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# Post-Global Crisis Inflation Dynamics in India: What has Changed?[§]

**ABSTRACT** This paper explores the sources of inflation persistence in India in recent years. The cross-sectional distribution of inflation shows that supply side shocks in the form of relative price increases, particularly for food, and reflected in mainly positive skew, influenced aggregate prices lastingly. A diffusion index captures the quick generalization of price increases in this high inflation episode. Inflation persistence, based on univariate analysis, increased in the post global crisis period. Multivariate analysis by estimation of a new Keynesian Phillips curve points to expectations as the main source of the increase in persistence, suggesting some discounting of monetary policy credibility. Shocks to inflation will require forceful, more than proportionate policy responses. Estimates of reaction functions indicate that the central bank places the highest weight on inflation stabilization, while emphasizing output stabilization, and reaping inflation control properties therefrom. High degree of interest rate smoothing—"baby steps"—could be imparting persistence to the inflation process. The debate on the appropriate monetary policy framework for India is being overtaken by impending legislative changes. A flexible inflation targeting framework of constrained discretion appears to be the overwhelming choice.

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## 1. Introduction

India rebounded from the global financial crisis of 2008 robustly and ahead of advanced economies as well as several comparators among large emerging economies. By the first quarter of 2009, real gross domestic product (GDP) growth was close to 8% and climbing, reviving aspirations of double-digit growth. Every silver lining has a cloud though. The weather gods summoned a familiar but dreaded scourge—inflation. Sinisterly on the heels of this bounce back, it crept in under the radar of the Reserve Bank of India (RBI) in middle of 2009 in the form of food inflation that crossed 10% following a weak monsoon and subsequent flooding. This was a virulent strain relative to recent history, becoming generalized by October 2009 when headline inflation crossed the tolerance threshold of 5% of the RBI. By the time the RBI responded with a 75 basis points (bps) raising of cash reserve requirements in January 2010 followed by a 25 bps increase in the policy repo rate in March, headline inflation had surged above 10% and food inflation to 20%.

Looking back in the middle of 2013–14 (April–March: India's financial year) when inflation dipped below 5% for the first time in 40 months, this visitation of high inflation has also turned out to be drug (read policy)-resistant until the time of writing. Its most notable feature has been its stubborn persistence around 9% through January 2010 to January 2013, despite successive increases in the policy rate of up to 375 bps supported by intermittent cash reserve ratio (CRR) increases, cumulating to 100 bps, right up to October 2011. In other episodes in the not too distant past, people's emotive resentment against pernicious inflation of this order led them to vote out the offending government of the day. This time around, they had moved on, but only more diabolically. Withdrawing their trust from perceived irresponsibility in policy governance, they reposed it where time had been tested and withstood—they bought gold, determined not to let stubborn inflation gnaw away at their purchasing power. By 2010–11, an average annual level of 700–800 tonnes of gold imports, already the highest by any country in the world, surged beyond 1000 tonnes and stayed above that level. The current account deficit (CAD), which on an average was near

zero as a proportion to GDP over the period 2003–09, burgeoned to above 4% of GDP in 2011–12 and kept rising unrelentingly, reaching 6.7% in Q3 of 2012–13. This unique, textbook-defying co-existence of high inflation and a high CAD was no less a vote of no-confidence.

Perhaps eclipsing all other inflation events in India's independent history, this one will be remembered as much for its tenacity as for the heat and dust it has stirred in its indolent passage. Several strands of opinion intertwine and uncoil in the full spectrum of this animated debate, but in the interest of brevity rather than generalization, it is perhaps useful to sketch out the end-points while recognizing that a rich diversity populates the space in between. At one end is the coagulation of opinion drawing from institutional and structural characteristics of the economy that this inflation was due to sector-specific cost-push factors—fuel and other commodity prices (Bhanumurthy et al. 2012; Hatekar et al. 2011; Rakshit 2011); adverse supply shocks to agricultural output (Balakrishnan 2011; Rakshit 2011; Sen and Himanshu 2011); clear evidence against a wage-price spiral in operation (Bose 2012)—all of which argues that orthodox monetary measures would be of little avail in an economy operating in the horizontal range of the aggregate supply curve (Mundle 2011). Many of these views were expressed at a seminar organized by the National Institute of Public Finance and Policy, New Delhi and have been encapsulated in Bose (2012). Any policy-induced compression of demand will cause output to fall and inflation to be pushed up. The RBI's anti-inflation actions spread over January 2010–October 2011, it is lamented, have been driven by the fever of a false sense of independence that make it pursue a monetarist policy into a morass of depression while ignoring the broader developmental objectives (Shetty 2013). Instead, the onus rests with the government to alter the agricultural supply side (Chand 2012; Sen and Himanshu 2011) through raising productivity and investment in agriculture and extension services, and more effective intervention through parastatals (Balakrishnan 2011; Chand 2011). In the articulation of this polarity, it has been argued that given the irrelevance of purely macroeconomic factors or overall excess demand, orthodox monetary (or fiscal) measures would be of little avail as anti-inflationary devices. Not only are their limitations specific to the conditions prevailing during the inflation episode, but given the nature and structure of the Indian macroeconomy, the case for orthodox measures appears extremely weak when inflation is the consequence of supply side shocks (Rakshit 2011). It has also been argued that excess demand for credit generated by financial inclusion, for instance, can cause the velocity of circulation of money to rise and put pressure on prices. In these conditions, monetary tightening through raising

interest rates will have no effect on inflation and that there could be a price to pay for this tightening without the attendant benefit of reduced inflation (Basu 2011), including in terms of unemployment and impairment to future growth (GOI 2011). At the other pole is the view that inflation persistence is essentially a result of costly policy errors in terms of misreading it as "narrowly based" and therefore misjudging the speed of its generalization, compounded by delayed reactions—"policymakers deliberately chose to fall behind the curve"—and by public communication of accommodation—"hand wringing"—all of which could have been avoided had inflation data per se been allowed "to do the talking" (Darbha and Patel 2012). Leaning towards this position is the view that, whether measured by real interest rates or by Taylor-rule type benchmarks, monetary policy was accommodative (IMF 2011).

Did the RBI succumb to time inconsistency? Or did it over-react to supply shocks and sectoral prices? The RBI's view has been that the high inflation that set in since the second half of 2009/10 has been due to a combination of global and domestic supply and demand factors—crude oil and other global commodity prices and pass through to domestic raw material prices; depreciation of the rupee; increased demand for food and especially proteins; increase in rural wages; crisis driven fiscal and monetary stimulus and consequent abundance of liquidity. In the context of the last factor, it has been explained as to why it was difficult to exit the "excessively accommodative monetary policy"—headline inflation had barely turned positive and was entirely driven by food inflation; industrial production had started to pick up but exports were still declining; and globally, most central banks favored continuing stimulus. Consequently, the view was that any aggressive monetary tightening at that point would have affected the recovery, though it was recognized that even after the subsequent tightening, the real policy rate was negative and monetary policy was still accommodative (Mohanty 2013). The preference for "a much more calibrated approach" to the emergence of inflationary pressures over the sharp and quick actions in response to the global crisis was seen as justified by the enormous amount of liquidity in the system—rendering transmission sluggish—amidst high uncertainty surrounding domestic and global scenarios. A frequent series of small rate hikes was regarded as "the best way to balance potentially conflicting objectives" i.e., between minimizing the sacrifice of growth and not letting expectations run out of control (Gokarn 2011). An abiding theme in the RBI's communication on monetary policy has been the concern about elevated food inflation and its persistence with the structural dimensions of proteins at its kernel, and its disappointment with the lack of an adequate supply response, given

that the direct role of monetary policy in combating food price pressures is limited (Gokarn 2011; Subbarao 2011). In a non-trivial way, this came to be associated with the persuasive argument for acquiescing to a new normal for inflation (Reddy 2012) that had started making rounds in the global circuit (Blanchard et al. 2010; Krugman 2012). Eventually, the case for a new normal for inflation had to be comprehensively rejected in the public domain by the Governor of the RBI (Subbarao 2013).

Following this debate can indeed be an absorbing intellectual pursuit, even if only for the worthwhile exercise of recording and evaluating the strength of conviction and the backing of evidence in these exchanges surrounding a definitive moment in recent history and accumulating the wisdom of hindsight for future use. Yet, perhaps, enough has gone into this discussion. Rather than being overwhelmed by it, this paper uses it as a motivation. Drilling into the granularities of this debate to explore India's inflation experience of the post-global crisis period, the paper asks: (a) have the underlying dynamics of inflation changed? and, (b) is a reassessment of the monetary policy framework warranted? The next section explores the characteristics of inflation to ascertain what has changed in relation to the pre-crisis years. Section 3 undertakes an analytical investigation of inflation persistence and its drivers, extending and refining previous contributions to the subject. Section 4 employs the findings thrown up in Sections 2 and 3 to critically evaluate the case for or against moving to an explicit inflation targeting framework in India, as in other emerging economies that have seen virtue in the predominantly Anglo-Saxon approach that started out in the late 1980s, alternatively lauded and vilified by the experience of the ensuing years including through the global crisis. The final section brings it all together and concludes the paper.

## 2. Anatomy of Postcrisis Inflation Persistence

Neither fish nor fowl, what then was this infliction? In this section, we probe the phenomenon of postcrisis inflation persistence by examining the inflation generating process to see if this time was different. *En passant*, we begin by addressing some stylized facts on situating this recent inflation experience in geography and time.

### *2.1. Made in India or Global?*

An issue that has vexed one pole of the debate outlined in the preceding section is the embarrassment that India has had the dubious distinction of

having the highest inflation in the world, or at least among major comparators (Darbha and Patel 2012; Srinivasan 2011). The RBI too, has regarded India as an "outlier" among emerging market economies in inflation performance (RBI 2010a, 2012). The other end of the debate is more sanguine, asserting that India was nowhere near hyperinflation, that this current bout has not taken inflation to its highest level by India's own history—that occurred in 1974 when inflation reached 33%—or by the history of any other country of the world—the record is held by Hungary in 1945 when prices rose $3.8 \times 10^{27}$ times and led to the replacement of its currency (Basu 2011).

Does height matter? The answer to this question appears to be country-specific and contextual. Prima facie, the stylized facts appear to respond in the negative. This is evident, for instance, in the wide variations in levels of inflation targets adopted around the world; the range is between 1 and 10% as shown in Table 1. Moreover, the widely accepted 2% positive inflation target among advanced economies is also state and time contingent—New Zealand, the first country to adopt inflation targeting, started out with a target of 0–2% in 1989. If Germany, arguably the most fiercely anti-inflation country, would have chosen an inflation target during the 1980s it would have had to be closer to 3% to be credible; in the 1970s, it would have been 5%! Several emerging and developing countries adopting inflation targeting have begun with targets higher than the golden mean of 2% prevalent among their advanced peers. Some countries, including Turkey and Russia, have had to revise their inflation targets within short periods of time. Perhaps it is better to evaluate a country's inflation performance in terms of its own context. In terms of inflation gaps i.e., actual inflation minus inflation targets/threshold for each specific country, it may be seen in Table 1 that in the postcrisis period, there has been reason to mind the gap—several countries experienced positive inflation gaps. In fact, the majority in our sample, which includes all inflation targeting countries as well as the USA and India, experienced persistent positive deviations. In the United Kingdom, Turkey, Iceland, Russia and Brazil, for instance, the deviations exceeded defined tolerance levels. Inflation deviations depicted on an annual basis may underplay the duration of inflation persistence. To illustrate, the Governor of the Bank of England wrote 10 open letters during the period March 2009–February 2012 to the Chancellor of the Exchequer to state that the inflation target had been missed, the reasons why and what was intended to bring inflation back to target. Other countries that wrote open letters in this period include the Philippines and Turkey. Importantly, although India's inflation gap was in the higher reaches of the country range, several countries did experience inflation gaps larger than that of India in the postcrisis period.

**TABLE 1. Inflation Heat Map**

| *Country* | *Inflation Target (%) (implicit/explicit)* | *Inflation Gap (percentage points)* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* |
| Armenia | 4.0+/–1.5 | –1.0 | 0.6 | 5.0 | –0.5 | 3.3 | 3.7 | –1.5 |
| Australia | 2.0–3.0 | 0.6 | –0.7 | 1.4 | –1.2 | –0.1 | 0.3 | –1.2 |
| Brazil* | 4.5+/–2.0 | –0.3 | –0.9 | 1.2 | 0.4 | 0.5 | 2.1 | 0.9 |
| Canada | 1.0–3.0 | –1.0 | –0.9 | –0.6 | –2.7 | –1.2 | –0.1 | –1.5 |
| Chile | 3.0 +/–1.0 | 0.4 | 1.4 | 5.7 | –1.5 | –1.6 | 0.3 | 0.0 |
| China** | 3.5** | –2.0 | 1.3 | 2.4 | –4.2 | –0.2 | 1.9 | –0.9 |
| Colombia | 2.0–4.0 | 0.3 | 1.6 | 3.0 | 0.2 | –1.7 | –0.6 | –0.8 |
| Czech Republic | 2.0+/–1.0 | 0.5 | 0.9 | 4.3 | –1.0 | –0.5 | –0.1 | 1.3 |
| Euro area | < 2.0 | 0.2 | 0.1 | 1.3 | –1.7 | –0.4 | 0.7 | 0.5 |
| Georgia | 6.0 | 3.2 | 3.2 | 4.0 | –4.3 | 1.1 | 2.5 | –6.9 |
| Ghana | 8.7+/–2.0 | 1.5 | 2.0 | 7.8 | 10.6 | 2.0 | 0.0 | 0.5 |
| Guatemala | 4.5+/–1.0 | 2.1 | 2.3 | 6.9 | –2.6 | –0.6 | 1.7 | –0.7 |
| Hungary | 3.0 | 0.9 | 4.9 | 3.1 | 1.2 | 1.9 | 0.9 | 2.7 |
| Iceland | 2.5 | 4.2 | 2.6 | 10.2 | 9.5 | 2.9 | 1.5 | 2.7 |
| Indonesia | 4.5 +/–1.0 | 8.6 | 2.2 | 5.3 | 0.3 | 0.6 | 0.9 | –0.2 |
| Israel | 1.0–3.0 | –0.9 | –2.5 | 1.6 | 0.3 | –0.3 | 0.5 | –1.3 |
| Korea | 3.0 +/–1.0 | –0.8 | –0.5 | 1.7 | –0.2 | –0.1 | 1.0 | –0.8 |
| Mexico | 3.0 +/–1.0 | 0.6 | 1.0 | 2.1 | 2.3 | 1.2 | 0.4 | 1.1 |
| New Zealand | 1.0–3.0 | 0.4 | –0.6 | 1.0 | –0.9 | –0.7 | 1.0 | –1.9 |
| Nigeria | 10.0 | –1.8 | –4.6 | 1.6 | 2.5 | 3.7 | 0.8 | 2.2 |
| Peru | 2.0 +/–1.0 | 0.0 | –0.2 | 3.8 | 0.9 | –0.5 | 1.4 | 1.7 |
| Philippines | 4.0 +/–1.0 | 1.5 | –1.1 | 4.2 | 0.2 | –0.2 | 0.7 | –0.9 |
| Poland | 2.5/+–1.0 | –1.5 | 0.0 | 1.7 | 0.9 | 0.1 | 1.8 | 1.2 |
| Romania | 3.0 +/–1.0 | 3.6 | 1.8 | 4.8 | 2.6 | 3.1 | 2.8 | 0.3 |
| Russia | 5.0–6.0 | 3.7 | 3.0 | 8.1 | 5.7 | 0.9 | 2.4 | –0.9 |
| Serbia | 4.0 +/–1.5 | 6.7 | 2.9 | 8.4 | 4.1 | 2.2 | 7.1 | 3.3 |
| South Africa# | 3.0–6.0 | –1.3 | 1.1 | 5.5 | 1.1 | –1.7 | –1.0 | –0.3 |
| Sweden | 2.0 | –0.6 | 0.2 | 1.4 | –2.5 | –0.8 | 1.0 | –1.1 |
| Switzerland | 0–2.0 | –0.9 | –1.3 | 0.4 | –2.5 | –1.3 | –1.8 | –2.7 |
| Thailand | 3+/–1.5 | 1.6 | –0.8 | 2.5 | –3.9 | 0.3 | 0.8 | 0.0 |
| Turkey | 5.0+/–2.0 | 9.5 | 8.7 | 10.4 | 6.2 | 8.5 | 6.4 | 8.9 |
| Uganda | 7.0 | 0.2 | –0.9 | 5.0 | 6.1 | –3.0 | 11.7 | 7.1 |
| United Kingdom | 2.0 | 0.3 | 0.3 | 1.6 | 0.1 | 1.3 | 2.5 | 0.8 |
| USA | 2.0 | 1.2 | 0.9 | 1.8 | –2.3 | –0.4 | 1.1 | 0.1 |
| Uruguay | 4.0–6.0 | 0.4 | 2.1 | 1.9 | 1.1 | 0.7 | 2.1 | 2.1 |
| India^ | 5.0 | 1.0 | –0.1 | 3.7 | –2.6 | 4.6 | 4.5 | 2.5 |

Inflation Gap ≥ 3 Inflation Gap ≥ 1.5 Inflation Gap > 0

Sources: www.centralbanknews.info, www.inflation.eu, IMF's World Economic Outlook (WEO) database and from "State of the Art of Inflation Targeting" by Gill Hammond, 2011, Centre for Central Banking Studies Handbook, No. 29, Bank of England.

Notes: *Official website of Central Bank of Brazil; **China has lowered inflation target recently for 2013.

# Target announced since Feb 2009.

##Thailand proposed target at the start of 2012.

^ WPI data.

Turning inwards from the vertical to the horizontal, a sift through the history of independent India reveals 10 episodes of inflation persistence—parsimoniously measured as inflation above 5% and sticky for a period of 12 months and above as seen in Table 2.

**TABLE 2. Episodes of Inflation Persistence**

| *Period* | *No. of Months* |
|---|---|
| Mar 56–Aug 57 | 18 |
| Dec 59–Mar 61 | 16 |
| Dec 63–Jan 68 | 50 |
| Jan 72–May 75 | 41 |
| Apr 79–Jan 82 | 34 |
| Nov 82–May 85 | 31 |
| July 86–Dec 95 | 114 |
| Mar 2000–Aug 01 | 18 |
| Feb 08–Jan 09 | 12 |
| Dec 09–March 13 | 40 |

Source: Authors' estimates.
Note: The table above depicts the period in months where inflation remained above an implicit target of 5%.

These visitations were relatively frequent right up to the middle of 1990s, including the one that lasted 114 months between July 1986 and December 1995, and was actually two episodes that collided. Whereas in the 1950s and 1960s, they were mainly associated with droughts and wars, the most infamous and widely cited is the one that occurred in the oil shock of the early 1970s when inflation stayed above 20%, and even above 30% for four consecutive months (Basu 2011 provides a panoramic overview). From the late 1980s, factors such as large and persistent fiscal deficits and exchange rate depreciations added their weight to the supply shocks and to inflation persistence. The balance of payments crisis of 1991 was a watershed, for in its aftermath came the correction, supported by an IMF stabilization program. Inflation fell below 7% briefly in early 1993 but was only biding its time in the shadow of deep-seated structural reforms, including trade and industrial sector liberalization. The institution of a market-based exchange rate regime in 1993 and opening up to foreign investment brought surges of capital inflows well above the economy's absorptive and sterilization capacity. Inflation returned in its full fury, averaging 12% over the period January 1994 to May 1995. The RBI, stung by public censure, embarked on a harsh disinflation strategy that broke the back of inflation persistence but posted the economy into a long slowdown.

Occurrences of inflation persistence became infrequent in the 2000s, attesting to a degree of weather-proofing of the economy as well as to its

progressive integration in a favorable global environment. This would soon prove to be a double-edged sword. In the latter part of this benign period, the seeds of the brief episode of inflation persistence during February 2008–January 2009 were being sown in the bed of capital flows driven monetary expansion. The episode itself was triggered by a surge of global commodity prices, partly demand-driven and partly by the proliferation of commodities as an independent investment asset class. Importantly, the usual suspects—fiscal deficits; weather adversities—were dormant. It was the global crisis that squelched this episode and pulled inflation into negative territory in June 2009.

Coming back to the present. What were the forces at work in the current episode that has lasted 40 months? In short, all of the above—drought albeit relatively short-lived; oil and commodity price shocks; large stimulus-driven fiscal deficits; depreciation; capital flows in 2010–11; monetary accommodation; and, supply capacity retardation (Annexure 2; Table 1).

Measured inflation is subject to transitory elements as well as general tendencies. Typically, monetary policy is expected to react to the "general" or generalized components of inflation which are induced by the changes in aggregate demand and expectations (Woodford 2003), given aggregate supply. Transitory components are associated with movements in relative prices and since they are typically supply driven, they should be ignored by forward looking monetary policy setting. Yet, it has been shown that relative price movements or changes in transitory components can become generalized and cause inflation persistence, and not only when it is a monetary phenomenon (*à la* Friedman and Schwartz 1963). Influential work has demonstrated that in the presence of nominal rigidities and frictions, there are menu costs in responding to all price changes. Large supply shocks warrant large responses to them and thus shifts in relative prices can affect the aggregate price level (Ball and Mankiw 1995). The influence of particularly volatile prices, such as those of petroleum and food, and prices set by government regulation—administered prices in the Indian context—have been cited as cases of relative price movements distorting the aggregate inflation rate (Roger 2000). Accordingly, a careful analysis of the cross-sectional distribution of inflation is important for the conduct of monetary policy, especially since it is found not to conform to the Gaussian or Normal distribution (Kottaridi et al. 2009).[1]

1. Roger (2000) reviewed work on this theme that dates back to Jevons in 1863.

### 2.2. The Moments of Inflation

Investigating the moments of the inflation process assumes importance for understanding the dynamics of the inflation process. These moments provide a useful summary of the cross-sectional distribution of its components, and thereby, insights into its formation and persistence. In view of the time span availability of disaggregate component-wise information on the wholesale price index or WPI (which has been used by the RBI as the measure of headline inflation in its communication) in the public domain on a comparable basis, this analysis is restricted to the period 1981–2013 using annual data. This brings into the ambit of our analysis the most persistent inflation experience spanning 1986–95 referred to in Table 2.

#### 2.2.1. The Mean

In the 1986–95 high inflation episode, the crossing of the threshold of 5% by the first moment, the mean rate of inflation, was driven by a pick-up in food inflation, followed after a year by a rise in non-food manufactured products inflation, both in monotonic elevation over the period of persistence right up to the peak in 1994–95. By contrast, in the next episode—March 2000 to August 2001—the mean was almost entirely associated with fuel price inflation and turned out to be relatively short-lived. In the third and fourth episodes in 2008 and in 2010–13, inflation was generalized across constituent categories, but starting from food inflation and followed by non-food manufactured products inflation (Annexure 2: Table 2). This suggests that since the late 1980s, fuel prices impacted the mean in the form of short-lasting shocks. On the other hand, high inflation episodes triggered by food inflation typically spread to non-food manufactured products inflation with varying lags and became generalized and persistent. This is corroborated by analyses of inflation dynamics in India in a new Keynesian Phillips curve framework (IMF 2011). This suggests that food inflation in India is rarely transitory and is most likely to be followed by rising non-food manufactured products inflation.

#### 2.2.2. Higher Order Moments

It is observed that the mean has a "zero breakdown point" i.e., even one large outlying observation is enough to drag it away from the true "centre" of the data distribution (Catik and Onder 2010). Headline inflation should, therefore, be seen in conjunction with higher order moments—standard deviation (SD) or the second moment, which provides a measure of the dispersion of the data around the mean; the third moment, skewness, which

provides a summary of the shape of the distribution in terms of the distance of the tails from the mean; and kurtosis, the fourth moment, indicates the extent to which the distribution has fat or thin tails relative to a normal distribution (Kearns 1998).

The relationship between the mean and dispersion is observed in the literature to be one of two way causality—inflation may affect the variance of relative price changes and the variance of relative price changes may affect inflation (Assarsson 2003). In India, over the period 1981–2013, the standard deviation has been high with occasional spikes, with some evidence of high levels of cross sectional volatility corresponding to periods of upside shocks to mean or headline inflation. In the postcrisis period, on the other hand, the rising mean of inflation has, in fact, been associated with declining dispersion. This has been regarded as evidence of generalization of inflation—concentration of commodity prices around the higher mean (RBI 2010b). In our view, however, this inference cannot be drawn without considering skewness.

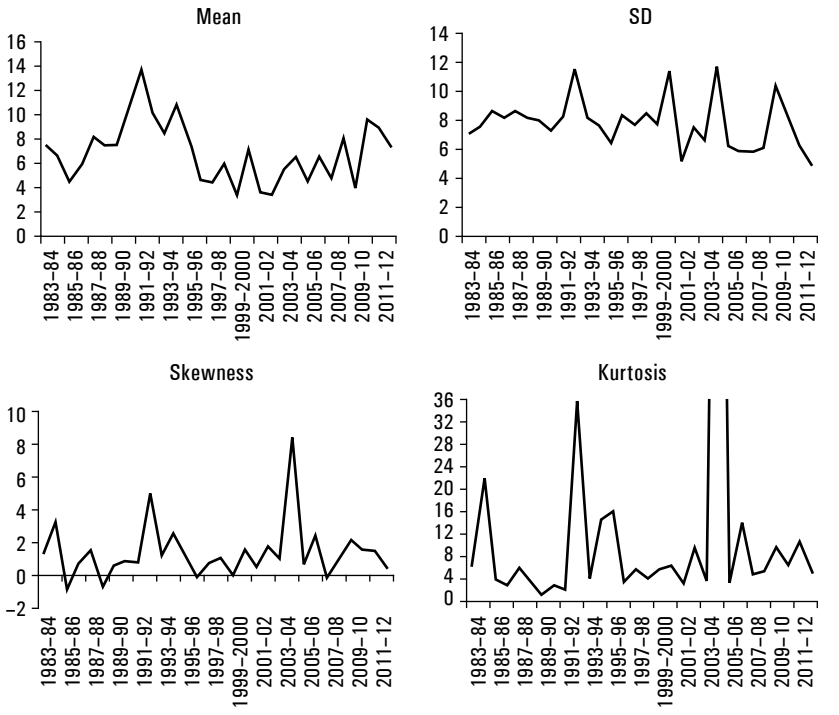
Analysis of the movements of second, third and fourth moments of the distribution of headline inflation in India provides interesting insights which could miss the naked eye. Skewness has a positive relationship with the mean of the distribution. Variance tends to magnify the asymmetry in the tails—a larger variance is inflationary when the distribution is skewed to the right and deflationary when it is skewed to the left. The cross-sectional distribution of inflation in India since 1980 is positively or right skewed throughout with an average coefficient of 1.4, other than in 1985–86, 1988–89, 1996–97 and 2007–08 when instances of negative skewness were evident. The preponderance of the positive skew is on account of sharp relative price changes coming out of supply side shocks which are not counter-balanced by equally large price decreases in other sectors. Such relative price movements can be interpreted as shifts in the Philips curve. The micro-foundations of this relationship draws from menu costs associated with pricing decisions of firms which create a range of inaction in response to shocks (Ball and Mankiw 1995) [2]—as mentioned earlier, firms are inclined to reset prices only in the face of large shocks. Darbha and Patel (2012) find high right skewness coinciding with high inflation only in the recent bout of inflation persistence and not in the episode of the mid-1990s. This is presumably because their sample period begins in 1994–95 when the

2. Bryan and Cecchetti (1999) argued that this is a small sample bias problem. Balke and Wynne (2000) on the other hand, attributed it to productivity shocks. Bils and Klenow (1998) provides an explanation for the positive relationship by combining the business cycle model with the nominal rigidity/skewness model of Ball and Mankiw (1995).

episode was ending; its origins were, however, earlier, as set out in Table 2 and Annexure 2: Table 3. Following Dopke and Pierdzioch (2001), the kernel density estimates of the WPI's cross-sectional inflation rates show high right skews in the early 1990s too (Annexure 2: Figure 1).

Thus, supply side price shocks have always impacted the Indian economy in the form of relative price increases which have influenced the aggregate level of prices in a lasting manner. The coefficient of the fourth moment or kurtosis has always been greater than 3 (other than for a brief period between 1989–90 and 1991–92), implying that the distribution of price changes has been leptokurtic or fat tailed—a large portion of the price index (WPI) experienced price changes significantly different from the mean or headline inflation rate (Figure 1).

**FIGURE 1. WPI (YoY) Inflation Moments**




Source: Authors' estimates.

Following Kearns (1998), we move underneath the analysis of trends in moments to their interplay. The positive correlation between inflation (mean) and skewness in India is in line with the priors set in the vast theoretical

and empirical literature (see Assarsson, 2003, for an overview). The high correlation between kurtosis and skewness indicates that a sizable number of constituent items of WPI contributed to the overall asymmetry observed in the distribution as well as to the positive skewness observed, especially in the postcrisis period (Table 3).

**TABLE 3. Correlation Coefficient of Moments**

| | *Mean* | *Standard Deviation* | *Skewness* | *Kurtosis* |
|---|---|---|---|---|
| Mean | 1.00 | | | |
| Standard Deviation | 0.28 | 1.00 | | |
| Skewness | 0.24 | 0.55 | 1.00 | |
| Kurtosis | 0.07 | 0.55 | 0.91 | 1.00 |

Source: Authors' estimates.

In the tradition of Ball and Mankiw (1995), we formally estimate the effects of variance and skewness on the mean of inflation using quarterly data for the period 1983 to 2013 (first quarter). Mean inflation is regressed on its skewness (SK) and standard deviation (SD), an interaction term between standard deviation and skewness (SD*SK) in order to capture the magnifying impact of variance on skewness, and lagged inflation in order to explain other effects (Equation 1 of Table 4). The results indicate that both skewness and standard deviation contribute positively and significantly to the observed inflation mean. However, the interaction terms SD*SK, though significant, is negatively signed, contrary to Ball and Mankiw (1995); but this negative sign has also been noted by studies conducted on Canada (Amano and Macklem 1997) and India (Tripathi and Goyal 2011). This is explained by the fact that the SD*SK interaction is susceptible to outliers and there is the need for an alternative measure which is robust to outlier effects (Amano and Macklem 1997).

Hence, in Equation 2, as suggested in Ball and Mankiw (1995) and Amano and Macklem (1997), we develop an alternative parsimonious measure to capture asymmetry due to the direct effect of skewness and the magnifying effect of variance with a single variable. Such a measure was also constructed for India by Tripathi and Goyal (2011). For any cut-off level X, the variable is defined as:

$$ASYMX = \sum_{i=1}^{N} r_i D_i^- + \sum_{i=1}^{P} r_i D_i^+$$

Where $r_i$ is the i$^{th}$ industry relative price change (i.e., an industry inflation rate minus the mean of industry inflation rates) weighted for industry size.

**TABLE 4. Inflation and Distribution of Price Changes**

| | *Dependent Variable: Inflation (yoy)* | |
|---|---|---|
| | *Equation 1* | *Equation 2* |
| Constant | –0.81 | 1.19 |
| | (–1.01) | (3.57) |
| Lagged Inflation | 0.76 | 0.77 |
| | (18.32) | (17.00) |
| Standard Deviation (SD) | 0.23 | |
| | (3.15) | |
| Skewness (SK) | 0.73 | |
| | (1.84) | |
| SD* SK | – 0.06 | |
| | (–1.89) | |
| ASYMX | | 0.37 |
| | | (3.72) |
| Dummy Variable (2009Q1, 2009Q2) | –2.75 | –2.55 |
| | (–7.03) | (–5.79) |
| Dummy Variable (1991Q3) | 4.50 | 4.42 |
| | (22.82) | (23.36) |
| $\bar{R}^2$ | 0.83 | 0.83 |
| L. M | 0.97 | 0.87 |
| | (0.62) | (0.65) |
| Breusch-Pagan-Godfrey | 8.08 | 2.76 |
| | (0.23) | (0.74) |

Source: Authors' estimates.

Notes: 1. Figures in parenthesis are t-statistics based on HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000).

2. Breusch-Pagan-Godfrey results gives the computed test statistic of Obs*R-squared and p-value of the null of homoskedasticity.

3. L.M reports Lagrange Multiplier Test statistic and p-value for the null of no autocorrelation for a lag of 2.

4. Estimation is by OLS for the sample period 1983:Q2 to 2013:Q1.

The variables $D_i^-$ and $D_i^+$ are binary variables: the former takes the value one when the i$^{th}$ industry's relative price change falls in the lower 10% of the distribution and zero otherwise, whereas the latter variable is one when the i$^{th}$ industry's relative price change falls in the upper 10% of the distribution and zero otherwise (Tripathi and Goyal 2011). In other words, *ASYMX* accumulates the relative price increases in the upper tail of the distribution and subtracts them from the absolute value of the accumulated relative price declines in the lower tail. Hence, *ASYMX* is zero for a symmetric distribution of relative price changes, positive when the right tail is larger than the left tail, and negative when the left tail is larger. Moreover, for any given skewness, *ASYMX* rises in absolute value when a larger variance magnifies the tails (Amano and Macklem 1997; Ball and Mankiw 1995).

The results presented in Equation 2 of Table 4 show that ASYMX is statistically significant and positively contributes to explaining the mean inflation rate. The goodness of fit of Equation 2 is unchanged in relation to that of Equation 1 where skewness, standard deviation, and their interaction were considered separately, implying that re-specification does not result in any loss of explanatory power.

Thus, relative price changes emanating from supply shocks have had a significant role in explaining the origin and nature of inflation persistence episodes; ignoring them as outside the realm of policy scrutiny and action risks a credibility question, with inflation becoming inertial and expectations unhinged.

### *2.3. A Diffusion Index for Policy Monitoring*

Having established that relative prices matter, it is important to monitor the pace at which they generalize into high aggregate inflation episodes. This is accomplished through a summary measure that captures the momentum of price increases across items constituting the WPI. The inflation diffusion index or IDEX categorizes constituent items in the WPI basket according to whether their prices are rising, stagnant or falling over the previous month and aggregates them to show whether the month-over-month (m-o-m) momentum of price changes overall has been expansionary or contractionary. A reading above 50 signals a broad expansion or inflation across the WPI basket and a reading below 50 signals a broad based deflation. In the context of business cycles, diffusion indices are employed to determine turning points, and are also observed to have lead indicator characteristics (Gets and Ulmer 1990). Our IDEX is defined as follows:

$$IDEX_t = \left( \frac{\sum_{i=1}^{N} wgt_i \times WPI_{it}}{N} \right) * 100$$

$$where\, WPI_{it} = 1\, if\, \Delta WPI_{it} \geq 0.05\%,$$

$$WPI_{it} = 0.5\, if\, -0.05\% \leq \Delta WPI_{it} < 0.05\%$$

$$WPI_{it} = 0\, if\, \Delta WPI_{it} < -0.05\%$$

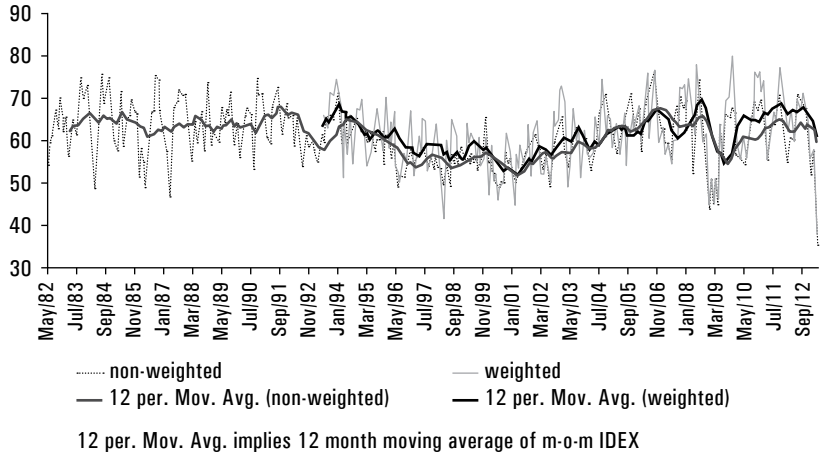
where *wgt* is the weight of item *i* in the WPI index and *N* is the total number of items in the WPI index.

For our computation, each item of the WPI is classified into the categories based on the Conference Board's[3] methodology of defining m-o-m

3. The Conference Board methodology for constructing diffusion indices as part of its Composite Index of Leading Indicators for the United States is utilized for determining the

price increases base on a threshold level of 0.05%. All items are seasonally adjusted. As we have combined WPI indices with three different base years, the number of items in the IDEX, its composition and sensitivity in terms of number of quotations would vary over time, but it would still give a reasonably accurate overview of the broad long-term trends in generalization of price increases (Figure 2 and Annexure 2: Table 4).

**FIGURE 2. Diffusion Index of WPI Items**




Source: Authors' estimates.

Though m-o-m movements tend to be noisy, the 12 month moving average of the IDEX indicates that episodes of high inflation in the 1980s, the 1990s and the recent post-global crisis experience indubitably showed a rapid spread or build-up of momentum of price increases. Moreover, prices increase over a large number of items persisted during these episodes. In the post-global crisis inflation episode, the IDEX showed a sharp reversal from a broad based deflationary situation in the second half of 2008–09 to one of quick increases in the diffusion of price increases during 2010–13. Thus, the IDEX provides a visual validation of the hypothesis that, in India, inflation formation starts from sharp relative price shocks, often in food prices, which quickly translate into broad based prices increases that are sustained for a considerable period of time.

threshold levels. Details on the methodology are available at http://www.conference-board.org/data/bci/index.cfm?id=2180

### *2.4. Is the Observed Prices Behavior Unique to WPI?*

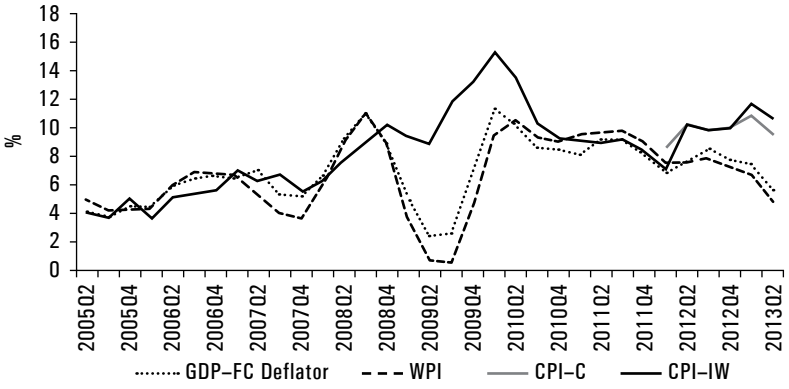
It will be remiss to close this section without addressing an issue in inflation measurement that has featured in the recent debate—which index to use, the WPI or the Consumer Price Index (CPI), with the former akin to a producer price index and the latter measuring prices at the retail level? [4] It has been pointed out that there are considerable differences in inflation measurement between these matrices in magnitude, dispersion and phasing, especially in the post-global crisis period, and the use of the WPI as an inflation measure has been criticized (Rakshit 2011). The opposing view is that it does not matter which index is used, since inflation measured by all these indices tend to converge over time. In a country with high disparity in incomes and living standards, it is difficult to think of a representative consumer meaningfully. Moreover, the CPI for industrial workers reveals a small but systematic upward bias (Basu 2011). Then there is the agnostic view that inflation measured by the WPI is used by the RBI, that it is the most comprehensive index in terms of disaggregation and that it is important to understand inflation dynamics, irrespective of the price data series (Darbha and Patel 2012). Adding to this debate has been the advocacy for the use of GDP deflator on the basis of its comprehensiveness in terms of fuller coverage of service sector prices, to understand inflation behavior. The counter argument is that GDP deflator by itself contains little additional information on prices than what is provided by WPI and CPIs (Shah et al. 2011). Moreover, there are considerable lags involved in obtaining GDP deflator data, currently two months, which reduces its usefulness as a real time indicator of price behavior.

The trends in inflation based on CPI, WPI and the GDP deflator reveals that WPI and GDP deflator based inflation show close co-movement during most of the period considered, but CPIs show considerable divergence, especially since 2012 Q2, as shown in Figure 3.

The co-movement between WPI and the GDP deflator has been attributed to the use of WPI by the Central Statistics Office of the Government of India in estimating the GDP deflator (Shah et al. 2011). The sharp divergence in recent period between CPIs and WPI, on the other hand, has been attributed to the considerable difference in weights and composition (Annexure 2: Table 5). However, it is often difficult to disentangle the effects of different weights and baskets in explaining the price movements between CPI and

4. Until recently, CPIs in India have been compiled for different classes of consumers—industrial workers, agricultural laborers and rural laborers, with the CPI for industrial workers being widely used as CPI measure for India. Since January 2011, a new national CPI, named as CPI-Combined (CPI-C), is being released by the Central Statistics Office (CSO).

**FIGURE 3. YoY Inflation Based on Various Price Indices**




Sources: Central Statistics Office, Ministry of Statistics and Programme Implementation, Labour Bureau, Government of India; Office of the Economic Adviser to the Government of India, Ministry of Commerce and Industry and Authors' Estimates.

WPI, as item level data and weights for CPIs are not available. In the absence of item level data, one way of ascertaining the impact of a divergent basket of commodities in the movements between CPI and WPI groups would be to construct commodity groups in WPI based on the consumer durable and non-durable goods in WPI which are reflected in the CPI basket. While While WPI excluding food and fuel groups constitutes 61% of the WPI basket, a WPI group constructed based on items in CPI excluding food and fuel groups would translate only to 20% of WPI basket.[5] This could result in episodes of divergence between the CPIs and the WPI. Trends in services price, which are captured directly in CPIs but not in WPI, would also add to the divergence in price trends. As seen in the bottom right panel in Annexure 2: Figure 2, WPI based on items in CPI excluding food group and fuel group, also exhibits elevated inflation in the recent period. In case of food items, a CPI basket based WPI inflation and WPI food inflation were almost same, implying the close similarity between CPI and WPI food baskets. Moreover, actual food inflation in WPI and CPIs were also broadly similar. Hence, information on food price trends captured by the CPIs and WPI could be more or less similar, largely due to the similarity of food items in CPIs and the WPI baskets. However, in case of inflation excluding food and fuel groups, episodes of divergence between the CPIs and WPI can arise, primarily due to composition differences. The impact of food and non-food items on overall inflation would also depend on the commodity weighting patterns in the CPIs and WPI.

5. The remaining items in WPI excluding food and fuel consist mainly of industry basic, intermediate and capital goods.

## 3. Analytics of Inflation Persistence: Methodological Issues and Results

Informed by these abstemious insights, we turn now from the relative to the absolute. No analogy is perfect, but in order to start out with a reasonable intuitive fix, persistence can perhaps be likened to inertia in physics—the resistance of a body to changing its velocity unless acted upon by an external force (Fuhrer 2009). The Inflation Persistence Network (IPN), a collaboration between the European Central Bank and the national central banks of the Eurosystem, provides a formal definition of inflation persistence: "the tendency of inflation to converge slowly to its long-run value following a shock" (Altissimo et al. 2006). Understanding the speed and manner in which inflation adjusts to shocks of varying nature, and measuring the patterns and determinants of inflation persistence is critical for fashioning the monetary policy response to upsurges in inflation—reacting heavy-handedly to short-lived episodes can lead to overkills of economic activity; by contrast, too delayed or too feeble a response to long-lasting inflation occurrences runs the risk of hardening inflation expectations and entrenching them at elevated levels with harmful effects that can even impair potential growth (IMF 2011). While the size and timing of monetary policy reactions are eventually judgment calls, empirical measurement of inflation persistence can shine light on the judgment process. Furthermore, this has to be country-specific since the characteristics of the economy in question play a determining role in the dynamics of inflation.

### *3.1. The Sources of Inflation Persistence*

In the post-global crisis episode in India, inflation has stayed above its threshold for a prolonged period, despite the output gap falling and even turning negative, which highlights the importance of understanding the nature of shocks. Was there a series of shocks? Was the initial response to inflation too inertial by economic agents—firms, households and policy makers? Or was there an error in estimation of the "true" domestic potential growth or of global economic conditions, especially as green shoots of recovery from an unprecedented crisis were being seen? Quite clearly, the circumstances in which inflation forms matter.

The large body of work on modeling inflation persistence and price stickiness has broadly identified four factors on the sources of inflation persistence: (a) backward-lookingness in the price-setting mechanism or "intrinsic" persistence; (b) inheritance from the mark-up over costs as reflected in marginal costs or the output gap—"extrinsic" persistence; (c) the

formation of inflation expectations or "expectations-based" persistence; and (d) persistence due to monetary policy regime shifts or "policy-driven" persistence which are best captured, for instance, in the degree of interest rate smoothing in policy reaction functions (Angeloni et al. 2006).

### *3.2. Modeling Inflation Persistence*

A common approach in the "early" efforts to model inflation persistence is to estimate univariate autoregressive (AR) time series models and to measure persistence as the sum of the estimated AR coefficients (Fuhrer and Moore 1995; Nelson and Plosser 1982; Pivetta and Reis 2007). The advantage of this approach is that it needs to rely on time series on inflation only. Moreover, its relative simplicity reduces specification errors. This model can be written as follows:

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

where $\pi$ is the rate of inflation, $\alpha$ is the autoregressive coefficient and $\varepsilon$ is a serially uncorrelated, but possibly heteroskedastic random error term. The measure of persistence is the sum of the AR coefficients, $\rho \equiv \sum \alpha_j$ (Andrew and Chen 1994), which can be obtained by rewriting equation (1) as,

$$\pi_t = C + \rho \pi_{t-1} \sum_{j=1}^{k-1} \beta_j^{\Delta} \pi_{t-j} + \varepsilon_t \tag{2}$$

where $\rho$ is the persistence parameter, while $\beta$ parameters are transformations of AR coefficients in equation (1), $\beta_{k-1} = - \alpha_k$. It has been shown, however, that the AR coefficients will be exaggerated if structural breaks in the mean are not considered (Perron 1989). Allowing for a mean break, the persistence parameter can be estimated as,

$$\pi = c_0 + c_1 D_t + \rho \pi_{t-1} \sum_{j=1}^{k-1} \beta_j^{\Delta} \pi_{t-j} + \varepsilon_t \tag{3}$$

$D_t$ equals zero for $t < T$ and 1 for $t \geq T$.

The measure of inflation persistence derives from this autoregressive function—the inflation series will be regarded as persistent if its correlation with its own past decays slowly. Typically, the model is estimated through rolling regressions to allow for shifts in the mean of inflation over different sub-samples. Moreover, by lowering the sub-sample size, the number of structural breaks that occur gets reduced.

Time series estimates of inflation persistence are essentially measures of unconditional persistence. They assume a stable mean and do not take into account the various factors driving the inflation data generating process, alluded to earlier, each of which exhibits its own level of persistence. This could impart a bias to measured persistence (Levin and Piger 2004). Moreover, rolling regressions do not entirely rule out the possibility of shifts in a specific sub-sample, especially when shifts are frequent, and they impose limits on the degrees of freedom. It follows, therefore, that each of these factors—intrinsic, extrinsic, expectations, and policy-driven—must be explicitly taken into account when modeling the inflation process and its persistence. In particular, for an economy like India, the persistence in macroeconomic shocks hitting inflation should be accounted for so that accurate estimates of inflation persistence are obtained. Accordingly, "newer generation" approaches to estimation of inflation persistence rely on small structural models of inflation dynamics which relate the evolution of inflation to its past as well as to its expected future path and the deviation of the economy's price mark-up over desired levels that is linked to some measure of economic activity. For emerging market economies, exchange rate movements display significant short-term volatility and are amongst the important determinants of short-term inflation (Batini et al. 2006; Ho and McCauley 2003; Ito and Sato 2006). Essentially, these approaches boil down to estimating a reduced form hybrid new Keynesian type Phillips curve, as given below:

$$\pi_t = c + \gamma\pi_{t-1} + (1-\gamma)E_t\,\pi_{t+1} + \beta y_t + e_t + \varepsilon_t \qquad (4)$$

where $\pi$ is inflation, $y$ is the output gap, $e$ is the exchange rate, $E$ denotes the expectation operator and $\varepsilon$ is a cost-push shock. In the above representation, $\gamma$ measures the degree of dependence of inflation on its own past—intrinsic persistence, $(1-\gamma)$ the degree of persistence due to formation of inflation expectations—expectations-based persistence, and $\beta$ the persistence due to fluctuations in determinants of inflation such as the output gap—extrinsic persistence.

For India, these models have been estimated with reasonably robust results, indicating that the new Keynesian type Phillips curve is alive and well here (Kapur and Patra 2003; Patra and Kapur 2012a, 2012b; Patra and Ray 2010; RBI 2002). This is found to hold after accounting for supply shocks and even without accounting for them (Mazumder 2011), thereby overturning the orthodoxy that ruled in the 1980s and the early 1990s which posited that the Phillips curve does not exist in India (Bhattacharya and Lodh 1990; Dholakia 1990; Rangarajan 1983; Rangarajan and Arif 1990).

### *3.3. Period of Study and Time Series Properties*

For analyzing the autoregressive properties of headline inflation and its components, we use both monthly and quarterly data spanning from April 1982 to March 2013. Monthly data are used for updating Khundrakpam (2008) which analyzed the period from April 1982 to March 2008. Univariate analysis using quarterly data is employed to validate the results from monthly data and also to enable a comparison with the results obtaining from the multivariate Phillips curve estimation that follows. Analyses based on quarterly data cover the period April 1996 to March 2013, the choice of period being determined by the availability of quarterly data on real GDP for India. Since monthly and quarterly estimates corroborate each other, the latter are reported here for the sake of continuity into the multivariate analysis while monthly estimates are reported in Annexure 3. All the variables are seasonally adjusted using the X-12 algorithm of the US Department of Commerce and transformed into percentage changes, except for the policy rate, the Fed funds rate and the OECD growth rate (used to proxy external demand). The output gap and the gross fiscal deficit (GFD/GDP) gap are measured as the difference between actual and trend obtained by the Hodrick–Prescott (HP) filter.

As regards the policy interest rate, we follow Patra and Kapur (2012a, 2012b) in using the effective policy rate i.e., the interest rate through which the RBI engages in its liquidity operations with market participants, depending on prevailing liquidity conditions.[6]

#### *3.3.1. Times Series Properties*

At a basic level, the unit root test is the first gauge of inflation persistence. If inflation contains a unit root, its persistence is unquestionably large and its variance is unbounded. Prior to the 1990s, most studies attest to the presence of a unit root in inflation (Barsky 1986; Ball and Cecchetti 1990); however, more recent work is unable to reject stationarity, ascribing this change to the more vigorous attention to inflation on the part of central banks (Fuhrer 2009). As shown in Table 5, two types of tests, i.e., the Augmented Dickey Fuller (ADF) and Phillips–Perron (PP) statistics reject the null of the presence of a unit root in inflation and its components (all measured in terms of rates of change which is the manner in which they enter the estimated equations). As for other variables, CRR, nominal policy rate (I) and the federal fund rate (FED), FOODG, M3G, NFCG and RNFCG are found to be nonstationary, while the rest are stationary at 5% level of significance by at least one of the tests.

6. Data sources are provided at Annexure 5.

**TABLE 5. Unit Root Tests**

| | *ADF* | | *PP* | |
|---|---|---|---|---|
| *Variable* | *Monthly* | *Quarterly* | *Monthly* | *Quarterly* |
| *Rate of Change in WPI and Components* | | | | |
| DCHE | –14.7* | –6.8* | –15.0* | –6.8* |
| DFOOD | –14.9* | –9.5* | –16.4* | –9.5* |
| DFUEL | –15.8* | –7.3* | –15.8* | –7.0* |
| DMAC | –7.4*(t) | –6.3*(t) | –16.4*(t) | –6.3*(t) |
| DMANU | –7.2*(t) | –6.2*(t) | –14.1* | –6.1*(t) |
| DMET | –7.0* | –5.9* | –15.7* | –5.5* |
| DMFOOD | –17.1* | –8.5*(t) | –17.2* | –8.5*(t) |
| DNFOOD | –14.1* | –7.3* | –14.2* | –7.0* |
| DPRI | –15.9* | –7.7* | –15.9* | –7.7* |
| DTEX | –7.0* | –4.7* | –11.8* | –5.9* |
| DWPI | –14.1* | –6.9* | –14.3* | –7.0* |
| *Other Variables* | | | | |
| Ag_gap | –5.2* | | –4.3* | |
| CRR | –2.6 | | –2.8 | |
| Ex_rain | –8.4* | | –8.4* | |
| Exrate | –5.3* | | –6.4* | |
| FED | –1.4 | | –1.4 | |
| FOODG | –2.6 | | –2.8 | |
| GFD_gap | –3.7* | | –14.6* | |
| I | –2.6 | | –2.5 | |
| $I^r$ | –4.5* | | –2.4 | |
| INV_gap | –3.3** | | –3.4** | |
| $M_3G$ | –2.5 | | –2.4 | |
| NEERG | –2.9 | | –3.4** | |
| NFCG | –1.4 | | –2.5 | |
| OECD_GR | –4.0* | | –3.4** | |
| OGAP | –3.6* | | –3.7* | |
| OILG | –4.5* | | –3.5** | |
| REERG | –3.6* | | –3.8* | |
| RNFCG | –2.3 | | –2.4 | |
| WPIG | –6.8* | | –2.4 | |
| $\pi$_GAP | –7.0* | | –2.43 | |

Source: Authors' estimates.

Notes: * and ** denote significance at 1% and 5% level, respectively. The lag length in the ADF tests was chosen based on Schwarz Bayesian Criterion (SBC). "t" in the parentheses indicate inclusion of a trend component in the estimates, which was based on its statistical significance in the equation.

### *3.4. Estimation Results*

We first extend Khundrakpam (2008) to obtain univariate estimates of inflation persistence incorporating the period following the global crisis i.e., 2009–13. This is followed by a multivariate approach to account for the critique of the time series approach and allow an independent verification of the univariate estimates.

### *3.4.1. Univariate Estimates*

The optimal lag length based on the Akaike Information Criterion (AIC) and the Schwarz–Bayesian Criterion (SBC) together suggest a lag length of order 1 for aggregate inflation as well as for most of the disaggregated components for the quarterly series, while for the monthly series, the AIC, in general, selects higher lags (Table 6; monthly estimates are given in Annexure 3: Table 6).

**TABLE 6. Break Estimates in Mean of Inflation—Quarterly**

| *Variable* | *Andrew–Quandt* | *Bai–Perron* | *Lag length* | |
|---|---|---|---|---|
| | | | *SBC* | *AIC* |
| All Commodities (DWPI) | 1995:2 | 1995:2 | 1 | 1 |
| I. Primary (DPRI) | No Break | No Break | 1 | 1 |
| Food (DFOOD) | No Break | No Break | 1 | 1 |
| Non-food (DNFOOD) | No Break | No Break | 1 | 4 |
| II. Fuel (DFUEL) | No Break | No Break | 1 | 1 |
| III. Manufacturing (DMANU) | 1995:2 | 1995:2 | 1 | 1 |
| Food (DMFOOD) | 1998:3 | 1998:3 | 1 | 3 |
| Textiles (DTEX) | 1995:2 | 1995:2 | 4 | 4 |
| Chemicals (DCHE) | 1995:2 | 1995:2 | 1 | 1 |
| Metals (DMET) | No Break | No Break | 1 | 1 |
| Machinery (DMAC) | 1992:4 | 1992:4 | 1 | 1 |

Source: Authors' estimates.

Structural break in the mean was identified using the Quandt–Andrews unknown break point test and the Bai–Perron break point test. Both the tests indicate a break in the mean of headline inflation in the second quarter of 1995 and more specifically in May 1995. This is also evident in the manufactured products component of the headline. The break coincides with the great disinflation undertaken by the RBI to counter the long inflation persistence that characterized the preceding 106 months. On the other hand, the primary articles and fuel components show no structural breaks in their means.

In view of the statistically significant evidence of a break, equation (2) has been estimated for the full sample period as well as two sub-sample periods—pre-break and post-break. Equation (3) is estimated only for the full sample period since it specifically accounts for the break in mean inflation. These results indicate that inflation persistence has gone up in the post-break period for headline inflation, bearing out Khundrakpam (2008), but with one big difference—inflation persistence in the manufactured

products category has gone up significantly, whereas in Khundrakpam (2008), it had declined. There are also non-trivial differences in the size of persistence of inflation in sub-categories of manufactures (Table 7; monthly estimates are given in Annexure 3: Table 7). The only plausible reason for these differences is the inclusion of the data for the post-global crisis period, necessitating a closer investigation.

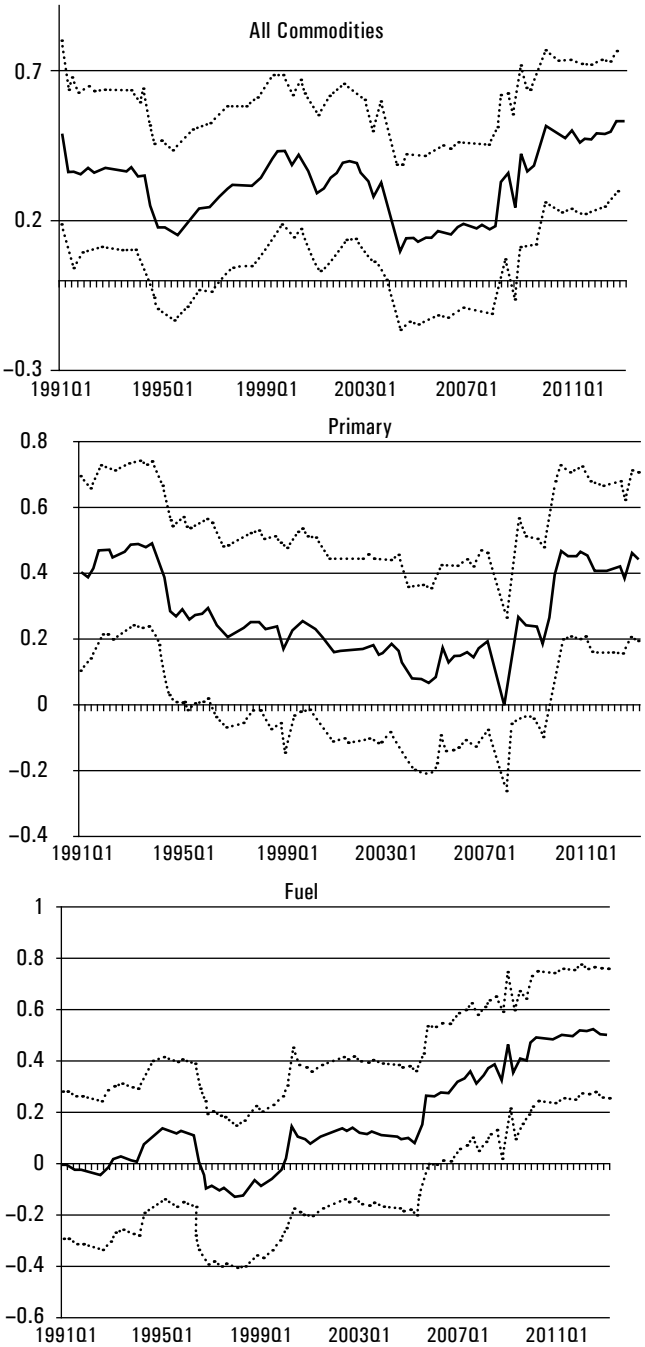
**TABLE 7. Estimates of Persistence During Sub-Samples—Quarterly (1982:2 to 2013:1)**

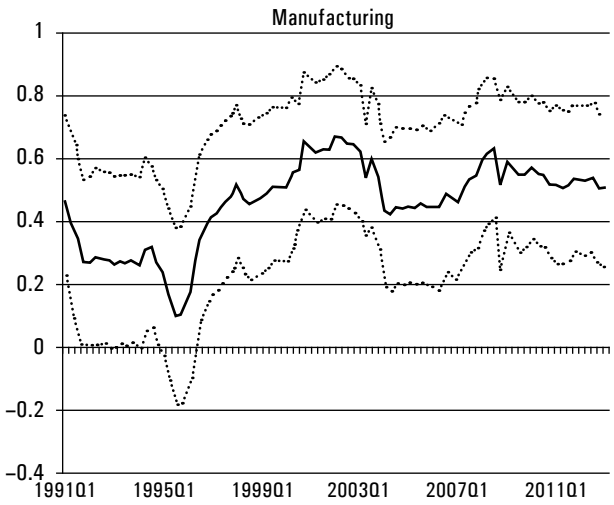
| *Variable* | *First Sample (Pre-Break)* | *Second Sample (Post-Break)* | *Full Sample* | |
|---|---|---|---|---|
| | | | *No Break* | *With Break* |
| All Commodities(DWPI) | 0.283*** | 0.428* | 0.436* | 0.369* |
| I. Primary (DPRI) | – | – | 0.340* | – |
| Food (DFOOD) | – | – | 0.146 | – |
| Non-food (DNFOOD) | – | – | 0.388* | – |
| II. Fuel (DFUEL) | – | – | 0.254* | – |
| III. Manufacturing (DMANU) | 0.294** | 0.499* | 0.556* | 0.396* |
| Food (DMFOOD) | 0.079 | 0.403* | 0.274* | 0.192* |
| Textile (DTEX) | 0.446* | 0.417* | 0.545* | 0.435* |
| Chemicals (DCHE) | 0.490* | 0.237** | 0.441* | 0.395 |
| Metal (DMET) | – | – | 0.543* | – |
| Machinery (DMAC) | 0.419* | 0.516* | 0.585* | 0.455* |

Source: Authors' estimates.
Note: *, ** and *** denote significance at 1%, 5%, and 10% level, respectively.

Rolling regressions show a steady rise in persistence in headline inflation, fuel inflation and elevated levels of persistence in manufactured products inflation from around the second half of 2008 after having fallen through the period 2004–08. Interestingly, food inflation also shows a sharp increase in persistence, particularly with quarterly data, from around the same time. These are major differences from Khundrakpam (2008) in which lowering of inflation persistence was interrupted only towards the end of the sample period, barring for manufactured products inflation. More importantly, the shift in inflation dynamics and in persistence is located in the second half of 2008 (Figure 4; figures for sub-components and on monthly rolling regressions are given in Annexure 3: Figures 3, 4 and 5). This is interesting because it suggests that the origins of post-global crisis inflation persistence may perhaps be in the expansionary phase of capital flows during 2005–08, ignited by the commodity price-driven inflation episode of February 2008–January 2009.

**FIGURE 4. Rolling Regressions of Major Components of WPI—Quarterly**






Source: Authors' estimates.

### *3.4.2. Multivariate Analysis: Structural Model Estimates*

Following Clarida et al. (1998, 2000) and Goodhart and Hofmann (2005), we estimate the new Keynesian Phillips curve (NKPC) using the Generalized Method of Moments (GMM) in view of leads/lags of the explanatory variables being used and potential endogeneity of the variables. Estimation of various alternative specifications shows statistical support for the backward-looking Phillips curve which corroborates previous studies mentioned earlier. We also conduct robustness tests by estimating it across two specifications—augmented with quarter-on-quarter exchange rate changes and without them—and over two sample periods—including and excluding the post-global crisis period.

Hansen's J-statistic indicates that the instruments satisfy the orthogonality condition and are, therefore, valid instruments. There is also no evidence of residual auto-correlation, as evidenced by the Q statistic. The Kleibergen–Paap rk Wald F-statistic, which tests the strength of instruments, appears reasonable, though no critical values are available. Accordingly, weak-identification-robust inference statistics for relevance of endogenous regressors such as the Anderson–Rubin (AR) Wald Test are preferred in the literature (for a discussion, see Patra and Kapur 2012a). This test strongly rejects the joint null in all the four specifications and, therefore, indicates that the endogenous regressors are relevant. Thus, the Phillips curve or aggregate supply function appears to be reasonably well identified.

The results turn out to be revealing. Intrinsic persistence, measured from the coefficient on lagged inflation, actually declines from the pre-global crisis period range of 0.58 and 0.74, with and without the exchange rate term, respectively, to the full sample period (including the post-global crisis period) coefficient range of 0.49 to 0.54, again with and without the exchange rate term. Thus, exclusion of the exchange rate term produces a sharper decline in intrinsic persistence than otherwise, suggesting misspecification and validating the need for incorporating exchange rate effects in the NKPC estimation for India. These results also show the exchange rate pass-through to inflation declining i.e., a 10% change in the exchange rate resulted in a 2.8% change in inflation before the global crisis and 0.09% change in inflation when the post-global crisis period is included (Table 8). Cross-country comparisons suggest that intrinsic inflation inertia in India, though declining, is still high.[7]

Turning to extrinsic persistence, its statistical significance is indicative of the presence of both real and nominal rigidities implied by Calvo-type staggered price setting behavior. This could also be reflecting both the substantial share of administered prices in the WPI and the inertia in the adjustment of output to its potential. Extrinsic persistence appears to have slightly increased when the post-global crisis period is included to 0.22 from 0.19 in the pre-global crisis period when the NKPC including the exchange rate term is considered; but, it is only about two-fifth of the intrinsic persistence. The estimated sacrifice ratio with the postcrisis period included is close to 2.3, slightly higher than 2.2 for the pre-global crisis period and also higher than the range of 1–2 in earlier studies for the pre-crisis period (Kapur and Patra 2003; RBI 2002). This suggests that monetary policy induced disinflation of one percentage point from its trend/long-run average is associated with a reduction of 2.3% in output, indicating a flattening of the aggregate supply curve post-global crisis.

Surprisingly, the contribution of expectations to inflation persistence in India, measured by the coefficient on one-period lead inflation, appears to have risen sharply in the post-crisis period to 0.60 from 0.46 in the pre-crisis period (again, only the exchange rate augmented NKPC is considered). This suggests that people lacked information on the nature of shocks impacting inflation, especially on the duration of the food price shock that started the inflation spiral in 2009, and the policy response thereto, and were perhaps confused when vegetable price spikes, which are typically seasonal, became

7. For the United States, it is estimated to be in the range of 0.73 to 0.80 and for the Euro Zone in the range of 0.42 to 0.45 (Dosschey and Everaertz 2007) or generally less than 0.5 (Altissimo et al. 2006). For Brazil, intrinsic inflation persistence has been estimated to be in range of 0.47 to 0.62 (Machado and Portugal 2012).

**TABLE 8. Estimates of Inflation Persistence Using Hybrid Augmented Philips Curve**

| | *(Dependent variable inflation-$\pi_t$)* | | | |
|---|---|---|---|---|
| | *Pre-crisis period* | | *Including post-crisis period* | |
| Constant | –0.014 | –0.003 | –0.01 | –0.007 |
| | (–5.85) | (–0.62) | (–4.43) | (–2.07) |
| $\pi_{(t-1)}$ | 0.74 | 0.58 | 0.54 | 0.49 |
| | (22.00) | (11.72) | (17.99) | (13.2) |
| $\pi^e$ | 0.49 | 0.46 | 0.59 | 0.60 |
| | (19.73) | (10.4) | (21.13) | (13.7) |
| $Y_{gap}$ | 0.16 | 0.19 | 0.19 | 0.22 |
| | (1.88) | (2.68) | (2.28) | (2.20) |
| Ex_Rain | –0.13 | –0.10 | –0.08 | –0.05 |
| | (–5.06) | (–4.11) | (–3.70) | (–1.88) |
| $X_t$ | | 0.12 | | 0.05 |
| | | (5.41) | | (3.21) |
| Sacrifice Ratio | 1.57 | 2.17 | 2.45 | 2.32 |
| Exchange Rate Pass-through (long-run) | | 0.28 | | 0.09 |
| $\bar{R}^2$ | 0.83 | 0.87 | 0.87 | 0.87 |
| J-Statistic | 9.75 | 10.41 | 12.93 | 12.12 |
| | (0.83) | (0.58) | (0.61) | (0.52) |
| LB-Q Statistics | 16.1 | 15.1 | 20.9 | 24.9 |
| | (0.71) | (0.77) | (0.41) | (0.20) |
| Wald Test ($\chi^2$) | 29.6 | 0.21 | 12.7 | 2.17 |
| ($\pi_{(t-1)} + \pi^e = 1$) | (0.00) | (0.64) | (0.00) | (0.14) |
| *Weak Instruments Tests* | | | | |
| KP Wald Tests | 1.58 | 2.83 | 3.27 | 2.36 |
| AR Wald F-Test | 15.1 | 12.4 | 20.8 | 32.3 |
| (p-value) | (0.00) | (0.00) | (0.00) | (0.00) |

Source: Authors' estimates.

Notes: 1. Figures in parentheses are t-statistics based on HAC standard errors corrected with Newey West/Bartlett window and one-step iteration.
2. LB-Q is the Box-Pierce-Ljung Q-statistic (p-values in parentheses) for the null of no residual autocorrelation for 20 lags.
3. Hansen's J-Statistic test for over-identifying restrictions for GMM estimates; p-values are in parentheses.
4. Estimation is by GMM methodology for the sample period 1997:2 to 2012:4. Instrument variables: Ygap(–2 to –3); GFD_gap(–1); FED(–1 to –3), NEERG(–1), OILG(–1), FOODG(0 to –4); OECDG, (0) and (0 to –1) for equations with and without NEERG, respectively; NFCG(–1), INV_gap(–1); and CRR, (0) and (0 to –1) for equations with and without NEERG, respectively.
5. The null hypothesis in Kleibergen–Paap rk (KP) Wald F-statistic is that the equation is weakly identified. The null hypothesis in the Andersen–Rubin (AR) Wald Test is joint significance of endogenous regressors being zero in the main equation and orthogonality conditions being valid.

longer lasting. The sharp increase in expectations driven inflation persistence also suggests that people discounted the credibility of monetary policy in its ability to lower inflation or in its commitment to the announced policy threshold.

### *3.5. Assessing the Policy Response*

Our results indicate that inflation dynamics have undergone a change in the wake of the global crisis. How monetary policy responded to these changes is the subject of this sub-section. Drawing on the rich literature on the subject, the response of the monetary authority to different shocks impacting the economy can be conceptualized in the form of a quadratic utility-based welfare function that minimizes the squared deviations of output and inflation from potential and target, respectively (Woodford 1997). While the validity of this approach has been questioned (Bernanke and Mishkin 1997; Blinder 1997; Clarida and Gertler 1997; DeLong 1997), our paper is mainly driven by its interest in a policy rule that sets a time path for the policy interest rate which optimizes the objective function subject to linear behaviorial constraints. Following Taylor (1993), this so-called "optimal policy rule" is incorporated in a simple optimizing interest rate specification that allows the central bank to vary its instrument—the interest rate—linearly to movements in inflation and output (Woodford 2001). A forward looking specification is recommended in theory in which the interest rate is adjusted to future inflation and output deviations from target/potential. It is also useful to incorporate interest rate smoothing to represent inertia in policy response (Clarida et al. 2000; Paez-Farrell 2009). Some studies have found that exchange rate smoothing is an important consideration in the policy reaction function of most emerging economies, including India (as in Mohanty and Klau 2004). We also follow the literature in augmenting the policy reaction function with the influence of key international interest rates on domestic monetary policy in the context of the growing degree of trade and financial integration, large capital flows and potential business cycle synchronization. Accordingly, our specification of the policy reaction function takes the form:

$$I_t = c_0 + c_1 * E_{t-j}\, \pi gap_{t+k} + c_2 * E_{t-j} y_{t+m} + c_3 * I_{t-1} + c_4 * \Delta X_t + C_5 * i^*_t + \varepsilon_t \quad (6)$$

where $I$ is the nominal policy/short-term interest rate, $y$ is the output gap, $\pi$gap is the inflation gap (in terms of deviation from the objective level set by the central bank for monetary policy purposes or the threshold level of 5% in India), i* is the Federal Funds rate, $\Delta X$ is the variation (quarter-on-quarter) in the nominal exchange rate of the rupee against the US dollar and "j" represents the possible information lag to which the central bank is subject. If $k$ and $m$ are both positive, we get a forward-looking version of the Taylor rule; the outcome is a backward-looking version if $k$ and $m$ are negative.

The results of estimating the policy reaction function are given in Table 9. Following Mishra and Mishra (2012a), we adopt a sequential approach to the estimation, beginning with the "pure inflation targeting" situation in which the RBI changes its policy rate to movements in the inflation gap alone. This is followed up with the introduction of the output gap, exchange rate changes measured in percent of appreciation/depreciation and the Federal funds rate in that order so as to progressively approximate the multiple indicator approach currently adopted by the RBI. Furthermore, we estimate this family of policy reaction functions for the pre-global crisis period and for the full sample period that includes the post-global crisis experience. Instruments satisfy the orthogonality condition as per the J-statistic and the Q statistic shows no evidence of residual auto-correlation. The Kleibergen–Paap rk Wald F-statistics are reasonably high, particularly in specifications excluding the exchange rate. The AR statistic indicates that the endogenous regressors are relevant.

In the hard inflation targeting case where the policy interest rate responds to future—one period ahead—movements in the inflation gap alone, the coefficient on the inflation gap slightly falls from 1.6 in the pre-crisis period to close to 1.4 in the full sample that includes the postcrisis years. This satisfies an important pre-condition for stability of the policy reaction function emphasized by Kerr and King (1996), Bernanke and Woodford (1997) and Clarida et al. (1998)—the coefficient on the inflation gap is expected to be at or above unity, failing which the policy rule can itself become a source of instability in the model leading to indeterminacy of the equilibrium. With this coefficient below unity, a rise in inflation leads to a decline in the real interest rate which stimulates a rise in aggregate demand which, in turn, induces a rise in inflation, thus confirming self-fulfilling revisions in expectations. When the coefficient is above unity, short-term real interest rates do not adjust to accommodate sunspot shifts in inflationary expectations.

Next, we introduce the output gap as an argument in the policy reaction function. The coefficient on the inflation gap rises to about 1.9 during the pre-global crisis period and to about 1.5 during the full sample period. The output gap coefficient, however, remains more or less unchanged at about 1.1. Third, we introduce the exchange rate into the reaction function. The exchange rate term is statistically insignificant, validating the point that the RBI does not react to exchange rate movements with interest rate changes but instead with foreign exchange interventions and capital controls (Mohan and Kapur 2009). The introduction of the exchange rate term, however, reduces the inflation gap coefficient and raises the output gap coefficient, and pre-global crisis period and full sample period coefficients are the same.

**TABLE 9. Estimates of Policy Reaction Function (Dependent Variable Policy Rate: $I_t$)**

| | *(1)* | | *(2)* | | *(3)* | | *(4)* | | *(5)* | | *(6)* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Pre* | *Post* | *Pre* | *Post* | *Pre* | *Post* | *Pre* | *Post* | *Pre* | *Post* | *Pre* | *Post* |
| Constant | 0.004 | 0.005 | 0.004 | 0.005 | 0.004 | 0.005 | 0.004 | 0.006 | 0.007 | 0.006 | 0.006 | 0.005 |
| | (5.05) | (2.37) | (3.06) | (3.28) | (2.00) | (2.54) | (3.48) | (3.80) | (5.50) | (3.88) | (4.10) | (4.30) |
| $\pi^e_{gap}$ | 0.12 | 0.15 | 0.12 | 0.13 | 0.10 | 0.13 | 0.06 | 0.15 | 0.09 | 0.15 | 0.10 | 0.15 |
| | (11.5) | (6.06) | (13.2) | (6.81) | (6.48) | (6.93) | (5.58) | (6.52) | (4.89) | (6.92) | (6.64) | (6.64) |
| $Y_{gap(t+1)}$ | | | 0.07 | 0.09 | 0.08 | 0.11 | 0.05 | 0.12 | 0.06 | 0.12 | 0.09 | 0.13 |
| | | | (2.31) | (2.89) | (2.53) | (2.97) | (1.63) | (2.11) | (1.66) | (2.42) | (2.48) | (2.99) |
| $\Delta X_{t+1}$ | | | | | 0.00 | −0.00 | 0.01 | 0.00 | 0.00 | 0.00 | −0.00 | 0.00 |
| | | | | | (0.6) | (−0.4) | (1.7) | (0.4) | (0.3) | (0.5) | (−0.2) | (0.4) |
| $FED_{(t-1)}$ | | | | | | | | | 0.07 | 0.04 | | |
| | | | | | | | | | (3.5) | (1.3) | | |
| $FED_{(t)}$ | | | | | | | 0.08 | 0.04 | | | | |
| | | | | | | | (5.93) | (1.53) | | | | |
| $FED_{(t+1)}$ | | | | | | | | | | | 0.03 | 0.03 |
| | | | | | | | | | | | (1.87) | (1.39) |
| $I_{(t-1)}$ | 0.92 | 0.90 | 0.94 | 0.91 | 0.93 | 0.91 | 0.89 | 0.88 | 0.84 | 0.88 | 0.88 | 0.89 |
| | (74.8) | (35.9) | (53.7) | (40.1) | (32.6) | (29.5) | (43.6) | (25.8) | (37.6) | (24.6) | (39.1) | (31.4) |
| *Long-run Coefficients* | | | | | | | | | | | | |
| Inflation | 1.58 | 1.41 | 1.94 | 1.51 | 1.46 | 1.46 | 0.58 | 1.22 | 0.41 | 1.26 | 0.84 | 1.29 |
| Output | | | 1.09 | 1.05 | 1.25 | 1.24 | 0.41 | 0.99 | 0.55 | 0.99 | 0.74 | 1.16 |
| Fed | | | | | | | 0.69 | 0.35 | 0.44 | 0.28 | 0.24 | 0.30 |
| Exchange | | | | | 0.04 | −0.03 | 0.08 | 0.02 | 0.01 | 0.02 | −0.01 | 0.02 |
| $\bar{R}^2$ | 0.91 | 0.85 | 0.89 | 0.85 | 0.89 | 0.84 | 0.89 | 0.85 | 0.91 | 0.85 | 0.91 | 0.85 |

*(Table 9 Contd)*

*(Table 9 Contd)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J-Statistic | 10.85 | 12.01 | 11.2 | 10.43 | 10.4 | 9.28 | 7.97 | 10.18 | 8.48 | 10.3 | 9.39 | 9.80 |
| | (0.97) | (0.94) | (0.92) | (0.94) | (0.79) | (0.86) | (0.92) | (0.81) | (0.97) | (0.85) | (0.95) | (0.88) |
| LB-Q Statistics | 23.0 | 23.5 | 26.6 | 20.7 | 29.0 | 21.0 | 29.6 | 21.5 | 25.8 | 21.5 | 26.5 | 22.1 |
| | (0.29) | (0.27) | (0.15) | (0.41) | (0.09) | (0.40) | (0.08) | (0.37) | (0.17) | (0.37) | (0.15) | (0.33) |
| *Weak Instruments Tests* | | | | | | | | | | | | |
| KP Wald Tests | 31.0 | 22.7 | 17.5 | 16.4 | 2.6 | 1.8 | 9.5 | 2.8 | 9.7 | 3.7 | 12.1 | 4.6 |
| AR Wald | 322 | 72 | 485 | 75 | 135 | 26 | 142 | 29 | 456 | 34 | 456 | 34 |
| F- Test (p-value) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |

Source: Authors' estimates.

Notes: 1. Figures in parentheses are t-statistics based on HAC standard errors corrected with Newey-West/Bartlett window and one-step iteration.

2. LB-Q is the Box-Pierce-Ljung Q-statistic (p-value in parentheses) for the null of no residual autocorrelation for 10 lags.

3. Hansen's J-Statistic (p-value in parentheses) for over-identifying restrictions for GMM estimates.

4. Estimation is by GMM methodology for the sample period 1997:2 to 2012:4. Instrument variables: ogap(–1 to –4); $\pi^{e}_{gap}$ (–1 to –3), except for column 1 which is –1 to –4; I(–2 to –4); GFD_gap, (0 to –1) for column 1 and 2 and (0) for the rest, M3G (0 to –2) for column 1 and 2 and (0 to –3) for the rest ; NFCG; OILG(0 to –2) for column 1 and 2 and(0) for the rest; XRATE(–1); CRR(–1); FED(–1).

5. The null hypothesis in Kleibergen-Paap rk (KP) Wald F-statistic is that the equation is weakly identified. The null hypothesis in the Andersen-Rubin (AR) Wald Test is joint significance of endogenous regressors being zero in the main equation and orthogonality conditions being valid.

The addition of the Fed Funds rate renders the reaction function unstable in the pre-crisis period; in the full sample period, it is not significant.

Overall, there is a high degree of interest rate smoothing in all cases. This suggests a slow or so-called "calibrated" response to shocks to inflation which, in some sense, could be imparting persistence to the inflation process, especially when large and unanticipated changes are warranted to unanchor inflation expectations from elevated levels (Poddar 2012). The preferred specification of the policy reaction function turns out to be the one with the inflation gap and the output gap, given the insignificance of exchange rate term and the federal funds rate.

Finally, in order to evaluate the performance of our estimates equations in an economy-wide framework, we nest the estimated expectations augmented hybrid NKPC in a fully specified New Keynesian macroeconomic model that includes our preferred specification of the policy reaction function and an aggregate demand function which relates the output gap to the real interest rate (derived from the effective policy rate minus inflation), its own lag, world output to reflect external demand effects, lag of excess rain and lag of real bank credit. The full estimated model is given below. In-sample deterministic dynamic simulations show that the model performs reasonably well in terms of the fit of the estimated path, including the turning points as seen in Table 10.

1. Aggregate demand

$$y_t = \underset{(-4.38)}{-0.0048} + \underset{(-2.30)}{-0.036*I^r_{(t-2)}} + \underset{(27.0)}{0.817*y_{t-1}} + \underset{(9.73)}{0.007*OECD\_gr} + \underset{(9.42)}{0.088*Ex\_Rain_{(t-1)}} + \underset{(2.19)}{0.015*RNFCG_{(t-3)}} - \underset{(-6.60)}{0.03*Dum2004Q1} + \underset{(13.5)}{0.017*Dum2001Q4}$$

   R-bar Square = 0.74; J-statistic = 14.0 (0.93)

2. Aggregate Supply

$$\pi_t = \underset{(-2.07)}{-0.007} + \underset{(13.2)}{0.489*\pi_{(t-1)}} + \underset{(2.20)}{0.22*y_{t-1}} + \underset{(5.11)}{0.511*\pi^e_{(t+1)}} + \underset{(3.21)}{0.046*\Delta X_t} - \underset{(-1.88)}{0.048*Ex\_Rain}$$

   R-bar Square = 0.87; J-statistic = 12.12 (0.52)

3. Policy Reaction function

$$I_t = \underset{(3.28)}{0.005} + \underset{(6.81)}{0.133*\pi^e_{gap(t+1)}} + \underset{(2.90)}{0.093*y_{t+1}} + \underset{(40.1)}{0.91*I_{(t-1)}}$$

   R-bar Square = 0.85; J-statistic = 10.4 (0.94)

Note: Figures in parentheses are t-statistics.

**TABLE 10. In-Sample Dynamic Forecasting Performance**

| *Sl. No.* | *Statistic* | *Policy rate (I)* | *Inflation* ($\pi$) | *Output gap* ($y_t$) |
|---|---|---|---|---|
| 1. | Mean Error | –0.0001 | 0.0008 | 0.0015 |
| 2. | Mean Absolute Error | 0.009 | 0.0067 | 0.0071 |
| 3. | Root Mean Square Error (MSE) | 0.012 | 0.0092 | 0.0092 |
| 4. | Theil's U | 0.082 | 0.074 | 0.40 |

Source: Authors' estimates.

## 4. Appraisal of the Monetary Policy Framework

In the aftermath of the global financial crisis and especially the bout of high inflation persistence, a debate is beginning to brew in India around the need or otherwise for a change in the monetary policy framework to make it relevant, effective and, above all, credible. It is in this context that the case for adoption of inflation targeting (IT) is under scrutiny. This discussion, by itself, is not new in India. On the one hand, it has been argued that the preconditions for inflation targeting are in place and the move to IT is apposite (Khatkhate 2006; Singh 2006), also because multiple objectives are sometimes in conflict (O'Neill and Poddar 2008; Poddar 2012). Others have pointed out that the liberalization of financial markets is far from complete, that the banking system has strong monopoly elements, that fiscal overhang still exists, and that there is a rather weak relationship between short-term interest rates and inflation measures in the Granger causation sense (Jha 2008). An influential view has also been expressed that in India, it is neither desirable nor practical for the central bank to focus exclusively on inflation oblivious of the larger development context in which more often than not, the drivers of inflation in India emanate from the supply side. There is also the formidable challenge of getting a single representative inflation rate for a large economy with 1.2 billion people, fragmented markets and diverse geography. Moreover, the monetary transmission mechanism is impeded by administered interest rates, asymmetric contractual relationships between banks and their depositors, illiquid bond markets and large government borrowings. Also managing large and volatile capital flows is not compatible with IT. At best, flexible IT—if inflation is way off target, a central bank's first call is to bring it within acceptable range, and if inflation is within the range, the central bank should focus on other objectives—is preferable to pure IT (Subbarao 2010). The lack of complete formation of pre-conditions has also been proferred as an argument for establishing flexible inflation

targeting despite its theorized suitability to Indian conditions (Mishra and Mishra 2012b).

To date, 28 countries have adopted IT since New Zealand pioneered it in 1989. With the ECB and the US Federal Reserve seen as implicit inflation targeters (Warburton et al. 2012), there are 30 countries that currently keep the faith. The country experience provides insights into what works, where and why (Annexure 4: Table 8).[8] There is no unanimity of opinion in the economics profession on IT. The global crisis itself has brought with a radical re-appraisal of IT. The loss of macro-prudential discipline even while inflation targets were observed is seen as undermining the validity of the IT framework in terms of fostering complacency. It has also been argued that IT is a communications strategy—a means of breaking inflationary psychology. It is an implicit contract with the public—the longer the inflation target is achieved, the greater the credibility of the central banker and of monetary policy. However, as the global crisis showed in 2008, circumstances may arise in which the central bank may want to break this contract. The massive quantitative easing engaged in by systemic central banks go well beyond abrogation of the implicit contract. Unconventional monetary policies have left the public uncertain whether the inflation target will be observed in future. Doubts have arisen about the durability and flexibility of IT to withstand severe financial shocks—a child of its time that cannot mature (Warburton et al. 2012). In fact, the case for a new normal for inflation at 4% (Blanchard et al. 2010) has been regarded as challenge to IT in its present form. The need to combine financial stability with price stability, dealing with asset prices and life at the zero interest rate bound is seen as the new challenges confronting IT in the future.

India's monetary policy framework can be described as de facto flexible IT with feedback. Our results show that the weight assigned to inflation is high by international standards, even in the presence of multiple objectives, and this ensures a stable reaction function. Furthermore, the coefficient on the inflation gap has increased when the post-global crisis period is incorporated into the policy reaction function. A deep-seated inflation aversion in the public's expectations strengthens the perception of inflation at 5% as a threshold beyond which it is harmful for growth itself. The coefficient on the output gap is above unity in all specifications, indicating a strong commitment to output stabilization relative to advanced economy central banks

8. The Bank of England's "State of the Art of Inflation targeting" CCBS Handbook No. 29 provides a rich and comprehensive overview.

(Blattner and Margaritov 2010) and several emerging economies (Mohanty and Klau 2004). Thus inflation is the dominant focus of monetary policy in India but it is accompanied by an emphasis on stabilizing output around its potential. It has been argued that this is indicative of the fact that the RBI regards deviation of output from trend as carrying the seeds of future inflation. What needs to be fixed, then? In our view, the critical issue is that of obtaining an accurate gauge of the nature of underlying inflation dynamics or more specifically of the degree of inflation persistence and its sources. If inflation persistence has increased as our results show, this requires a preemptive and aggressive monetary policy reaction to break inflation expectations before they become entrenched. This suggests a closer scrutiny of the inertia emanating from monetary policy itself as evident in the high degree of policy smoothing. Furthermore, most inflation persistence episodes tend to emanate from food price shocks which become generalized. Consequently, accommodating food inflation on the argument that the Indian economy is more prone to supply shocks than demand shocks (Balakrishnan 1992) is a perilous strategy. The monetary policy framework will also be strengthened by some changes in its institutional apparatus. The new national level CPI must progressively be employed as the official measure of inflation in the RBI's communication, as in all 28 IT countries. This has practical and operational benefits since it is available on a monthly basis, reflects retail inflation, and should be conveyed as a headline measure rather than in its core form—excluding food which comprises 48% would lack credibility. At present, the new CPI is only three years old and lacks sufficient inflation data points to test for its stability and comprehensiveness. Another institutional innovation could be the mainstreaming of inflation expectations into the monetary policy framework. In this context, the RBI's surveys of urban households and professional forecasters hold promise.[9]

The debate on IT for India is, in a sense, being overtaken by the momentum gathering around impending legislative changes to the proposed monetary policy framework. The Report of the Financial Sector Legislative Reforms Commission (GoI 2013) envisages price stability as the prime

9. The Reserve Bank has been conducting the inflation expectations survey of households since September 2005 to obtain the perception of urban households on price and inflation movements for three months ahead and one year ahead. The survey responses are both quantitative and qualitative in nature. At present, the survey covers 250 households from 16 cities. The Reserve Bank has been conducting the Survey of Professional Forecasters on a quarterly basis from the quarter ended September 2007. Point forecasts on inflation are also among the responses elicited from professional forecasters. The forecasts are collected for the entire financial year, various quarters as well for longer periods like 5 and 10 years ahead.

determinant of the conduct of monetary policy, but stops short of specifying such a requirement in its draft Code. Instead, it recommends that the Central Government determine the predominant medium-term objective of monetary policy as well as other secondary but prioritized objectives, each quantified numerically, through a formal process of articulation in a statement released in the public domain. It seeks independence for the central bank through the establishment of a monetary policy committee, with two external members appointed by the Central Government in consultation with the Governor, and the remaining three external members without consultation with the Governor. A formal voting structure, with attribution and public release of the voting record and rationale is also envisaged. The Central Government is also required to establish what constitutes a substantial failure to achieve policy objectives, requiring the central bank head to write a document explaining the failure, propose remedial action and specify a time horizon over which the return to target is to be achieved.

The recommendations of the Commission will inevitably be subjected to a national debate before the preparation of the formal legislation for parliamentary discourse and sanction. It is therefore timely to take note of some caveats to these recommendations in their present form. They essentially draws from the Anglo-Saxon approach of goal dependent, instrument independent monetary policy which was found wanting in the context of the global crisis. It is necessary to carefully evaluate the more pragmatic and resilient alternative of the US Federal Reserve/ECB approach of goal-independent, instrument-independent monetary policy. The latter provides flexibility which is critical to the conduct of monetary policy. It makes the central bank more accountable since it has to report to Parliament.[10] Most importantly, it strictly precludes fiscal dominance in monetary policy, which is particularly crucial in a country like India in which a significant portion of inflation is determined by the Central Government through administered prices (and wages), and monetary transmission is mainly impeded by Government's administered interest rates, directed credit, statutory preemptions and ownership in banking.

If, however, the UK model is preferred in the national debate, the objectives of monetary policy (both predominant and secondary) must be specified

10. In the United Kingdom, for instance, the view at the time of institution of IT was that the Bank of England "would not be able to account for its monetary stewardship on the Floor of the House of Commons. In a parliamentary system of democracy, it is Ministers who are accountable" (Tucker 2007). Similar arguments are raised in the Indian context, but may not hold if the central bank is given statutory independence. Moreover, breaking away from the British model may bring a refreshing improvement in accountability.

clearly in an Act of Parliament, restricting the flexibility of the Central Government in terms of scope for changing the objectives from time to time, unless and until the Act is amended. If the FSLRC Act, hypothetically, mandates the RBI with an "inflation targeting" framework focused on price stability as the predominant objective, then the new Act must also recognize necessary preconditions for such a framework to work—fiscal discipline; better capacity to manage supply constraints and augment supply capacity to contain supply side persistent pressures on inflation (so that trade-off costs of inflation targeting are minimized); and improved monetary policy transmission through more complete and integrated financial markets. The FSLRC also mimics the approach of the Bank of England in its accountability mechanism. Over the period December 2009 to March 2013, the Bank of England has missed its target in several months and communicated its failure through monthly open letters to the Chancellor of the Exchequer (when inflation exceeded the target by 100 basis points). This process, while based on strong institutional foundations, does not at all appear to enhance the credibility of either the monetary policy or the Government. Identification of substantial failure and correctional strategies can only follow the establishment of strong credibility by the MPC in delivering on the target(s) set.

The conduct of monetary policy and the relative weights assigned to objectives is inevitably an informed judgment based on careful analysis of macroeconomic and financial developments. Specifying a medium term hierarchy of objectives with the expectation that they "would be modified only occasionally" (GOI 2013) severely strait-jackets this judgment and could result in sub-optimal monetary policy. As an instrument of public policy, monetary policy is expected to be nimble and forward looking in response to fast changing macroeconomic dynamics relative to other instruments. Furthermore, all objectives may be difficult to quantify numerically as, for instance, financial stability.

## 5. Conclusion

Writing this paper has been like driving by watching the rear-view mirror—hindsight confers 20/20 vision, but also the sobering reality that objects in the mirror are closer than they appear. What began as an exploration of a recent inflation episode has turned out to be a voyage of introspective discovery, providing valuable insights not just into understanding inflation persistence but also into managing it from a policy perspective.

Policy makers are destined to live a life of self-annihilation, rising from the depths into moments of public discontent (usually), only to repose back into the anonymity of their unresting lives. Theirs cannot be the luxury of theism or intellectual edifices. It is ordained that they shall be judged only by the razor's edge of outcomes, never how, always how much. So they have to be clinical, dispassionate and opportunistic in delivering on assigned objectives. Low and stable inflation is a contract between central banks and the public, an article of faith without escape clauses. Reneging on this commitment never goes unpunished, as the recent experience in India has shown. After forty excruciating months, inflation has begun to reluctantly recede, but the beast is not beaten, far from it. We suspect it lurks, waiting to rear its ugly head, not just in India but across the world, overtly in emerging economies and subliminally in advanced economies in the slosh of abundant liquidity. Consequently, pre-emptive strikes to the unraveling of its dynamics are critical, no driver off the radar, no response off the table. This paper proposes an empirical framework to empower this monetary policy stance.

Our journey has yielded several lessons. First, overestimation of potential output growth has deleterious consequences. Misperceptions of supply capacities lead to emergence of demand pressures and inflation inevitably rises above conscionable levels. If the initial burst of inflation gets entrenched in expectations, the greater persistence in inflation will require prolonged monetary policy tightening which could produce lasting impairment to potential growth itself. To be fair, estimating potential growth is always difficult, and even more so in the aftershock of a global crisis. At the very least, however, there should be a preparedness to revise potential growth regularly and allow these revisions to inform the setting of monetary policy. Secondly, the large variance of inflation associated with a right skew is inflationary and persistent, a characteristic of inflation episodes in India right from the 1980s. A large portion of the components of inflation experience price movements significantly different from the headline or even core. Scrutinizing the cross-sectional distribution of inflation is, therefore, important for monetary policy. The IDEX constructed in this paper tracks well the broad-basing of price increases/decreases across the constituents of the price index.

Our results suggest that inflation persistence has increased in the post-global crisis period. Though the influence of past inflation and that of inheritance from the macroeconomic environment has been declining, both are still high. Shocks to inflation will require forceful, more than proportionate policy responses. Output stabilization has important inflation spillovers and

is a legitimate argument in the monetary policy reaction function. Extrinsic persistence works in the same direction as intrinsic persistence, amplifying it through rigidities in the economic structure that impede elastic supply responses and result in high output costs of bringing down inflation. The "surprise" in our estimations and, perhaps, a contribution to the understanding of recent inflation behavior in India, is the role of inflation expectations. Expectations have played a much larger role than before in inflation inertia in the post global crisis period. Did communication and action get decoupled, at least in the period of the incubation of inflation in 2009–10? In fact, only 10.5 to 12.3% of respondents polled in the RBI's household inflation expectations survey believed that the RBI's actions would lower inflation and this proportion was actually lower than in earlier rounds. Also, the high degree of interest rate smoothing in the policy reaction function could have been a source of persistence if agents viewed the "measured" policy responses as inadequate in relation to the magnitude of the increase in inflation.

What does this imply for the monetary policy framework? By itself, it does not suggest a radical change. The RBI explicitly states a numerical threshold of 5% as its inflation tolerance and 3% as its medium-term goal. Transparency instruments include quarterly publications of its inflation report titled "Monetary and Macroeconomic Developments", publication of the minutes of its purely advisory monetary policy committee without attribution, publication of inflation forecasts with fan charts (forecasts of GDP growth as well as the rates of money supply, deposit and credit growth are also provided), speeches by the Governor and Deputy Governors and their testimonies before the Parliamentary Committee on Finance. On the other hand, the fiscal authority is still viewed as profligate and fiscal dominance as large. Monetary policy transmission is fragmented and incomplete, the financial sector is weakening, and the quality of macroeconomic data leaves much to be desired.

The monetary policy regime in India is currently the subject of tectonic change and significant institutional reform is being contemplated that would bring India closer to an inflation targeting regimen than ever before. By all considerations, a flexible inflation targeting framework of constrained discretion appears to be the consensus choice. Inflation is a developmental objective; it is most unjust to the unindexed poor. To end this paper, we can do no better than to back the RBI's resolve in its annual monetary policy statement for the year 2013–14: "*the Reserve Bank will endeavour to condition the evolution of inflation to a level of 5.0 per cent by March 2014, using all instruments at its command.*"

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## Annexure

### *Annexure 1: List of Variables*

Ag_gap = Agricultural output gap measured as seasonally adjusted real agricultural GDP less trend obtained through HP filter.
ASYMX = Alternative measure of asymmetry for cutoff X percent.
CRR = Cash reserve ratio required to be maintained by banks.
DCHE = Month-on-month/quarter-on-quarter percentage change in manufacture chemicals component of WPI
DFOOD = Month-on-month/quarter-on-quarter percentage change in primary food component of WPI
DFUEL = Month-on-month/quarter-on-quarter percentage change in fuel component of WPI
DWPI = Month-on-month/quarter-on-quarter percentage change in aggregate WPI
DMAC = Month-on-month/quarter-on-quarter percentage change in manufactured machine component of WPI
DMANU = Month-on-month/quarter-on-quarter percentage change in manufacturing component of WPI
DMET = Month-on-month/quarter-on-quarter percentage change in manufactured metal component of WPI
DMFOOD = Month-on-month/quarter-on-quarter percentage change in manufactured food component of WPI
DNFOOD = Month-on-month/quarter-on-quarter percentage change in primary non-food component of WPI
DPRI = Month-on-month/quarter-on-quarter percentage change in primary component of WPI
DTEX = Month-on-month/quarter-on-quarter percentage change in manufactured textile component of WPI
Exrate = Year-on-year percentage change in Indian rupee and US Dollar exchange rate.
Ex_rain = Deviation of actual rainfall from long period average.
FED = Federal fund rate
FOODG= Year-on-year percentage change in primary non-food component of WPI.
GFD_gap = Gross fiscal deficit (GFD) of central government measured as seasonally adjusted GFD less trend obtained through HP filter.
I = Policy rate

$I^r$ = Real policy rate (policy rate minus year-on-year percentage change in aggregate WPI)

IDEX = Inflation Diffusion Index

INV_gap = investment gap measured as seasonally adjusted real investment less trend obtained through HP filter.

$M_3G$ = Year on-year percentage change in broad money.

NEERG = Year-on-year percentage change in nominal effective exchange rate.

NFCG = Year-on-year percentage change in non-food credit.

REERG = Year-on-year percentage change in real effective exchange rate.

RNFCG = Year-on-year percentage change in non-food credit minus year-on-year percentage change in WPI.

OECD_G = Real growth in OECD GDP

OGAP = output gap measured as seasonally adjusted real GDP less trend obtained through HP filter.

OILG = Year-on-year percentage change in crude oil prices.

SD = Standard Devation

SK = Skewness

SD* SK= Standard deviation of year on year inflation times skewness of year on year inflation.

WPIG = Year-on-year percentage change in WPI.

Xrate = Annualized quarter-on-quarter percentage change in Indian rupee and US Dollar exchange rate.

$\pi^e$_GAP = Year-on-year change in aggregate WPI minus implicit inflation target of 5.0 per cent.

*Annexure 2*

**TABLE 1. Key Macroeconomic Indicators**

| Year | *GDP growth (%)* | *M3 growth (%)* | *Reserve money growth (%)* | *Gross fiscal deficit-center (% to GDP)* | *Gross fiscal deficit – combined (% to GDP)* | *Current account deficit to GDP ratio (%)* | *Foreign investment to GDP ratio (%)* | *Global energy price growth (%) ** | *Global non-energy price growth (%) ** | *Global food prices growth (%) ** | *INR/USD* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980–81 | 7.2 | 18.1 | 17.4 | 5.7 | 7.4 | –1.5 | 0.0 | 20.6 | 10.4 | 17.4 | 7.9 |
| 1981–82 | 5.6 | 12.5 | 7.9 | 5.1 | 6.2 | –1.7 | 0.0 | –0.5 | –12.5 | –8.3 | 9.0 |
| 1982–83 | 2.9 | 16.6 | 10.1 | 5.6 | 5.8 | –1.7 | 0.0 | –6.3 | –15.8 | –21.7 | 9.7 |
| 1983–84 | 7.9 | 18.2 | 25.5 | 5.9 | 7.2 | –1.5 | 0.0 | –10.6 | 9.7 | 9.7 | 10.3 |
| 1984–85 | 4.0 | 19.0 | 21.5 | 7.0 | 8.8 | –1.2 | 0.0 | –4.7 | 2.2 | 3.6 | 11.9 |
| 1985–86 | 4.2 | 16.0 | 8.4 | 7.8 | 7.9 | –2.1 | 0.0 | –3.9 | –15.0 | –19.2 | 12.2 |
| 1986–87 | 4.3 | 18.6 | 17.4 | 8.4 | 9.8 | –1.9 | 0.1 | –41.3 | –5.7 | –14.5 | 12.8 |
| 1987–88 | 3.5 | 16.0 | 19.4 | 7.6 | 9.1 | –1.8 | 0.2 | 15.6 | 7.9 | 7.2 | 13.0 |
| 1988–89 | 10.2 | 17.8 | 17.7 | 7.3 | 8.5 | –2.7 | 0.1 | –14.0 | 24.5 | 29.6 | 14.5 |
| 1989–90 | 6.1 | 19.4 | 23.2 | 7.3 | 8.8 | –2.3 | 0.1 | 17.0 | –1.3 | 0.7 | 16.6 |
| 1990–91 | 5.3 | 15.1 | 13.1 | 7.8 | 9.4 | –3.0 | 0.0 | 24.9 | –6.3 | –7.8 | 17.9 |
| 1991–92 | 1.4 | 19.3 | 13.4 | 5.5 | 7.0 | –0.3 | 0.1 | –12.5 | –4.7 | –1.5 | 24.5 |
| 1992–93 | 5.4 | 14.8 | 11.3 | 5.3 | 7.0 | –1.7 | 0.2 | –2.4 | –1.9 | 0.3 | 30.6 |
| 1993–94 | 5.7 | 18.4 | 25.2 | 7.0 | 8.2 | –0.4 | 1.5 | –10.4 | –0.2 | 0.3 | 31.4 |
| 1994–95 | 6.4 | 22.4 | 22.1 | 5.7 | 7.1 | –1.0 | 1.5 | –5.2 | 14.7 | 9.4 | 31.4 |
| 1995–96 | 7.3 | 13.6 | 14.9 | 5.1 | 6.5 | –1.6 | 1.4 | 9.0 | 10.0 | 9.4 | 33.4 |
| 1996–97 | 8.0 | 16.2 | 2.8 | 4.8 | 6.3 | –1.2 | 1.6 | 16.7 | –2.1 | 7.4 | 35.5 |
| 1997–98 | 4.3 | 18.0 | 13.2 | 5.8 | 7.3 | –1.4 | 1.3 | –6.1 | –2.8 | –7.7 | 37.2 |
| 1998–99 | 6.7 | 19.4 | 14.5 | 6.5 | 9.0 | –1.0 | 0.6 | –28.7 | –13.5 | –8.4 | 42.1 |
| 1999–2000 | 7.6 | 14.6 | 8.2 | 5.4 | 9.5 | –1.0 | 1.2 | 28.0 | –11.7 | –18.6 | 43.3 |
| 2000–01 | 4.3 | 16.8 | 8.1 | 5.7 | 9.5 | –0.6 | 1.5 | 54.6 | 0.3 | –3.4 | 45.7 |

*(Table 1 Contd)*

*(Table 1 Contd)*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001–02 | 5.5 | 14.1 | 11.4 | 6.2 | 9.9 | 0.7 | 1.7 | –10.6 | –5.8 | 2.1 | 47.7 |
| 2002–03 | 4.0 | 14.7 | 9.2 | 5.9 | 9.6 | 1.2 | 1.2 | –1.8 | 5.3 | 6.8 | 48.4 |
| 2003–04 | 8.1 | 16.7 | 18.3 | 4.5 | 8.5 | 2.3 | 2.6 | 17.9 | 9.8 | 8.4 | 46.0 |
| 2004–05 | 7.0 | 12.0 | 12.1 | 3.9 | 7.2 | –0.4 | 2.2 | 31.2 | 16.5 | 12.6 | 44.9 |
| 2005–06 | 9.5 | 21.1 | 16.9 | 4.0 | 6.5 | –1.2 | 2.6 | 38.3 | 9.1 | –2.1 | 44.3 |
| 2006–07 | 9.6 | 21.7 | 23.9 | 3.3 | 5.4 | –1.0 | 3.1 | 17.6 | 25.1 | 10.8 | 45.3 |
| 2007–08 | 9.3 | 21.4 | 31.0 | 2.5 | 4.1 | –1.3 | 5.0 | 10.8 | 20.9 | 25.7 | 40.2 |
| 2008–09 | 6.7 | 19.3 | 6.4 | 6.0 | 8.5 | –2.3 | 2.3 | 40.0 | 20.3 | 33.9 | 45.9 |
| 2009–10 | 8.6 | 16.9 | 17.0 | 6.5 | 9.4 | –2.8 | 4.8 | –37.3 | –22.0 | –16.5 | 47.4 |
| 2010–11 | 9.3 | 16.1 | 19.1 | 4.9 | 8.1 | –2.7 | 3.4 | 26.5 | 22.5 | 8.9 | 45.6 |
| 2011–12 | 6.2 | 13.2 | 3.6 | 5.9 | 7.0 | –4.2 | 2.7 | 30.1 | 20.7 | 23.9 | 47.9 |
| 2012–13 | 5.0 | 13.3 | 6.2 | 5.1 | | | | –0.4 | –9.5 | 0.7 | 54.5 |

Source: Authors' estimates.

Note:* Growth over calendar years starting from 1980 onwards to 2012.

**TABLE 2. Mean Inflation Rates and Weighted Contribution to Overall Inflation**

| *Year* | *WPI* | *Food items* | *Non-food articles* | *Fuel group and minerals* | *Non-food manufacturing* |
|---|---|---|---|---|---|
| 1981–82 | 4.9 | 1.7 | 0.1 | 0.9 | 2.3 |
| 1982–83 | 7.6 | 3.6 | 1.1 | 0.5 | 2.4 |
| 1983–84 | 6.4 | 1.4 | 1.1 | 0.7 | 3.3 |
| 1984–85 | 4.5 | 0.6 | –0.3 | 1.2 | 3.0 |
| 1985–86 | 5.8 | 2.9 | 1.1 | 0.7 | 1.2 |
| 1986–87 | 8.2 | 2.6 | 2.2 | 0.2 | 3.2 |
| 1987–88 | 7.5 | 2.4 | –0.2 | 0.5 | 4.7 |
| 1988–89 | 7.4 | 1.4 | 0.4 | 0.5 | 5.1 |
| 1989–90 | 10.3 | 3.2 | 1.7 | 1.4 | 3.9 |
| 1990–91 | 13.7 | 5.2 | 1.9 | 1.5 | 5.1 |
| 1991–92 | 10.0 | 3.4 | 0.0 | 1.5 | 5.2 |
| 1992–93 | 8.3 | 2.0 | 0.9 | 2.0 | 3.4 |
| 1993–94 | 10.9 | 3.0 | 2.0 | 1.0 | 4.9 |
| 1994–95 | 12.6 | 3.6 | 1.5 | 1.3 | 6.2 |
| 1995–96 | 8.0 | 1.7 | 0.6 | 0.7 | 5.1 |
| 1996–97 | 4.6 | 2.6 | –0.1 | 1.4 | 0.6 |
| 1997–98 | 4.4 | 1.4 | 0.2 | 1.9 | 0.9 |
| 1998–99 | 5.9 | 3.4 | 0.7 | 0.5 | 1.4 |
| 1999–2000 | 3.3 | 0.8 | –0.4 | 1.4 | 1.5 |
| 2000–01 | 7.2 | 0.1 | 0.1 | 4.5 | 2.4 |
| 2001–02 | 3.6 | 0.5 | 0.3 | 1.7 | 1.1 |
| 2002–03 | 3.4 | 0.8 | 0.5 | 1.1 | 1.0 |
| 2003–04 | 5.5 | 1.2 | 0.8 | 1.3 | 2.3 |
| 2004–05 | 6.5 | 1.0 | 0.0 | 2.4 | 3.0 |
| 2005–06 | 4.4 | 0.9 | –0.1 | 2.2 | 1.5 |
| 2006–07 | 6.6 | 1.9 | 0.2 | 1.4 | 3.1 |
| 2007–08 | 4.7 | 1.4 | 0.5 | 0.2 | 2.7 |
| 2008–09 | 8.1 | 2.2 | 0.5 | 2.2 | 3.1 |
| 2009–10 | 3.8 | 3.6 | 0.2 | –0.1 | 0.1 |
| 2010–11 | 9.6 | 3.0 | 1.0 | 2.4 | 3.1 |
| 2011–12 | 8.9 | 2.0 | 0.5 | 2.9 | 3.6 |
| 2012–13 | 7.4 | 2.5 | 0.5 | 1.9 | 2.4 |

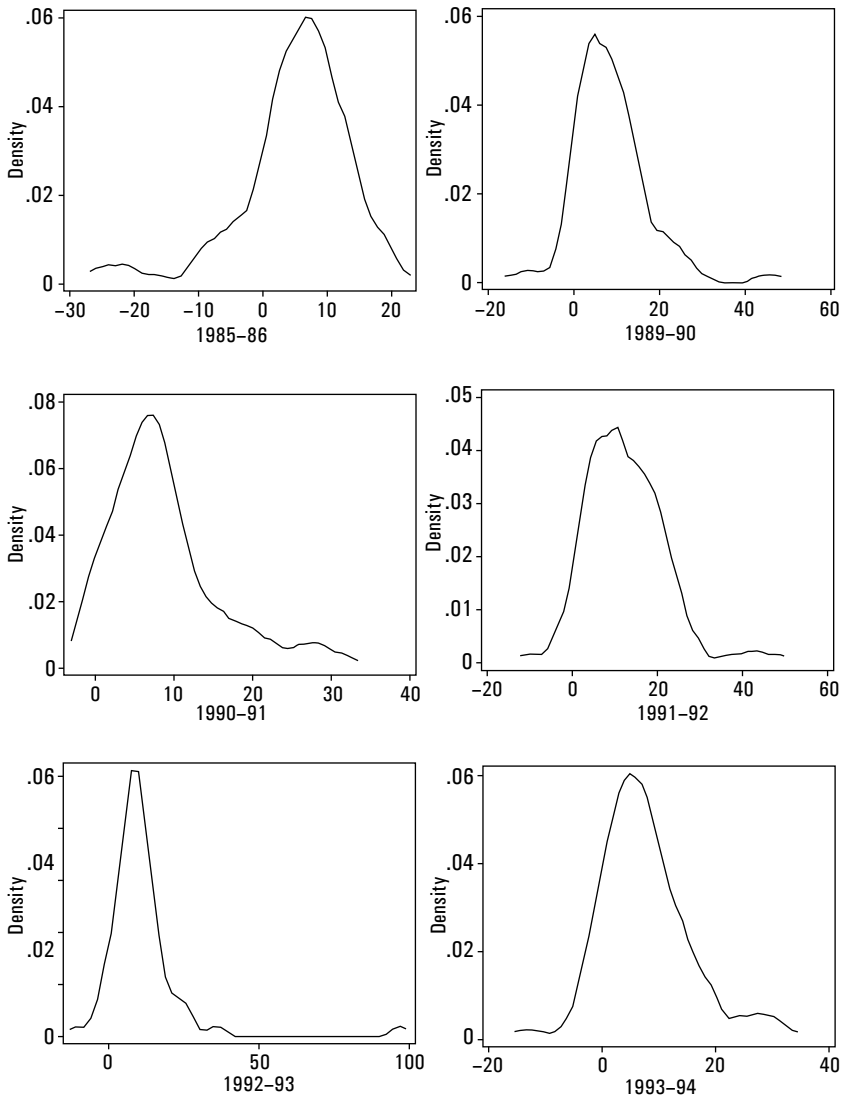
Source: Authors' estimates.

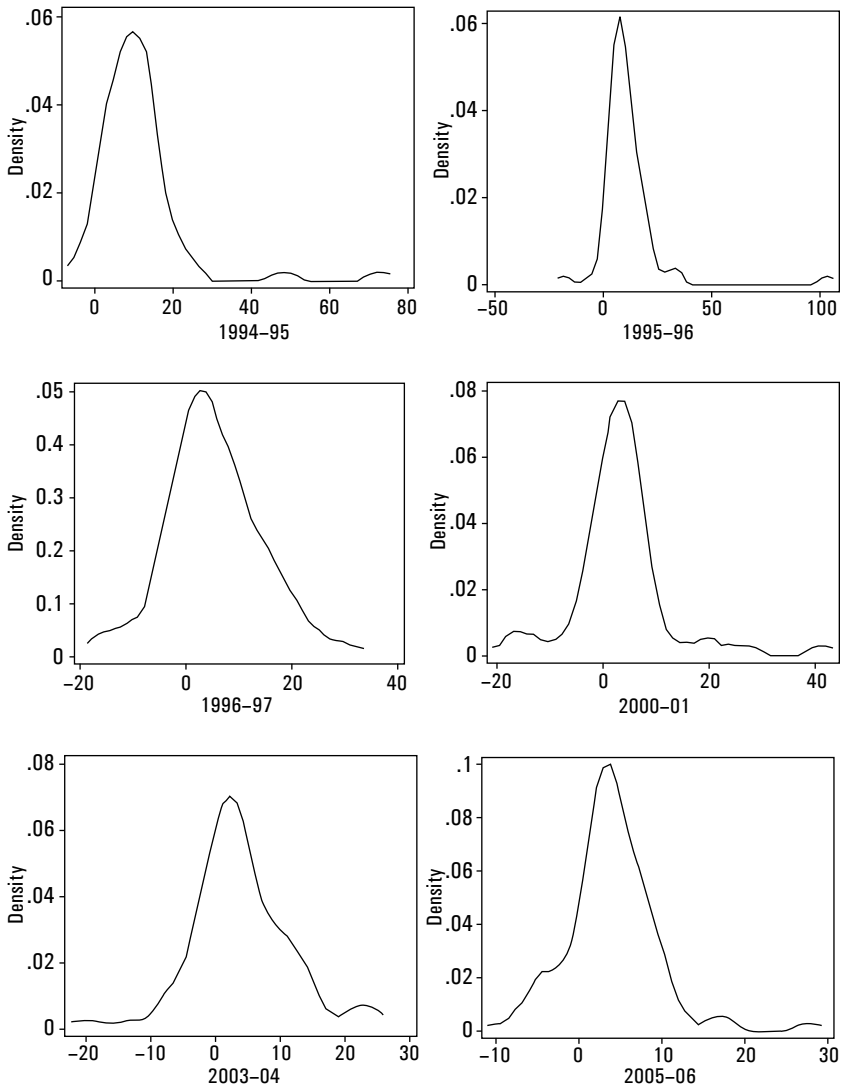
**TABLE 3. Moments of WPI Distribution**

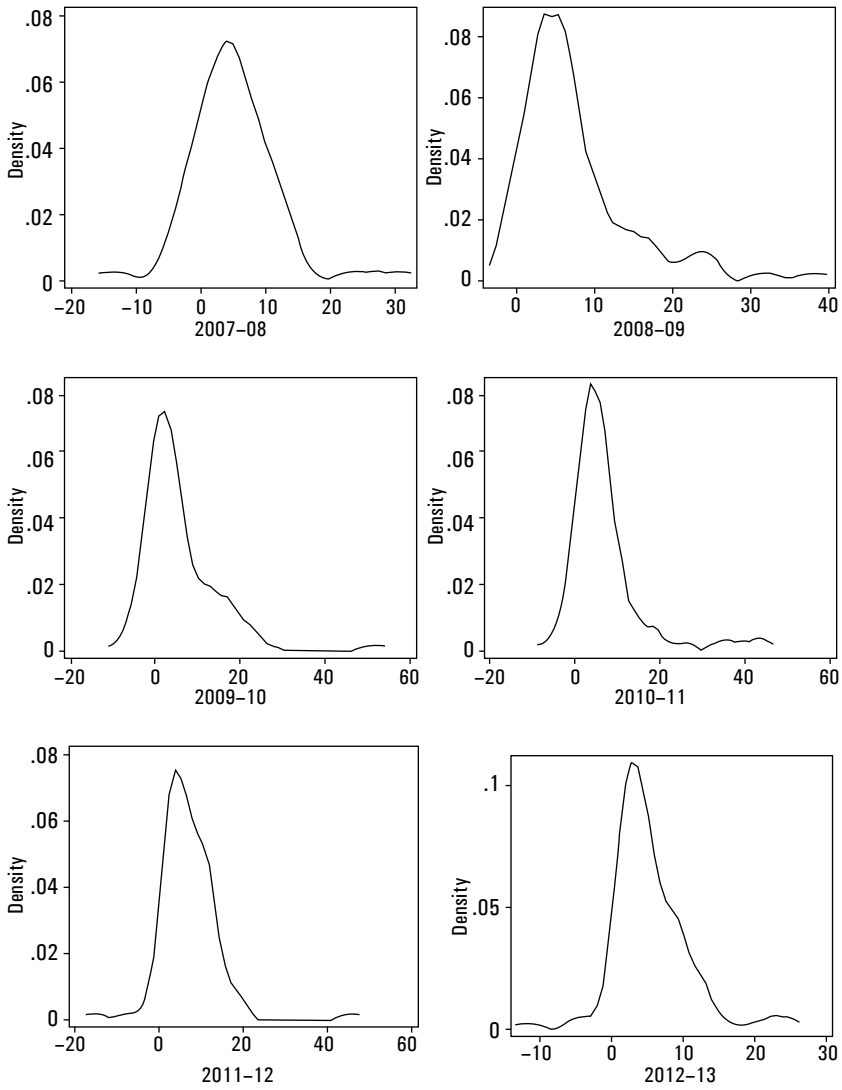
| *Year* | *Mean* | *Standard deviation* | *Skewness* | *Kurtosis* |
|---|---|---|---|---|
| 1983–84 | 7.5 | 7.1 | 1.3 | 6.8 |
| 1984–85 | 6.5 | 7.7 | 3.3 | 21.9 |
| 1985–86 | 4.4 | 8.7 | –0.9 | 3.9 |
| 1986–87 | 5.8 | 8.2 | 0.7 | 3.1 |
| 1987–88 | 8.1 | 8.7 | 1.6 | 6.0 |
| 1988–89 | 7.5 | 8.2 | –0.7 | 3.8 |
| 1989–90 | 7.5 | 8.0 | 0.7 | 1.2 |
| 1990–91 | 10.3 | 7.3 | 0.9 | 2.9 |
| 1991–92 | 13.7 | 8.2 | 0.8 | 2.3 |
| 1992–93 | 10.1 | 11.6 | 5.0 | 38.7 |
| 1993–94 | 8.4 | 8.2 | 1.1 | 4.2 |
| 1994–95 | 10.9 | 7.7 | 2.6 | 14.6 |
| 1995–96 | 8.0 | 6.5 | 1.4 | 16.2 |
| 1996–97 | 4.6 | 8.4 | –0.1 | 3.8 |
| 1997–98 | 4.4 | 7.7 | 0.8 | 5.7 |
| 1998–99 | 5.9 | 8.5 | 1.2 | 4.4 |
| 1999–2000 | 3.3 | 7.7 | 0.1 | 5.8 |
| 2000–01 | 7.2 | 11.4 | 1.6 | 6.5 |
| 2001–02 | 3.6 | 5.2 | 0.5 | 3.5 |
| 2002–03 | 3.4 | 7.6 | 1.8 | 10.2 |
| 2003–04 | 5.5 | 6.7 | 1.0 | 4.0 |
| 2004–05 | 6.5 | 11.7 | 8.4 | 114.8 |
| 2005–06 | 4.5 | 6.2 | 0.6 | 3.7 |
| 2006–07 | 6.6 | 5.8 | 2.5 | 14.4 |
| 2007–08 | 4.7 | 5.9 | –0.1 | 4.9 |
| 2008–09 | 8.1 | 6.2 | 1.1 | 5.4 |
| 2009–10 | 3.8 | 10.4 | 2.2 | 10.2 |
| 2010–11 | 9.6 | 8.3 | 1.6 | 6.6 |
| 2011–12 | 8.9 | 6.3 | 1.5 | 11.2 |
| 2012–13 | 7.4 | 4.9 | 0.4 | 5.4 |

Source: Authors' estimates.

**FIGURE 1. Kernel Density Function (KDF) of WPI Inflation**




Density
.06
.04
.02
0
0 20 40 60 80
1994–95
Density
.06
.04
.02
0
–50 0 50 100
1995–96
Density
.05
0.4
0.3
0.2
0.1
0
–20 0 20 40
1996–97
Density
.08
.06
.04
.02
0
–20 0 20 40
2000–01
Density
.08
.06
.04
.02
0
–20 –10 0 10 20 30
2003–04
Density
.1
.08
.06
.04
.02
0
–10 0 10 20 30
2005–06




Source: Authors' estimates.

**TABLE 4. Inflation Diffusion Index (IDEX) Values**

| *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* |
|---|---|---|---|---|---|---|---|---|
| May 1982 | 54.3 | | Jul 1986 | 67.5 | | Sep 1990 | 62.7 | |
| Jun 1982 | 59.6 | | Aug 1986 | 66.4 | | Oct 1990 | 74.5 | |
| Jul 1982 | 60.8 | | Sep 1986 | 75.1 | | Nov 1990 | 70.7 | |
| Aug 1982 | 65.6 | | Oct 1986 | 74.1 | | Dec 1990 | 71.2 | |
| Sep 1982 | 67.3 | | Nov 1986 | 67.5 | | Jan 1991 | 69.3 | |
| Oct 1982 | 62.4 | | Dec 1986 | 64.6 | | Feb 1991 | 65.4 | |
| Nov 1982 | 69.7 | | Jan 1987 | 61.8 | | Mar 1991 | 60.3 | |
| Dec 1982 | 67.0 | | Feb 1987 | 56.9 | | Apr 1991 | 59.1 | |
| Jan 1983 | 62.3 | | Mar 1987 | 49.6 | | May 1991 | 67.8 | |
| Feb 1983 | 65.3 | | Apr 1987 | 46.6 | | Jun 1991 | 70.1 | |
| Mar 1983 | 56.1 | | May 1987 | 62.1 | | Jul 1991 | 72.3 | |
| Apr 1983 | 58.5 | | Jun 1987 | 68.2 | | Aug 1991 | 72.2 | |
| May 1983 | 65.1 | | Jul 1987 | 69.2 | | Sep 1991 | 65.9 | |
| Jun 1983 | 62.1 | | Aug 1987 | 71.8 | | Oct 1991 | 61.3 | |
| Jul 1983 | 61.1 | | Sep 1987 | 71.2 | | Nov 1991 | 66.7 | |
| Aug 1983 | 71.1 | | Oct 1987 | 70.7 | | Dec 1991 | 68.5 | |
| Sep 1983 | 74.8 | | Nov 1987 | 70.8 | | Jan 1992 | 65.1 | |
| Oct 1983 | 69.3 | | Dec 1987 | 66.2 | | Feb 1992 | 65.2 | |
| Nov 1983 | 72.7 | | Jan 1988 | 61.9 | | Mar 1992 | 66.3 | |
| Dec 1983 | 73.1 | | Feb 1988 | 55.3 | | Apr 1992 | 58.9 | |
| Jan 1984 | 66.0 | | Mar 1988 | 54.5 | | May 1992 | 65.1 | |
| Feb 1984 | 61.9 | | Apr 1988 | 65.2 | | Jun 1992 | 59.2 | |
| Mar 1984 | 48.9 | | May 1988 | 59.5 | | Jul 1992 | 54.8 | |
| Apr 1984 | 48.8 | | Jun 1988 | 63.9 | | Aug 1992 | 53.7 | |
| May 1984 | 58.4 | | Jul 1988 | 67.0 | | Sep 1992 | 59.4 | |
| Jun 1984 | 69.4 | | Aug 1988 | 57.5 | | Oct 1992 | 61.4 | |

*(Table 4 Contd)*

*(Table 4 Contd)*

| *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* |
|---|---|---|---|---|---|---|---|---|
| Jul 1984 | 75.4 | | Sep 1988 | 67.8 | | Nov 1992 | 58.1 | |
| Aug 1984 | 68.3 | | Oct 1988 | 73.4 | | Dec 1992 | 60.4 | |
| Sep 1984 | 70.7 | | Nov 1988 | 62.5 | | Jan 1993 | 57.5 | |
| Oct 1984 | 74.6 | | Dec 1988 | 58.6 | | Feb 1993 | 59.5 | |
| Nov 1984 | 70.2 | | Jan 1989 | 61.9 | | Mar 1993 | 54.9 | |
| Dec 1984 | 65.7 | | Feb 1989 | 60.6 | | Apr 1993 | 55.8 | |
| Jan 1985 | 59.5 | | Mar 1989 | 59.4 | | May 1993 | 61.6 | 63.4 |
| Feb 1985 | 58.1 | | Apr 1989 | 62.5 | | Jun 1993 | 59.4 | 66.2 |
| Mar 1985 | 57.3 | | May 1989 | 68.0 | | Jul 1993 | 63.7 | 65.9 |
| Apr 1985 | 71.4 | | Jun 1989 | 63.2 | | Aug 1993 | 64.6 | 62.7 |
| May 1985 | 58.4 | | Jul 1989 | 67.4 | | Sep 1993 | 65.2 | 71.0 |
| Jun 1985 | 61.0 | | Aug 1989 | 65.7 | | Oct 1993 | 66.1 | 70.7 |
| Jul 1985 | 65.3 | | Sep 1989 | 71.2 | | Nov 1993 | 64.8 | 70.4 |
| Aug 1985 | 64.9 | | Oct 1989 | 64.2 | | Dec 1993 | 69.7 | 74.3 |
| Sep 1985 | 69.2 | | Nov 1989 | 58.9 | | Jan 1994 | 70.8 | 71.6 |
| Oct 1985 | 69.7 | | Dec 1989 | 64.0 | | Feb 1994 | 67.0 | 68.7 |
| Nov 1985 | 66.4 | | Jan 1990 | 55.7 | | Mar 1994 | 56.6 | 51.4 |
| Dec 1985 | 66.5 | | Feb 1990 | 57.4 | | Apr 1994 | 65.4 | 64.5 |
| Jan 1986 | 51.4 | | Mar 1990 | 61.2 | | May 1994 | 66.9 | 59.5 |
| Feb 1986 | 58.2 | | Apr 1990 | 65.7 | | Jun 1994 | 59.2 | 56.6 |
| Mar 1986 | 55.0 | | May 1990 | 67.5 | | Jul 1994 | 64.1 | 66.3 |
| Apr 1986 | 48.9 | | Jun 1990 | 66.7 | | Aug 1994 | 59.0 | 54.5 |
| May 1986 | 55.7 | | Jul 1990 | 66.0 | | Sep 1994 | 63.0 | 62.7 |
| Jun 1986 | 63.3 | | Aug 1990 | 53.2 | | Oct 1994 | 65.4 | 67.5 |
| Nov 1994 | 63.8 | 67.1 | Mar 1999 | 57.8 | 64.2 | Jul 2003 | 62.9 | 61.2 |
| Dec 1994 | 61.9 | 69.3 | Apr 1999 | 54.7 | 58.0 | Aug 2003 | 61.6 | 59.8 |
| Jan 1995 | 62.4 | 61.2 | May 1999 | 56.8 | 61.6 | Sep 2003 | 61.3 | 63.3 |
| Feb 1995 | 60.3 | 55.0 | Jun 1999 | 54.8 | 59.6 | Oct 2003 | 56.3 | 51.4 |

*(Table 4 Contd)*

*(Table 4 Contd)*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mar 1995 | 59.6 | 54.0 | Jul 1999 | 56.2 | 59.8 | Nov 2003 | 60.3 | 62.3 |
| Apr 1995 | 62.2 | 55.7 | Aug 1999 | 52.9 | 55.1 | Dec 2003 | 61.6 | 62.3 |
| May 1995 | 62.1 | 57.3 | Sep 1999 | 54.6 | 60.5 | Jan 2004 | 57.4 | 56.8 |
| Jun 1995 | 59.5 | 63.7 | Oct 1999 | 57.3 | 54.0 | Feb 2004 | 55.0 | 55.8 |
| Jul 1995 | 57.4 | 65.8 | Nov 1999 | 60.0 | 55.9 | Mar 2004 | 52.6 | 56.3 |
| Aug 1995 | 60.4 | 67.5 | Dec 1999 | 65.1 | 60.5 | Apr 2004 | 55.8 | 56.8 |
| Sep 1995 | 60.0 | 62.1 | Jan 2000 | 57.4 | 55.8 | May 2004 | 57.8 | 65.4 |
| Oct 1995 | 60.8 | 61.0 | Feb 2000 | 50.6 | 47.0 | Jun 2004 | 61.5 | 61.5 |
| Nov 1995 | 54.5 | 58.0 | Mar 2000 | 57.7 | 58.7 | Jul 2004 | 66.1 | 59.6 |
| Dec 1995 | 60.6 | 70.0 | Apr 2000 | 50.5 | 50.5 | Aug 2004 | 71.6 | 74.3 |
| Jan 1996 | 59.7 | 58.1 | May 2000 | 51.5 | 52.3 | Sep 2004 | 69.7 | 66.8 |
| Feb 1996 | 58.6 | 64.0 | Jun 2000 | 49.9 | 45.6 | Oct 2004 | 70.7 | 60.4 |
| Mar 1996 | 55.7 | 59.0 | Jul 2000 | 49.0 | 51.1 | Nov 2004 | 67.7 | 65.9 |
| Apr 1996 | 58.7 | 66.5 | Aug 2000 | 50.7 | 49.4 | Dec 2004 | 63.3 | 65.1 |
| May 1996 | 55.5 | 53.6 | Sep 2000 | 50.0 | 53.9 | Jan 2005 | 58.1 | 58.4 |
| Jun 1996 | 49.1 | 53.1 | Oct 2000 | 57.0 | 61.4 | Feb 2005 | 61.5 | 60.4 |
| Jul 1996 | 49.7 | 49.9 | Nov 2000 | 54.2 | 57.9 | Mar 2005 | 56.9 | 63.8 |
| Aug 1996 | 51.6 | 54.9 | Dec 2000 | 55.7 | 57.3 | Apr 2005 | 58.0 | 60.1 |
| Sep 1996 | 50.9 | 56.9 | Jan 2001 | 52.3 | 49.0 | May 2005 | 57.4 | 56.7 |
| Oct 1996 | 52.4 | 55.6 | Feb 2001 | 51.1 | 44.4 | Jun 2005 | 60.9 | 60.1 |
| Nov 1996 | 55.6 | 57.9 | Mar 2001 | 50.1 | 57.0 | Jul 2005 | 62.8 | 66.5 |
| Dec 1996 | 57.8 | 66.7 | Apr 2001 | 51.5 | 52.2 | Aug 2005 | 64.0 | 54.4 |
| Jan 1997 | 54.6 | 61.5 | May 2001 | 53.3 | 58.9 | Sep 2005 | 66.9 | 63.4 |
| Feb 1997 | 54.5 | 51.7 | Jun 2001 | 54.9 | 54.3 | Oct 2005 | 71.0 | 61.0 |
| Mar 1997 | 57.1 | 56.3 | Jul 2001 | 55.6 | 57.4 | Nov 2005 | 69.5 | 65.8 |
| Apr 1997 | 59.2 | 61.0 | Aug 2001 | 58.7 | 57.2 | Dec 2005 | 61.7 | 61.9 |
| May 1997 | 58.0 | 58.4 | Sep 2001 | 59.5 | 63.4 | Jan 2006 | 65.1 | 64.4 |
| Jun 1997 | 58.0 | 65.2 | Oct 2001 | 52.5 | 51.6 | Feb 2006 | 67.2 | 68.2 |
| Jul 1997 | 58.6 | 64.6 | Nov 2001 | 60.6 | 62.0 | Mar 2006 | 57.2 | 60.0 |

*(Table 4 Contd)*

*(Table 4 Contd)*

| *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* |
|---|---|---|---|---|---|---|---|---|
| Aug 1997 | 57.0 | 52.5 | Dec 2001 | 61.1 | 64.6 | Apr 2006 | 65.2 | 67.5 |
| Sep 1997 | 53.7 | 56.4 | Jan 2002 | 59.7 | 64.5 | May 2006 | 67.5 | 71.0 |
| Oct 1997 | 55.9 | 56.2 | Feb 2002 | 61.2 | 61.9 | Jun 2006 | 69.9 | 75.6 |
| Nov 1997 | 53.2 | 60.1 | Mar 2002 | 55.4 | 52.1 | Jul 2006 | 67.5 | 60.2 |
| Dec 1997 | 55.6 | 63.9 | Apr 2002 | 53.2 | 52.4 | Aug 2006 | 73.0 | 69.1 |
| Jan 1998 | 53.9 | 61.4 | May 2002 | 56.8 | 56.2 | Sep 2006 | 76.2 | 76.4 |
| Feb 1998 | 53.1 | 53.5 | Jun 2002 | 51.8 | 55.7 | Oct 2006 | 69.7 | 67.6 |
| Mar 1998 | 53.7 | 49.3 | Jul 2002 | 48.7 | 50.1 | Nov 2006 | 66.3 | 63.6 |
| Apr 1998 | 50.0 | 41.7 | Aug 2002 | 50.8 | 51.0 | Dec 2006 | 67.5 | 59.1 |
| May 1998 | 54.9 | 60.2 | Sep 2002 | 59.3 | 66.6 | Jan 2007 | 61.5 | 61.3 |
| Jun 1998 | 53.1 | 56.7 | Oct 2002 | 61.3 | 63.5 | Feb 2007 | 62.8 | 62.6 |
| Jul 1998 | 49.1 | 53.0 | Nov 2002 | 62.7 | 64.9 | Mar 2007 | 59.5 | 56.5 |
| Aug 1998 | 57.2 | 64.8 | Dec 2002 | 63.0 | 71.6 | Apr 2007 | 59.2 | 59.3 |
| Sep 1998 | 54.7 | 62.6 | Jan 2003 | 65.4 | 72.9 | May 2007 | 55.4 | 54.8 |
| Oct 1998 | 57.6 | 61.1 | Feb 2003 | 59.4 | 68.8 | Jun 2007 | 60.8 | 54.4 |
| Nov 1998 | 54.6 | 57.3 | Mar 2003 | 54.6 | 51.6 | Jul 2007 | 63.9 | 60.0 |
| Dec 1998 | 58.8 | 55.9 | Apr 2003 | 54.7 | 49.0 | Aug 2007 | 68.3 | 60.8 |
| Jan 1999 | 57.2 | 55.6 | May 2003 | 53.7 | 56.3 | Sep 2007 | 65.2 | 63.4 |
| Feb 1999 | 57.6 | 55.7 | Jun 2003 | 57.8 | 67.1 | Oct 2007 | 70.2 | 72.5 |
| Nov 2007 | 67.5 | 72.1 | Mar 2012 | 60.7 | 67.1 | | | |
| Dec 2007 | 68.7 | 73.1 | Apr 2012 | 59.3 | 66.8 | | | |
| Jan 2008 | 62.1 | 67.5 | May 2012 | 60.7 | 59.8 | | | |
| Feb 2008 | 64.9 | 74.5 | Jun 2012 | 68.9 | 69.4 | | | |
| Mar 2008 | 62.7 | 69.8 | Jul 2012 | 71.0 | 66.9 | | | |
| Apr 2008 | 51.8 | 63.6 | Aug 2012 | 69.4 | 68.4 | | | |
| May 2008 | 62.7 | 61.7 | Sep 2012 | 67.8 | 71.0 | | | |
| Jun 2008 | 72.5 | 77.6 | Oct 2012 | 66.5 | 67.8 | | | |

*(Table 4 Contd)*

*(Table 4 Contd)*

| | | | | | |
|---|---|---|---|---|---|
| Jul 2008 | 73.9 | 69.6 | Nov 2012 | 65.4 | 66.5 |
| Aug 2008 | 66.9 | 66.2 | Dec 2012 | 62.2 | 62.7 |
| Sep 2008 | 66.8 | 59.7 | Jan 2013 | 51.3 | 55.6 |
| Oct 2008 | 60.9 | 61.4 | Feb 2013 | 53.3 | 57.7 |
| Nov 2008 | 51.9 | 52.0 | Mar 2013 | 45.5 | 46.1 |
| Dec 2008 | 43.8 | 44.9 | | | |
| Jan 2009 | 51.2 | 50.8 | | | |
| Feb 2009 | 47.5 | 45.1 | | | |
| Mar 2009 | 45.3 | 51.0 | | | |
| Apr 2009 | 44.6 | 46.2 | | | |
| May 2009 | 58.8 | 63.7 | | | |
| Jun 2009 | 57.4 | 55.0 | | | |
| Jul 2009 | 61.6 | 61.9 | | | |
| Aug 2009 | 65.8 | 69.4 | | | |
| Sep 2009 | 66.6 | 69.7 | | | |
| Oct 2009 | 65.0 | 71.6 | | | |
| Nov 2009 | 67.3 | 80.0 | | | |
| Dec 2009 | 66.3 | 74.6 | | | |
| Jan 2010 | 56.3 | 66.9 | | | |
| Feb 2010 | 56.1 | 59.0 | | | |
| Mar 2010 | 57.3 | 55.5 | | | |
| Apr 2010 | 55.8 | 61.4 | | | |
| May 2010 | 54.1 | 60.5 | | | |
| Jun 2010 | 58.1 | 55.9 | | | |
| Jul 2010 | 59.2 | 60.2 | | | |
| Aug 2010 | 63.1 | 65.6 | | | |
| Sep 2010 | 64.6 | 64.2 | | | |
| Oct 2010 | 69.5 | 76.0 | | | |
| Nov 2010 | 67.2 | 74.9 | | | |

*(Table 4 Contd)*

*(Table 4 Contd)*

| *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* | *Month* | *Non-weighted* | *Weighted* |
|---|---|---|---|---|---|---|---|---|
| Dec 2010 | 69.4 | 75.7 | | | | | | |
| Jan 2011 | 66.5 | 71.2 | | | | | | |
| Feb 2011 | 68.4 | 74.2 | | | | | | |
| Mar 2011 | 62.1 | 61.4 | | | | | | |
| Apr 2011 | 55.5 | 56.0 | | | | | | |
| May 2011 | 60.9 | 63.8 | | | | | | |
| Jun 2011 | 63.9 | 64.4 | | | | | | |
| Jul 2011 | 63.0 | 66.3 | | | | | | |
| Aug 2011 | 63.7 | 64.1 | | | | | | |
| Sep 2011 | 69.2 | 72.9 | | | | | | |
| Oct 2011 | 70.7 | 76.9 | | | | | | |
| Nov 2011 | 64.7 | 71.7 | | | | | | |
| Dec 2011 | 63.1 | 68.0 | | | | | | |
| Jan 2012 | 55.2 | 62.4 | | | | | | |
| Feb 2012 | 54.4 | 62.7 | | | | | | |

Source: Authors' estimates.

**TABLE 5. Comparison between CPIs and WPI**

| | *CPI-IW* | *CPI-combined* | *WPI* |
|---|---|---|---|
| *Base year* | *2001* | *2010* | *2004–05* |
| Population | Industrial Workers (78 Centers) | Rural villages (1,188 villages) + Urban Towns (310 towns, 1,114 quotations) in 35 States/UTs | Urban Towns (5,482 quotations) |
| *Coverage—Commodity Group Weights (%)* | | | |
| (i) Food Beverage and Tobacco | 48.39 | 49.71 | 24.31 |
| (ii) Fuel and Light | 6.42 | 9.49 | 14.93^ |
| (iii) Housing | 15.29 | 9.77 | - |
| (iv) Clothing, Bedding and Footwear | 6.58 | 4.73 | 60.78# |
| (v) Miscellaneous * | 23.32 | 26.31 | |
| Total ( i to v) | 100 | 100 | 100 |
| Basis for Weighting Diagram | Consumption pattern at selected centers during 1999–2000 | 61st round Consumer Expenditure Survey (2004–05)—NSSO | National Accounts Statistics (NAS), 2007 |

Sources: Central Statistics Office, Ministry of Statistics and Programme Implementation, Labour Bureau, Government of India; Office of the Economic Adviser to the Government of India, Ministry of Commerce and Industry and Authors' Estimates.

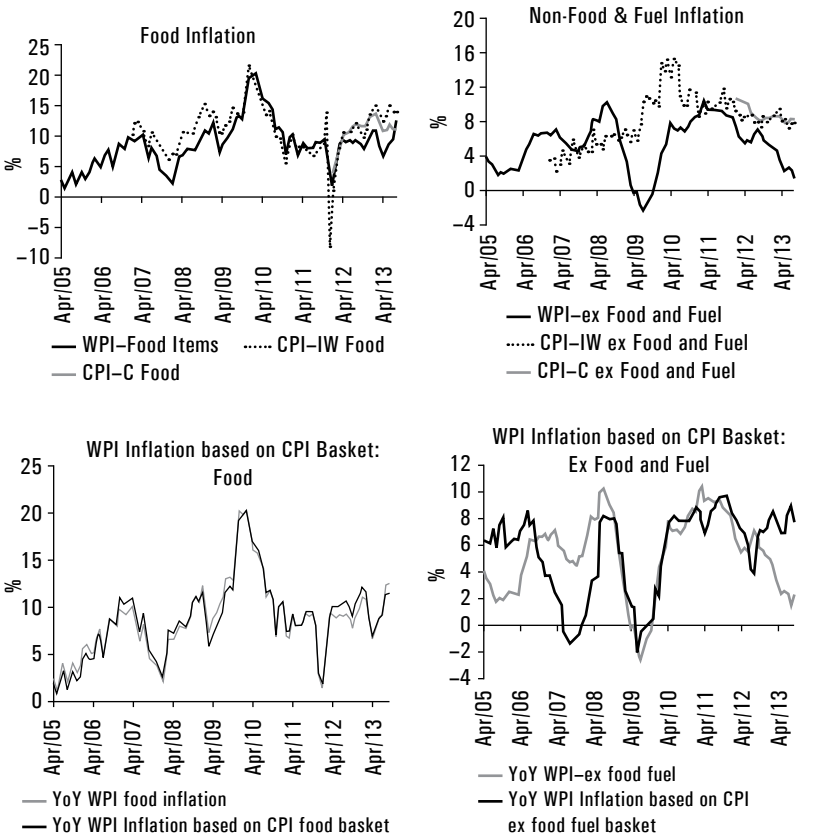
Notes: @ In CPIs the commodity groups are largely based on the Classification of Individual Consumption according to Purpose (CICOP) criterion. The commodity basket in CPIs is grouped into (i) to (v) indicated in the table above. In WPI, the concept of wholesale price used for construction of the index comprises, as far as possible, all transactions at first point of bulk sale in the domestic market. The commodity basket is classified based on National Industrial Classification (NIC) which is comparable to International Standard Industrial Classification (ISIC) and the basket is grouped into Primary Articles (20.1%), Fuel and Power (14.9%) and Manufactured Products (65.0%).

* Miscellaneous group in CPIs consists primarily of price indices of medical-care, education, recreation and amusement, transport and communication, personal care items and household requisites among others.

^ Includes prices of domestic and industrial electricity, domestic and industrial fuel consumption.

# In WPI classification non-food non-fuel items mainly includes WPI non-food manufactured products group (weight of 55% of the WPI basket). This group consists of a mix of consumer durables and non-durables as well as industrial basic, intermediate and capital goods. It also includes two sub-groups from primary article group, i.e., non-food primary articles (4.3% weight) and minerals (1.5% weight).

**FIGURE 2. Inflation across Food and Non-Food Fuel Groups based on WPI and CPI**




Sources: Central Statistics Office, Ministry of Statistics and Programme Implementation, Labour Bureau, Government of India; Office of the Economic Adviser to the Government of India, Ministry of Commerce and Industry and Authors' Estimates.

*Annexure 3*

**TABLE 6. Break Estimates in Mean of Inflation—Monthly**

| | | | | *Lag length* | |
|---|---|---|---|---|---|
| *Variable* | | *Andrew–Quandt* | *Bai–Perron* | *SBC* | *AIC* |
| All Commodities | | 1995:5 | 1995:5 | 1 | 3 |
| I. | Primary | No Break | No Break | 1 | 3 |
| | Food | No Break | No Break | 2 | 2 |
| | Non-food | No Break | No Break | 1 | 1 |
| II. | Fuel | No Break | No Break | 1 | 1 |
| III. | Manufacturing | 1995:7 | 1995:7 | 3 | 6 |
| | Food | No Break | No Break | 1 | 1 |
| | Textile | 1995:6 | 1995:6 | 3 | 3 |
| | Chemicals | 1995:7 | 1995:7 | 1 | 3 |
| | Metals | No Break | No Break | 3 | 3 |
| | Machinery | 1992:10 | 1992:10 | 3 | 3 |

Source: Authors' estimates.

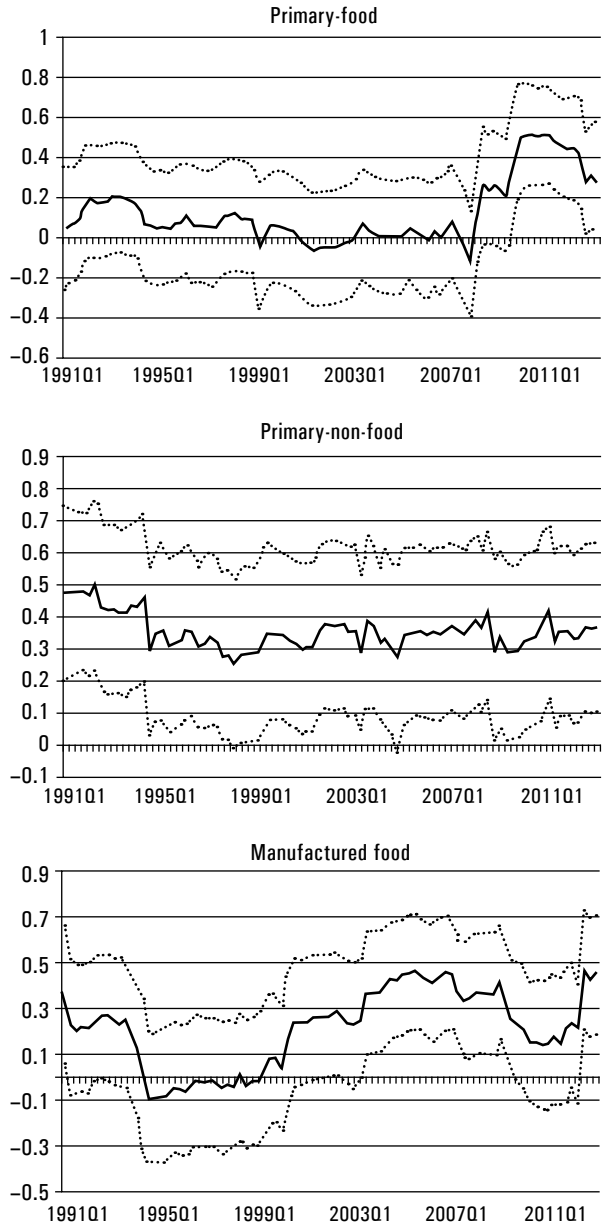
**TABLE 7. Estimates of Persistence during Sub-Samples—Monthly (1982:4 to 2013:3)**

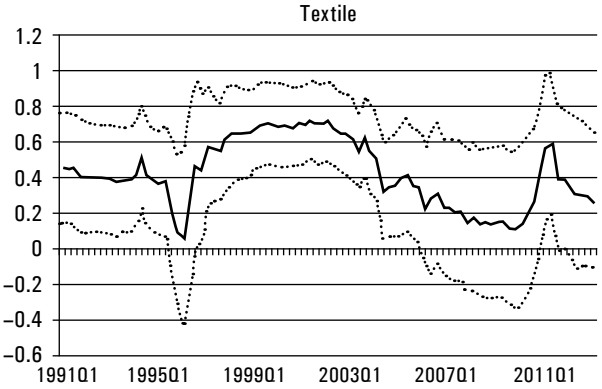
| | | *First sample* | *Second sample* | *Full sample* | |
|---|---|---|---|---|---|
| *Variable* | | *(Pre-break)* | *(Post-break)* | *No break* | *With break* |
| All Commodities | | 0.198** | 0.339* | 0.302* | 0.269* |
| I. | Primary | – | – | 0.187* | – |
| | Food | – | – | 0.006 | – |
| | Non-food | – | – | 0.298* | – |
| II. | Fuel | – | – | 0.194* | – |
| III. | Manufacturing | 0.318* | 0.548* | 0.565* | 0.423 |
| | Food | – | – | 0.112** | – |
| | Textile | 0.496* | 0.548* | 0.582* | 0.523 |
| | Chemicals | 0.230* | 0.246* | 0.260* | 0.236 |
| | Metal | – | – | 0.510* | – |
| | Machinery | 0.448* | 0.390* | 0.542* | 0.418 |

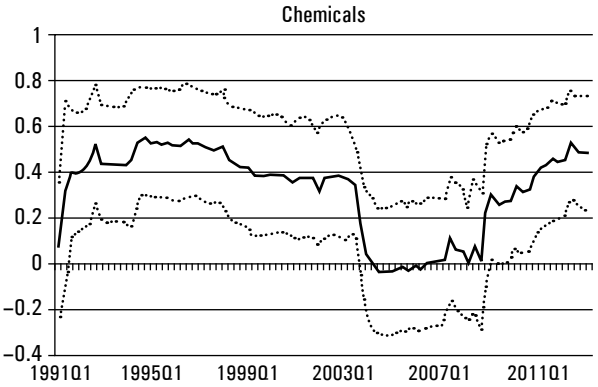
Source: Authors' estimates.

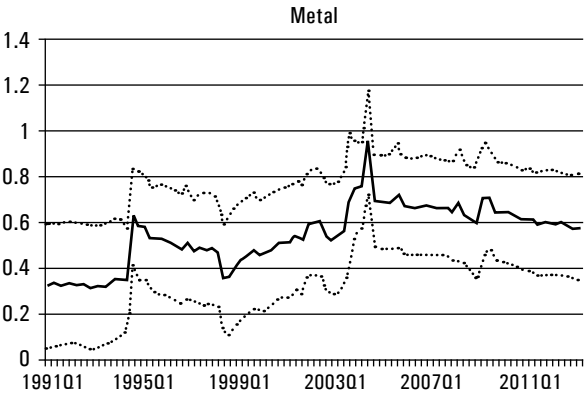
Note: * and ** denote significance at 1% and 5% level, respectively.

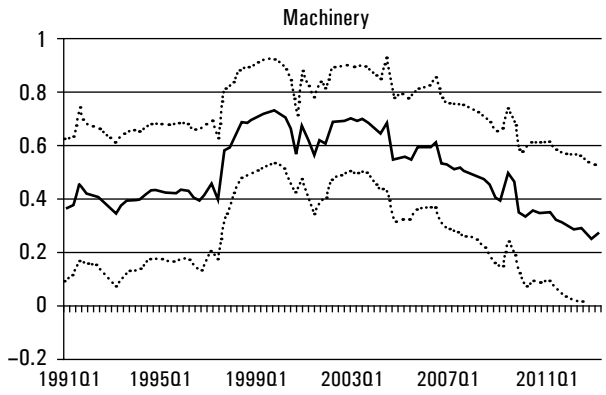
**FIGURE 3. Rolling Regressions of Sub-Components of WPI—Quarterly**




Textile
1.2
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
1991Q1
1995Q1
1999Q1
2003Q1
2007Q1
2011Q1

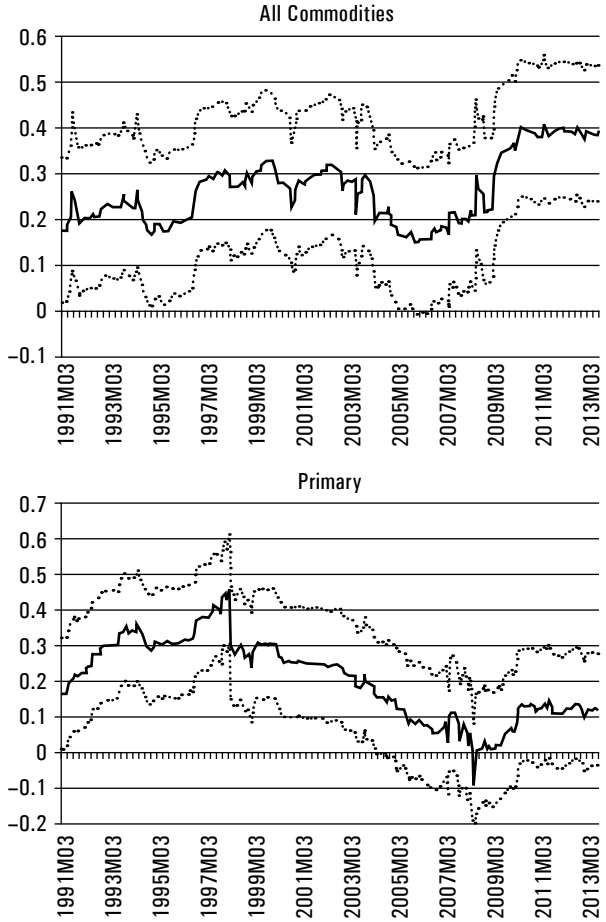

Chemicals
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
1991Q1
1995Q1
1999Q1
2003Q1
2007Q1
2011Q1

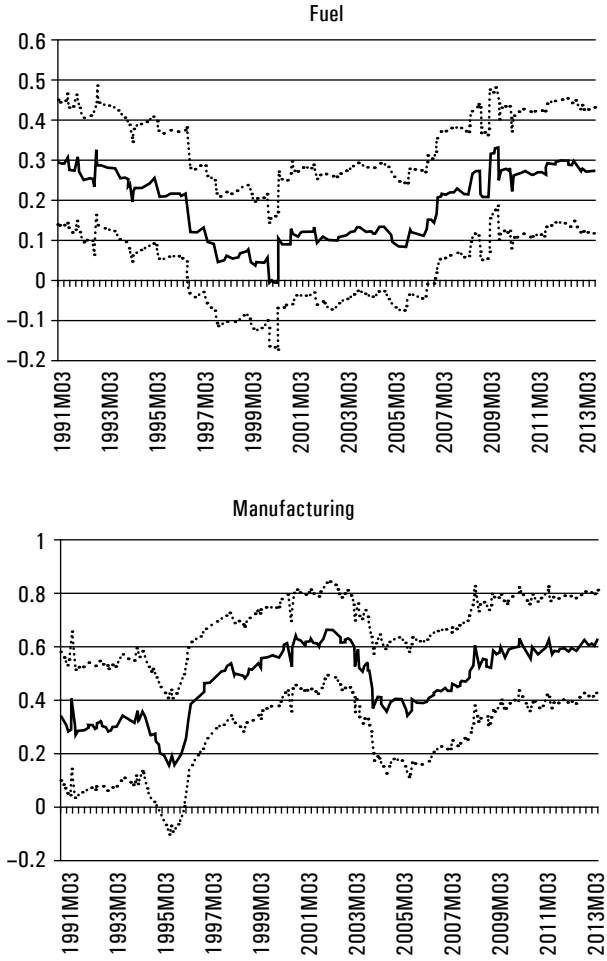

Metal
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1991Q1
1995Q1
1999Q1
2003Q1
2007Q1
2011Q1




Source: Authors' estimates.

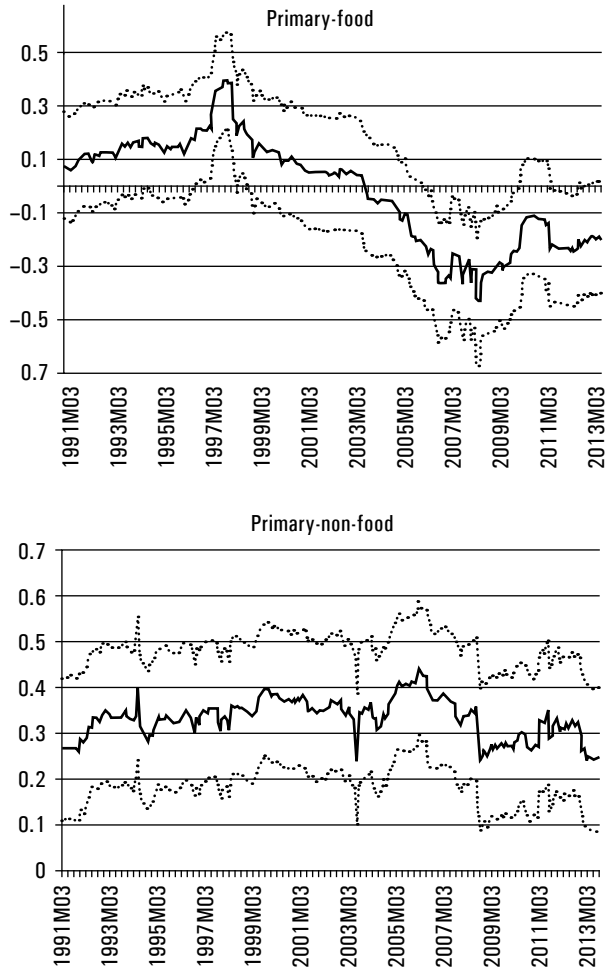
**FIGURE 4. Rolling Regressions of Major Components—Monthly**

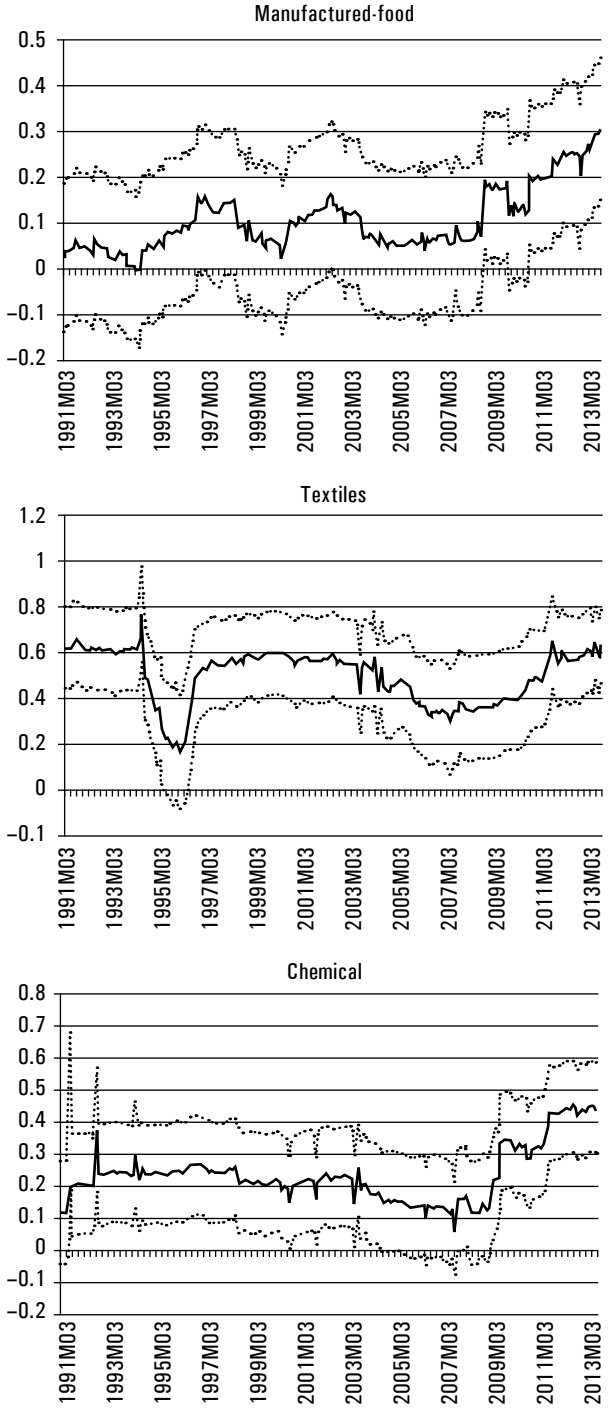


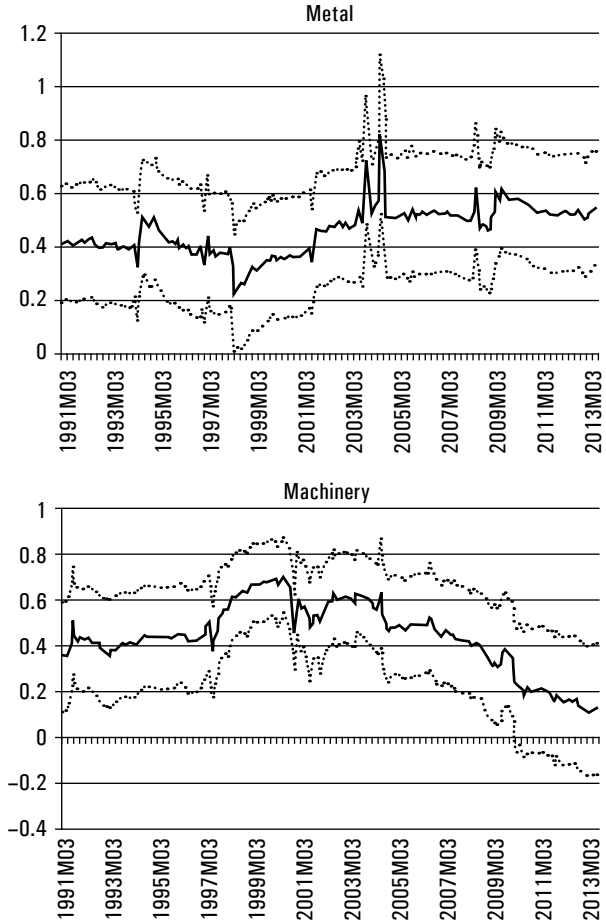



Source: Authors' estimates.

**FIGURE 5. Rolling Regressions of Sub-Components—Monthly**




Manufactured-food
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
1991M03
1993M03
1995M03
1997M03
1999M03
2001M03
2003M03
2005M03
2007M03
2009M03
2011M03
2013M03
Textiles
1.2
1
0.8
0.6
0.4
0.2
0
−0.1
1991M03
1993M03
1995M03
1997M03
1999M03
2001M03
2003M03
2005M03
2007M03
2009M03
2011M03
2013M03
Chemical
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
1991M03
1993M03
1995M03
1997M03
1999M03
2001M03
2003M03
2005M03
2007M03
2009M03
2011M03
2013M03




Source: Authors' estimates.

*Annexure 4*

**TABLE 8. Inflation Targeting Countries—A Snapshot**

| *Country* | *Inflation targeting adoption date* | *Target set by* | *Current target (%)* | *Target type* | *Number on policy making committee* | *Meetings per year* | *Decision making process* | *Parliamentary hearings (per year)* | *Open letter* | *Frequency of inflation report (year)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Armenia | 2006 | G,CB | 4±1.5 | P+T | 7 | 12 | V | 1 | No | 4 |
| Australia | 1993 | G,CB | 2–3 | Range | 9 | 11 | C | 2 | No | 4 |
| Brazil | 1999 | G,CB | 4.5±2 | P+T | 8 | 8 | V | 6 | Yes | 4 |
| Canada | 1991 | G,CB | 2* | P+T | 6 | 8 | C | 2 | No | 4 |
| Chile | 1999 | CB | 3±1 | P+T | 5 | 12 | V | 4 | No | 4 |
| Colombia | 1999 | CB | 2–4 | Range | 7 | 12 | V | 2 | No | 4 |
| Czech Republic | 1997 | CB | 2±1 | P+T | 7 | 8 | V | Nil | No | 4 |
| Ghana | 2007 | G,CB | 8.7±2 | P+T | 7 | 6 | C | Nil | No | 4 to 6 |
| Guatemala | 2005 | CB | 4.5±1 | P+T | 8 | 8 | V | 2 | No | 3 |
| Hungary | 2001 | CB | 3.0 | Point | 7 | 12 | V | 1 | No | 4 |
| Iceland | 2001 | G,CB | 2.5 | Point | 5 | 8 | CV | 2 | Yes | 4# |
| Indonesia | 2005 | G,CB | 4.5±1 | P+T | 7 | 12 | C | Nil | No | 4 |
| Israel | 1997 | G,CB | 1–3 | Range | 6 | 12 | V | 2 | No | 2 |
| Mexico | 2001 | CB | 3±1 | P+T | 5 | 8 | C | Y | No | 4 |
| New Zealand | 1990 | G,CB | 1–3 | Range | G | 8 | Gov | 4 | Other | 4 |
| Norway | 2001 | G | 2.5 | Point | 7 | 6 | C | Y | No | 3 |
| Peru | 2002 | CB | 2±1 | P+T | 7 | 12 | V | 1 | No | 4 |
| Philippines | 2002 | G,CB | 4.0±1 | P+T | 7 | 8 | V | Nil | Yes | 4 |
| Poland | 1998 | CB | 2.5±1 | P+T | 10 | 12 | V | Nil | No | 4 |

*(Table 8 Contd)*

*(Table 8 Contd)*

| *Country* | *Inflation targeting adoption date* | *Target set by* | *Current target (%)* | *Target type* | *Number on policy making committee* | *Meetings per year* | *Decision making process* | *Parliamentary hearings (per year)* | *Open letter* | *Frequency of inflation report (year)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Romania | 2005 | G,CB | 3±1 | P+T | 9 | 8 | V | Nil | No | 4 |
| Serbia | 2006 | G,CB | 4.0±1.5 | P+T | 5 | 12 | V | Nil | Yes | 4 |
| South Africa | 2000 | G | 3–6 | Range | 7 | 6 | C | 3 | No | 2 |
| South Korea | 2001 | CB , G | 3±1 | P+T | 7 | 12 | V | Y | No | 2 |
| Sweden | 1993 | CB | 2.0 | Point | 6 | 6 | V | 2 | No | 6^ |
| Thailand | 2000 | G,CB | 3.0±1.5 | P+T | 7 | 8 | V | Nil | Yes | 4 |
| Turkey | 2006 | G,CB | 5.0±2 | P+T | 7 | 12 | V | 2 | Yes | 4 |
| United Kingdom | 1992 | G | 2.0 | Point | 9 | 12 | V | 3 | Yes | 4 |

Source: Official central bank websites and "State of the Art of Inflation Targeting" by Gill Hammond, 2011, Centre for Central Banking Studies Handbook, No. 29, Bank of England.

Notes: C: Consensus, V: Vote, Gov: Governor, G: government, CB: Central Bank, Y: Yes.

P+T: point with tolerance band.

* mid-point of 1–3.

^3 inflation reports +3 others.

# 2 inflation reports

**Monetary council has 6 members.

## *Annexure 5*

### *Data Sources*

Data on OECD real GDP growth and oil prices are from the OECD and database on Primary Commodity Prices, respectively. Data on the US federal funds rate target are from the Fred database of the Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/fred2/). Data pertaining to Indian economy are obtained from the RBI's Database on Indian Economy (http://dbie.rbi.org.in/DBIE/dbie.rbi?site=home), data put out on the website of the Central Statistics Office, Ministry of Statistics and Programme Implementation (http://mospi.nic.in/Mospi_New/Site/home.aspx), Labour Bureau, Government of India (http://www.labourbureau.gov.in/main2.html) and Office of the Economic Adviser to the Government of India, Ministry of Commerce and Industry (http://eaindustry.nic.in/). Data on the gross fiscal deficit of central government are obtained from the website of the Controller General of Accounts, Government of India (www.cga.nic.in).

# Comments and Discussion

**Kenneth M. Kletzer**
*University of California*

After the disinflation of the 1990s, the rate of inflation for India gradually rose leading up to the global financial crisis. Despite the crisis, inflation did not abate after 2009 and continues to exceed the levels of inflation of advanced and other major emerging market economies. The return of inflation approaching 10% per annum and the depreciation of the rupee have become headline headaches for policy makers. As elsewhere, inflation is unpopular in India. The policy response to the financial crisis appropriately addressed the prospect that financial distress and recessions abroad would result in a domestic contraction. Stimulus under the circumstances of 2009 was a cautious policy. The subsequent decline in economic growth was modest but inflation was sustained.

This paper addresses three related topics associated with India's postcrisis inflation experience. The first concerns the statistics of inflation and the sources of its persistence. The second is how monetary policy may have contributed to this inflationary episode. Third, the paper considers the possibility of implementing flexible inflation targeting in India.

The empirical analysis of the paper uses the Wholesale Price Index (WPI) and its primary component series. The WPI is the most commonly cited price index for India and is used to communicate monetary policy to the public by the RBI. Its flaws as a measure of inflation and guide for monetary policy are widely acknowledged, although publication of the comprehensive All India CPI began only in February 2011. However, it is worth repeating that the WPI is not a producer price index (some prices are retail and others are wholesale) and that services are included in CPI. The paper addresses this by comparing the univariate analysis for the WPI and CPIs. Ideally, we would like to see a historical series constructed from the underlying survey data replicating a comprehensive CPI for studying the inflation process and consequences of monetary policy in India.

The moments of inflation for India are not surprising in that inflation displays typical skewness and kurtosis. The relationship between the dispersion

of inflation rates across expenditure categories and mean or median inflation ought to tell us something about inflation dynamics. I am perplexed by the proposed index of diffusion (IDEX). As far as I can tell, it centers inflation about zero, and it uses an arbitrary band of five percentage points each side. I may be misreading, but the dispersion of inflation might be more meaningfully measured around an estimate of core inflation (for example, a moving average). The degree of diffusion could be measured by the frequency that individual category inflation exceeds various thresholds calculated for the data such as two standard deviations from the mean, median or a moving average.

The univariate analysis reveals a postcrisis increase in the persistence of nominal food price increases and that inflation in food products tends to lead inflation in the overall WPI over the entire data sample. The authors commendably resist the popular interpretation that food price rises cause inflation. It is worth recalling that food price increases are relative price changes and inflation is an overall rise in nominal prices. An empirical relationship between relative price increases and persistent nominal price rises reflects events in the money market—a change in either money demand or supply. Attributing inflation to food price shocks is uninformative about policy because the relationship is created by policy.

The results that food or fuel price increases lead to rising inflation may tell us something about the process of nominal price adjustment and monetary policy reactions to shifts in aggregate supply. For example, if the costs of resetting sticky nominal prices are lower for food products than for other manufacturing goods, then an increase in expected future inflation will lead to a transitory rise in relative food prices if price-setters are forward looking. Expected inflation depends on news about future monetary policy and its conditional response to aggregate supply and demand shocks. In this example, a rise in expected money growth would lead to a temporary increase in relative food prices and subsequent convergence of overall inflation to food price inflation: nominal food prices lead the price level but do not cause inflation.

How expectations are formed depends on how policy makers respond. Thus, if monetary policy accommodates aggregate supply shocks, price-setters ought to expect higher inflation to follow supply shocks. Because relative food price rises are found to lead to persistent increases in nominal food prices and overall inflation, price-setters will expect a monetary expansion to follow a relative food price shock. We ought to be concerned about how monetary policy responds to transitory and permanent commodity price shocks.

The analysis of persistence is appropriate and thrifty. The multivariate analysis begins with a new Keynesian Phillips curve that allows for backward and forward price-setting behavior. The main observation to highlight is that inflation continues to be comparatively sticky for India by international comparison (intrinsic persistence). The consequences of overall persistence of inflation verified by the univariate and multivariate regressions for policy are raised by the relatively large intrinsic and small expectational components. The resulting costs of disinflation and persistence of monetary accommodation of supply shocks create a challenge for central bank policy.

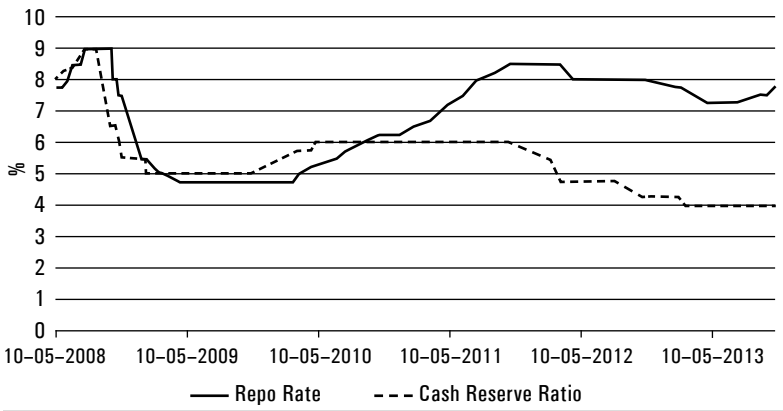
The important part of the empirical analysis is the estimation of the monetary policy rule. The specification is a generalized Taylor rule for which the lagged policy interest rate, inflation gap and output gap are significant. Reserve Bank policy displays sensitivity to both inflation and output as its stated policy goals, but it also shows a sluggish response to the inflation gap. Interest rate smoothing reflects policy adjustment. The lagged policy rate receives a coefficient estimate of 0.9, which is in line with other emerging markets. However, the coefficient estimate for the inflation gap is very small by comparison. Cumulatively, the policy rule is stable, but historically, policy rate adjusts are infrequent in the face of persisting inflation. In the preferred specification, a 1% rise in inflation leads to a 13 basis point quarterly rise in the policy (repo) rate followed by a 12 basis point rise the next quarter and so on. The predicted cumulative increase in the repo rate to a persistent one percentage point of inflation exceeding the inflation target over one year is 45 basis points. This falls short of a median emerging central bank response of roughly 150 basis points.

The authors do not highlight this result and its implication. They demonstrate empirically that the Reserve Bank has responded to persisting inflation either in small steps or with substantial lags. Eventually, the policy rate responds but it take a long time. When this equation is combined with the estimated new Keynesian Phillips curve at the end of Section III, we find that inflation indeed persists and a rule with a higher response to current inflation and less inertia could lead to shorter duration inflationary episodes.

Looking at the policy response after the Lehmann crisis in September 2008 in Figure 1, we can see that the Reserve Bank did respond aggressively to the crisis reducing the repo rate from 9.00% in October 2008 to 4.75% in April 2009. An accommodative policy response to the global financial crisis seems both prudent and a source of the ensuing inflation. As inflation returned, the repo rate was progressively raised in 0.25% steps from March 2010 until it reached its peak of 8.50% at the end of October 2011.

The cumulative 3.75 percentage increase over more than 18 months presumably was in response to WPI inflation of 10%, 5 percentage points over often stated target inflation. Assessing the appropriateness of the weights placed on economic growth (the output gap) and inflation since 2009 is beyond the scope of either the paper or a brief discussion. What we do learn from the multivariate analysis of Patra, Khundrakpam and George is that the interest rates have responded slowly to inflationary shocks for some time.

**FIGURE 1. Repo Rate and Cash Reserve Ratios Postcrisis**




Source: RBI Database on the Indian Economy.

The remainder of the paper cautiously enters the debate over whether India should adopt an inflation targeting regime. The discussion is informative about the implications of a formal inflation targeting framework and the discussion so far. Of particular interest to the authors is the delegation of responsibility for setting goals for monetary policy and for implementing those goals. Two points made are worth stressing. The first is that India displays a de facto inflation target. Policymakers seem to agree that inflation should be around 5%, and the Reserve Bank sets its policy rate responsively to the inflation gap and the output gap, as under a flexible inflation target with multiple objectives.

The second point is that a framework with monetary policy goals set by the government and implementation determined by the central bank, following the model of the United Kingdom, is favored in the current discussion. As shown in Table 8 of Annex 4, several inflation targeting countries opted for joint goal setting by the government and the central bank. Given the history and current reality of fiscal dominance of monetary policy in

India, it is unlikely that the Reserve Bank could gain more independence than the clear assignment of responsibility for implementing a target which the government sets.

If India adopts an inflation targeting regime, then the Reserve Bank will face a challenge implementing an explicit target. The relationship between monetary policy actions and credit expansion or price-setting is not well understood. Indian finance is primarily intermediated by the commercial banks, and as we have learned, these do not extend new loans or increase credit to existing debtors very responsively to short-term interest rates or investment opportunities and returns. While understanding how markets and real activity respond to monetary policy instruments is a matter of ongoing research and practice, the data that are used to guide the formation of central bank policy need to make sense. The more realistic comprehensive CPI ought to be adopted over the WPI to measure inflation both internally at the Reserve Bank and externally for communicating with the public. The argument that credibility is served by sticking with a familiar but flawed price index is not convincing. Credibility should be easier to gain using a more meaningful measure of inflation.

The main results of the paper are the measurement of the persistence of inflation in India and of the short-run response of monetary policy to inflation increases. It appears that as supply shocks fade, inflation persists because the Reserve Bank raises its policy rate slowly in response to inflation as negative output gaps decline. This may well be a consequence of the lack of independence of the central bank. However, it does appear to be a source of inflation persistence in the empirical results presented here. The transition to a formal inflation targeting regime with instrument independence for the Reserve Bank should bring an opportunity for gaining greater credibility for generating lower inflation. The authors have thoughtfully summarized the parameters and issues for a reasoned consideration of monetary policy reform for India.

## Surjit Bhalla

*O[x]us Investment*

I had made several points with regard to the Patra et al. paper at the time of the conference in July 2013. I have gone through the revised paper in some detail; unfortunately, I find that the authors have ignored the comments and suggestions for revision. This is their prerogative, but the least one would

have expected is that the authors would dismiss, in an academic fashion, the suggestions made. My comments, therefore, remain as I had stated in July.

In today's post-global crisis scenario, India stands out as a singular exception to the prevailing disinflation scenario. Indeed, the six-year average CPI inflation ending in 2013 is within a whisker of 10%, and within spitting distance of the record six-year average of 10.1% observed in 1975. Recall that the 1975 average was caused by oil prices quadrupling in Oct. 1973. No such easy explanation is available for the present Indian record. An analysis of the determinants of such inflation is what I was looking for in the Patra paper. Instead, what the paper delivers is a lot of elevator statistics (this went up and this down and at so much statistical significance) and precious little explanation as to why CPI inflation has raged on for the last six years at double-digit levels.

A pertinent inflation issue that was missed by the paper was the deep divergence between the WPI, which is used by the RBI, and the CPI. The excuse given by the RBI, time and again, is the fact that this CPI is a new index and is not comprehensive enough. However, the authors don't even mention, let alone discuss, the fact that a comprehensive rural (CPIAL) and urban (CPIIW) price index has existed for the last sixty years, and can be used to construct a synthetic all India index. If this had been done, then the authors would have found that there is no precedent to the deep divergence that exists today between the WPI and CPI. One of the simplest explanations behind this new phenomenon is the weighting diagram, i.e. the share of food in the index. The share of food in the CPI is an exorbitantly high 50%. On the other hand, its share in the WPI is at a much lower 22%. Therefore, an important explanation for high double-digit CPI inflation is inappropriate weights.

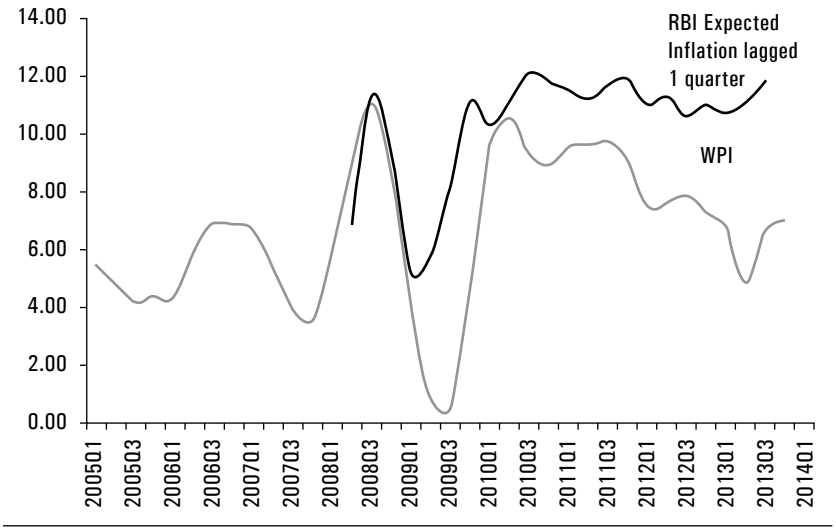
Incidentally, the Patra et al. paper makes no mention of the GDP or the implicit GDP deflator, which are extremely important to the study of inflation. To emphasize this point, the implicit GDP deflator accounts for all the goods and services in the economy and it would have been interesting point to focus on, especially given the deficiencies in the CPI and WPI. A reason behind this oversight could have been the case of "have data, will analyze" without focusing on the reasons behind the current situation. [In the revised paper, the authors have a sentence or two brushing aside the importance, or relevance, of the GDP deflator].

*History of what is being analyzed—inflation:* Between the broad range of years 1960 to 1993, inflation in India, irrespective of the chosen measure, not only averaged around 8% per annum but also had relatively low

volatility. In the mid-1970s, there was a spike in inflation due to oil price rise. However, through the mid-1970s and even with the economic reforms in 1991, inflation stayed at this average level of 8%. It was during the period between 1996 to 2007 that inflation suddenly fell to an average of 4 to 5%, regardless of the inflation measure (whether it is GDP deflator, CPI or WPI). After 2007, the scenario completely changed and inflation went to double digits, in terms of both CPI and WPI. With this brief peek into history, the question arises as to what happened post-2008. The government and the RBI give a range of reasons behind the rise and fall of inflation—external factors, external shocks, oil prices. In these comments on the Patra et al. paper, an attempt is made to offer robust explanations as to what might have happened.

A favorite explanation for high inflation in India is "inflation expectations". Figure 2 depicts the inflation expectations measure as well as the actual WPI value. The inflation expectations measure is constructed using a survey conducted at the end of each quarter, in which people are posed questions on their expectations of inflation over a certain period of time—3 months, 6 months, etc. Note the close correspondence between the expectations of inflation and actual WPI inflation. The main point of the graph is the lack of any causal linkage between the inflation expectations measure and actual inflation. And therefore, the argument presented in the paper of inflation being affected by persisting expectations is without much empirical basis.

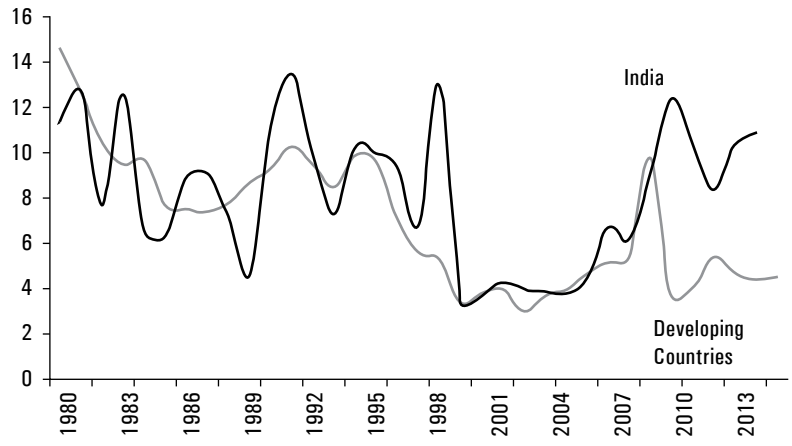
**FIGURE 2. Inflation Expectations (Expectation and Actual year-on-year, in %)**




Sources: Reserve Bank of India, Data Handbook of the Indian Economy.

*Imported Inflation:* Figure 3 compares the inflation in India with other developing countries for the period of 1980–2012. The median inflation is used for developing countries and the CPI measure is used for India. The interesting fact to note, especially by government officials, is the existence of a close correlation between the two. The turning points of the curves are mostly captured, except for post-2008, which still need to be addressed. It is the answer to the post-2008 divergence that should have been the focus of the paper.

**FIGURE 3. CPI Inflation in India and Developing Countries: 1980–2013; in %**




Source: World Bank, World Development Indicators.

*Do supply shocks explain inflation?* Supply shocks, especially food supply shocks, rainfall and droughts are often considered as important explanators of high inflation. With regard to agricultural supply shocks, it is noteworthy that the period of low inflation—1996 to 2007—was accompanied by very bad rainfall shocks. The period 1998 to 2003 (particularly 2002) was the third worst rainfall period in Indian history since 1871, which led to low agricultural growth as well. While there was a spike in onion inflation around this period, the aggregate inflation, surprisingly, still remained between 3 to 5% despite the food supply shocks.

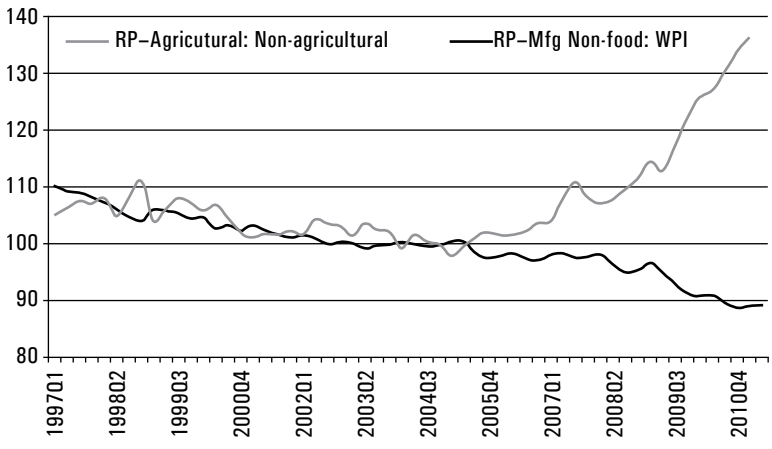
*Role of administered food prices in causing inflation:* In Bhalla (2011a), I had offered an explanation for the high CPI inflation India was experiencing. In that paper I had contended that high procurement prices for foodgrains, sugar, cotton, etc., were causing the relative price of food to increase, and this increase in the relative price was a major cause of high inflation. For those unfamiliar with the operations of the Indian economy, prices of several

crops—rice, wheat, sugar—are administered by the government. These prices are weighted by the share of these crops to create an index called the procurement price index.

The chain of causation is as follows. When the government raises the procurement price of agricultural output, then the price of the factors of production for that good—land, wages will rise. In the post-2008 period, wages, especially rural wages, rose at an unprecedented pace. But this had less to do with NREGA and more with the fast paced increases in the relative price of food.

To put this into perspective, between 1996 and 2004, the relative price of food stayed within a band ±5%, i.e., if the chosen index is 100, then the relative price of food was between 95 to 105. However, post-2005, the relative price of food exploded and shot up by 30%, simply in the span of four years (Figure 4).

**FIGURE 4. Relative Prices (Indices, Base = 2004/05)**

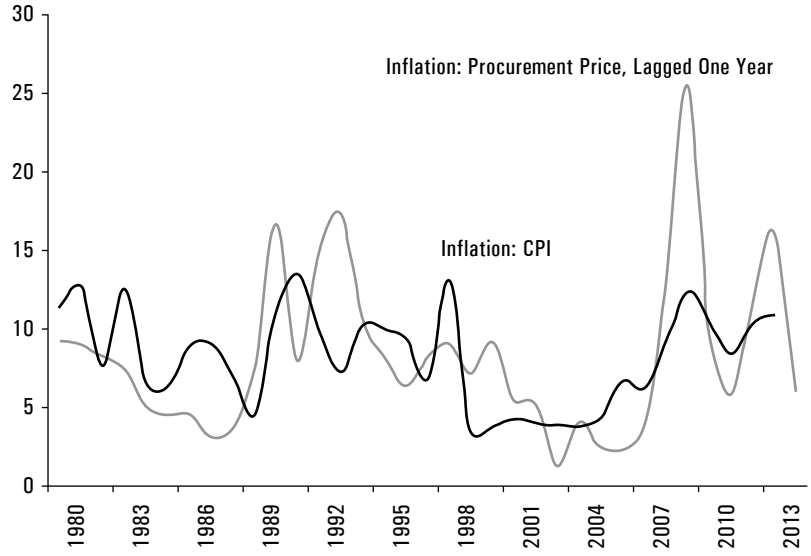



Source: Reserve Bank of India, Data Handbook of the Indian Economy.
Note: RP - Relative Price.

I ran a simple regression using percentage change in CPI inflation as the dependent variable and aggregate percentage change in the procurement price index (lagged 1 period) as the independent variable. The coefficient of the procurement price was 0.3, which implies that a 10 percentage point increase in procurements prices leads to a 3 percentage point increase in CPI. It is important to note that these results come with a simple one-variable regression. Dummy variables for three years have also been included, for 1983, 1991, and 1998 (procurement prices in India started in 1976).

Figure 5 depicts the CPI inflation, procurement prices and its values as predicted by the above regression. From 1978 to 2006 (the sample used for the regression), the predicted values are completely accurate. Moreover, it continues to predict accurately post the sample period as well. See Bhalla et al. (2011a) for details.

**FIGURE 5. CPI vs. Procurement Prices (year-on-year % changes)**




Source: Reserve Bank of India, Data Handbook of the Indian Economy.

*"Taylor formulation"*: The authors estimate a Taylor formulation to explain the determination of short-term interest rates, the repo rate. A near identical exercise was conducted by Bhalla et al. (2011b) for 27 different countries. The results for India are very similar except for the role of exchange rate changes—Patra et al. do not find any statistical significance for exchange rate changes, while Bhalla et al. do. It would have been useful for the authors to explore this divergence in the results.

## References

Bhalla, Surjit S., Ankur Choudhary, and Nikhil Mohan. 2011a. "Indian Inflation: Populism, Politics and Procurement Prices," *Developing Trends*, Oxus Research & Investments, 1 (2), July, 2011. Available at www.oxusinvestments.com.

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## General Discussion

Indira Rajaraman argued that RBI policy has been significantly handicapped by unreliable measures of the inflation rate. In particular, the CPI fully incorporates indirect taxes and the WPI includes some taxes. She believed that the shift to a value added tax after 2005 was a major factor contributing to the rise in inflation, and such changes should be excluded from an index used as an indicator for monetary policy. The monetary authorities should have a price index for policy purposes that excludes the direct effects of tax changes.

T.N. Srinivasan contended that the models and policy framework were basically those of high-income countries, such as the United States or the United Kingdom, and were insufficiently modified to reflect the specific circumstances of India. He also thought there was an inadequate explanation of the computation of potential output and questioned its usefulness. He pointed out that the paper also suggests that there is no coordination between monetary and fiscal policy: are the monetary authorities trying to correct for the actions of the fiscal authorities, or vice versa. Finally, he disapproved of a formulation of the policy objective that did not explicitly include the welfare of the Indian population as a goal.

Vijay Joshi pointed out that the paper suggested a worsening in recent year of the tradeoff between inflation and output growth. He attributed that to increased indexation of wages and suggested that the effort to reduce inflation would be more costly in terms of lost output than in the past. Second, he argued that adoption of a policy of inflation targeting was inconsistent with India's current practice of devoting considerable attention to managing the exchange rate. The monetary policy authorities cannot target two objectives and would be forced to choose. Finally, he noted that a regime of inflation targeting is also inconsistent with the notion of policy coordination, an issue raised by T.N. Srinivasan, unless the coordination is all on the side of the fiscal authorities. Advocates of inflation targeting explicitly reject the notion of policy coordination. He wondered how these issues could be resolved in the Indian context. Devesh Kapur added that the conflict was even greater because the monetary authorities were actually targeting three

goals: minimizing inflation, maximizing output growth, and stabilizing the exchange rate.

Tom Richardson thought it strange that India still focuses on the WPI to guide its monetary policy instead of the CPI. He argued that the new All India CPI index closely follows the index for industrial workers during their period of overlap. Could not the industrial worker index be used to extrapolate the All India series back in time, enabling the new series to be adopted for analysis and policy guidance? T.N. Srinivasan thought the problems with the inflation measures went deeper than simply choosing between the CPI and WPI. The adjustments for quality change and new products were inadequate and the WPI should be eliminated in favor of a true producer price index.