significance levels varied. The coefficient in question was significantly less than zero when the instrumental variable was real GDP in 2010 US dollars (on the grounds that larger economies adopt IT while smaller ones prefer to peg the exchange rate), the World Bank measure of voice and accountability (on the grounds that IT tends to be adopted in countries with a culture of transparency), and regulatory quality (on the grounds that IT requires administrative capacity that is common to monetary policy and other forms of regulation).

8. Conclusion

Inflation targeting in India is barely four years old, which has hindered earlier efforts at performance evaluation. Here, we take advantage of the limited accumulation of data to analyze what, if anything, changed with the advent of IT. We show that the RBI is best characterized as a flexible inflation targeter: contrary to some assertions and criticisms, it does not neglect changes in the output gap when setting policy rates. We do not find that the RBI became more hawkish following the transition to IT; on the contrary, adjusting for inflation and the output gap, policy rates became lower, not higher. We find some evidence that inflation has become better anchored: increases in actual inflation do less to excite inflation expectations, indicative of improved anti-inflation credibility. This is consistent with the fact that a number of other inflation-related outcomes are more stable post-IT than before.

Finally, we ask whether the shift to IT has enhanced the credibility of monetary policy such that the RBI is in a position to take extraordinary action in response to the COVID-19 crisis. We argue that the rules and understandings governing IT regimes come with escape clauses allowing central banks to temporarily disregard their inflation targets under specific circumstances that may be satisfied by the COVID-19 pandemic. Cross-country comparisons confirm that IT, in conjunction with related institutional arrangements, have provided benefits in terms of additional policy room for maneuver in this crisis.

Appendix A

TABLE A.1. India's Monetary Policy Framework

	Initial Phase 1935–49	*Developmental Years 1949–69*	*Credit Planning 1969–85*	*Monetary Targeting 1985–98*	*Multiple Indicator Approach 1998–2015*	*Flexible Inflation Targeting 2016 onward*
Objective	Sterling–rupee parity	Development and stability	Financing economic growth and ensuring price stability	Inflation and growth	Inflation and growth	Price stability while simultaneously focusing on growth when inflation is under control
Target	Exchange rate	Administering supply and demand of credit	Priority sector credit targeting	Reserve money (M0) was used as the operating target, and Broad money (M3) as an intermediate target	Multiple indicators: rates, credit, external, fiscal variables, and expectations survey used for growth and inflation projections	Headline CPI inflation
Operating procedure (instruments)	Bank rate, OMOs, CRR	Bank rate, reserve requirements, and OMOs	Bank rate, reserve requirements, selective credit controls, and OMOs	Bank rate and reserve requirements (CRR, SLR)	Direct: CRR, SLR; Indirect instruments: repo operations under LAF and OMOs	Repo rate as intermediate target and WACR as the operating target
Additional comments	1. The focus of monetary policy was on regulating liquidity in the system through OMOs—by buying and selling of government securities—so as to maintain exchange rate parity; 2. CRR was to be used in exigencies rather than as an active instrument of credit control. The RBI used selective credit control and moral suasion to restrain banks from extending credit for speculative purposes.	1. SLR requirement prescribed for banks emerged as a secured source for government borrowings; 2. In the 1960s, inflation was considered to be structural and inflation volatility primarily caused by agricultural failures, so there was greater reliance on selective credit controls.		1. Monetary targeting was flexible to accommodate changes in real GDP growth. In practice, it was an indicative monetary targeting framework with a feedback from real economic activity; 2. CRR was used as the primary instrument for monetary control; 3. By the second half of the 1990s, the RBI was able to move away from direct instruments to indirect market-based instruments in its liquidity management operations.	Some of these instruments, including changes in reserve requirements, standing facilities and OMOs were meant to affect the quantum of marginal liquidity, while changes in policy rates, such as the Bank rate and reverse repo/repo rates were the instruments for changing the price of liquidity.	

Source: Mohanty (2017); Das (2020).

TABLE A.2. Description of Variables Used in the Analysis

Variable	*Description*
CPI inflation	This measure is the "2011–12 CPI headline inflation" series from 2012 Q1 onwards. Prior to 2012 Q1, it is the CPI–IW headline inflation.
CPI food inflation	This measure is the "2011–12 CPI food inflation" series from 2012 Q1 onwards. Prior to 2012 Q1, it is CPI–IW food inflation.
CPI core inflation	This measure is the "2011–12 CPI core inflation" series (i.e., headline excluding food and beverages, and fuel and light) from 2012 Q1 onwards. Prior to 2012 Q1, it is CPI–IW core inflation.
WPI (manufacturing/ food) inflation	The three measures of WPI inflation—WPI, WPI manufacturing, WPI food—are spliced using standard splicing methodology. For instance, if the new inflation rate series starts from 2012 Q1, we consider the new series from thereon, and prior to that, the inflation rate as implied by the old series is considered.
Inflation	This inflation measure is defined as: $$\text{Inflation}_t = \begin{cases} \text{CPI Inflation}_t, \text{ if } t \geq \text{Q1 2014} \\ \text{WPI Inflation}_t, \text{ if } t \leq \text{Q4 2013} \end{cases}$$ This definition of headline inflation has been used while estimating the central bank's reaction function.
Core inflation	This inflation measure is defined as: $$\text{Core Inflation}_t = \begin{cases} \text{CPI Core Inflation}_t, \text{ if } t \geq \text{Q1 2014} \\ \text{WPI Manufacturing Inflation}_t, \text{ if } t \leq \text{Q4 2013} \end{cases}$$ This definition of core inflation has been used while estimating the central bank's reaction function.
Food inflation	This inflation measure is defined as: $$\text{Food Inflation}_t = \begin{cases} \text{CPI Food Inflation}_t, \text{ if } t \geq \text{Q1 2014} \\ \text{WPI Food Inflation}_t, \text{ if } t \leq \text{Q4 2013} \end{cases}$$ This definition of food inflation has been used while estimating the central bank's reaction function.
Exchange rate	We use the quarter-on-quarter percentage point change in the INR/ USD exchange rate. Thus, $$\text{Exchange rate}_t = 100 \times \left(\frac{\text{INR/USD}_t}{\text{INR/USD}_{t-1}} - 1 \right)$$ where t denotes the quarter.
Output gap	We apply the Hodrick-Prescott filter to the seasonally-adjusted quarterly real GDP series and then express the output gap as a percentage of GDP. Seasonal adjustment is carried out using the X-11 filter. The output gap obtained by applying X-13 ARIMA SEATS for seasonal adjustment, is very similar to the one obtained using the X-11 method.

(Table A.2 Contd.)

Variable	*Description*
IT dummy	The inflation targeting period starts from 2016 Q3 because in May 2016 an amendment was made to the RBI Act, 1934, to provide a statutory basis for the implementation of the flexible IT framework. We consider the start date from the third quarter as the Act was amended in the middle of the second quarter. Thus, $T_t = \begin{cases} 1, \text{ if } t \geq \text{Q3 2016} \\ 0, \text{ otherwise} \end{cases}$
Global Financial Crisis dummy	This denotes the Global Financial Crisis period, that is, Q3 2008–Q1 2009. Thus, $GFC_t = \begin{cases} 1, \text{ if Q3 2008} \leq t \leq \text{Q1 2009} \\ 0, \text{ otherwise} \end{cases}$
Post-Global Financial Crisis dummy	This denotes the post-Global Financial Crisis period, that is, Q2 2009–Q4 2019. Thus, $\text{Post GFC}_t = \begin{cases} 1, \text{ if Q2 2009} \leq t \leq \text{Q4 2019} \\ 0, \text{ otherwise} \end{cases}$ Our last sample point is Q4 2019.
Effective policy rate	We define the effective policy rate as in Patra and Kapur (2012) $\text{Effective Policy Rate}_t = \begin{cases} \text{Bank rate}_t, & \text{if Q2 1997} \leq t \leq \text{Q1 2002} \\ \text{Reverse repo rate}_t, & \text{if Q2 2002} \leq t \leq \text{Q2 2006} \\ \text{Repo rate}_t, & \text{if Q3 2006} \leq t \leq \text{Q4 2008} \\ \text{Reverse repo rate}_t, & \text{if Q1 2009} \leq t \leq \text{Q2 2010} \\ \text{Repo rate}_t, & \text{if Q3 2010} \leq t \leq \text{Q4 2019} \end{cases}$ The bank rate, repo rate, and reverse repo rate represent the average value in a quarter.
Fiscal deficit, fiscal deficit (% of GDP)	We aggregate the Central government's monthly fiscal deficit at a quarterly frequency. To compute the fiscal deficit to GDP ratio, we seasonally adjust both series using X-11 and X-13 ARIMA SEATS and construct two measures of deficit based on different filters applied.
Market borrowings, market borrowings (% of GDP)	We aggregate the Central government's monthly market borrowings data at a quarterly frequency. To compute the market borrowings to GDP ratio, we seasonally adjust both series using X-11 and X-13 ARIMA SEATS. Both seasonal filters give very similar results.
Portfolio flows: Equity and debt	We use daily portfolio flows (equity and debt) data as published by the National Securities Depository Limited.
IIP	The IIP series has been spliced using the standard splicing method. The year-on-year growth rates starting 1996 are based on the 1993–94 series; from April 2006 onwards, they are based on the 2004–05 series; and from April 2013 onwards, they are based on the 2011–12 series.

(Table A.2 Contd.)

(Table A.2 Contd.)

Additional Data Used for Analysis in Section 7: COVID and Credibility

Variable	*Description*
Population	We use population data for the year 2018. For regression analysis, we transform the population sum into the log level (Source: WDI).
Real GDP (constant 2010 USD)	Data are in constant 2010 USD. Dollar figures for GDP are converted from domestic currencies using the 2010 official exchange rates. We use the 2018 values and convert them into log terms for analysis. (Source: WDI, World Bank national accounts data, and OECD National Accounts data files).
Real GDP per capita (constant 2010 USD)	GDP per capita is gross domestic product divided by mid-year population. Data are in constant 2010 USD. We use the 2018 values and convert them into log terms for analysis. (Source: WDI, World Bank national accounts data, and OECD National Accounts data files).
Trade (% of GDP)	Trade is the sum of the exports and imports of goods and services measured as a share of gross domestic product. We use the values for 2018. (Source: WDI, World Bank national accounts data, and OECD National Accounts data files).
Central bank independence weighted index	(Source: Garriga, Ana Carolina. 2016. "Central Bank Independence in the World: A New Data Set," *International Interactions*, 42 (5): 849-868. DOI: 10.1080/03050629.2016.1188813) The Central Bank Independence measure is based on rules pertaining to legislative reforms, policy formulation, etc., which are coded and combined into a single weighted index. We use values for 2012 (the latest reported year).
Governance indicators	The Worldwide Governance Indicators report on six broad dimensions of governance over the period 1996–2018—voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. We use the percentile ranks for the year 2018 to conduct our analysis and construct an average governance indicator (rank) by simply averaging the percentile ranks over six categories of reported indicators (Source: World Bank).
Financial development index and related indices	We use nine indices that summarize how developed financial institutions and financial markets are in terms of their depth, access, and efficiency. These indices are then aggregated into an overall index of financial development (financial development index). All indices are for year 2017 (latest available). (Source: IMF Strategy, Policy and Review Department)

Source: Authors' compilation.

TABLE A.3. Inflation Basket in Various CPI Series

	CPI-Combined	*CPI–IW*	*CPI Agricultural Labor (CPI–AL)*	*CPI Rural Labor (CPI–RL)*
Base year	*2012*	*2001*	*1986–87*	*1986–87*
Weights of major groups				
Food, beverages, tobacco	48.24	48.47	72.94	70.47
Fuel and light	6.84	6.42	8.35	7.9
Housing	10.07	15.29	–	–
Clothing and footwear	6.53	6.58	6.98	9.76
Miscellaneous	28.32	23.32	11.73	11.87
Total	100	100	100	100
Compiling agency	CSO, GoI		Labour Bureau, GoI	

Source: Central Statistics Offics (CSO), Ministry of Statistics and Programme Implementation, Government of India (GoI); Labour Bureau, GoI.

TABLE A.4. Correlation Coefficients between the Different Variables and their Summary Statistics

	Policy Rate	*Output Gap*	*Inflation*	*Exchange Rate Depreciation*	*Fiscal Deficit/ GDP*	*Government Market Borrowing*
Policy rate	1					
Output gap	0.35*	1				
Inflation	0.19	0.15	1			
Exchange rate depreciation	0.30*	–0.07	0.18	1		
Fiscal deficit/GDP	0.09	–0.32*	0	0.17	1	
Government market borrowing	–0.13	–0.27*	0.02	–0.06	0.49*	1

Source: Authors' calculations.
Notes: *indicates that the correlation coefficient is significant at the 1 percent level. Correlation between policy rate and inflation is significant at the 10 percent level.

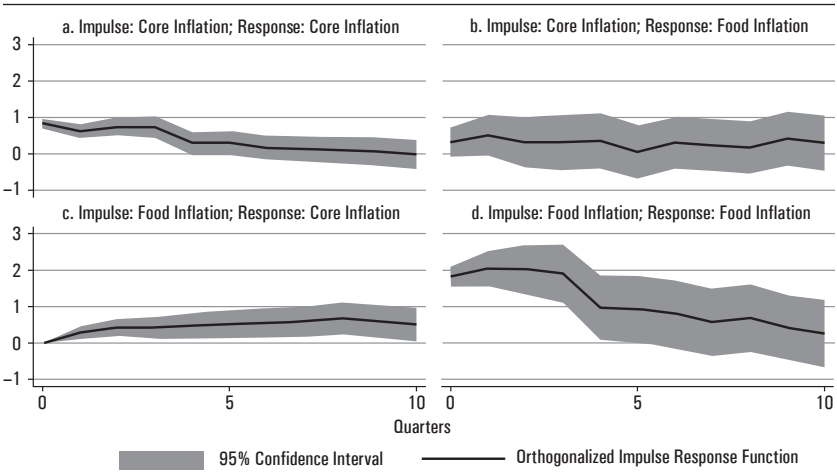
Appendix B: Further Analysis of the Food-Price-Core-Inflation Pass-through

We use a VAR model to identify the pass-through effect of food inflation on core inflation and vice versa. Our sample goes from 1997 Q1 to 2019 Q4. We splice the respective CPI series using standard splicing methods to arrive at CPI food, core, and fuel inflation. In particular, we have used the CPI–IW variant prior to 2012 Q1 and new CPI food/fuel/core 2011–12 series post that.

Our VAR model includes food and core inflation as endogenous variables and fuel inflation as exogenous. We select a lag length of 8 using the information criteria.[47] For fuel inflation, we consider 4 lags as exogenous to the model. As an additional check, we implement the same model by replacing each variable by its first difference (the optimal lag length changes to 4 with first difference specification).

a. *Persistence of shocks:* We find that inflationary shocks are quite persistent, that is, the shock to food or core inflation does not dissipate in the next period but stays intact for almost three quarters and eventually converges to lower levels. For instance, in Figure B.1d., we see that a one Cholesky standard deviation shock to food inflation stays intact until the fourth quarter and tends to vanish fully only after a year. The same is true for the core inflation shock as is evident from Figure B.1a.
b. *Pass-through from food to core inflation:* Figure B.1c shows the orthogonal impulse response of one Cholesky standard deviation shock to food inflation with core inflation as the response. The effect of the food inflation shock shows up after one quarter lag and tends to spiral up, albeit at a slower pace, until it starts moderating after the eighth quarter.
c. *Pass-through from core to food inflation:* In the orthogonal impulse response of one Cholesky standard deviation shock to core inflation

FIGURE B.1. Orthogonal Impulse Response



Source: Authors' calculations.

47. Optimal lag length is selected using both Schwarz Bayes and Akaike information criteria.

with food inflation as the response, the results suggest no pass-through from core to food inflation despite an immediate jump in the point estimate of the orthogonal impulse response. The extreme wide confidence intervals signal the insensitivity of food inflation to core inflation shocks. This is not surprising given that food inflation in India is largely driven by supply-side shocks such as rain, and weather and climatic conditions.

d. *Results using first difference specification:* The persistence results as described in point (a) remain consistent with this first difference specification. However, the argument for the pass-through effects from food to core inflation weakens as the confidence interval around the impulse response widens. The results also suggest an immediate pass-through from core inflation to food inflation, which points to the role of channels other than supply shocks. The immediate pass-through from core to food inflation is very short-lived and dies out in the third quarter.

Appendix C: Inflation Persistence

C.1. First-Order Autocorrelations

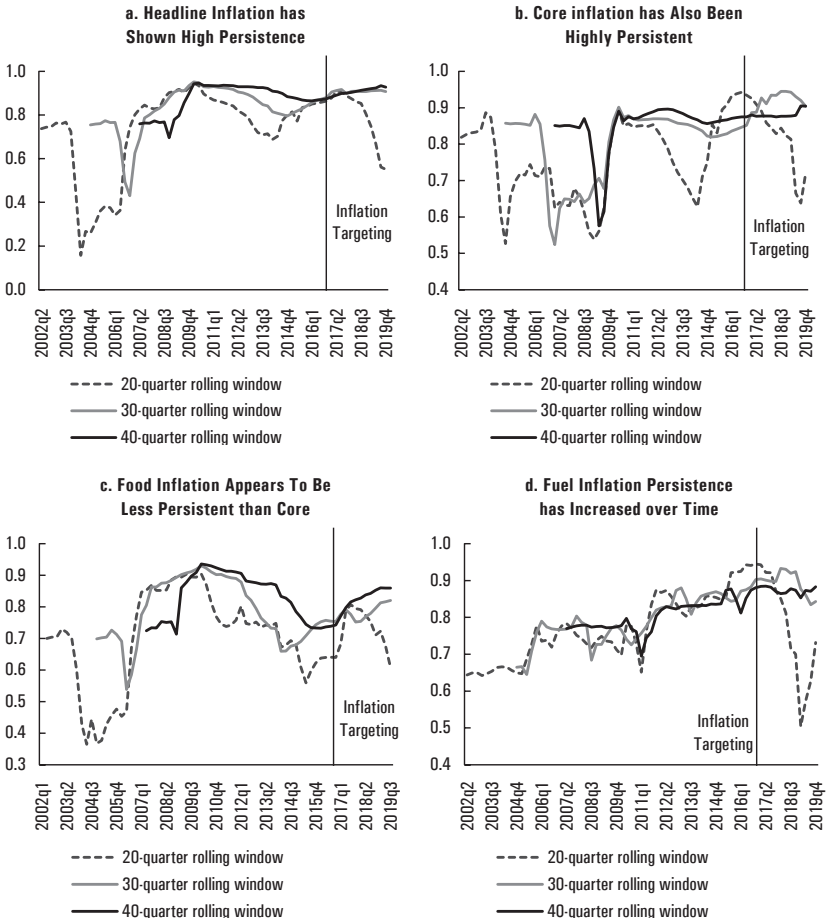
We construct the rolling window estimates of first-order autocorrelation for headline, core, food, and fuel inflation (similar to Pivetta and Reis [2007], Fuhrer [2010]). We consider three windows for rolling sample autocorrelation with length 20, 30, and 40 quarters. Headline and core inflation display similar time variation in their autocorrelation and a very high degree of persistence with their autocorrelation coefficients lying in the range of 0.8–0.9, based on a 10-year rolling window (see Figures C.1a and C.1b). Food inflation persistence, as measured by the first-order autocorrelation, appears to have declined from being highly persistent in 2010 (having a correlation coefficient slightly above 0.9); the autocorrelation coefficient has hovered around 0.8 in the recent quarters.

C.2. Dominant Root of the Univariate Time Series Process

We now consider Largest autoregressive root (LAR) or "dominant root" implied by the univariate autoregressive process for inflation as a measure of persistence. Consider an AR(p) model:

$$y_t = \theta_0 + \sum_{i=1}^{p} \theta_i y_{t-i} + \epsilon_t \tag{C1}$$

FIGURE C.1. First-order Autocorrelation for Alternative Inflation Measures



Source: Authors' calculations.

The lag polynomial obtained from the AR(p) model can written as:

$$L(p) = \left(1 - \theta_1 L - \theta_2 L^2 - \ldots . \theta_p L^p\right) \tag{C2}$$

which can be factored and expressed as:

$$L(p) = \left(\left(1 - \beta_1 L\right)\left(1 - \beta_2 L\right)\left(1 - \beta_3 L\right) \ldots . \left(1 - \beta_p L\right)\right) \tag{C3}$$

where the β_i coefficients are ordered according to their size, with β_1 the largest. In the long run, the effect of a shock on inflation will be dominated

TABLE C.1. Dominant AR Root for Inflation Measures 1997 Q2–2019 Q4

	Dominant AR Root			
CPI Inflation Series	*p = 1*	*p = 2*	*p = 3*	*p = 4*
Headline	0.85	0.71	0.72	0.66*
Core	0.87	0.84	0.76	0.77*
Food	0.80	0.69	0.58	0.74*
Fuel and light	0.81	0.54*	0.76*	0.74*

Source: Authors' calculations.
Notes: 1. * denotes complex roots.
2. Results are based on maximum likelihood estimation (MLE) of AR(*p*) model.

by this largest root: in the case where β_1 is one, the series has a unit root, and all shocks are permanent. The advantage to the LAR measure is that it effectively measures how close a given inflation series is to having a unit root, that is, how close to permanent a given shock will be. A disadvantage, however, is that the other roots beyond the unit root are ignored, while they matter too in practice, for example, a series with a β_2 of coefficient of 0.8 will display more persistence than one with 0.2.

Table C.1 summarizes the results. All the measures of inflation are highly persistent, as suggested by their dominant AR roots. Comparing across the measures, we find core inflation to be relatively more persistent than food inflation. It is worth noting that the AR roots are estimated using OLS estimation and are likely to be biased downward.

C.3. Sum of Autoregressive Coefficients

Another widely used persistence measure is the sum of autoregressive coefficients (SARC). For this measure, the AR(p) measure chosen above for each of the inflation indices is estimated, and the θ coefficients in the equation are summed. SARC is a widely used method for assessing persistence, first proposed with some modifications in Andrews and Chen (1994), who present it as a better single number estimate of long-term dynamics than unit root tests. However, it also has shortcomings, particularly those that relate to oscillating dynamics. If some of the θ coefficients are positive and others are negative, the sum will be close to zero despite what could be near-infinite dynamics. Table C.2 presents the SARC estimates for different AR models with varying lag lengths. This measure also suggests a high degree of persistence across all four measures of inflation with persistence being relatively higher in core inflation than food or fuel inflation. For the AR(1) model, the SARC estimates are very close to the

TABLE C.2. Sum of AR Coefficients for Inflation Measures 1997 Q2–2019 Q4

	Sum of AR Coefficients			
CPI Inflation Series	*p = 1*	*p = 2*	*p = 3*	*p = 4*
Headline	0.85	0.82	0.82	0.81
Core	0.88	0.87	0.85	0.82
Food	0.81	0.78	0.77	0.74
Fuel and light	0.81	0.75	0.69	0.70

Source: Authors' calculations.
Note: Results are based on the OLS estimation of the AR(*p*) model.

dominant AR roots for all four inflation measures. Some of the observed difference in the SARC estimates and dominant AR root estimates could be attributed to the estimation methodology, as the former is estimated using OLS while the latter is estimated using MLE. Among the first four measures of persistence considered so far, none of them has quantified the time until which an inflation shock persists in the economy. The best way to visualize this is by analyzing the impulse response function estimated from a univariate or a multivariate time series model. However, to quantify the cut-off time period until which the shock lasts, we analyze another measure known as half-life.

C.4. Half-Life

Another measure for estimating persistence is calculating the impulse half-life. For this method, an impulse response function for each of the AR(*p*) models is derived. The number of periods required to reduce the impulse response function below 0.5 from an initial unit shock is the half-life. Unlike the previously described methods, this produces integral measures of persistence. For an AR(1) model, a simplified formula is used to calculate half-life, as described below:

$$\text{Half-life (in periods)} = \frac{\log(0.5)}{\log(\theta_1)} \tag{C4}$$

where θ_1 is the coefficient on AR(1) term in the AR(1) model. Table C.3 presents the half-life estimates based on OLS estimation of AR(1) model for different inflation components. The results suggest a higher persistence of core inflation as the shock's half-life is around five quarters while that of food and fuel is about three quarters. The half-life for headline inflation is estimated to be around four quarters.

TABLE C.3. Half-life for Inflation Measures 1997 Q2–2019 Q4

CPI Inflation Series	*Half-life*
Headline	4.12
Core	5.16
Food	3.12
Fuel and light	3.38

Source: Authors' calculations.
Note: Results are based on the OLS estimation of the AR(1) model. Half-life, here, is measured in terms of number of quarters.

Appendix D: GMM Estimates of the Monetary Policy Reaction Function

Below in Table D.1 we present results from the GMM estimation of the reaction function. In columns (1), (2), (5), and (6), inflation is instrumented

TABLE D.1. Estimation of the Monetary Policy Reaction Function

	(1)	*(2)*	*(3)*	*(4)*
Inflation	0.33***	0.30***	0.19**	0.26***
	(4.15)	(3.70)	(2.56)	(3.01)
Output gap (% of GDP)		0.37***	0.56***	0.53***
		(5.24)	(4.20)	(4.14)
Lagged effective policy rate				
Constant	4.81***	4.99***	5.74***	5.36***
	(10.48)	(11.36)	(14.91)	(11.80)
Observations	87	87	87	87
Adjusted R^2	0.00	0.12	0.12	0.09
	(5)	*(6)*	*(7)*	*(8)*
Inflation	0.11***	0.10***	0.09***	0.09***
	(3.79)	(3.22)	(3.45)	(3.27)
Output gap (% of GDP)		0.19***	0.22***	0.21***
		(3.07)	(3.79)	(3.65)
Lagged effective policy rate	0.86***	0.82***	0.85***	0.85***
	(19.30)	(17.59)	(19.27)	(20.31)
Constant	0.27	0.59**	0.49*	0.45*
	(0.93)	(1.98)	(1.87)	(1.77)
Observations	87	87	87	87
Adjusted R^2	0.86	0.89	0.89	0.89

Source: Authors' calculations.
Notes: Robust t statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

by its four lags while the output gap is treated as exogenous; in columns (3) and (7), the output gap is instrumented by its four lags, while inflation is treated as exogenous; and in columns (4) and (8), the output gap and inflation are both assumed to be endogenous and are instrumented by four lags of inflation and the output gap.

Appendix E: Previous Estimates of Monetary Policy Reaction Functions for India: A Review

The theoretical model built by Taylor (1993) is used widely as a workhorse for the empirical estimation of monetary policy reaction functions. The model assumes the policy rate as a function of inflation and output gaps. Many studies have estimated the monetary reaction function for India. We list some of them below.

1. **Virmani (2004)** estimated India's monetary policy reaction function by using the Taylor (1993) rule as well as the McCallum (1988) rule augmented with a change in the real effective exchange rate. The sample period was from the third quarter of 1992 to the fourth quarter of 2001. From the OLS and GMM estimations, it was found that the backward-looking Taylor rule captures the evolution of the short-term interest rate reasonably well, as does the backward-looking McCallum rule.
2. **Mohanty and Klau (2004)** extended the Taylor rule to include changes in the real effective exchange rate and examined how the central bank changes the policy rate in response to inflation, the output gap, and the exchange rate. They used quarterly data from 1995 to 2002 in 13 emerging economies, including India. Empirical results of OLS and GMM for India showed that all the explanatory variables are significant with the expected signs, and that the interest rate responds to exchange rate volatility more than inflation and the output gap.
3. **Ranjan et al. (2007)** find a significant response of the Monetary Policy Index (MPI)[48] to the output and inflation gaps over the period 1951–2005 (coefficient on output gap: 0.88 and on inflation gap: 0.52).

48. The MPI their analysis uses is a composite index of policy actions, defined as the geometric mean of the index of the Bank rate, CRR, and SLR.

Both these coefficients go up (output gap: 1.89, inflation gap: 1.65) when the sample is restricted to begin in 1992. When the output gap is replaced by its first lag, the coefficient values decline in almost all the models in both periods. The authors estimate three different measures of the output gap and the results are robust to the choice of such a measure, though the coefficient on the output gap changes slightly.

4. **Inoue and Hamori (2009)** empirically estimate India's monetary policy reaction function by applying the Taylor (1993) rule and its open-economy version that employs dynamic OLS. The analysis uses monthly data of IIP (as a proxy for output), WPI, REER, and the call rate (as interest rate) from April 1998 to December 2007. When the simple Taylor rule was estimated for India, the output gap coefficient was statistically significant, and its sign was found to be consistent with the theoretical rationale; however, the same was not true of the inflation coefficient. After including the exchange rate, the coefficients of the output gap and the exchange rate had statistical significance with the expected signs, whereas the results of inflation remained the same as before.
5. **Hutchison et al. (2010)** estimate an exchange-rate-augmented Taylor rule for India over the period 1980 Q1 to 2008 Q4. They investigate monetary policy changes between pre- and post-liberalization periods in order to capture the potential impact of macroeconomic structural changes on the RBI's monetary policy conduct. Overall, the authors find that the output gap seems to matter more to the RBI than inflation, there is greater sensitivity to consumer price inflation, exchange rate changes do not constitute an important policy factor, and the post-1998 conduct of monetary policy seems to have changed in the direction of less inertia.
6. **Singh (2010)** estimates the monetary policy reaction function for the Indian economy for the period 1951–2009. The function has exchange rate and interest rate smoothing terms in addition to the inflation gap and the output gap. In addition to estimating for the whole period, the author also estimates these functions separately for the period up to 1988 and thereafter. The coefficients have expected signs in most of the models. While the coefficients are significant in very few models in the pre-1989 period, in the remaining period, these coefficients are significant in most of the models. This is in line with the findings of Ranjan et al. (2007). The interest rate smoothing

term is highly significant in most of the models, more in the pre-1989 period than after that.

7. **Hutchison et al. (2013)** estimate a time-varying Taylor-type rule for India during 1987 Q1 to 2008 Q4 using IIP (as a proxy for output), WPI, call money market rate, and the nominal exchange rate. They find that the conduct of monetary policy over the last two decades can be characterized by two regimes—hawk and dove. In the first of these two regimes, the central bank reveals a greater relative (though not absolute) weight on controlling inflation vis-à-vis narrowing the output gap. The central bank, however, was found to be in the "dove" regime through about half of the sample period, focusing more on the output gap and exchange rate targets to stimulate exports rather than moderating inflation.
8. **Kumawat and Bhanumurthy (2016)** model the monetary policy response function for India, for the period April 1996 to July 2015. Using the 91-day Treasury bill rate as the policy rate, they find that monetary policy has been responsive to the inflation rate, output gap, and exchange rate changes during this period but with substantial time-varying behavior in the reaction function. The regime shift tests show that the transition is driven by the inflation gap as well as by exchange rate changes. Another important finding is that there is a high degree of inertia in the policy rates.

Appendix F

TABLE F.1. Literature Comparing the Macroeconomic Performance Pre- and Post-inflation Targeting

	Sample			
Author	*Countries*	*Time*	*Estimation Methodology*	*Conclusions*
Ball and Sheridan (2005)	20 OECD members (all developed and moderate inflation economies): 7 IT and 13 NIT	1960–2001	Cross-section OLS (difference-in-difference approach)	No evidence that IT improves macroeconomic performance as measured by the behavior of inflation, output, or interest rates.
Vega and Winkelried (2005)	World; 23 IT and 86 NIT		Propensity score matching	IT has helped in reducing the level and volatility of inflation in the countries that adopted it.
Gonçalves and Salles (2008)	36 EMEs: 13 IT	1980–2005	Cross-section OLS	Compared to non-targeters, developing countries adopting the IT regime experienced greater drops not only in inflation but also in growth volatility.
Mishkin and Schmidt-Hebbel (2007)	21 IT (8 AEs and 13 EMEs); 13 NIT AEs 21 post-IT; 21 pre-IT Stationary IT; 13 NIT AEs	1990–2005	Cross-section OLS, IV Panel	IT helps countries achieve lower inflation in the long run, have a smaller inflation response to oil-price and exchange rate shocks, strengthen monetary policy independence, improve monetary policy efficiency, and obtain inflation outcomes closer to target levels. The performance attained by industrial–country inflation targeters generally dominates the performance of emerging economy inflation targeters and is similar to that of industrial non-IT countries.
Batini and Laxton (2007)	21 IT; 29 NIT	1985–2004	Cross-section OLS	Targeting is associated with lower inflation, lower inflation expectations, and lower inflation volatility in the initial years of operation. There are no visible adverse effects of targeting on output, and performance along other dimensions—such as the volatility of interest rates, exchange rates, and international reserves—has been favorable.

(Table F.1 Contd.)

(Table F.1 Contd.)

Author	*Sample*		*Estimation Methodology*	*Conclusions*
	Countries	*Time*		
Lin and Ye (2007)	AEs: 7 IT	1985–1999	Propensity score matching	IT has no significant effects on either inflation or inflation variability in these seven countries. Evidence from long-term nominal interest rates and income velocity of money also supports the window-dressing view of IT.
Brito and Bystedt (2010)	EMEs: 13 IT and 46 NIT	1980–2006 (annual)	Various panel models	No evidence that the IT regime results in lower inflation in developing countries. There is evidence of lower output growth during IT adoption.
Calderón and Schmidt-Hebbel (2010)	World: 24 IT; 73 NIT	1975–2005 (annual)	Multivariate structural inflation model; panel models: fixed effects, random effects, and system GMM	Controlling for high inflation and hyperinflation episodes, IT regimes and fixed exchange rate regimes are associated with lower inflation.
Gemayel et al. (2011)	EMEs: 10 IT; 29 NIT	1990–2008 (annual)	Cross-section OLS, panel estimation (via GMM)	IT is associated with lower inflation and inflation volatility. There is no robust evidence of an adverse impact on output.
Pontines (2011)	22 Industrial, 52 developing; 23 IT (10 industrial, 13 developing)	1985–2005 (annual)	Treatment effect regression that jointly estimates the probability of being an inflation targeter and the outcome equation (considers the problem of self-selection in the countries' decision to be an inflation targeter).	Nominal and real exchange rate volatility are lower in IT countries than in countries that do not target inflation.
Rose (2007)	23 IT; 42 countries in the control group (selected based on real GDP and population)	Jan 1990–Dec 2005 (monthly)	Difference-in-difference (comparing pre- and post-IT while controlling other factors)	Inflation targeters have lower exchange rate volatility and less frequent sudden stops of capital flows than similar countries that do not target inflation. IT countries do not have current accounts or international reserves that look different from other countries.

Source: Authors' compilation.

Note: IT stands for inflation targeting countries, NIT for non-inflation targeting countries, EMEs for emerging market economies, and AEs for advanced economies.

References

Acharya, Viral. 2017. "Monetary Transmission in India: Why Is It Important and Why Hasn't It Worked Well?" (Inaugural Aveek Guha Memorial Lecture). Mumbai: Tata Institute of Fundamental Research, November 16.

Andrews, Donald W. K., and Hong-Yuan Chen. 1994. "Approximately Median-Unbiased Estimation of Autoregressive Models." *Journal of Business and Economic Statistics*, 12 (2): 187–204.

Asnani, Swati, Pankaj Kumar, and Shekhar Tomar. 2019, December 18. "Does Inflation Targeting Anchor Inflation Expectations? Evidence from India" (Paper presented at the 15th ISI-CSH Annual Conference on Growth and Development, held at Indian Statistical Institute, New Delhi).

Athey, Susan, Andrew Atkeson, and Patrick Kehoe. 2005. "The Optimal Degree of Discretion in Monetary Policy." *Econometrica*, 73 (5): 1431–475.

Ball, Lawrence M., Anusha Chari, and Prachi Mishra. 2016. "Understanding Inflation in India." *India Policy Forum*, 12: 1–45. New Delhi: National Council of Applied Economic Research.

Ball, Lawrence M., and Niamh Sheridan. 2005. "Does Inflation Targeting Matter?" In *The Inflation Targeting Debate*, edited by B. Bernanke and M. Woodford. Chicago; London: University of Chicago Press.

Basu, Kaushik, Barry Eichengreen, and Poonam Gupta. 2015. "From Tapering to Tightening: The Impact of the Fed's Exit on India." *India Policy Forum*, 11: 1–66. New Delhi: National Council of Applied Economic Research.

Batini, Nicoletta, and Douglas Laxton. 2007. "Under What Conditions Can Inflation Targeting be Adopted? The Experience of Emerging Markets." In *Monetary Policy under Inflation Targeting*, edited by F. Mishkin, K. Schmidt-Hebbel, and N. Loayza, 467–506. Santiago: Central Bank of Chile.

Benes, Jaromir, Kevin Clinton, Asish George, Joice John, Ondra Kamenik, Douglas Laxton, Pratik Mitra, G. V. Nadhanael, Hou Wang, and Fan Zhang. 2017. "Inflation-Forecast Targeting for India: An Outline of the Analytical Framework" (IMF Working Paper WP/17/32). Washington, DC: International Monetary Fund.

Bhoi, Barendra Kumar, Abhishek Kumar, and Prashant Mehul Parab. 2019. "Aggregate Demand Management, Policy Errors and Optimal Monetary Policy in India" (IGIDR Working Paper No. 2019-029). Mumbai: Indira Gandhi Institute of Developmental Research.

Brito, Ricardo D., and Brianne Bystedt. 2010. "Inflation Targeting in Emerging Economies: Panel Evidence." *Journal of Development Economics*, 91 (2010): 198–210.

Calderón, Cesar and Klaus Schmidt-Hebbel. 2010. "What Drives Inflation in the World?" In *Inflation in an Era of Relative Price Shocks*, edited by R. Fry, C. Jones, and C. Kent, 138–77. Sydney: Reserve Bank of Australia and Centre for Applied Macroeconomic Analysis of the Australia National University.

Cecchetti, Stephen. 2007. "Core Inflation Is an Unreliable Guide." *The Financial Times*, March 1.

Chhibber, Ajay. 2020. "With Food and Fuel Consumer Price Index Surges, It's Time to Rethink the Inflation Target Regime." *Economic Times*, January 24.

Das, Shaktikanta. 2020. "Seven Ages of India's Monetary Policy" (Reserve Bank of India Governor's Speech, St Stephen's College, University of Delhi), January 24.

Davis, J. Scott and Ignacio Presno. 2014. "Inflation Targeting and the Anchoring of Inflation Expectations: Cross-country Evidence from Consensus Forecasts," Globalization Institute Working Papers 174, Dallas: Federal Reserve Bank of Dallas.

Dua, Pami. 2020. "Monetary Policy Framework in India." *India Economic Review*, 55 (1): 117–154.

Fuhrer, Jeffrey C. 2010. "Inflation Persistence." In *Handbook of Monetary Economics*, Vol. 3, edited by Benjamin M. Friedman and Michael Woodford, 423–86. New York: North Holland.

Garriga, Ana Carolina. 2016. "Central Bank Independence in the World: A New Data Set." *International Interactions*, 42 (5): 849–868.

Gemayel, Edward R., Sarwat Jahan, and Alexandra Peter. 2011. "What Can Low-Income Countries Expect from Adopting Inflation Targeting?" (IMF Working Paper No. WP/11/276). Washington, DC: International Monetary Fund, November.

Ghate, Chetan, and Kenneth Kletzer, eds. 2016. *Monetary Policy in India*: *A Modern Macroeconomic Perspective*. New Delhi: Springer India.

Gonçalves, Carlos Eduardo S., and João M. Salles. 2008. "Inflation Targeting in Emerging Economies: What Do the Data Say?" *Journal of Development Economics*, 85 (1–2): 312–318.

Grossman, Herschel, and John Van Huyck. 1988. "Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation." *American Economic Review,* 78 (5): 1088–1097.

Heenan, Geoffrey, Marcel Peter, and Scott Roger. 2006. "Implementing Inflation Targeting: Institutional Arrangements, Target Design and Communications" (IMF Working Paper WP/06/278). Washington, DC: International Monetary Fund.

Hutchison, Michael, Rajeswari Sengupta, and Nirvikar Singh. 2010, September 18. "Estimating a Monetary Policy Rule for India." *Economic & Political Weekly*, 45 (38): 67–68.

———. 2013. "Dove or Hawk? Characterizing Monetary Policy Regime Switches in India." *Emerging Markets Review*, 16 (2013): 183–202.

Inoue, Takeshi, and Shigeyuki Hamori. 2009. "An Empirical Analysis of the Monetary Policy Reaction Function in India" (IDE Discussion Paper No. 200). Chiba: Institute of Developing Economies, Japan External Trade Organization (JETRO).

JPMorgan. 2018. "Is Inflation Dead? A Discussion" (Economic Research). Mumbai: JP Morgan Chase Bank, April.

Kose, M. Ayhan, Hideaki Matsuoka, Ugo Panizza, and Dana Vorisek. 2019. "Inflation Expectations: Review and Evidence" (World Bank Policy Research Paper No. 8785). Washington, DC: World Bank.

Kumawat, Lokendra, and N. R. Bhanumurthy. 2016. "Regime Shifts in India's Monetary Policy Response Function" (Working Paper No. 16/177). New Delhi: National Institute of Public Finance and Policy.

Lewis, W. Arthur. 1954. "Economic Development with Unlimited Supplies of Labour." *The Manchester School,* 22 (2): 139-191.

Lin, Shu, and Haichun Ye. 2007. "Does Inflation Targeting Really Make a Difference? Evaluating the Treatment Effect of Inflation Targeting in Seven Industrial Countries." *Journal of Monetary Economics*, 54 (8): 2521–2533.

Mccallum, Bennet T. 1988. "Robustness properties of a rule for monetary policy" *Carnegie-Rochester Conference Series on Public Policy,* 29: 173–203.

Mishkin, Frederic S., and Klaus Schmidt-Hebbel. 2007. "Does Inflation Targeting Make a Difference?" In *Monetary Policy under Inflation Targeting*, edited by F. Mishkin, N. Loayza and K. Schmidt-Hebbel, 291–372. Santiago: Central Bank of Chile.

Mishra, Prachi, and Devesh Roy. 2012. "Explaining Inflation in India: The Role of Food Prices." *India Policy Forum,* 8: 139–223. New Delhi: National Council of Applied Economic Research.

Mishra, Prachi, Peter Montiel, and Rajeswari Sengupta. 2016. "Monetary Transmission in Developing Countries: Evidence from India" (IMF Working Paper No. 16/167). Washington, DC: International Monetary Fund, December.

Mohan, Rakesh, and Muneesh Kapur. 2009. "Managing the Impossible Trinity: Volatile Capital Flows and Indian Monetary Policy" (SCID Working Paper No. 401). Stanford: Stanford University.

Mohan, Rakesh, and Partha Ray. 2018. "Indian Monetary Policy in the Time of Inflation Targeting and Demonetization" (Working Paper No. 4). New Delhi: Brookings India.

Mohanty, Deepak. 2014. "Why Is Recent Food Inflation in India So Persistent?" (Speech delivered at the Annual Lalit Doshi Memorial Lecture, St Xavier's College, Mumbai), January 13.

Mohanty, Madhusudan, and Marc Klau. 2004. "Monetary Policy Rules in Emerging Market Economies: Issues and Evidence" (BIS Working Paper No. 149). Basel: Bank for International Settlements.

Naqvi, Bushra, and Syed Kumail Abbas Rizvi. 2009. "Inflation Targeting Framework: Is the Story Different for Asian Economies?" (MPRA Paper No. 19546). Germany: University Library of Munich.

Obstfeld, Maurice. 1997. "Destabilizing Effects of Exchange-Rate Escape Clauses." *Journal of International Economics*, 43 (1–2): 61–77.

Patnaik, Ila, and Radhika Pandey. 2020. "Moving to Inflation Targeting" (NIPFP Working Paper No. 316). New Delhi: National Institute of Public Finance and Policy.

Patra, Michael D., and Muneesh Kapur. 2012. "Alternative Monetary Policy Rules for India" (IMF Working Paper No. 12/118). Washington, DC: International Monetary Fund.

Patra, Michael D., and Partha Ray. 2010. "Inflation Expectations and Monetary Policy in India" (IMF Working Paper No. 10/84). Washington, DC: International Monetary Fund.

Patra, Michael D., S. Pattanaik, J. John, and H.K. Behera. 2016. "Global Spillovers and Monetary Policy Transmission in India" (RBI Working Paper Series No. 03/2016). New Delhi: Reserve Bank of India.

Pivetta, Frederica, and Ricardo Reis. 2007. "The Persistence of Inflation in the United States." *Journal of Economic Dynamics and Control*, 31 (4): 1326–1358.

Pontines, Victor. 2011. "The Nexus between Inflation Targeting and Exchange Rate Volatility" (Staff Papers No. sp84). Kuala Lumpur: South East Asian Central Banks (SEACEN) Research and Training Centre.

Raj, Janak, Sangita Misra, Asish Thomas George, and Joice John. 2020. "Core Inflation Measures in India: An Empirical Evaluation using CPI Data" (RBI Working Paper Series No. 05). New Delhi: Reserve Bank of India, May 12.

Rangarajan, Chakravarty. 2020. "The New Monetary Policy Framework—What It Means" (NIPFP Working Paper Series No. 20/297). New Delhi: National Institute of Public Finance and Policy.

Ranjan, R., R. Jain, and S. C. Dhal. 2007. "India's Potential Economic Growth: Measurement Issues and Policy Implications." *Economic & Political Weekly*, 42 (17): 1563–1572.

Reserve Bank of India. 2014. "Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework" (Chairman: Dr Urjit Patel). Mumbai: Reserve Bank of India. Available at https://www.rbi.org.in/SCRIPTs/PublicationReportDetails.aspx?UrlPage=&ID=743 (accessed April 20, 2021).

Rose, Andrew K. 2007. "A Stable International Monetary System Emerges: Inflation Targeting Is Bretton Woods Reversed." *Journal of International Money and Finance*, 26 (5): 663–681, September.

Singh, Bhupal. 2010. "Monetary Policy Behaviour in India: Evidence from Taylor-Type Policy Frameworks" (Staff Study SS [DEAP]: 2/2010). Mumbai: Reserve Bank of India.

Taylor, John B. 1993. "Discretion versus policy rules in practice." *Carnegie-Rochester Conference Series on Public Policy,* 39: 195–214, North-Holland.

Vega, Marco, and Diego Winkelried. 2005. "Inflation Targeting and Inflation Behavior: A Successful Story?" *International Journal of Central Banking*, 1 (3): 153–175.

Virmani, Arvind. 2004. "Operationalizing Taylor-Type Rules for the Indian Economy" (Technical Report). Ahmedabad: Indian Institute of Management.

Woodford, Michael. 2001. "The Taylor Rule and Optimal Monetary Policy." *American Economic Review*, 91 (2): 232–237.

Comments and Discussion*

Chair: **Rakesh Mohan**
Yale Jackson Institute & Centre for Social and Economic Progress

Kenneth Kletzer
University of California, Santa Cruz

The authors have written an exceptionally clear, informative, and thorough paper, integrating empirical analysis with insightful and well-supported interpretations. I am particularly interested in having an interim assessment of inflation targeting for India available. It does seem early to perform an interim appraisal of a monetary policy regime that has not quite completed its fourth year, but inflation targeting will face review in 2021. Although less critical than public health and other interventions to alleviate individual hardship, monetary policy everywhere is tackling a major macroeconomic challenge due to COVID-19. The authors wisely combine a discussion of the role for monetary policy in the present crisis with the retrospective analysis of the current policy regime. The result is a valuable analytical paper accessible and informative to policymakers.

The appraisal of inflation targeting in India follows a well-used, appropriate empirical practice in the area. It also follows a substantial literature on Indian inflation, the importance of food price inflation in India, and the effects of adopting inflation targeting in emerging market and middle-income economies. I discuss the paper in the context of the following four topics.

The first concerns the appropriate measure of inflation to adopt as the operative inflation target. The paper begins with an overview of the comparison of the unified CPI, component-wise CPIs, and the WPI, and provides a very clear explanation as to why the CPI is the more meaningful and useful measure of inflation. This is expected, but it is convincingly done. The authors then address the attention given to food price inflation by policymakers and commentators. The authors' comparisons of the volatility,

* To preserve the sense of the discussions at the India Policy Forum, these discussants' comments reflect the views expressed at the IPF and do not necessarily take into account revisions to the conference version of the paper in response to these and other comments in preparing the final, revised version published in this volume. The original conference version of the paper is available on NCAER's website at the links provided at the end of this section.

persistence, and interactions of food inflation, core inflation, and headline inflation replicate and update the findings from others, including two previous papers presented at the NCAER India Policy Forum itself in 2011 and 2015. Food inflation remains less persistent than headline or core inflation, and the volatilities have quite similar magnitudes. Combining the CPI and the CPI for industrial workers for a longer time series, the authors show that food inflation predicts core inflation, but core inflation does not predict food inflation. They conclude that the standard core inflation measure, all items less food and fuel, provides an inferior inflation target than headline inflation, which incorporates the long-run effects of food inflation.

Although the Granger-causality tests in the text are supplemented by vector autoregressions in the Appendix, earlier papers have also demonstrated these results using cointegration and vector error correction models. Among these is the 2011–12 IPF paper by Prachi Mishra and Devesh Roy, who also argue that because the conventional exclusionary measure of core inflation does not converge to headline inflation in the long run, headline inflation is the more appropriate measure for an inflation target. Laurence Ball, Anusha Chari, and Prachi Mishra in the 2015–16 IPF use disaggregated sectoral price data and propose the use of trimmed mean or median inflation as a better guide for targeting inflation. One observation they make is that food and fuel contribute about two-thirds of the upper 10 percent tail of quarterly price changes. This is consistent with the similar volatility and shorter duration of food price shocks shown by the authors of this paper. Ball et al. (2015–16), however, use the Phillips curve to assess the choice of a core inflation measure. I strongly recommend to the current authors adding references to both previous IPF papers, perhaps including some comparisons to the present paper. There are also two recent RBI papers, one published this year, that I recommend the authors take a look at (Raj et al. 2020; Rath et al. 2000). Although it is common, I recommend a little temperance using the phrase "the pass-through of inflation" to describe Granger-causality. There is a natural explanation, involving price and wage-setting behavior, why food-specific shocks such as weather cause overall inflation to rise, but the test actually just shows prediction. Further, monetary policy reaction functions should affect this statistical relationship.

The second point in the paper concerns the importance of output growth, or the output gap, in the Reserve Bank's policy goals under inflation targeting. The RBI implements a flexible inflation target. The paper does a convincing job demonstrating so by showing that the output gap plays no less of a role in determining changes in the effective policy rate after the inception of inflation targeting than it did before. The monetary policy rule

regressions further confirm that policy rate changes respond to headline inflation and not additionally to food inflation. Hopefully, writers in the business press will take note.

Sections 5 and 6 address what I think is the third major point. This is the assessment of the performance of the inflation targeting regime. Does it appear to be a success so far? As we go through Section 5, inflation in the CPI, as well as headline, core, and food inflation, is significantly, and economically, lower after inflation targeting than before, whether the change in the policy regime is dated at the formal start in 2016 or when the RBI began adopting the procedures of inflation targeting in 2014. The volatility of all measures of inflation, with the exception of food inflation, are also lower. The overall absence of effects on exchange rates, foreign reserves, and portfolio flows, as well as the reductions in the volatility of exchange rates, the stock market, and the call rate, are all checks on the plus side. Indeed, India fares better than most emerging market and middle-income countries in the various cross-country studies compiled in the Appendix. It seems to me that inflation targeting in India is doing very well so far.

Another important question in this assessment is whether progress has been made towards anchoring inflation expectations since the adoption of inflation targeting. The evidence is ambiguous. The survey of inflation expectations for households continues to illustrate tremendous persistence in their inflation expectations. The slow decline in expected inflation in response to the decrease in inflation over several years and the large 3 percent difference between the inflation expected by households and actual inflation are disconcerting. Since the introduction of the RBI's survey of inflation expectations for professional forecasters, actual inflation and expected inflation for the professional forecasters have tracked quite well. The progress toward the anchoring of expectations is clouded by the absence of a significant effect of inflation on expected inflation, shown in Table 14, and of expected inflation on actual inflation for households, shown in Table 15. The positive results for professional forecasters are encouraging, but we do not understand how inflation expectations by households are formed. Nor can we yet learn how important this discrepancy might be in the presence of inflation shocks following expansive monetary policies in the near-term responses to the pandemic. A question left unanswered is which group's expectations matter more for the impact of expected inflation on current inflation. This has to do with who sets which prices and wages. I am not aware of an adequate analysis of the relative importance of professional forecaster expectations to help. I really appreciate that the authors present their analysis of whether expectations

are becoming more anchored carefully and clearly, and forego reaching conclusions not yet ready to be made.

The fourth major contribution of the paper is the discussion of the monetary policy response to COVID-19 for India and escape clauses for inflation-targeting central banks in the face of *force majeure*. As noted by the authors, India, like other emerging market and middle-income countries, has acted quickly in its monetary policy response to the pandemic crisis by lowering policy rates four times since February. They argue that the RBI has some room to cut rates with inflation just at the upper bound of its target range of 6 percent. The paper nicely uses a standard textbook aggregate supply and aggregate demand model to explain how the timing of supply and demand shocks will determine qualitatively how inflationary policy rate cuts will be. I think this is the right explanation and the right way to communicate it. A central bank that enjoys anchored expectations under inflation targeting will have the credibility to use forward guidance to mitigate the inflationary consequences of an expansionary monetary response to a temporary supply shock. The authors close the paper with an insightful piece of empirical evidence in favor of inflation targeting. Table 17 shows that inflation-targeting central banks have been able to lower their policy rates more aggressively since the onset of the beginning of 2020 than non-inflation targeters.

The paper points out that if the disruptions to production and trade persist, then monetary policy in response to the supply shock should be contractionary. With a persistent pandemic, potential output will fall. Thus, the output gap rises, and the monetary policy rule instructs the central bank to raise policy rates. In such circumstances, as in the advanced economies in the 1970s, rising inflation is likely to lead to a loss of central bank credibility and a de-anchoring of expectations.

At the end, the paper raises the possibility that the theory of repeated games, albeit from a time long ago, may be useful for communicating departures from monetary policy rules under exceptional shocks. Several game theoretic analyses of the conflict between commitment and discretion in monetary policymaking have been published in recent years, showing that monetary policies can allow central bankers to use their private information about the state of the world. An implicit escape clause that allows the central bank to deviate from an inflation target in exigent circumstances observable by all will work in a basic reputational equilibrium. Rules that allow flexibility are possible and rely on reputations. This may be an exotic literature, but the difficulty for policymakers of any kind in the face of uncertainty, not risk, is a problem likely to be with macroeconomics for some time.

In summary, I found this to be a superb paper on monetary policy in the context of an emerging market economy containing a very large number of important results. The text is thoughtfully written so that it will reach policymakers and other observers without sacrificing sufficient empirical analysis, appropriate econometrics, and interpretations. I am hopeful that its main message will find a grateful audience.

References

Ball, Laurence, Anusha Chari, and Prachi Mishra. 2015–16. "Understanding Inflation in India." *India Policy Forum*, 12: 1–45. New Delhi: National Council of Applied Economic Research.

Mishra, Prachi, and Devesh Roy. 2011–12. "Explaining Inflation in India—The Role of Food Prices." *India Policy Forum*, 8: 139–224. New Delhi: National Council of Applied Economic Research.

Raj, Janak, Sangita Misra, Asish Thomas George, and Joice John. 2020. "Core Inflation Measures in India: An Empirical Evaluation using CPI Data" (RBI Working Paper No. 05). Mumbai: Reserve Bank of India, May 12.

Rath, Deba Prasad, Deepak Mohanty, and M. Ramaiah. 2000. "Measures of Core Inflation for India." *Economic & Political Weekly*, 35 (5): 273–275, January 29.

Rajeswari Sengupta

IGIDR

Using detailed empirical analysis, the paper comments on the effectiveness of the inflation targeting (IT) regime in India adopted in 2016. It finds that the Reserve Bank of India (RBI) has been a flexible inflation targeter since 2016 and has not neglected changes in output gap when setting policy rates. Specifically, it has not been an "inflation nutter" and has adjusted policy rates by less in response to inflation. The paper interprets this finding as a sign of enhanced credibility for the RBI as a monetary policy authority. This implies that smaller changes are needed to signal the RBI's intent. The paper also argues that inflation expectations have become better anchored with the advent of the IT regime, and other inflation-related outcomes, such as the exchange rate, are also more stable than before.

The essence of the paper is that the RBI has established its credibility as an inflation targeting central bank and the consequence of this, in the context of the ongoing COVID-19 pandemic, is that the central bank is now in a position to disregard the inflation target and ease monetary policy

to help revive growth. This is a very detailed and well-written paper with a comprehensive assessment of the IT framework, which is also relevant from a policy perspective, given that the inflation target is about to be reviewed by the government in 2021 as per the law.

Our main comment centers around the key question: Has the RBI achieved credibility as an inflation targeting central bank in the last four years?

A good way to assess performance is by looking at inputs rather than outcomes. Outcomes can be affected by exogenous factors. Two important inputs that play a critical role in developing policy credibility are: (a) the technical ability to deliver, and (b) the commitment towards the objective. Significant questions remain on both.

In order to help understand whether the RBI has demonstrated the technical ability to achieve the inflation target, we analyze its forecasts, the macroeconomic data used to prepare these forecasts, and the state of monetary policy transmission in India.

The ability to forecast well is an integral element of successful inflation targeting because, in effect, the policy rate is supposed to target forecasted inflation in the medium term. In other words, the policy rate is based on the central bank's forecasts of future GDP growth and inflation. A comparison of RBI's forecasts and the actual data shows that since the advent of IT, the central bank has systematically overpredicted both the output gap and the inflation gap. Its projections on GDP growth have almost always been higher than the actual data, often prompting frequent revisions in the forecasts. The same applies to its inflation forecasts, resulting in arguably a more hawkish monetary policy stance than what could have been the case had the forecasts been more accurate.

Second, the RBI has been operating and making its statistical projections based on the new 2011–12 base year GDP series, and there has been ample evidence in the academic as well as policy domains that this series may not have conveyed the true picture of the economy, especially during the 2015–2018 period, which also coincided with the implementation of IT. The net result was that RBI's forecasts of closing the output gap, and hence risks to inflation, led to an excessively tight monetary policy (Bhoi et al. 2019). For instance, during the period September 2016 to March 2019, while CPI inflation averaged 3.7 percent, the policy repo rate was 6.3 percent and the real rate of interest was 3.2 percent.

Finally, it is well established in empirical research that monetary policy transmission in India is weak (Mishra et al. 2016). The effectiveness of

transmission channels has not improved with the advent of IT. In the absence of well-functioning policy transmission, achieving the inflation target through changes in the policy rate becomes difficult. This, in turn, raises questions about the RBI's ability to deliver on the objective.

We next turn to the second input to assess the RBI's demonstrated commitment to its inflation target. Here, we focus on the liquidity actions taken by the central bank during the IT period as well as its official monetary policy communication. It is worth noting that the RBI's liquidity management has often contradicted the interest rate decision taken by the Monetary Policy Committee (MPC). For instance, in August 2017, the MPC lowered the repo rate from 6.25 percent to 6 percent, signaling an easing of monetary policy, but the RBI conducted an open market sale in the bond market, which is akin to a monetary policy contraction. Such policy contradictions hamper the transmission of rate actions to lending rates.

How strong was the RBI's commitment to the newly established inflation target as understood from its official communication? The RBI Amended Act (2016) explicitly mentions, "…the primary objective of the monetary policy is to maintain price stability while keeping in mind the objective of growth;…"

However, when Shaktikanta Das took over as the RBI Governor in January 2019, in his maiden speech he said the following:

> At the RBI, we are committed to playing our role as the monetary authority for maintaining mandated price stability objective while keeping in mind the objective of growth; and as the regulator and supervisor of the banking sector and payment systems. We will take necessary steps to maintain financial stability and to facilitate enabling conditions for sustainable and robust growth.

This indicated that the RBI under his leadership would be flexible enough to assume multiple responsibilities, instead of the one-point agenda of remaining fixated on inflation, not quite a message that should be sent out by an inflation targeting central bank committed to achieving the target.

In terms of analytical specifics, the paper estimates a Taylor Rule equation to find out the kinds of weights assigned by the RBI to different macroeconomic variables such as inflation and output gap, and other variables. If the RBI was focusing on controlling inflation, as claimed by the paper, we should see an inflation coefficient greater than 1 in the Taylor Rule, and we should see the size of the estimated coefficient go up post adoption of IT. However, this is not what the paper finds. Instead, it finds that the relationship between inflation and the policy rate becomes weaker post IT.

What does this imply about: (a) RBI's pursuit of IT and (b) RBI establishing its credibility as an inflation targeting central bank? The main claim of the paper is that because the RBI has achieved credibility, it has changed interest rates by less since the introduction of IT. But there is no evidence of this credibility.

The paper finds that in the IT period, the effect of inflation on the policy rate is negative. This result contradicts actual data as well as existing research.

Some of the other quibbles with the paper are that the objective of the paper needs to be described more clearly, the metrics used for assessing the IT framework also need to be outlined, and a discussion of relevant factors such as low oil prices and record levels of food grain production, that is, factors that could have also kept CPI inflation low during the IT period, must be included.

In addition, in the Taylor Rule estimation, the 91-day treasury bill rate may be used as the dependent variable, as it is a comprehensive proxy for the overall monetary policy stance, the exchange rate needs to be included in the baseline model, given the occasional attempts by the RBI to manage exchange rate fluctuations using the policy rate, and the same inflation measure must be used everywhere for the sake of consistency.

The paper also claims that the exchange rate has been stable during the IT period, which is a sign of RBI's enhanced credibility, but that does not appear to be correct. The rate has been stable because the RBI has intervened regularly in the foreign exchange market. If anything, this calls into question the RBI's commitment to IT, given the trade-offs involved in the Impossible Trilemma framework.

Finally, the paper uses its assertion of increased credibility to recommend that the RBI can ignore the IT framework during the COVID-19 pandemic period and lower rates to boost growth. In this context, the post-2008 experience with inflation in the aftermath of the Global Financial Crisis might be worth revisiting.

There was a certain amount of complacency regarding inflation back then. The RBI lowered the policy rate (the repo rate came down from 9 percent in September 2008 to 4.75 percent in December 2009) and did a massive amount of liquidity infusion. Uncharted territory was cited, and hence erring on the side of caution was justified, quite similar to the current circumstances. CPI inflation went up from 6.2 percent in 2007–08 to 12.4 percent in 2009–10. The economy had to bear the cost of bringing inflation down and the RBI had to raise the policy rate from 4.75 percent to more than 8 percent in a series of consecutive monetary policy meetings. We should avoid making the same mistake again. The paper needs to take cognizance of this risk.

References

Bhoi, Barendra Kumar, Abhishek Kumar, and Prashant Mehul Parab. 2019. "Aggregate Demand Management, Policy Errors and Optimal Monetary Policy in India" (IGIDR Working Paper No. 2019-029). Mumbai: Indira Gandhi Institute of Developmental Research.

Mishra, Prachi, Peter Montiel, and Rajeswari Sengupta. 2016. "Monetary Transmission in Developing Countries: Evidence from India" (IMF Working Paper No. 16/167). Washington, DC: International Monetary Fund.

General Discussion

Participants in the General Discussion included **Raghuram Rajan**, **Sajjid Chinoy**, **Vijay Joshi**, **Ajay Chhibber**, and of course, the Chair, **Rakesh Mohan**.

To get a sense of the richness of this discussion, we invite you to view the video of the General Discussion segment of this IPF session. Please use the appropriate hyperlink on the IPF 2020 Program available at the links below.

The session video and all slide presentations for this IPF session are hyperlinked on the IPF Program available by scanning this QR code or going to

https://www.ncaer.org/IPF2020/Agenda/Agenda_IPF_2020.pdf