SHEETAL K. CHAND
University of Oslo

KANHAIYA SINGH
National Council of Applied Economic Research

How Applicable Is the Inflation-Targeting Framework for India?

A key component in stabilizing an economy is keeping the rate of inflation within acceptable bounds and doing so in a manner that does not detract from other goals. This is a difficult exercise, and there have been many failures both in the advanced economies and especially in emerging economies. The record of inflation control in India, while not unsatisfactory, could have been better. Inflation in the first half of 2005–06 is around 5 percent, which is relatively high in the current global environment of mild inflation and, contingent on the handling of the ongoing oil price increases, could easily ratchet upward. The issue of inflation control in India is therefore important. In recent years, several countries have adopted the inflation-targeting framework (ITF) approach, which is now being strongly recommended to others as a best-practice approach for keeping inflation under control. Although it is still too early to tell whether or not the approach has been decisive in reducing inflation rates—its introduction coincided with a period of exceptional weakness in commodity prices following the break up of the Soviet Union—a strong theoretical case has been made for it.[1] Detailed operational guidelines and procedures have also been developed for its application.[2]

Essentially the ITF approach consists of setting an inflation target, aligning monetary policy to ensure its attainment, and doing so in a manner that is both transparent and accountable. The target is set publicly and considerable information is made available to the public regarding the modalities

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1. See especially Svensson (1997).

2. See, for example, various reports of the Bank of England. Bernanke and others (2001) provide some useful historical details.

for achieving it in an attempt to establish credibility and to manage inflation expectations. A major advantage claimed for the ITF is that it enables focusing on the inflation target in a nonmechanical, flexible way that can take account of various contingencies and possible trade-offs with other objectives such as the level of economic activity.

For a country to be able to apply the ITF successfully, it must have strong fiscal and financial institutions and a balanced exposure to foreign exchange risks. Questions have therefore been raised about whether many emerging economies qualify for the ITF. Some of them, including India, have large fiscal deficits, and others such as China have weak banks and financial institutions. Moreover, most of them appear to exhibit a "fear of floating" and intervene to stabilize the exchange rate, thereby compromising the practice of inflation targeting. However, some have argued that, provided the authorities in these economies are sufficiently motivated to want the benefits of inflation targeting, they should not delay but use the introduction of the ITF as an incentive device to promote needed reforms in economic structure.[3] It is presumably in this spirit that the International Monetary Fund (IMF) and other agencies have been encouraging emerging economies to adopt the ITF.[4]

In making these recommendations, it is taken for granted that the ITF is an appropriate institution for emerging economies such as India. But this assumption may be questionable. The issue is not that of denying the importance of a low inflation rate; indeed, for India it has been amply demonstrated that the lower the inflation rate the more favorable the growth outcome.[5] The issue, which this paper focuses on, is whether lower inflation is best brought about through the adoption of ITF. At the heart of the ITF is a specific view of the inflation-generating process determined largely by demand, a conviction that the most efficient way of dealing with it is through an interest rate rule, and the belief that the public's inflation expectations can be managed. From this follows the prescription that the central bank, as the custodian of interest rate policy, should play a dedicated and dominant role in promoting the inflation objective.

But what if the inflation-generating process differs from that commonly assumed to hold for the advanced economies? For example, supply shocks and price management could feature more prominently than demand effects, while the latter could be influenced by a different array of instruments.

3. See Mishkin (2004), among others.
4. See, for example, IMF (2005).
5. Singh and Kalirajan (2003) provide a demonstration.

Expectations could also be more difficult to manage, especially if the economy is large, diverse, and segmented as is India's. But aside from these considerations, emerging economies may have good reasons for not wanting to free up fully the process of interest and exchange rate determination by the market. They may fear being exposed to persistent deviations in the exchange and interest rates from equilibrium levels and also to greater volatility in them, since they lack the hedging capabilities and facilities present in the advanced economies. All this implies that these emerging economies may find it more prudent and welfare enhancing f to pursue a strategy other than the standard ITF for controlling inflation, at least until they reproduce conditions favorable for an ITF.[6] They will then have to seek nominal anchors elsewhere.

In analyzing these issues, this paper first presents the rationale for the ITF and examines a standard theoretical formulation based on Svensson's work. The central proposition of this formulation is tested on Indian data and found inadmissible. Rather than accept the implication of that specification that demand does not affect the inflation rate, an alternative structure for determining inflation is then developed. This shows how demand may play a role in influencing the inflation rate as part of a broader scheme, and the choices of instruments for dealing with inflation. Testing on Indian data is more favorable to the alternative specifications developed. In light of the findings, the paper then examines how best to ensure an adequate inflation performance and the implied institutional allocation of responsibilities. A sharp distinction is drawn between "flow" responsibilities concerning operations in the goods market for which a combination of fiscal, credit, and supply-price management policies may be appropriate and "stock" responsibilities involving balance-sheet operations to influence asset valuations in desirable directions. As will be seen, this distinction determines a specific allocation of responsibilities in the Indian context between the government and the central bank.

A Rationale and Test of ITF Using Indian Data

Controlling inflation has traditionally been viewed as a matter of anchoring the money supply. The issue arises specifically with fiduciary money, since

6. However, concerns over interest rate and exchange rate misalignments and volatilities, including especially their divergent asset market and goods market effects, could limit interest in the ITF.

its amount can be increased at virtually no cost. This section briefly reviews the evolution of views as to what constitutes a good anchor, culminating in the inflation forecast targeting rule.

Why an ITF?

In a textbook closed economy, controlling the money stock is a sufficient anchor, while in an open economy, the traditional approach to anchoring the money supply is to peg the exchange rate. Observing the peg enforces the needed discipline on the central bank as it cannot expand the money supply excessively without suffering a loss of international reserves, which will threaten the peg. However, the increasing trend to capital market liberalization renders the exchange rate peg more vulnerable to large swings in capital flows. Following a number of spectacular failures in both developed and emerging economies to maintain the peg in the face of speculative pressures, pegged exchange rates were largely abandoned in favor of floating exchange rates.

Since a floating exchange rate regime confers considerable independence on monetary policy, the issue of its anchor had to be resolved anew; generally an anchor was achieved through adoption of money supply targets. Financial innovations, however, have made money demand growth unstable and unpredictable, and thus the experience with monetary targeting has not been satisfactory. Pursuit of a given rate of growth in a selected monetary aggregate could result in unacceptable inflation rates.

As monetary targeting is abandoned, emphasis is increasingly being placed directly on the inflation rate. If the principal consequence of undisciplined monetary policy is the generation of unacceptable inflation rates, an alternative to attempting to control an elusive monetary aggregate would be to target the inflation rate, and to seek instruments that would realize it. In pursuit of the inflation target, the central bank must be free to use its interest rate instrument, since this is the only alternative to money supply targeting available to it. But this in turn implies that the central bank cannot be diverted by any simultaneous need to influence the exchange rate. Ruling out the exchange rate, interest rates, and monetary aggregate as potential anchors implies that the anchoring role is instead performed by the inflation target.

Beginning with New Zealand, an increasing number of countries have adopted inflation targeting. There is little doubt that the ITF countries have improved their inflation record after adopting this framework (table 1). The actual mechanism that reduced inflation is an open question, however.

TABLE 1. Coefficient of Variation of Exchange Rate in United States, Japan, India, and Selected Inflation-Targeting Countries

		Exchange rate variation			*CPI inflation (mean)*		
	ITF date	*During 3 years before ITF*	*During first 3 years after ITF*	*During full period after ITF*	*During 3 years before ITF*	*During first 3 years after ITF*	*During full period after ITF*
Brazil	Q2-1999	20.86	17.08	24.28	6.83	6.78	8.34
Chile	Q1-1991	11.17	7.81	23.57	19.45	17.69	7.25
South Africa	Q1-2000	13.15	20.25	22.70	6.60	7.04	5.51
Israel	Q1-1992	9.07	8.35	19.23	18.64	11.90	2.03
Peru	Q1-1994	40.44	6.95	16.67	721.51	15.21	6.49
Czech Republic	Q1-1999	10.00	4.79	16.29	8.84	3.60	2.58
Iceland	Q1-2001	8.77	14.18	16.18	3.41	4.36	4.12
New Zealand	Q1-1990	5.70	0.07	15.89	9.17	2.57	2.28
Hungary	Q1-2001	12.47	13.33	15.41	11.27	6.41	11.32
Australia	Q4-1994	6.06	6.59	15.21	1.61	2.32	2.68
Sweden	Q1-1995	15.20	7.35	14.76	3.46	0.98	1.16
Switzerland	Q1-2000	5.40	8.60	13.78	0.54	1.06	0.92
Norway	Q1-2001	7.52	12.59	13.67	2.64	1.98	1.82
Colombia	Q3-1999	21.90	10.57	13.39	17.42	8.14	7.49
Mexico	Q1-1999	10.86	2.66	8.15	23.56	10.38	7.80
Poland	Q4-1998	12.67	5.99	7.73	16.11	7.77	5.02
Canada	Q1-1992	5.78	5.63	7.72	3.14	1.21	1.83
Korea	Q1-1998	30.26	8.28	7.57	4.95	3.09	3.51
United Kingdom	Q1 1993	8.25	2.78	6.74	6.02	2.51	2.52
Thailand	Q2-2000	4.70	3.72	4.73	3.62	1.39	1.72
United States[a]	Q1-1995	2.49	5.04	6.14	2.87	2.50	2.46
India[a]	Q1-1995	9.37	7.71	12.56	9.80	8.87	6.41
Japan[a]	Q1-1995	10.48	13.26	10.50	1.36	0.70	–0.05

Source: Basic data come from IMF (2005).

Note: All variations are reported in US$, except for variations for the United States, which are reported in special drawing rights. Data exclude the crisis period for Brazil, and 1997–2000 for Thailand. Chile had a crawling peg before 1991. Mexico has an oil fund.

a. Countries do not have an inflation-targeting framework.

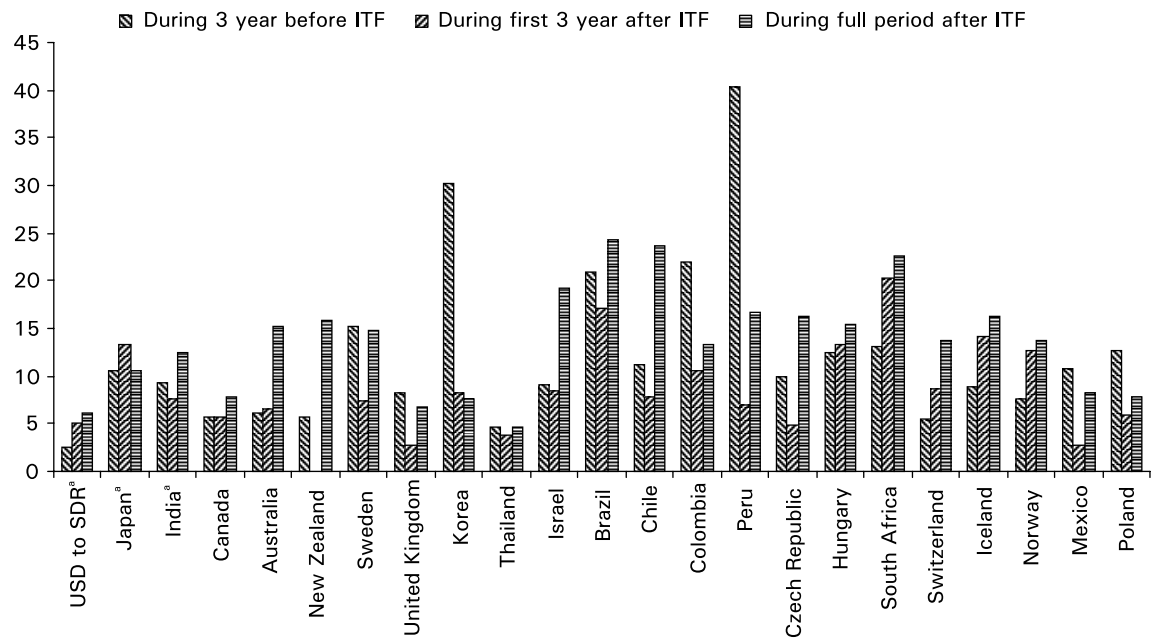
Was it the intention to target inflation, was it the inflation-targeting framework, or were some other exogenous factors responsible?

The rigorous implementation of the ITF would imply increased volatility in variables such as the exchange rate. A close look at the quarterly variation in exchange rates during the three years before and the three years after implementation of the ITF indicates a mixed outcome (see table 1 and figure 1, where variation in the U.S. dollar is reported with respect to special drawing rights, while variation in the currencies of other countries is reported with respect to the U.S. dollar). For most of the ITF countries (with the exception of Hungary, Iceland, Norway, South Africa, and Switzerland), the volatility in nominal exchange rate, measured as a coefficient of variation with respect to the U.S. dollar, was reduced during the first three years of implementation.

When a longer period after implementation of the ITF is considered, however, the coefficient of variation increases considerably beyond the initial three-year period in almost all cases. One explanation is that the countries have, contrary to the ITF requirements, engaged in a "dirty" peg of their domestic currency to the dollar as a way to reduce inflation, since the United States is a low-inflation, low-interest-rate country. Most of the ITF countries appear to have adopted this strategy in the initial period following the adoption of the ITF. Having achieved reasonable stability, monetary policy is then better aligned with ITF requirements; that situation is reflected in a more volatile exchange rate during the later periods. Such volatility could also be partially attributable to an increase in the volatility of the U.S. dollar. While it is difficult to fully disentangle the contributions of these alternative explanations, the data give some support to the implication that the ITF leads to volatile asset markets, indicating that at least some of the countries were more rigorous in their application of the ITF.

In general, for countries to be able to abandon traditional anchors in favor of inflation targeting, their economies must have the capacity to tolerate wide swings in nominal interest rates and in the nominal exchange rate. On the stock side, these swings will exert valuation effects. They may contribute to mismatches between different categories of assets and liabilities on balance sheets. This could generate various problems both in the financing and production spheres as became readily apparent during the Asian crisis of the late 1990s. Firms that borrow short in one currency and invest long in another may find their net worth wiped out. Declines in asset values affect both the ability of firms to borrow from banks and the desire of individuals to spend. Deterioration in investment and consumption activities will then act as a drag on output growth.

FIGURE 1. Coefficient of Variation of Exchange Rate in United States, Japan, India, and Selected Inflation-Targeting Countries



Source: Basic data come from IMF (2005).

Note: All variations are reported in US$, except for variations for the United States, which are reported in special drawing rights. Data exclude the crisis period for Brazil, and 1997–2000 for Thailand. Chile had a crawling peg before 1991. Mexico has an oil fund.

a. Countries do not have an inflation-targeting framework.

In a world of sticky prices, nominal swings in interest and exchange rates also imply corresponding fluctuations in their real counterparts. These fluctuations affect relative prices and have additional implications for flow behavior. A change in real interest rates affects the terms of trade between the present and the future, thereby influencing investment and savings behavior. Real exchange rate adjustments modify the relative price ratios between tradable and nontradable goods, and between home and foreign goods, that affect profitability in the respective sectors. These changes also contribute to changing production and investment patterns. Of particular concern is the phenomenon of exchange rate overshooting. For example, when interest rates are tightened, the exchange rate overappreciates so as to induce an expectation of subsequent depreciation in order to balance financial markets. But this overappreciation could have serious adverse consequences for the country's international trade.

Volatility in real interest rates and exchange rates can thus be disruptive. Not surprisingly, many in emerging market economies widely believe that their developmental needs are better served by stable real exchange interest rates, provided these are set at appropriate levels. Emerging economies such as China, India, and Malaysia have had some success in pursuing a less volatile approach with respect to these two key variables of interest and exchange rates.

Before deciding whether to adopt the ITF, an emerging economy should establish how capable it is of withstanding the volatile stock-flow implications that the ITF and its monetary actions entail. Most emerging economies, including India despite its fairly developed financial sector, lack the hedging facilities and regulatory capabilities of advanced economies. However, if the only instrument available for satisfactorily dealing with inflation is the nominal interest rate instrument, an emerging economy's only alternative may be adoption of the ITF. In that case, the volatility-related costs incurred on the financial stock side and the production sectors will have to be tolerated. It is therefore important to test the suitability of the ITF's mode of applying monetary policy, and the availability of alternatives, before making a decision.

A Standard Theoretical Formulation

Svensson provides a clear exposition of the standard inflation-targeting approach, which is used as the reference in the following discussion.[7] He

7. Svensson (1997).

assumes a closed economy, and although in other papers he relaxes that assumption, that is not essential for our purposes here.[8] Since our concern is with the assumed transmission mechanism that links the monetary policy instrument with the domestic rate of inflation, the analysis of the simpler closed-economy case could be regarded as embedded in a more comprehensive open-economy model. Simplifying even further, we assume, with Svensson, that the focus is on pure inflation targeting without any trade-offs with other objectives.

THE SVENSSON VERSION. The model structure is as follows:

$$\pi_{t+1} = \pi_t + \alpha_1 x_t + \varepsilon_{t+1} \tag{1}$$

$$x_{t+1} = \beta_1 x_t - \beta_2 (i_t - \pi_t) + \eta_{t+1} \tag{2}$$

where $\pi_t = p_t - p_{t-1}$ is the inflation rate in year t, p_t is the log of the price level, x_t is the output gap defined as the log of actual to potential output, i_t is the monetary policy instrument, and ε_t and η_t are i.i.d. shocks in year t that are not known in year $t - 1$. All coefficients are nonnegative; $\beta_t < 1$.

The formulation of this model is based on stylized empirical factors as they pertain to the advanced industrial economies. Equation 1 determines inflation as a function of the preceding period's inflation rate, output gap, and a stochastic shock. Equation 2 indicates that the output gap is a positive function of the previous period's output gap and negatively affected by the ex post real interest rate.

The model yields a reduced form solution for the inflation rate on taking note of the assumed stylized lag structure and making the relevant substitutions. The important point is that there is a one-year lag between the output gap and the inflation rate, while the output gap responds to the previous year's real interest rate. In other words, the central bank, in setting the nominal interest rate, can only influence inflation two years down the road.

$$\pi_{t+2} = a_1 \pi_t + a_2 x_t - a_3 i_t + (\varepsilon_{t+1} + \alpha_1 \eta_{t+1} + \varepsilon_{t+2}) \tag{3}$$

where

$$a_1 = 1 + \alpha_1 \beta_2,\ a_2 = \alpha_1 (1 + \beta_1),\ a_3 = \alpha_1 \beta_2.$$

8. Svensson (2003) reviews several variants of the basic model. See also Aghenor (2002) for an exposition. The main effect of opening the economy is to introduce another channel of influence through the exchange rate on the domestic rate of inflation. Since the exchange rate is floating, the effect would be in the same direction as the monetary action; for example, an appreciation accompanying a monetary tightening would accelerate the improvement in the inflation rate.

The solution shows that the inflation rate that will prevail at time $t + 2$ will be determined by the current profile of the specified key variables and the relevant shocks that occur over the next two periods. Since those shocks cannot be anticipated, the inflation rate expected at time $t + 2$ will be a function only of current variable values and the interest rate instrument setting. An optimal inflation-targeting rule is obtained by minimizing the present expected value of an intertemporal loss function

$$E_t \sum_{\tau=t}^{\infty} \delta^{\tau-t} L(\pi_\tau) \tag{4}$$

where $\delta \in (0, 1)$ is the discount factor.

The loss function for each period is specified as the squared deviation of the inflation rate from the target level π^*.

$$L(\pi_\tau) = \frac{1}{2}(\pi_\tau - \pi^*)^2 \tag{5}$$

The decision problem is to select a time path of nominal interest rates that will minimize the expected sum of discounted squared future deviations of inflation from the target, subject to the constraint imposed by equation 3. This is a potentially complicated exercise in dynamic programming, but Svensson shows how the problem can be simplified by using the lag structure. Since the central bank can only influence the inflation rate two periods ahead, the optimal interest rate in year t is found as the solution to a period-by-period problem.

$$\text{Min}_{i_t} E_t \delta^2 L(\pi_{t+2}) \tag{6}$$

The first-order condition for minimizing equation 6 with respect to i_t is

$$\frac{\partial E_t \delta^2 L(\pi_{t+2})}{\partial i_t} = -\delta^2 a_3 (E_t \pi_{t+2} - \pi^*) = 0 \tag{7}$$

The condition is met if the expected rate of inflation two years hence equals the target rate. This is equivalent to equating the current two-year inflation forecast (given by equation 3) to the target rate. On setting this forecast equal to the target rate, the following optimal policy rule for the nominal interest rate is derived

(8) $$i_t = \pi_t + b_1(\pi_t - \pi^*) + b_2 x_t$$

where

$$b_1 = \frac{1}{\alpha_1 \beta_2}, b_2 = \frac{1+\beta_1}{\beta_2}$$

It is an inflation *forecast* targeting rule, which corresponds to the strict inflation-targeting version of the well-known Taylor rule.[9] However, unlike the Taylor rule, where the coefficients would either be arbitrary or somehow estimated from past data, Svensson's derivation is based on the postulated underlying structure of the economy. His rule sets the interest rate by reference to the deviation of the current inflation rate from the target rate. As he points out, this is not because current inflation is targeted, which it cannot be since it is predetermined, but because current inflation is one of the inputs in predicting future inflation (see equation 3). The ITF targets the inflation rate through the adoption of a relatively flexible approach centered on the interest rate as the preferred instrument of choice. It attempts to cope with inherent uncertainties arising from the complexity of the economy that precludes rigid targeting, through the adoption of a so-called flexible "rule." While the rule is optimal in the sense of being derived from minimizing a loss function, it is a far cry from the optimal "control" approach to targeting that was pursued and abandoned in the 1970s.

Equation 8 implies that in a steady state in which the inflation target is attained and the output gap is zero, the nominal interest rate should equal the target rate of inflation. This implies a zero real rate of interest, but it is straightforward to ensure some positive target real interest rate level by including it in equation 2, which then yields the desired term in equation 8. Notice also that the specification of the structural equation 2 provides only for a real interest term as the principal influence on the output gap. In particular, no role is specified for fiscal policy, indicating either that it is impotent or that it has no part to play in inflation control, which is implicitly assigned to monetary policy.

A Test of the Svensson Model

The foregoing discussion raises three important issues, which need to be resolved to select a consistent macroeconomic policy procedure. These issues include the persistence of inflation and its lag structure, the effect of

9. Taylor (1993).

the output gap and its lag structure, and how they relate to the underlying actual process of inflation in the case of India. The discussion here is based on annual data because quarterly data are not available for a sufficiently long period. First we examine the time series behavior of inflation and then test the structure suggested by Svensson. In undertaking the estimation, particular attention is paid to the inflation equation 3. The variables used in the empirical analysis are described in table A-1 and their descriptive statistics are presented in table A-2. An augmented Dicky-Fuller test is used to check the stationary properties of the variables, and the final outcomes are reported in table A-2. The normal convention in this paper is to prefix a variable with 'L' to indicate that the variable is taken in log and by *D* to indicate that the variable is taken in first difference. Thus, a prefix *DL* means first difference of the logged value of the variable. As a general practice in this paper, the estimations (particularly for modeling inflation) are carried out taking data from 1970–71 to 2002–03, while data from 2003–04 to 2004–05 are used to check the predictive power of the models.

Inflation (*DLWP*) is defined as the first difference of log wholesale price index (WPI). The selection of this particular price index is guided by several factors. The most important reason is that macroeconomic policy decisions in India are based on movements in the WPI; moreover, this index has the largest basket of commodities and is therefore most representative of economic activities. In addition to the WPI, four other price indexes are published in India. Three are consumer price indexes (CPIs) targeted to three different groups of consumers. The fourth is the gross domestic product (GDP) deflator.

The difference between the CPI and WPI also stems from the different composition of the basket of commodities and the weight given to them. For instance, the WPI includes manufactured goods with a weight (1993–94 base) of 63.75 percent in the basket, while primary articles account for 22 percent. In contrast, the CPI has a weight of about 57 percent for food articles alone. Thus, the WPI has a lesser weight for volatile elements and can be considered a closer proxy of core inflation. Finally, the WPI captures larger components of imports, which reflects on domestic inflation.

The GDP deflator is an implicit price index, which can be derived from the national accounts for GDP, consumption, or investment. Covering all three sectors of services, industry, and agriculture, it largely represents producer prices. However, the GDP deflator can be known only with a lag of two to three years after accounts are final. Nor is the GDP deflator well understood by the economic agents compared with the directly published prices indexes. Furthermore, in the context of monetary policy analysis,

information on price movements is needed at quick intervals to allow policymakers to forecast inflation trends and to take corrective measures. Probably for these reasons, the GDP deflator is not a popular measure of the price index for analyzing the Indian economy.

The WPI includes service charges from wholesalers and retail profits; it covers 447 commodities spread over primary articles, fuel products, and manufactured items. It does not include the services sector per se; nor does it account for price effects of efficiency gains. However, it can be argued that WPI implicitly captures the effect of service sector prices, including asset prices, because of its wide coverage of commodities albeit with different lags. For example, an increase in real estate prices would increase rentals and consequently increase the prices of traded goods. Similarly, a booming stock market would lead to increases in deposit rates and consequently lending rates, which may affect the commodity prices.[10] For the monetary authorities to be fully aware of the broadest possible inflation coverage, any model of inflation must be able to explain price variations as a whole. Therefore, the WPI has been adopted as the preferred price index in this study. Henceforth, any reference to price index or inflation in this paper means the WPI unless otherwise specifically stated.

An evaluation of the inflation series shows that it is a stationary process, and its autocorrelation function in table 2 and figure 2 indicate that the series has poor persistence. Neither of the two widely used criteria, Box-Pierce and the Ljung-Box statistic, support persistence. The first and fourth lags are significant at 10 percent only, but the fourth lag is negative. The standardized spectral density at zero frequency, presented in table 3 along with standard errors, also indicates no significant evidence of persistence.

Taking four lags, we present an ARMA (4, 1) forecasting model for the series in table 4, the lag structure being selected by Akaike information criteria and the Schwartz Bayesian criteria starting with six lags. In this formulation too, the evidence for persistence is not strong; the sum of the lagged coefficients is negative. The moving-average term, however, is significant, positive, but less than one. Clearly, any shock to the inflation series dies down very soon.

To test equation 3, we require a time series on the stationary output gap and a measure of the interest rate, which is close to policy rates. To obtain a series on potential output we employ a widely accepted method of filtering

10. Nevertheless, this does not mean that India should not strive to create a better time series to capture effects of the services sector adequately. The government has already set up a committee to improve the WPI and develop a producer price index covering a wider spectrum of inputs.

TABLE 2. Autocorrelation Coefficients of *DLWP*

Order	*Autocorrelation coefficients*	*Standard error*	*Box-pierce statistic*	*Ljung-box*
1	0.296	0.172	2.973 [0.085]	3.243 [0.072]
2	–0.171	0.186	3.972 [0.137]	4.367 [0.113]
3	–0.149	0.190	4.728 [0.193]	5.245 [0.155]
4	–0.270	0.194	7.214 [0.125]	8.228 [0.084]
5	–0.117	0.205	7.680 [0.175]	8.807 [0.117]
6	0.173	0.207	8.696 [0.191]	10.113 [0.120]
7	0.182	0.211	9.823 [0.199]	11.615 [0.114]
8	–0.064	0.215	9.962 [0.268]	11.808 [0.160]
9	–0.101	0.216	10.307 [0.326]	12.304 [0.197]
10	–0.010	0.217	10.310 [0.414]	12.310 [0.265]
11	0.010	0.217	10.314 [0.502]	12.315 [0.340]

Note: Numbers in brackets are *p*-values.

FIGURE 2. Autocorrelation Function of *DLWP*, Sample from 1971 to 2004

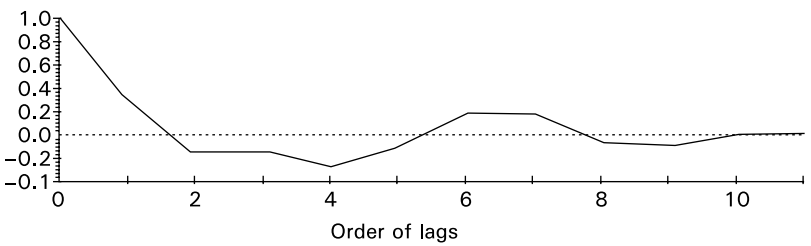


TABLE 3. Standardized Spectral Density Functions of *DLWP* at Zero Frequency with Estimated Asymptotic Standard Errors, Sample from 1971 to 2004

	Bartlett weights	*Turkey weights*	*Parzen weights*
Standardized spectral density functions of *DLWP*	0.765	0.699	0.79
Asymptotic standard errors	0.525	0.509	0.487

TABLE 4. Distributed Lag Model with ARMA (4, 1), 1971–2004

DLWP = 0.121* – 0.126 *DLWP* (–1) – 0.250 *DLWP* (–2)*** +0.0261 *DLWP* (–3) – 0.331 *DLWP* (–4)*
(0.024) (0.135) (0.126) (0.124) (0.124)

Moving average term: U = E + 0.487 E (–1)*
(0.145)

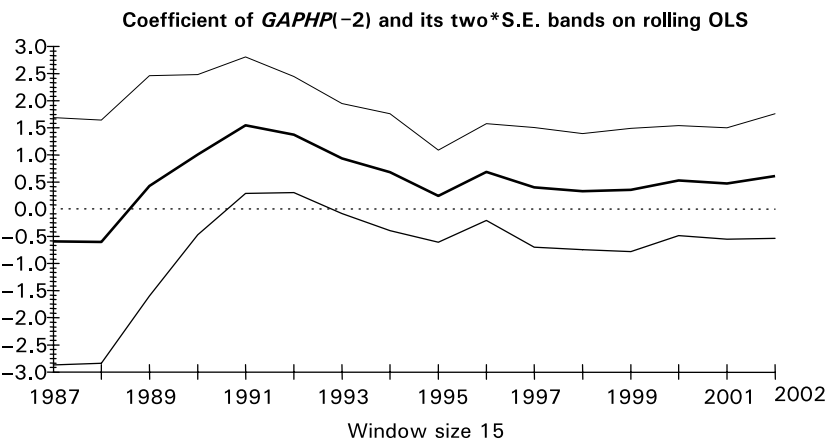
a = a2 + a3 + a4 + a5 = – 0.680 (0.284)**

R^2 = 0.42; $\bar{R}^2$ = 0.28; SER = 0.035; root mean sum-sq prediction errors = 0.0284.
*Significant at the 1 percent level; **Significant at the 5 percent level; ***Significant at the 10 percent level. Standard errors are in parentheses; *p*-values are in brackets.

the output series (real gross domestic product, RGDP, or *Y*) using the Hoderick-Prescott filter with penalizing parameter λ equal to 7 as suggested by Harvey and Jaeger.[11] Thus, the real output gap (*GAPHP*) is calculated as *GAPHP* = *LY* – *LYHP*, where *LYHP* is the log of the filtered series of real GDP. The deposit interest rate variable *DR*1 is not stationary, but it is kept in the model as required by the theory. However, the residuals of the regression are tested for unit root to see the consistency of the regression. The results are presented in table 5 as models A-1 and A-2. Model A-1 has exactly the same lag structure as equation 3 whereas model A-2 has the full set of lags and encompasses the spirit behind equation 1. Given the theoretical construct of equation 3, we do not expect the regressors to be correlated with the error term. The same conclusion is supported by the diagnostic tests. Neither of the two regressions are significant, however (see *F*-test), although A-2 appears to be better specified. Our interest is more in the sign and significance of the lagged output gap term (*GAPHP*). Clearly, for the sample period, the output gap is not significant in explaining inflation.

However, it may be argued that during most of the sample period, the Indian economy remained supply-driven, with all kinds of controls clamped on by the government. To see the effects of the controls, we run a rolling regression with a window size of fifteen, using the same set of variables; the results are recorded in figures 3, 4, 5, and 6. The lagged output gap is not significant enough to explain current inflation, although the signs are correct.

FIGURE 3. Result of Rolling Regression with Variables in Model A-1



11. Harvey and Jaeger (1993).

TABLE 5. Regression Results with Svensson's Lag Structure: Selected Models

Regressor/Dependent variable	*1972–73 to 2002–03 Model A-1* DLWP	*1972–73 to 2002–03 Model A-2* DLWP
Intercept	0.171 (0.053)*	1.124 (0.072)***
DLWP (–1)		0.392 (0.262)
DLWP (–2)	–0.092 (0.242)	–0.151 (0.288)
GAPHP (–1)		0.351 (0.697)
GAPHP (–2)	0.570 (0.690)	0.630 (0.759)
DR1 (–1)		–0.348 (1.460)
DR1 (–2)	0.987 (0.529)	–0.401 (1.456)
Summary statistics		
R^2	0.184	0.270
$\bar{R}^2$	0.091	0.071
SER	0.050	0.051
F statistic, $F(k-1, n-k)$, n = 31, k = no. of regressors including intercept	1.96 [0.66]	1.37 [0.27]
Diagnostic tests		
LM (1) serial correlation	2.08 [0.15]	0.21 [0.65]
LM (2) serial correlation	2.08 [0.05]	1.24 [0.54]
ARCH (2) test CHSQ (3)	11.92 [0.00]	3.85 [0.14]
Functional form CHSQ (1)	4.46 [0.04]	1.68 [0.20]
Normality CHSQ (2)	1.22 [0.54]	3.58 [0.17]
Predictive failure CHSQ (2)	0.83 [0.66]	0.32 [0.85]
Residual unit root		
Test statistics (DF)	–3.49	–5.88

Note: Predictive failure tests are conducted by breaking the sample at 2002. Unit root test statistics are presented corresponding to the SBC model selection criteria in a unit root test with second order ADF.

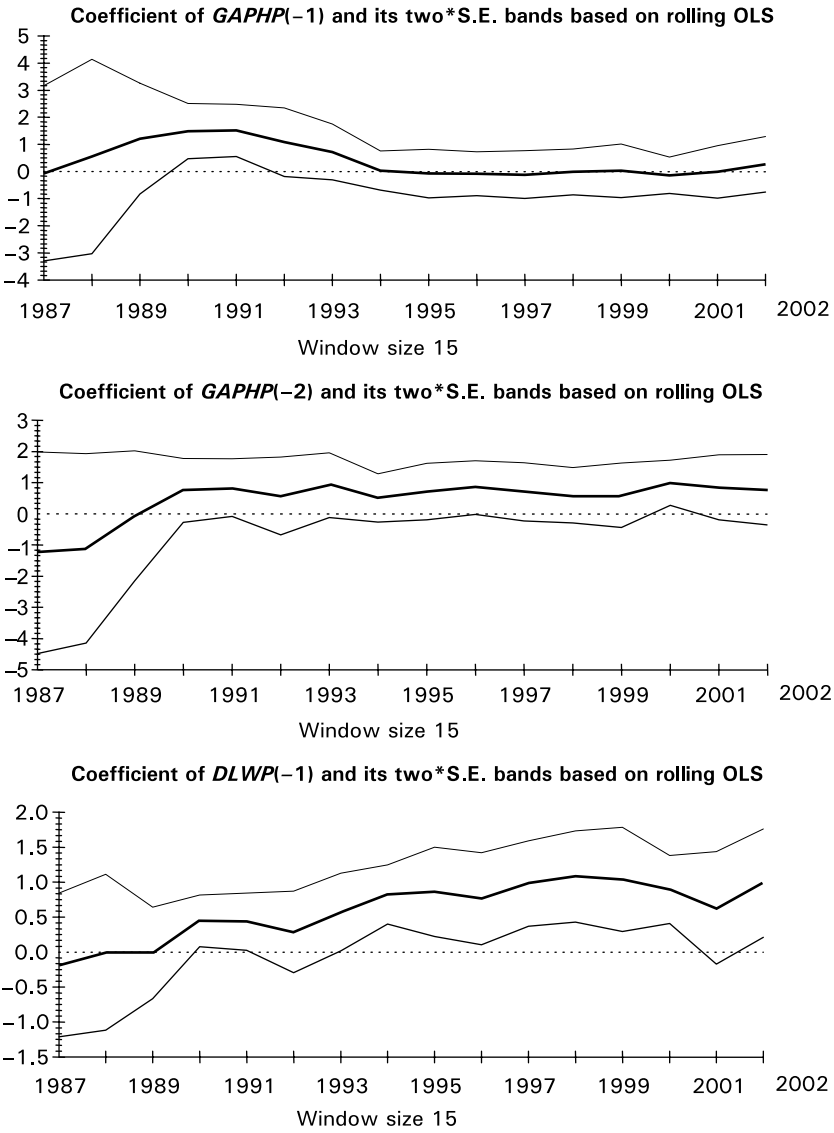
*Significant at the 1 percent level. **Significant at the 5 percent level. ***Significant at the 10 percent level. Standard errors are in parentheses; p-values are in brackets.

The rolling regression does suggest some persistence of inflation during the more recent periods. In this context, note that since the second half of 1990s, India has experienced significantly low levels of inflation. At lower levels of inflation, the variance is small and the series appears to persist.

An Alternative Formulation of the Inflation Equation for India

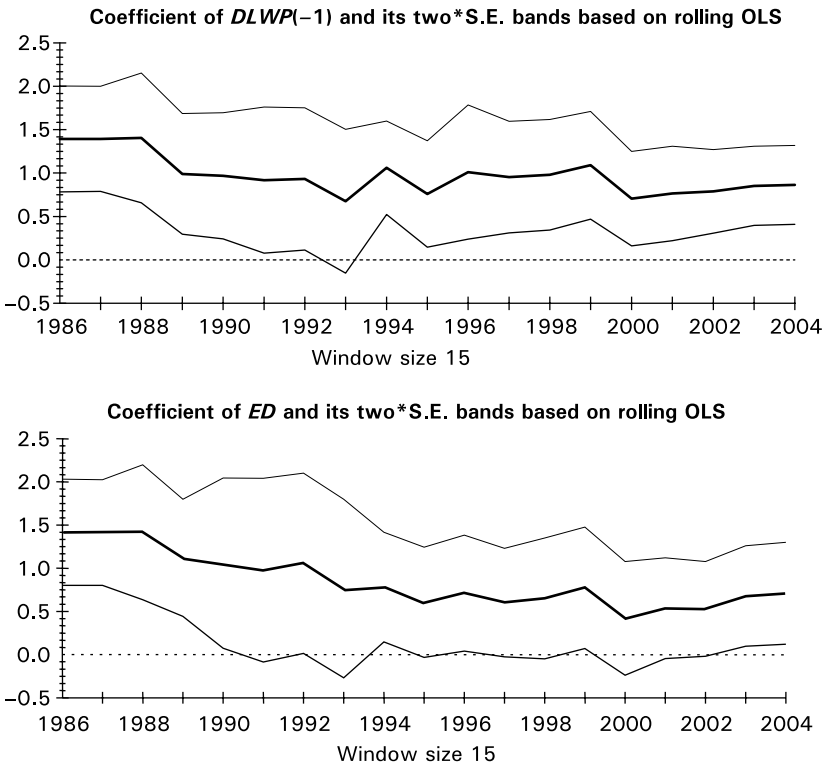
Svensson's derivation of the optimal policy rule depends on the assumed structure of the economy and its implications for the inflation-generating process. This derivation was not found to be satisfactory in the Indian context. The failure to capture demand effects in that model need not mean

FIGURE 4. Result of Rolling Regression with Variables in Model A-2



that they are unimportant, however; the outcome could be the result of structural misspecification. The focus here is on replacing Svensson's postulated structure, with its Phillips curve, with an alternative that might better accord with conditions in India.

FIGURE 5. Result of Rolling Regression with Variables in Model B-1



The Alternative Equation

$$\pi_{t+1} = \pi_t + \alpha ed_{t+1} + \varepsilon_{t+1} \tag{9}$$

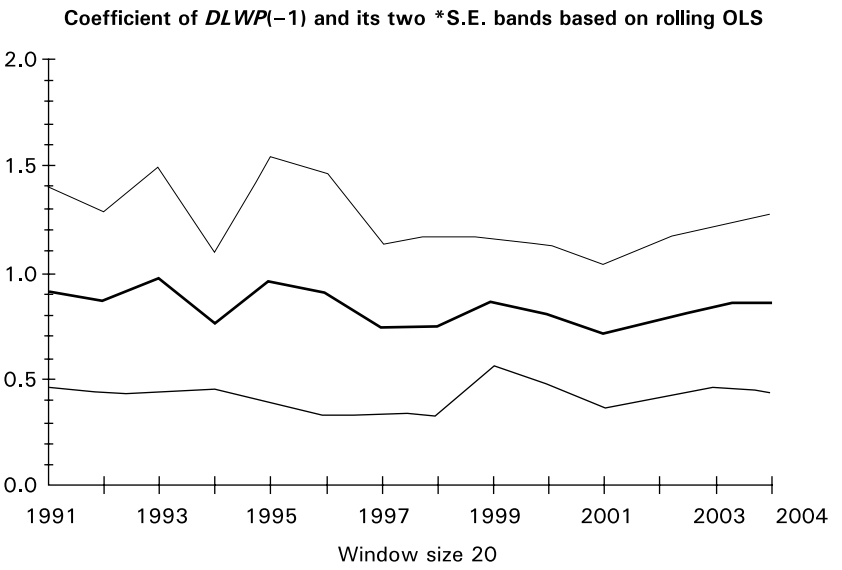
$$ed_{t+1} \equiv y_{t+1} - [(1+\pi_t)(1+\hat{q}_{t+1}) - 1] \tag{10}$$

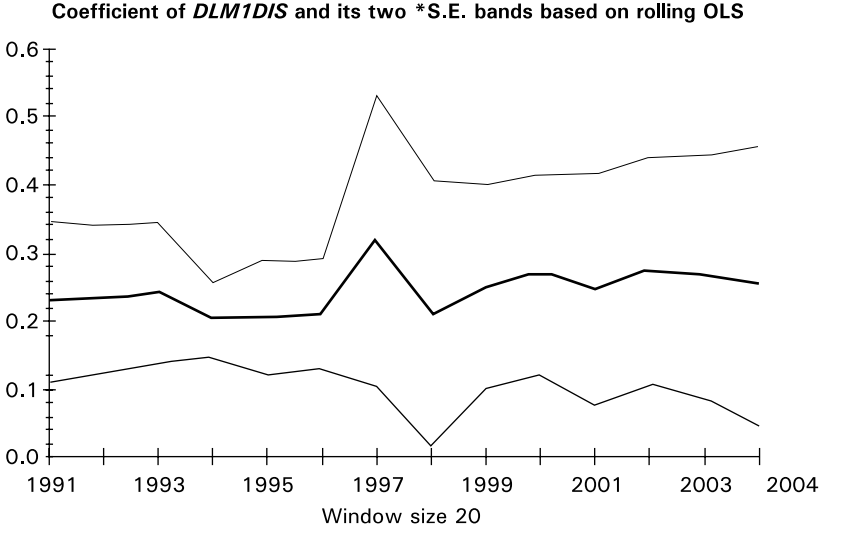
$$y_{t+1} - (\pi_t + \hat{q}_{t+1})$$

$$y_{t+1} = c + \beta_1 Dd_t - \beta_2 D(i_t - \pi_t) + \eta_{t+1} \tag{11}$$

In addition to the variables defined earlier, *ED* is the growth rate of nominally valued aggregate excess demand, d is the budget deficit ratio, y is the nominally valued GDP growth rate, and $\hat{q}$ is the growth rate of potential output. D is the difference operator. All coefficients are positive, $\alpha \leq 1$ and the stochastic terms have the same interpretation as before.

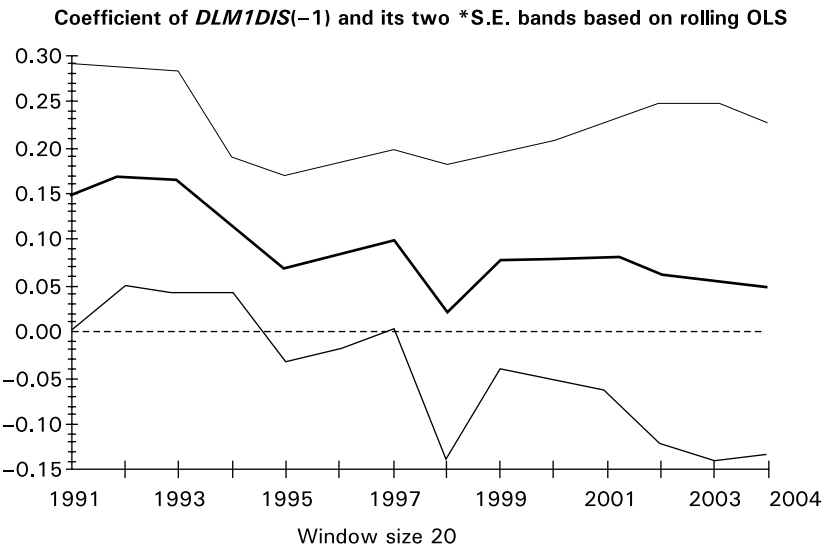
FIGURE 6. Rolling Diagrams of Regression for Model D-3: *DLWP* on *INPT*, *DLWP*[1], *ED*[0], *DLPEO*[0], *DLPMO*[0], *DLWOP*, *DLM1DIS*[0–1], *DRAINR*[0], *DLFERUWB* [0], and *DLWAGPI*[0]

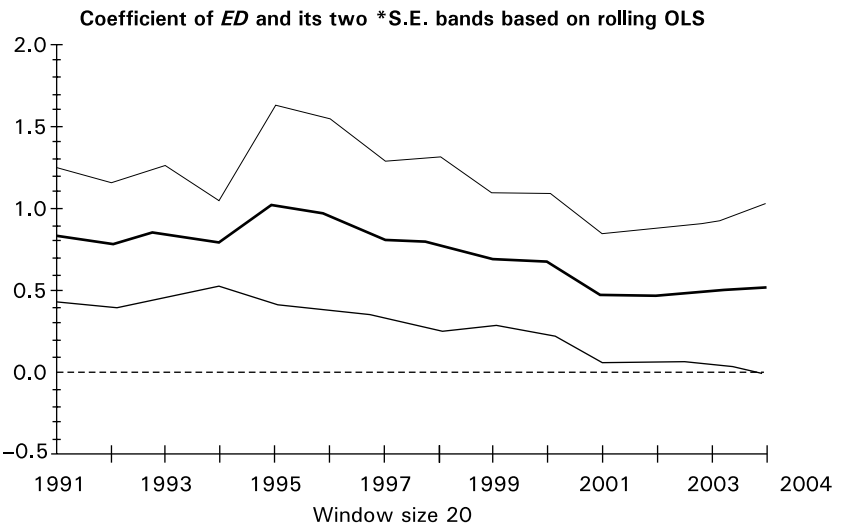




(Figure 6 continued)

(Figure 6 continued)





(Figure 6 continued)

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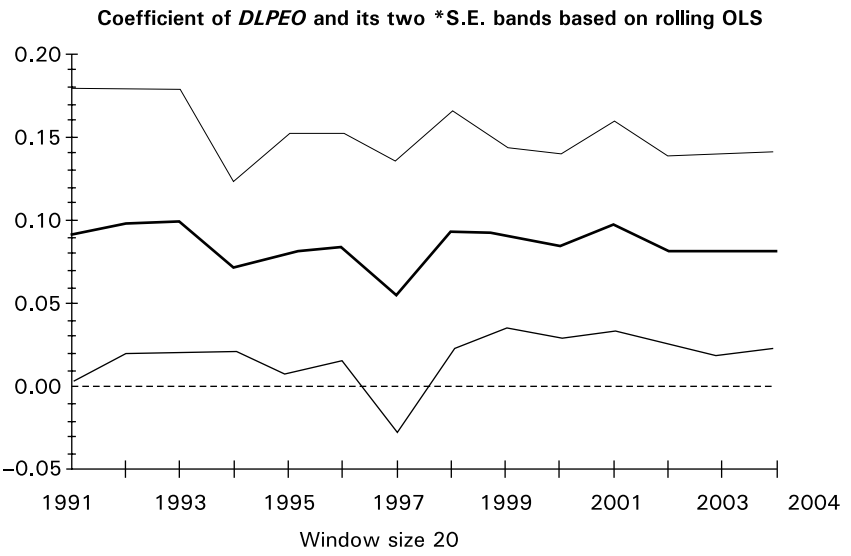

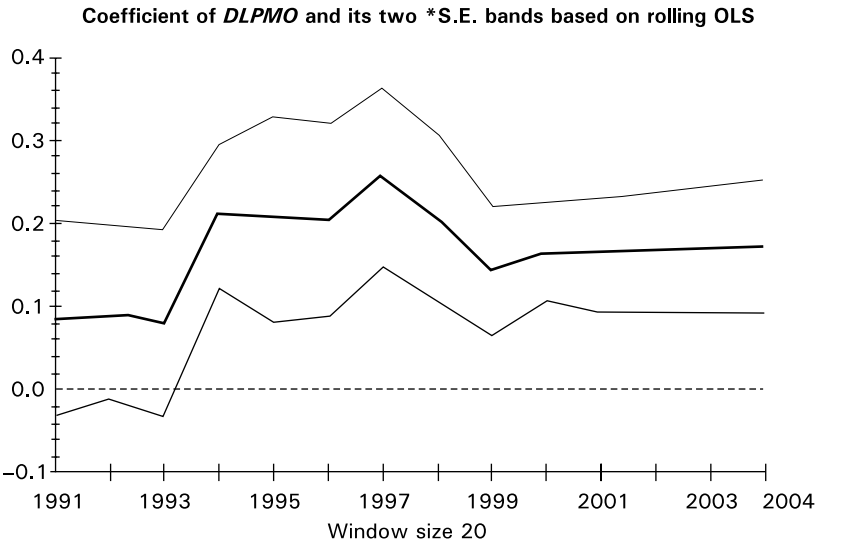

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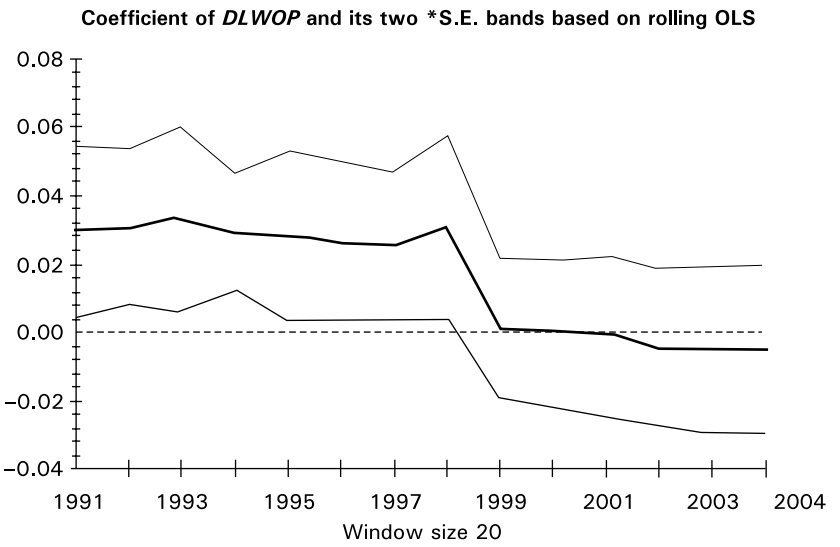

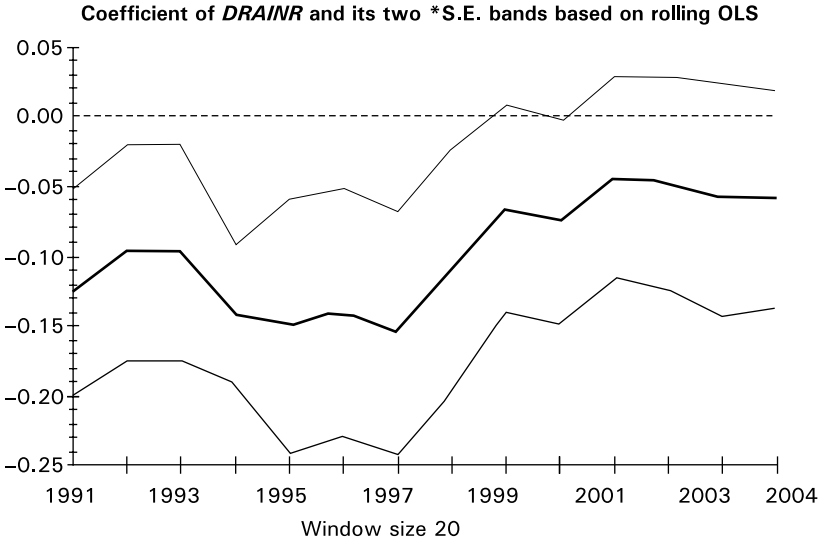

(Figure 6 continued)

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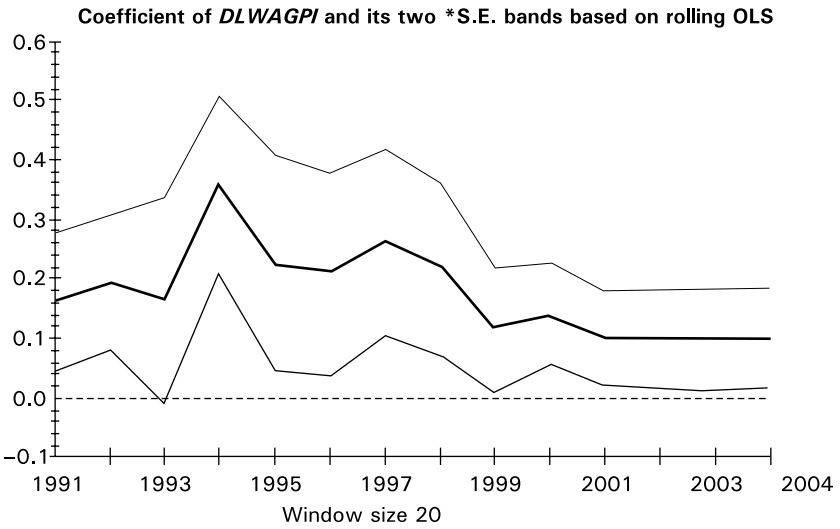
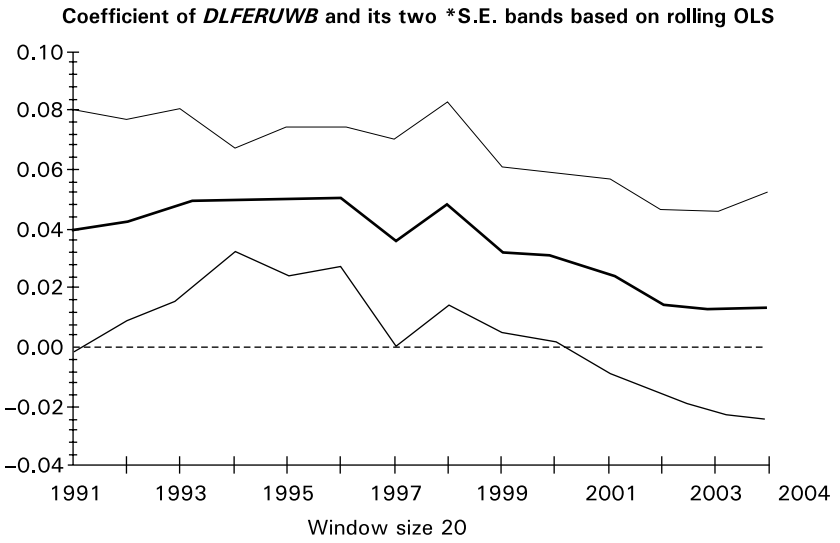




Equation 9 states that the inflation rate equals the previous period's inflation rate, a one-year lag being needed to allow for the type of inflation persistence found in India. If the growth in aggregate excess demand is other than zero, however, a proportion of that growth α will be reflected in

the inflation rate. Aggregate excess demand growth is defined in equation 10 as the difference between the nominal GDP growth rate y and the growth rate of potential output $\hat{q}$ valued at the preceding year's rate of inflation. The definition involves three postulates: first, that the growth in current sales is indicated by y; second, that the growth in sales receipts required to induce the economy to expand its production at its potential growth rate must cover the growth in input costs, allowing for some unspecified but stable profit margin; and third, that the growth in input costs is proxied by the lagged inflation rate.[12] According to this definition, if the nominal income growth rate equals the nominal potential output growth rate, excess demand growth would be zero.[13] There would then be no additional pressure on the inflation rate, which would maintain its inertial rate, assumed to be the previous period's rate. Hence, actual output growth would coincide with that of potential output.

The potential output growth rate is a function of technology, labor, and capital inputs, and is taken as exogenously given in the current short-run context, because it is difficult for policy to modify the output growth rate in such a short time span. The other component of fluctuations in the nominal excess demand growth rate is provided by the nominal GDP growth rate. This growth rate can be more readily influenced in the short run through, for example, the application of monetary and fiscal policies. As an initial working hypothesis that is subsequently tested, equation 11 hypothesizes that the nominal income growth rate is a positive function of the previous period's growth in the fiscal deficit, and a negative function of the change in the realized real rate of interest. Such a hypothesis accords with conventional thinking about some of the key determinants of aggregate demand. If there are no changes in these variables, which would be the case in a steady state, nominal income growth is assumed to settle at some constant rate c, which is given by the long-run potential output growth rate and the long-run target inflation rate, consistent with standard monetary theory.

The above model specifies how nominal income growth, postulated to be determined as a separate process, is distributed between real output

12. The use of the previous period's rate of inflation in valuing potential output growth rates can be viewed alternatively as reflecting a specific process governing the expectations of suppliers.

13. Chand (1997) develops this structural specification. The exercise is that of decomposing nominal income, viewed as determined separately, into its output and price components; see also Gordon (1981). Imposing a Phillips-type linkage on the output and price components as in Svensson's derivation may not be consistent with the determination of nominal income from the demand side, resulting in a structural misspecification.

growth and the rate of inflation. Applying a proportion α to *ED* to indicate its impact on inflation assumes that the remaining proportion of excess demand will affect the output growth rate. Note that the specification in equation 11 provides for two potential policy instruments involving the fiscal deficit and the nominal interest rate. These are instruments traditionally invoked to influence aggregate demand, but in principle there could be additional or alternative policy instruments for managing aggregate demand. The selected specifications are tested in the next section.

Retaining the strict inflation-targeting goal of minimizing deviations between the forecast inflation rate and the target rate, what does the above model imply for the choice of instrument and the optimal setting? Undertaking a similar optimization procedure to Svensson's, first generate a solution for the inflation rate from equations 9, 10, and 11.

$$\pi_{t+1} = \pi_t - \alpha(\pi_t + \hat{q}_{t+1} - c) + \alpha\beta_2 D(\pi_t - i_t) + \alpha\beta_1 Dd_t + \alpha\eta_{t+1} + \varepsilon_{t+1} \tag{12}$$

Next, minimize the present discounted value of losses from deviations between the expected rate and the target inflation rate subject to equation 12.

$$\text{Min}_{i_t, d_t} E_t \delta L(\pi_{t+1}) \tag{13}$$

The first-order conditions with respect to the nominal interest rate instrument and the fiscal deficit are respectively

$$\frac{\partial E_t \delta L(\pi_{t+1})}{\partial Di_t} = -\delta\alpha\beta_2(E_t\pi_{t+1} - \pi^*) = 0, \tag{14}$$

and

$$\frac{\partial E_t \delta L(\pi_{t+1})}{\partial Dd_t} = -\delta\alpha\beta_1(E_t\pi_{t+1} - \pi^*) = 0 \tag{15}$$

The conditions are met if the expected rate of inflation a year from now equals the target rate. Since this is equivalent to equating the inflation forecast given by equation 12 to the target rate, we can employ the target rate in equation 12 and solve for the optimum values for whichever of the two instruments is used for promoting the inflation target.

$$Di_t = D\pi_t + \frac{1}{\alpha\beta_2}(\pi_t - \pi^*) + \frac{\beta_1}{\beta_2} Dd_t - \frac{1}{\beta_2}(\pi_{t-1} + \hat{q}_t - c) \tag{16}$$

$$Dd_t = -\frac{(\pi_t - \pi^*)}{\alpha\beta_1} + \frac{\beta_2}{\beta_1} D(i_t - \pi_t) + \frac{1}{\beta_1}(\pi_{t-1} + \hat{q}_t - c) \quad (17)$$

Equation 16 is broadly similar to the standard model's equation 8 earlier: the more the current rate of inflation exceeds the target the higher the nominal interest rate should be set. However, the output gap does not appear in equation 16, where it has been replaced by a term involving the nominal value of potential output growth and also the fiscal deficit. Increasing the last stimulates excess demand, which raises the inflation rate, thereby requiring a higher nominal interest rate to offset it.

An interesting new element is the alternative model's optimal policy rule for the fiscal deficit. Should the forecast inflation rate be higher than the target, the fiscal deficit has to be reduced to lower excess demand and bring the forecast inflation rate back to target. However, if in the process the real interest rate is made higher, the reduction in the fiscal deficit will need to be restrained to counteract the interest rate's deflationary consequences.

Having two instruments directed at the same target gives an extra degree of freedom. Which instrument should be dispensed with? In accordance with well-established procedures in policy analysis (the Mundell rule), the instrument with a bigger impact on the target variable and milder side effects should be selected. From equation 12 the relative impacts on the target variable are determined by comparing the respective sizes of the β coefficients. But even if the fiscal deficit, ideally adjusted to remove feedback effects on it, is less potent than the nominal interest rate instrument, it may still be the preferred instrument for dealing with inflation insofar as its side effects are milder. Considerations that may be decisive in the instrument assignment would also be the scope for using interest rates to address other problems such as that of ensuring a stable exchange rate and preventing revaluation volatility in balance sheets.

Testing the Alternative Specification

We start here with estimation of equation 9 (the results are presented as model B-1 in table 6). Clearly, *ED* along with lagged inflation appears to explain a much larger part of inflation than was the case with the previous model, and the estimation results are also consistent. However, the coefficient estimates are much too large since they exceed unity, indicating the presence of some upward bias possibly involving linkages with omitted variables. Since the normality assumption is violated in model B-1, the significance of the variables was tested using Wald's maximum likelihood

TABLE 6. Regression Results under Alternative Formulation: Selected Models

Regressor/ dependent variable	*1972–73 to 2002–03 Model B-1* DLWP	*1972–73 to 2002–03 Model B-2* DLWP	*1972–73 to 2002–03 Model B-3* DLWP	*1973–74 to 2002–03 Model B-4* ED
Intercept	–0.009 (0.016)	–0.009 (0.016)	0.190* (0.057)	– 0.034* (0.012)
DLWP (–1)	1.157 (0.198)*	–0.044 (0.138)	–0.067 (0.260)	
DDLWP (–1)			0.279 (0.194)	
DLYHP			–2.041** (0.960)	
ED	1.152 (0.204)*			
EDNP		1.151 (0.204)*		
DGAPHP				
DGAPHP (–1)				
DLCFGAP (–1)			–0.055 (0.079)	–0.057 (0.050)
DLCFGAP (–2)				0.108* (0.043)
DDR1 (–1)			0.443 (1.228)	– 2.383* (0.623)
DDR1 (–2)				1.693** (0.697)
DSBI (–2)				– 0.552 (0.339)
DLIPIG5				0.942* (0.181)
DLIPIG5 (–1)				0.366*** (0.174)
DGBG5 (–2)				1.480** (0.612)
DDLM1DIS (–1)				0.302* (0.064)
Summary statistics				
R^2	0.580	0.570	0.311	0.862
$\bar{R}^2$	0.550	0.539	0.167	0.800
SER	0.035	0.035	0.048	0.022
F statistic, *F*(*k*–1, *n*–*k*), *n*=31, *k*= no. of regressors including intercept	18.66 [0.00]	18.54 [0.00]	2.167 [0.09]	13.92 [0.00]
Diagnostic tests				
LM (1) serial correlation	0.11 [0.75]	0.04 [0.83]	0.08 [0.78]	0.83 [0.36]
LM (2) serial correlation	0.97 [0.61]	0.46 [0.79]	0.08 [0.6]	1.29 [0.52]
ARCH (2) test CHSQ (2)	0.06 [0.97]	0.32 [0.85]	0.49 [0.17]	0.16 [0.92]
Functional form CHSQ (1)	1.16 [0.28]	1.06 [0.30]	4.09 [0.04]	6.33 [0.01]
Normality CHSQ (2)	11.12 [0.00]	11.30 [0.00]	2.55 [0.28]	2.78 [0.25]
Predictive failure CHSQ (2)	0.07 [0.97]	0.05 [0.98]	0.01 [0.99]	0.68 [0.71]
Residual unit root				
Test statistics [DF/ADF (1)]	–4.94	–6.07	–5.20	–4.01

Note: Predictive failure tests are conducted by breaking the sample at 2002. Unit root test statistics are presented corresponding to the SBC model selection criteria in a unit root test with second order ADF.

*Significant at the 1 percent level. **Significant at the 5 percent level. ***Significant at the 10 percent level. Standard errors are in parentheses; *p*-values are in brackets.

criterion. The results indicated that both variables were highly significant. The rolling regression of lagged inflation is significant, and despite intermittent failure *ED* is also significant during most of the windows, particularly the recent period (figure 5).

An alternative and possibly more intuitive way of presenting equation 9 is to substitute equation 10 in equation 9 to yield a relationship between the current inflation and the difference between the nominal growth rate and the real potential growth rate. This difference is represented by the variable *EDNP*. This regression is presented as model B-2 in table 6. The estimated coefficient attaching to *EDNP* is virtually identical to that associated with *ED* in B-1. The importance of B-2 is that it relates the inflation process directly to the difference between the nominal income growth rate and the potential real growth rate but without imposing any valuation on the latter. The rate of inflation is now a proportion of the excess of nominal income growth over real potential growth. As a consequence the contribution of the lagged inflation term is reduced.

Rather than use *ED* we could use the parallel concept of the change in output gap (*DGAPHP*), which corresponds in growth rate terms to the output gap earlier employed. When this variable is used in model B-3, the sign is significantly negative. This is puzzling, given the conventional view that an increase in the output gap should be more inflationary.[14] Such a result indicates that this view needs to be reconsidered. The fact that a negative sign resulted from regressing the inflation rate on the change in the output gap suggests that nominal income is determined by a process separate from that of its constituents. Hence, since nominal income growth is the sum of the inflation rate and the rate of output growth, if the latter increases the former must decline as long as nominal income is unchanged, which would explain the estimated negative sign.

Next we estimate a reduced-form equation for inflation using equation 12 with the specified lag structure and present the results as model B-4. Neither the lagged growth in fiscal deficit nor the lagged change in interest rate affects current inflation. However, when the same variables are used to explain *ED*, they are found to be significant albeit with a different lag

14. In a more recent work, the Reserve Bank of India has estimated inflation using the output gap and claims to have obtained a positive relationship between the output gap and inflation (RBI 2004). However, this relationship is a very specific case where estimations are made without intercepts. The results are fragile to inclusion of an intercept term and, therefore, cannot be taken as robust.

structure (model B-5, table 5). The signs are also as expected. The determinants of *ED* must be established to identify and quantify the effects of demand-side variables on nominal income, and some testing is undertaken to establish the influence of additional variables and different lag structures.

Variables that affect *ED* through the external sector include growth rates in industrialized countries (*DLIPIG5*) and changes in GDP-weighted government bond yields (*DGBG5*). Five countries, France, Germany, Japan, the United Kingdom, and the United States (G5), are taken to represent industrialized countries. With increasing yield on international bonds, the domestic currency depreciates, thereby increasing exports. Similarly, with an increase in international output, demand on Indian exports increases. Both these factors lead to an increase in *ED*.

Looking at domestic financial intermediation, the domestic deposit rate (*DR1*) and lending rates (*SBI*) have opposite signs with two lags. A higher deposit rate indicates liquidity constraint and presumably restrains expenditures with one lag, while a higher lending rate reduces them with apparently two lags. Concerning monetary and fiscal influences, excess acceleration in narrow money growth (*DDLM1DIS*) and growth in fiscal deficit (*DLCFGAP*) are found to significantly affect *ED* , but with one and two lags respectively. Money growth might itself be affected by the fiscal growth with a lag, although the two growth rates are not contemporaneously highly correlated. In addition the lag structure of the two variables reduces the possibility of endogeneity. The finding that the first lag of the fiscal variable is not significant need not indicate that fiscal effects are unimportant, but rather that they have not been adequately represented. Aside from the issue of adjusting the fiscal deficit variable to exclude endogeneity effects so as to capture its discretionary aspect, the inclusion of the monetary acceleration term could primarily reflect fiscal influences, given the dominant role of the budget in the process of generating the money supply.

Expanding the Alternative Specification

Considering that the inflation models discussed so far have rather limited explanatory power and the standard errors of regression are high, it is important to explore other sources of inflation in India. The particular limitation comes from the inadequacy of demand-side variables such as *ED* in explaining inflation. An alternative approach to modeling the demand side would be to adopt the monetarist way of modeling inflation. In this approach, which continues to dominate the Indian literature, the price equation is

obtained by inverting the demand for money equation.[15] However, a pure demand-type monetarist model can at best provide only a poor and incomplete specification of the inflation process in India, because inflation movements may not result simply from excess money over nominal income alone as predicted by such models. It is revealing that in the annual commentary on price and distribution in various issues of the *Economic Survey*, particularly during the 1990s, the discussion emphasizes supply-side effects.[16] Also several studies have demonstrated supply-side dominance in the inflationary process in India.[17]

Nonetheless, even though the supply of money is dominated by the fiscal deficit and its monetary financing requirements, no model of inflation in India can ignore money. This is in keeping with general observations elsewhere.[18] Further, given a desire to collect inflation taxes, the possibility of some discretion in conducting monetary policy cannot be ignored. It is also important to identify a potential monetary aggregate that can be treated as exogenous to the inflationary process. In the current study, narrow money (M1) is identified as the preferred aggregate based on causality tests.

Fewer attempts have been made in recent years in India to address supply-side aspects of price formation behavior involving such variables as nominal wages and prices of important inputs and intermediates at the aggregate level. Balakrishnan modeled manufactured prices through an error correction model, using annual data for 1952–80, and found that labor and raw material costs were both significant determinants of inflation in the industrial sector.[19] Joshi and Little modeled food and nonfood inflation separately using money, consolidated fiscal deficit, food production, nonfood production, and import prices as explanatory variables.[20] Callen and Chang modeled WPI-based annual inflation for the period 1957–58 to 1997–98, with output gaps in

15. Pradhan and Subramanian (1998), Arif (1996), and Rangarajan (1998) are three studies where a predominantly monetarist approach has been used. Most recent among these, Pradhan and Subramanian (1998) model the CPI for urban nonmanual workers (CPI-UNME) and the CPI for agricultural labor (CPI-AL), which is dominated by food items. The series on CPI-AL has already been rendered outdated (GOI 1994, 1996), however, and the CPI-UNME has limited application in conducting monetary policy because of its very small basket size, which is focused on a particular segment of the labor force.

16. The *Economic Survey* is the official document of the Ministry of Finance issued before the presentation of the annual budget of the Government of India.

17. See, for example, Bhattacharya and Lodh (1990) and Singh (2002).

18. See, for example, McCallum (1994).

19. Balakrishnan (1991, 1992, 1994). Balakrishnan uses a dataset of old vintage that probably cannot be updated due to discontinuation in data compilation. Therefore, the usefulness of such a study is necessarily limited.

20. Joshi and Little (1994).

industrial and agricultural components of GDP, treating them separately as well as combined.[21] They found that the lagged industrial gap was insignificantly positive, while the lagged agricultural output gap was significantly negative and the lagged combined output gap insignificantly negative. This led them to conclude that inflation in India is structural. They did not analyze the contemporaneous gaps, however.

Drawing on the above considerations, we adopt the following strategy: First, an input-based basic model is created. This is augmented by adding demand-side variables in three alternative forms: monetarism, a Phillips curve output gap analysis, and the alternative *ED* approach.

A general form of the price equation based on costs can be written as follows.

$$P = \mu \prod_{i=1}^{n} X_i^{\alpha_i}, \sum_{i=1}^{n} \alpha_i = 1 \tag{18}$$

Here, X_i is the cost of the i^{th} factor, α is the share of the i^{th} factor in total cost and μ is a constant capturing the markup. Taking logs and then differentiating yields an input-based inflation equation. In an economywide model, the selection of such variables is limited. Most such inputs may form part of the WPI basket. However, we select those sensitive components that are important in the production process of several other goods and thus proxy a wider range of inputs. We consider petroleum mineral oil as a key energy source, and we proxy energy prices using the international price of oil (*WOP*), as well as the domestic price of mineral oil (*WPIMO*). *DLWOP* and *DLWPMO* represent inflation rates in world oil prices and domestic oil prices. Both variables must be considered because the government of India controls domestic oil prices using several instruments, and the inflation rates for domestic oil prices and world oil prices are not synchronized. However, the world oil price can affect inflation in India through other channels such as the international prices of goods and services, the transport cost of Indian exports, and expectations about future prices.

To capture agriculture-specific effects, we choose the price of fertilizer (*WPIFZ*) as another key input. Edible oil (*WPIEO*) is considered as a critical input to manufactured food. The weights of mineral oil, edible oil, and fertilizer in the overall WPI are about 6.7 percent, 2.5 percent, and 3.9 percent, respectively. The weight of manufactured goods is 63.8 percent; that

21. Callen and Chang (1999) also model quarterly inflation using an index of industrial production-based output gap and report signs of the output gap term that are not consistent with standard expectations.

of fuel, power, and lubricants is 14.2 percent; food products, 15.4 percent; and nonfood primary products including minerals, 6.6 percent.

Edible oil inflation, which is part of the manufacturing sector, is not highly correlated with inflation in that sector, partly because a substantial part of it is imported. In line with expectations, mineral oil and edible oil price inflation are not themselves correlated (table A-2). Therefore, both can be allowed in the inflation model as supply-side variables, where they proxy a sensitive component of import prices in India.[22] In addition, we also use world consumer price inflation (*DLCPIW*), as reported by the International Monetary Fund in its *International Financial Statistics*, to capture the general inflation trend worldwide. The sign of *DLCPIW* is positive and significant, indicating the wider interaction of the Indian economy with the rest of the world.

Regarding wage price inflation, wages of public sector employees (*WAGPI*) are used as the benchmark salary for workers in other sectors, since India has no series to represent general wage price inflation. However, public sector wages are likely to influence the wages elsewhere in the economy and so considered a suitable proxy for wage inflation at the aggregate level.

Finally, to see if it provides a suitable hybrid, money is introduced into model C-2 as excess money growth over its long-term trend growth rate (*DLM1DIS*). Treating money in this way yields the same coefficients with or without the long-term trend growth The advantage of this definition, however, is that it corresponds better to the meaning of discretionary money growth. In addition, the selection of narrow money is motivated by the finding that this aggregate precedes inflation in the sense of Granger causality, while other aggregates have bidirectional causality. Although the introduction of money in model C-2 improves the model significantly, the coefficients of monetary growth are small at 0.35 including both lags, a finding that indicates that the scope for purely monetary control on inflation is limited, at least in the short run (table 7).

Table 8 incorporates the two additional and alternative specifications of the demand side in the basic supply-side platform. Model D-1 clearly indicates the supply dominance on the economy's inflation rate. Most of the supply-side variables remain significant. While contemporaneous as well as lagged *DGAPHP* remains negative, however, the size of the coefficients is reduced significantly. All the variables contained in model C-1 retain their signs as well as size. The model D-1 is statistically well estimated with high R^2 and good forecasting ability, but the size of the demand-side effects is difficult to know because the sign of *DGAPHP* is negative.

22. Singh (2002).

TABLE 7. Regression Results of Input-Based Inflation Models: Selected Models

Regressor/Dependent variable	*1972–73 to 2002–03* *Model C-1* DLWP		*1972–73 to 2002–03* *Model C-2* DLWP	
Intercept	0.107	(0.013)	0.027***	(0.014)
DLWAGEPI	0.018	(0.063)	0.020	(0.061)
DLWFZ	0.113**	(0.049)	0.108**	(0.046)
DLPEO	0.175*	(0.034)	0.159*	(0.035)
DLPMO	0.115***	(0.061)	0.129**	(0.057)
DLWOP	0.040**	(0.016)	0.038**	(0.014)
DLCPIW	0.230*	(0.081)	0.123	(0.086)
DLM1DIS			0.150**	(0.073)
DLM1DIS (–1)			0.155***	(0.076)
Summary statistics				
R^2	0.858		0.889	
$\bar{R}^2$	0.822		0.850	
SER	0.022		0.020	
F statistic, $F(k-1, n-k)$, $n=31$, $k=$ no. of regressors including intercept	24.16	[0.00]	22.10	[0.00]
Diagnostic tests				
LM (1) serial correlation	0.03	[0.87]	0.05	[0.83]
LM (2) serial correlation	4.15	[0.13]	4.20	[0.12]
ARCH (2) test CHSQ (3)	0.92	[0.63]	1.30	[0.52]
Functional form CHSQ (1)	0.30	[0.58]	0.57	[0.45]
Normality CHSQ (2)	0.41	[0.82]	2.46	[0.29]
Predictive failure CHSQ (2)	0.35	[0.84]	0.69	[0.71]
Residual unit root				
Test statistics (DF)	–4.94		–4.99	

Note: Predictive failure tests are conducted by breaking the sample at 2002. Unit root test statistics are presented corresponding to the SBC model selection criteria in a unit root test with second order ADF.

*Significant at the 1 percent level. **Significant at the 5 percent level. ***Significant at the 10 percent level. Standard errors are in parentheses; *p*-values are in brackets.

Model D-2 is obtained by superimposing input price inflation rates on demand-side effects captured in *ED*. The coefficient of *ED* is positive and highly significant, but its size is reduced from the one obtained in model B-1, which was excessive. The R^2 is more than 0.90, but the model is not acceptable statistically because of the problem of serial correlation in errors. Model D-2 can be augmented in a number of ways, as indicated in table 8, by including more variables such as deviations in rainfall (*DRAIN*) and growth in foreign exchange reserves (*DLFERU*). Inclusion of these variables improves the explanatory and predictive power of the models. It may be noticed that *DRAIN* and *DLFERU* are also supply-side variables, which are observed to be significant with appropriate signs only in the presence of demand-side variables and the lagged inflation. These variables did not

TABLE 8. Regression Results of Hybrid Inflation Models with Demand- and Supply-Side Variables: Selected Models

Regressor/ Dependent variable	*1972–73 to 2002–03 Model D-1* DLWP		*1972–73 to 2002–03 Model D-2* DLWP		*1972–73 to 2002–03 Model D-3* DLWP		*1972–73 to 2002–03 Model D-4* DLWP	
Intercept	0.008	(0.012)	–0.025	(0.011)	–0.043*	(0.013)	–0.042*	(0.009)
DLWP (–1)	0.294***	(0.161)	0.840*	(0.131)	0.693*	(0.196)	1.032*	(0.113)
ED	0.517*	(0.162)	0.797*	(0.142)	0.722*	(0.195)	0.932*	(0.118)
DGAPHP								
DGAPHP (–1)								
DLWAGEPI	0.012	(0.054)	0.093**	(0.042)	0.101***	(0.054)	0.102**	(0.037)
DLWFZ	0.158*	(0.038)						
DLPEO	0.095**	(0.038)	0.082*	(0.031)	0.100**	(0.040)	0.066*	(0.027)
DLPMO	0.078	(0.053)	0.152**	(0.031)	0.180*	(0.039)	0.161*	(0.025)
DLWOP	0.035**	(0.013)	0.013	(0.010)	0.028*	(0.014)		
DLCPIW	0.148***	(0.080)			0.173**	(0.082)		
DLM1DIS			0.207*	(0.046)				
DLM1DIS (–1)			0.121**	(0.053)				
DRAINR			–0.115*	(0.032)	–0.087***	(0.044)	–0.111*	(0.030)
DLFERU			0.034*	(0.013)	0.036**	(0.016)	0.033*	(0.011)
DDLM1DIS							0.161*	(0.031)
DDLM1DIS (–1)							0.191*	(0.033)
Summary statistics								
R^2	0.906		0.949		0.912		0.963	
$\bar{R}^2$	0.870		0.923		0.879		0.947	
SER	0.019		0.014		0.018		0.012	
F statistic, *F*(*k*–1, *n*–*k*), *n*=31, *k*= no. of regressors including intercept	26.42	[0.00]	37.29	[0.00]	27.26	[0.00]	58.50	[0.00]
Diagnostic tests								
LM (1) serial correlation	2.87	[0.09]	0.74	[0.38]	0.91	[0.98]	0.01	[0.93]
LM (2) serial correlation	8.20	[0.02]	1.89	[0.38]	5.90	[0.05]	0.88	[0.65]
ARCH (2) test CHSQ (2)	1.13	[0.57]	0.67	[0.72]	2.19	[0.35]	0.46	[0.79]
Functional form CHSQ (1)	0.62	[0.43]	0.00	[0.95]	0.26	[0.61]	2.95	[0.09]
Normality CHSQ (2)	3.13	[0.21]	1.01	[0.60]	3.13	[0.21]	0.99	[0.61]
Predictive failure CHSQ (2)	0.20	[0.91]	2.89	[0.24]	0.21	[0.90]	1.57	[0.46]
Residual unit root								
Test statistics [DF/ADF(1)]	–6.62		–5.62		–5.31		–5.25	

Note: Predictive failure tests are conducted by breaking the sample at 2002. Unit root test statistics are presented corresponding to the SBC model selection criteria in a unit root test with second order ADF.

*Significant at the 1 percent level. **Significant at the 5 percent level.***Significant at the 10 percent level. Standard errors are in parentheses; *p*-values are in brackets.

improve the results for the models shown in table 5. Therefore, they could be considered to be conditionally significant. Also, in models D-3 and D-4, we removed *DLWFZ* (fertilizer price inflation) in favor of oil price inflation to improve the model specification. The fertilizer price could be partly determined by the oil price, which is one of the key inputs and also by weather conditions (during favorable weather, farmers are tempted to use more inputs, which raises the fertilizer price).

Adding these additional variables improves the statistical properties. Therefore, on statistical grounds we select model D-3 for further analysis and run a rolling regression for all the variables on the right-hand side taking a window size of 20, which is reasonable given the number of variables in the model. The results of the rolling regression are presented in figure 6. Clearly, contemporaneous money growth, edible oil price inflation, mineral oil price inflation, *ED*, lagged inflation, and wage price inflation remain significant.

A Strategy for Controlling Inflation in India

The empirical results discussed in this paper indicate that the determination of the inflation rate in India does not correspond to the stylized profile of the demand-dependant Phillips curve trade-off prevalent in the advanced economies, and the associated use of the nominal interest rate as the chief instrument with which to influence the inflation rate. Nor did the (shorter-run) monetarist model perform well. An alternative model was developed to better portray demand-side effects on inflation, while allowing for supply-side phenomena. This model performed much better under conditions prevailing in India. The estimation results indicate that the transmission lag between the expenditure stimulus, represented by the excess demand variable *ED*, and the inflation rate is quite short. This finding suggests a more active use of demand-management policy in inflation control, for example, through the use of fiscal policy, since it is more feasible to adopt and maintain a fiscal stance that is geared to projected developments a year ahead than for, say, two or more years.

An issue that needs to be clarified is that of the determinants of *ED*. For estimation purposes we assumed that fiscal effects could be captured by the unadjusted fiscal deficit. The results obtained did not bear this out. More research will be needed to identify precisely how fiscal instruments affect aggregate demand. In particular, a fiscal measure is required that separates out feedback effects of the economy on the budget. Under Indian

institutional conditions, it seems likely that fiscal effects are being captured by the growth in M1—for which budget deficit financing requirements are prominent—in a context of interest rate restraint.

In any case, given the size of the fiscal deficit and its undoubted stimulus and crowding out effects, one component of the suggested approach to inflation targeting in the Indian context would be to rely more on fiscal restraint. If the forecast rate of inflation is likely to exceed the target rate, both the fiscal deficit and its monetary financing would need to be reduced. Of course, simply reducing the monetary financing would not be adequate, either because with unchanged interest rates the increased supply of government paper would be monetized, or because interest rates would increase and some private sector crowding out would occur through that channel.

It is also apparent that safeguards would need to be built in to ensure that political expediency does not lead to a watering down of the commitment to restrain inflation. India has adopted the Fiscal Responsibility and Budget Management Act, which is expected to ensure fiscal discipline. That law eases the concern that relying on fiscal instruments is more open to short-term political expediency. It may still be necessary to develop further the mechanisms for ensuring sound fiscal policy. A simple way to achieve this is to require that the government and the central bank agree on the size of the fiscal deficit and the amount of permissible monetary financing. If the agreement cannot be upheld, then the central bank would be free to raise interest rates.

Another component of *ED* is private expenditures, which in an expenditure approach to inflation control may also need to be restrained. Using the interest rate for this purpose may not be advisable if it has undesirable side effects; for example, the exchange rate could appreciate in a persistent manner that damages export prospects and leads to excessive imports. Asset valuations could become so depressed that long-lasting adverse effects on capital accumulation are created. Regulating the flow supply of credit that finances investment expenditures by adjusting liquidity ratios may be more appropriate, especially since that approach is likely to have weaker, less direct adverse effects on stock asset valuations.

Abstracting from an active use of the interest rate for purposes of inflation control raises the issue of what role the Reserve Bank of India (RBI) would play, aside from regulating liquidity ratios? A useful application would involve portfolio side operations. A key objective for portfolio operations would be to maintain a desired real interest rate, with the nominal interest adjusted whenever the underlying inflation rate deviates from target. From time to time, shifts in liquidity preferences result in asset transactions that

either press interest rates above or below the target long-term level. Accommodating liquidity preference shifts through appropriate open market operations helps keep interest rates stable. If, for example, interest rates were to be reduced to very low levels, there would be at least two effects: first, the reward from postponing consumption would be reduced, which would tend to stimulate current consumption, and second, the discount factor used in establishing the present values of assets would be lowered, which would increase asset values and could have undesirable distortions on the goods market.

In this connection, some recent institutional changes affecting the operations of the RBI are of interest. The inflow of remittances and foreign institutional investors has added to the foreign exchange reserves at an average annual rate of about 18 percent during the last ten years. Concerned over possible currency appreciation and potential adverse effects on exports, the RBI has been undertaking heavy sterilization, with the result that its holdings of domestic assets are almost depleted. A new instrument called a market stabilization scheme (MSS) has now been implemented, whereby the RBI prints money that is kept in a sterilized government account, and pays interest on the equivalent Treasury bills to buy foreign exchange assets from the domestic market. This maneuver enables the RBI to restrain appreciation, but at the cost of keeping interest rates above international levels, the current wedge being about 2 percentage points. This, of course, tends to attract capital inflows, given the market's perception that the RBI will keep exchange rates stable, which then requires some further sterilization and reserve accumulation. A potential for conflict thus exists between interest rate levels that are better geared to internal requirements and those needed as a consequence of international considerations. One way of resolving the conflict would be to apply regulatory and control devices of various sorts to prevent excessive capital inflows.

Conclusion

Key support for the inflation-targeting framework has emerged from two important experiences. First, financial sector reforms and globalization have led to the breakdown of the broad money demand equation in several countries, including India, which has rendered monetary targeting less reliable. The second key reason has been a broader agreement worldwide on maintaining a lower level of inflation as it is detrimental to sustainable growth for various reasons including uncertainties in investment and savings behavior.

The advantage of the ITF is the direct relationship between the inflation target and the objective of monetary policy. However, there is an important question about the efficacy of monetary instruments in targeting inflation, especially in the case of developing countries where a number of rigidities persist because of direct and indirect controls and constraints. The economy may not fully employ its resources and the concept of a nonaccelerating rate of unemployment may not apply. The supply-side dominance appears sufficiently prominent that monetary stance, which relies on influencing the demand side, may be a misjudged risky option. Monetary policy may end up tightening the supply too much, or it may be too proactive, adversely affecting current income flows. Furthermore, it carries potential asset and balance sheet valuation effects that could be disruptive, in addition to adverse real exchange rate developments.

Even advanced economies have been exposed from time to time to costly consequences from persistent deviations of interest and exchange rates from equilibrium levels, and from increased volatility. For example, the real appreciation of the euro by almost 60 percent against the dollar in recent years is an important factor in the erosion of competitiveness and the sluggish economic performance that much of Europe is experiencing today. Even though interest rates are low in Europe, with the European Central Bank essentially operating as an inflation targeter, rates have been even lower in the United States. In addition, for some time now, prospective inflation rates have appeared to be well below target, spawning a "fear of deflation" syndrome that has led to an unprecedented lowering of nominal interest rates in several advanced economies.[23] The low interest rates in turn have contributed to an excessive upward revaluation of assets in these economies, including especially real estate, where low rates appear to have fueled a less productive investment boom in that area, while excessively stimulating

23. The concern with deflation is understandable in an economy, such as Japan's, that has experienced a long period of stagnation. However, it is more difficult to explain these concerns in such economies as the United States, the United Kingdom, or even Australia, since they are, or have been, booming. The unexpectedly benign inflation performance appears to have contributed to this fear of deflation and led to historically low interest levels as inflation targeting would counsel. There is an asymmetry when monetary authorities avow that they are able to identify a deflationary prospect but not an inflationary asset price bubble. Nonetheless, the deflationary reading may have been inappropriate, which illustrates the importance of distinguishing between supply shocks to inflation—productivity growth, the "China factor," or appreciating exchange rates—and demand-side shocks. The fact that the aforementioned economies have simultaneously run very large current account deficits on their balance of payments suggests that demand pressures were potentially inflationary but were dissipated through higher imports, especially from China.

consumption. On occasion regulatory facilities have also been found wanting, as evidenced by the Long-Term Capital Management Hedge Fund crisis or recent concerns that hedge funds are too lightly regulated.

A more cautious approach to inflation targeting in India would rely on both monetary and fiscal instruments and be closely coordinated with other instruments such as government buffer stock and other supply-side operations. If the forecast rate of inflation were to exceed the target rate, both the fiscal deficit and its monetary financing and the general availability of credit flows would be reduced, but without necessarily raising real interest rates. Of course, safeguards would need to be installed to ensure that political expediency does not lead to a watering down of the commitment to restraining inflation.

APPENDIX

Table A-1. List of Variables and Their Descriptions

CGAP	Combined gap between outlay and revenue (Rs. mn).
CPIG5	Consumer Price Index for trade-weighted geometric mean of G-5 countries. Base: 1993–94.
CPIW	Consumer Price Index for world. Converted Base: 1993–94.
DR1	One-three year commercial bank deposit rates (percent per year).
DRAINR	Variation of actual rain fall from normal (fraction).
DSBI	sbi-sbi(–1).
ED	dlyn – [(1 + dlwpl)*(1 + dlyhp) – 1].
FERURB	Foreign exchange reserves, including gold (current US$ mn).
FERUWB	Gross international reserves, including gold (current US$ mn).
GAPHP	ly – lyhp.
GBG5	International government bond (GB) rates. Average of the monthly (line 61 of IFS).
INPT	Intercept.
IPIG5	Industrial production index of G5 countries (trade-weighted geometric mean).
LYHP	hpf(ly, 7).
LYNHP	hpf(lyn, 7).
M1	Narrow money M1 (Rs. mn).
RGDP	GDP at market prices, in constant 1993–94 prices (Rs. mn).
SBI	Average lending rate of State Bank of India (percent per year).
T	Time trend.
USGB	U.S. government bond yield (percent per year). Source: IFS: M111.61.
WAGPI	Index of per capita remunerations of public sector employees (1993 = 100).
WOP	World oil (crude) price index. Converted Base: 1993–94 = 100. Source: IFS.
WPI	World price index of all commodities at 1993–94 prices. Source: ES.
WPIEO	WPI for edible oil (domestic).
WPIFD	WPI for primary food (domestic).
WPIFZ	WPI for fertilizer (domestic).
WPIMO	WPI for mineral oil (domestic).
Y	GDP at market prices, in constant 1993–94 prices (Rs. mn).
YN	GDP at market prices, in current LCU (Rs. mn).

TABLE A-2. Statistical Properties of Selected Variables, 1972–2004

Variable(s)	*Maximum*	*Minimum*	*Mean*	*Std. deviation*	*Skewness*	*Kurtosis-3*	*Coef. of variation*	*Unit root test*[a]
DLWP	0.2247	–0.0109	0.0762	0.0507	1.0484	1.1452	0.67	–4.41
ED	0.0716	–0.2000	–0.0028	0.0487	–1.8686	6.3217	17.46	–5.86
DLPEO	0.4021	–0.2422	0.0747	0.1341	–0.1985	0.1058	1.79	–7.66
DLPMO	0.5248	0.0000	0.1058	0.1134	1.9208	4.1505	1.07	–4.74
DLWOP	0.8520	–0.5508	0.0878	0.3070	0.7943	0.8114	3.50	–4.23
DLM1DIS	0.1034	–0.2474	–0.0071	0.0602	–1.7212	5.9565	8.48	–6.93
DRAINR	0.1617	–0.2472	–0.0353	0.1057	–0.2486	–0.6377	2.99	–7.42
DLWAGPI	0.2838	–0.0408	0.1178	0.0772	–0.0434	0.2544	0.66	–6.53
DLFERUWB	0.5912	–0.3928	0.1408	0.2328	–0.2968	–0.1007	1.65	–3.81
DGAPHP	0.0490	–0.0871	–0.0001	0.0246	–1.1346	3.2304	364.00	–8.05
DLCPIW	0.2443	0.0327	0.1186	0.0565	0.0618	–0.7032	0.48	–1.47
DLWPFZ	0.5770	–0.1395	0.0646	0.1356	2.0055	4.9481	2.10	–4.47

a. Critical value at 5 percent = 2.99. *DLCPIW* demonstrates a structural break at 1994–96 when inflation falls from previous high levels of around 20 percent to low levels of around 5 percent after 1996.

TABLE A-3. Correlation Matrix of the Selected Variables, 1972–2004

	DLWP	*ED*	*DLPEO*	*DLPMO*	*DLWOP*	*DLM1DIS*	*DRAINR*	*DLWAGPI*	*DLFERUWB*	*DGAPHP*	*DLCPIW*	*DLWPFZ*
DLWP	1.00											
ED	0.22	1.00										
DLPEO	0.57	0.54	1.00									
DLPMO	0.66	–0.18	0.07	1.00								
DLWOP	0.49	0.15	0.14	0.48	1.00							
DLM1DIS	0.06	0.09	0.00	–0.15	–0.12	1.00						
DRAINR	–0.15	0.01	–0.14	–0.14	–0.25	0.19	1.00					
DLWAGPI	0.12	–0.36	–0.37	0.32	0.09	–0.19	0.12	1.00				
DLFERUWB	0.05	0.26	0.09	0.02	0.18	0.07	–0.17	–0.18	1.00			
DGAPHP	–0.35	–0.29	–0.26	–0.17	–0.30	–0.20	0.66	0.14	–0.35	1.00		
DLCPIW	0.44	–0.04	0.18	0.09	0.00	0.24	0.24	0.16	–0.24	0.00	1.00	
DLWPFZ	0.65	–0.41	0.10	0.74	0.16	–0.05	–0.13	0.40	0.07	–0.05	0.28	1.00

Comments and Discussion

Rajnish Mehra*: The authors, whose analysis builds on their earlier work, have produced a thought-provoking paper.[1] They highlight many interesting issues regarding the policy implications of inflation targeting and draw upon the experience of countries that have adopted this framework. I do, however, take issue with the methodology of the study—that of testing an atheoretical model on historical data and then using it for policy analysis. My specific comments on the paper appear at the end of this discussion.

I begin by focusing on some of the issues raised in the paper and by making a distinction between targeting inflation and inflation targeting.

Targeting Inflation

The rational for targeting inflation is the lesson learned over the past three decades, about which there is broad consensus, that positive expected inflation, above some low rate, is welfare reducing.

There is less agreement on how this low inflation state should be achieved. In the late 1960s, the prevailing view, championed by Paul Samuelson and Robert Solow, advocated the use of control theory for formulating and implementing macroeconomic policy. A minority, notably Milton Friedman, argued against this, claiming that policy acted with long, variable, and unpredictable lags. With the advent of the Lucas Critique and the Time-Inconsistency literature, the later view has gradually prevailed.[2]

Today, most academics and policymakers accept the view that the economy is complex and that control theory is inappropriate for macroeconomic stabilization. It is also the view, articulated by Friedman and Phelps, that there is no long-run Phillips-curve trade-off.[3]

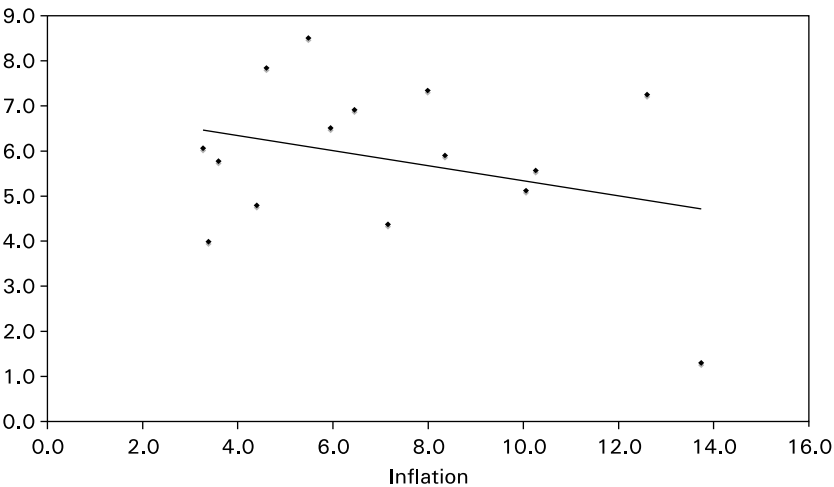
*I specially thank Henning Bohn, Barry Bosworth (the editor), John Donaldson, and Edward Prescott for their insightful comments. I am grateful to the participants of the India Policy Forum Conference for a stimulating discussion.

1. See, in particular, Chand (1997), McKibbin and Singh (2003), and Singh and Kalirajan (2003).
2. Kydland and Prescott (1977).
3. Friedman (1968); Phelps (1968).

Whether there is indeed a short-run Phillips-curve relationship and whether monetary policy can beneficially exploit this short-run trade-off between inflation and the output gap is a long-standing dispute that is still at the center of monetary policy discussions. Friedman and Lucas have argued that given the inherent complexity of the economy and our incomplete knowledge of it, monetary policy should be limited to achieving nominal stability. Their arguments are based on the view that although monetary policy has strong short-run real effects, there is no way to exploit them beneficially. They suggest that a response in the form of a *k*-percent rule for money growth is the best way to achieve nominal stability. Svensson and Woodford on the other hand, argue that there are (limited) short-run exploitable trade-offs.[4] In their analysis, they describe a framework involving optimal exploitation of the short-run trade-off.

Irrespective of one's position on the issues discussed above, the rational for targeting inflation is clear. *Lower inflation rates lead to better operating characteristics for the economy.* See, for example, figure 7, which plots the real growth of gross national product versus inflation for India for the postwar period.

FIGURE 7. Real GNP Growth Rate versus Inflation for India



4. Svensson (1999); Svensson and Woodford (2004).

Inflation Targeting

What is inflation targeting? This is not an easy question to answer as there are many variations on the theme. As broadly accepted, it is a framework for monetary policy *whereby a short-term interest rate instrument responds to deviations of expected future inflation from the target rate and to deviations of output from its full-employment level.* It explicitly incorporates the type of Phillips-curve trade-off discussed earlier. An important feature of inflation targeting is the articulation of this policy—to clearly communicate to the public the plans and objectives of the monetary authorities. This is intended to serve as a quasi-commitment mechanism.

One variant—"the hard version"— is the original Svensson framework.[5] It argues that the central bank should concentrate only on inflation to the exclusion of any other objectives. There are a host of other variations—"the soft versions"—with inflation as only one of the targeted variables. The variants differ depending on what is included in the targeted set. Informal conversations with central banking officials in a number of countries lead me to believe that inflation targeting in practice is almost never implemented in its hard version.

Several questions must then be addressed before a soft version can be effectively implemented. The policymaker must not only articulate the relative weights to attach to inflation and output and specify the horizon for expected inflation and output but must also explicitly address the issue of what variables, other than expected inflation and the output gap, are to be targeted. Thus, inflation targeting in practice targets inflation as well as the output gap, interest rate fluctuations and perhaps other macroeconomic variables as well.

Although many of its proponents, including Svensson, call it a rule, in the face of multiple objectives, it is a discretionary policy with the Phillips curve as its deus ex machina. Its implementation (especially in the face of multiple objectives) will be plagued by all the issues associated with "the multiperiod control problem under uncertainty."[6]

Crucial to its success is the issue of credibility and managing expectations. The more objectives that are targeted, the less credible will be the commitment to target inflation since some of these objectives may be mutually inconsistent. I revisit this issue in the next section.

5. Svensson (1997). Henning Bohn suggested this "hard version" usage, which is the version "tested" by the authors in the paper.

6. By postulating a specific lag structure, Svensson and others convert the multiperiod problem to a sequence of static problems and circumvent some of these issues and their implications.

There is little doubt that a central bank can control inflation. This control, though not perfect due to macroeconomic shocks (such as oil supply shocks) involves costs, which may not be (politically) acceptable. Economic agents, of course take this into account when forming their expectations.

The United States does not explicitly target inflation; in contrast, Canada and the United Kingdom are explicit inflation targeters.[7] In all three countries inflation is low, but it is difficult to attribute this categorically to ITF programs. Ball and Sheridan examine a sample of twenty industrialized countries, seven of which are targeters and thirteen nontargeters.[8] They conclude that on a number of dimensions there is no evidence that inflation targeting improves economic performance. Others, notably Bernanke, King, Mishkin, Svensson and several central bankers (of course!) beg to differ. In the absence of credibility, inflation targeting is just another value-loaded term (with a positive valence).

The Indian Context

Implementing inflation targeting in India raises a number of issues, some technical, others more serious, which address credibility. These include:

—India lacks a comprehensive price index that adjusts for quality and technical innovation. This "measurement issue" could be a major impediment to implementing inflation targeting effectively. Current estimates are most likely upwardly biased.

—What is the evidence on the Phillips curve in India, given the structure of the labor force?

—To what extent will the policy of pegging the rupee to the dollar undermine the credibility of a central bank that promises to inflation target? Pegging the currency and inflation targeting are not in general, mutually consistent. If an inflationary shock mandates high rates in the one country, while low rates persist in the other, capital will flow to the high-rate country, putting pressure on the currency peg. To peg the rupee to the dollar, the Reserve Bank of India has engaged in a classic sterilization policy, buying foreign currency and bonds and offsetting these purchases by selling domestic bonds. Given that the domestic assets of the RBI are rapidly being

7. With Bernanke's appointment as the Chairman of the Federal Reserve, this will probably change as, unlike his predecessor, Bernanke has long supported the concept. It should be noted that by law the Federal Reserve is mandated to pursue maximum employment.

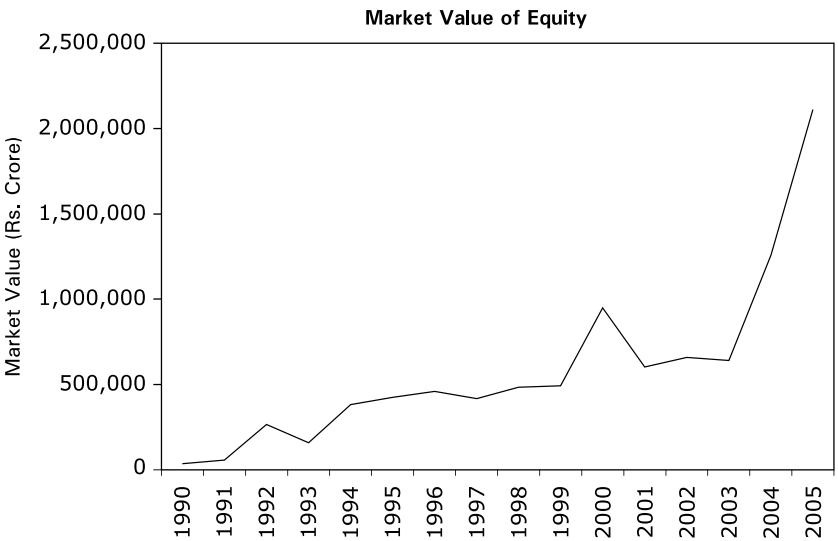
8. Ball and Sheridan (2003).

depleted, it is only a matter of time before the monetary base will be affected—with the concomitant effect on inflation.

—What is the role of current asset valuation levels? Inflation targeting in its hard version also precludes intervening in asset markets in case of a bubble. As Bernanke and Gertler emphasize: "Importantly, it also implies that policy should *not* respond to changes in asset prices, except in so far as they signal changes in expected inflation."[9] Asset valuations in India are at an all-time high. The Indian stock market had risen by more than 90 percent between June 2004 and June 2005 and continues to rise. Figure 8 illustrates this dramatic increase in valuation. The 15 percent decline in the stock index on May 17, 2004, surely had information content regarding fundamental valuations! Again this raises the issue of credibility.

—What about taxation. Given a large parallel economy and political considerations that preclude the taxation of certain sectors of the economy such as agriculture, an inflation tax may be a necessary evil. There is always a temptation for governments to let inflation exceed expectations and needless to say the populace is aware of this! Credibility issues once again are at the forefront of concern.

FIGURE 8. Market Value of Equity in the Indian Stock Market



9. Bernanke and Gertler (1999, p. 18).

Inflation in India is currently running at about 5.6 percent with GDP growth at a healthy 8 percent. The current environment is ideal for embarking on an inflation targeting program. In the absence of a comprehensive price index, the core CPI should be targeted after allowing for a bias in measurement of, say, 1 percent. An advantage of this is that it avoids potentially destabilizing policy responses. The credibility issues raised above would have to be addressed in a transparent manner. The challenge would be to articulate a policy that is credible but not vacuous.

Comments and Quibbles

The paper addresses many, sometimes orthogonal, issues. This is both a strength and a weakness. On the positive side, it alerts the reader to a host of interesting questions; on the other hand, at times it appears to lack a unifying theme.

The paper starts out by "testing" a reduced form of the Svensson model. The authors conclude it does poorly when confronted with Indian data (see table 5). The authors then propose two alternative models: the first focuses on excess demand, where they essentially replace the output gap in the Svensson model with the fiscal deficit. The other is an input-based supply-side model that examines industrial commodities and their price effects on overall inflation. These extensions are completely ad hoc and atheoretical. The authors provide no justification, either empirical or theoretical, for their formulations. In fact the "excess demand" model is a radical change of the Svensson formulation—a change from "levels" to "growth rates." They find that these alternatives are an improvement in the sense that certain coefficients are "significant." I disagree with this as a research methodology especially for formulating policy.

Their key conclusion is that in the Indian context, the use of fiscal policy rather than monetary instruments is likely to be more effective in controlling inflation.

I remain skeptical. To quote Friedman, "Inflation is always and everywhere a monetary phenomena." The effectiveness of policies predicated on using fiscal instruments is an open question. The fiscal deficit is a far more difficult policy instrument to control—quickly and smoothly—than are monetary instruments. While the coordination of fiscal and monetary policy may sound good in theory, it can lead to undesirable outcomes since these policies act with differing lags and over different time intervals. The formulation in the paper implicitly assumes that these time intervals are identical.

The authors emphasize that Indian inflation in recent years appears to be motivated by supply rather than demand shocks. However, there is no evidence in the literature that ITF programs work better under supply-induced inflation than under demand-induced inflation, and I would argue that that this is not a relevant distinction at our current level of understanding. From a practical point of view, as mentioned earlier, the lack of a comprehensive price index in India that adjusts for quality and technical innovation is a major impediment to inflation targeting.

The authors also argue that a supply side model of inflation works best for India and that the lag between an expenditure stimulus and inflation is shorter for India. Unfortunately, they do not offer any cross-country comparison to substantiate this claim or indeed, their observation that the nominal interest rate appears to be a less powerful instrument in India than in other countries.

The paper notes that the ITF has had variable success across countries but does not provide data to support this, nor does it address whether the Indian subcontext resembles the countries for which the policy has been a success or where it has failed. There *are* differences between developed and emerging markets.[10]

In closing, I compliment the authors for initiating a serious debate on the relative merits of inflation targeting and its appropriateness as a policy prescription for India. Their paper will undoubtedly be an impetus for further research in this important area.

Kenneth Kletzer: The widespread popularity of inflation targeting as a framework for monetary policy quite naturally raises the question whether India should also adopt an inflation-targeting regime. The reputation of inflation targeting has been bolstered by the recent ability of the central banks of several industrialized countries to maintain low and stable inflation without neglecting real economic performance. Further, the adoption of the inflation rate as the nominal anchor by some emerging market central banks, particularly in Latin America, has met with some apparent success as well as providing useful learning experiences.

In this interesting and well-done paper, Chand and Singh ask whether inflation targeting would be appropriate for adoption by the RBI given the structure of the Indian economy. They emphasize that the analytical arguments for inflation targeting are based on specific models of the dynamics

10. See, for example, tables 1 and 2 in Fraga, Goldfajn, and Minella (2003), which highlight these differences.

of inflation and aggregate output fluctuations and that the nominal interest rate takes the central role as the instrument of monetary policy. The primary argument of Chand and Singh is that the basic assumptions of the macroeconomic models used to motivate a monetary policy regime targeting inflation with interest rate instruments fail to match the dynamics of inflation and output growth in India. Certainly, the empirical evidence presented in the paper demonstrates the poor relationship of the inflationary process underlying monetary policy analysis in advanced industrialized countries to the macroeconomic data for the Indian economy.

Much of the analysis and criticism of applying inflation targeting in emerging markets centers on countries with open capital accounts, raising concerns about the conflicting objectives of price level stabilization and nominal exchange rate stabilization, as well as the consequences of inflation stabilization for interest rate volatility. Chand and Singh raise these issues in their argument that India is not a good candidate for an inflation-targeting framework for monetary policy. At the same time, proponents of inflation targeting often emphasize the importance of building credibility around announced inflation goals in emerging market economies as several emerging market governments have adopted inflation-targeting regimes with varying degrees of discretion. Rather than reiterate the credibility question, Chand and Singh concentrate on the modeling issue—how does the inflationary and real growth process work in India.

In contrast with most emerging market economies that are candidates for inflation-targeting monetary regimes, India restricts international capital flows and has not liberalized financial capital outflows to any significant extent. An important and open question concerns the appropriate monetary policy framework for India in anticipation of further liberalization of the economy and integration with international financial markets. The motivating issue for the Chand and Singh paper is the analysis of appropriate choices of monetary policy rules for the Indian economy. In my view, an important challenge for macroeconomists considering India is the design of monetary policy for the transition from an economy that had repressed financial markets to one with an open capital account. That is, how should the monetary policy framework complement the on-going process of economic reform and liberalization in India. I turn to these broader issues after discussing the particulars of the Chand and Singh paper.

Chand and Singh focus their attention on the theoretical analysis of inflation targeting exemplified by the basic model used by Svensson.[11]

11. Svensson (1997).

A conventional reduced-form model leads to a simple nominal interest rate rule for a central bank that seeks to minimize deviations from a given inflation target. The policy rule derived by Svensson is a strict inflation-targeting version of the Taylor rule that specifies the nominal interest rate as an increasing function of the deviation of current inflation from the inflation target and of the output gap. Chand and Singh question whether such a model is an appropriate empirical representation of the structure of the Indian economy, providing econometric evidence that it is not. They propose an alternate model of the aggregate adjustment process for the Indian economy, derive a policy rule for an inflation-targeting central bank and ask whether a version of an inflation-targeting regime makes sense in this new model.

An important feature of the model given in equations 9–11 is the dependence of inflation on the difference between the nominal growth rates of GDP and potential GDP. This implies a proportional relationship between the expected change in inflation and the expected difference between the growth rate of real GDP and real potential GDP. This is a change in the interpretation of the output gap term in the basic model and implies that inflation remains constant if the growth rate equals the potential growth rate. The innovation in the proposed model appears in equation 11, which relates the growth rate of nominal GDP to the growth of the public sector budget deficit as a share of GDP and the change in the real rate of interest. Relating the real interest rate and real fiscal expansions to nominal output growth seems a bit unusual, although the relationship between fiscal policy growth, real interest rates, and the growth of real output can be disentangled with algebra along with an equation for the change in the inflation rate.

The major implication of the Chand and Singh model of inflation and optimal policy for a central bank that seeks to minimize a conventional loss function around an inflation target is that there are two policy instruments, the nominal interest rate, and the growth of the public sector budget deficit as a share of output. Their main observation about the dynamics of the macroeconomy for India is that fiscal policy is an important driving variable for real output growth and inflation. Their econometric analysis lends support to the inclusion of fiscal expansion in a traditional way in the short-run aggregate supply equation. In the derived optimal policy, the change in the nominal interest rate is increasing in the inflation rate as well as in the deviation of the current inflation rate from the targeted inflation rate given a constant deficit to GDP ratio. The interpretation of this model is that the nominal interest rate can be used to guide monetary policy built around an inflation target if the expansion of the fiscal deficit is exogenous. There are

two instruments and either can be used. If fiscal policy is made autonomously (a reasonable assumption in my view), then the central bank can implement an inflation target using the nominal interest rate. The model is consistent with the claim that perpetual growth in the public sector budget deficit forces tighter monetary policies to contain inflation. The real interest rate rises with the growth of the deficit, although the model does not address policy sustainability. That is, not all the necessary conditions for an optimal policy are in the text; sustainability should restrict the fiscal policy variable so that its inclusion as a policy instrument is not redundant.

The econometrics reveals that the textbook model used as a benchmark does not perform well against Indian data. Introducing supply-side effects such as commodity price inflation and public sector wage growth is reasonable, as is the inclusion of changes in fiscal policy. The results do not really negate the applicability of an inflation-targeting regime until losses other than deviations from the inflation target are included in the derivation of optimal policy. The costs of real interest rate and output growth volatility are not included in the objective function of the central bank.

There are important reasons to think about using a nominal interest rate rule to meet the objectives of price and output growth stability in the case if India. Some of these are common to emerging market economies that have adopted inflation-targeting frameworks, notably Chile and Brazil. Those two experiences may be very useful for considering the applicability of inflation targeting for India. One caveat is that both countries liberalized capital account transactions some time ago. Lessons learned from other emerging market economies might be appropriate for India after the relaxation of controls on capital outflows. However, credibility should be crucial for the success of inflation-stabilizing discretionary monetary policy in any context. The route to achieving credibility is not easy to identify, although current thinking focuses on the importance of strong monetary institutions, a sound fiscal and financial environment, and transparency in central bank governance and policy.

One issue of importance is whether an inflation target that takes account of output growth makes sense before liberalization. A simple answer is that the more credible central bank policy is before international financial integration, the more able are monetary authorities to manage inflation and exchange rate volatility. The broad preconditions for adopting inflation targeting are reviewed by Chand and Singh.[12] These are the same conditions just listed as appropriate starting points for gaining credibility for price

12. Mishkin (2004) elaborates on each.

stability, and they are also reasonable preconditions for a successful liberalization of the capital account. Another issue of importance for an emerging market economy whose central bank is pursuing an inflation target is the need to give the inflation rate precedence over the nominal exchange rate. As Chand and Singh note, resistance to floating is a common feature of monetary policy in emerging markets, creating a conflict in the choice of a nominal anchor. The track record for the rupee and for exchange rate intervention in India suggests that monetary authorities care very much about exchange rate volatility. As a concern for inflation targeting, though, this should not be seen as a primary issue for now because the conflict between these objectives only comes into play with an open capital account.

In the Indian context, the first important barrier to adopting inflation targeting is the continuing growth of outstanding public debt and deficits as a share of GDP. But the debt and deficit of the public sector is a barrier to progress on any macroeconomic front. The potential monetization of deficits and debt interferes with any effort to establish credibility for maintaining low inflation with or without any manner of central bank independence. Financial repression plays a significant role for financing public sector deficits without rising inflation in India. Further financial market liberalization and reform will reduce the capacity of the government to deliver low inflation by issuing long-maturity public debt at modest interest rates, and full capital account liberalization should eliminate the government's ability to do so. A worry should be that any credibility gained by the RBI from its choice of monetary regime in the current fiscal situation with capital controls will be lost immediately at the very time that is needed most, with the liberalization of capital outflows.

The second precondition is a sound domestic financial sector with adequate prudential regulation and supervision. Again, this is also a condition for avoiding financial crises in an economy with free financial capital mobility and for improving the allocation of savings and investment and overall macroeconomic performance in the domestic economy. It may be useful to observe that the adverse conditions faced by the RBI for predicting the successful adoption of an inflation-targeting framework for monetary policy are the same deficiencies that arise in any discussion of macroeconomic policy for India. Indeed, the virtues of each transcend the particular choice of targets and instruments for monetary policy.

A tough question is how the central bank gains or maintains credibility in the environment of Indian fiscal policymaking. The literature on inflation targeting (and similar policies) raises the problem that a targeting regime may be doomed if monetary policy is subordinate to fiscal policy. Questions

that need to be considered include how the RBI should conduct monetary policy when government debt is rising as a share of the economy at the same time that domestic financial reform is under way. Central bankers face the unpleasant task of an increasing prospect of inflating away outstanding domestic currency debt if efforts to improve domestic financial intermediation by reducing financial repression proceed. The critique of inflation targeting in emerging markets concerns countries that do not have effective capital controls, as does India. These countries are, therefore, susceptible to capital account reversals and unable to resist exchange rate fluctuations without sacrificing the inflation rate objective. These are not yet the issues for India; adopting a monetary policy regime to accompany fiscal reform, accommodate financial reform and meet the importance of stability of the inflation rate are major issues.

Partha Sen: This paper seeks to study the appropriateness (or otherwise) of adopting inflation targeting in India. Two sets of issues are addressed: Is inflation targeting the appropriate policy framework in developing countries? What is the process that determines inflation in India? The first issue is addressed rather perfunctorily. The paper's main focus is on the second one.

Here I address both issues but with more emphasis on the first. I shall argue that inflation targeting is not necessarily appropriate in developing economies—a position that Chand and Singh share (see table 1 and figure 1). Given this position, the inflation-generating process in India becomes (somewhat) less important.

Inflation targeting is the flavor of the month for monetary policymakers. Whether it will prove to be more durable, only time will tell. Theoretically, there is a weak case for it.[13] But as of 2005, about eight developed economies and thirteen emerging market economies are classified as having inflation-targeting regimes. Preliminary evidence suggests that it seems to work well in reducing inflation in both developed and developing countries.[14]

What does an inflation-targeting regime entail? Mishkin stipulates five conditions that such a regime must meet:

> 1) The public announcement of medium-term numerical targets for inflation; 2) an institutional commitment to price stability as the primary goal of monetary policy, *to which other goals are subordinated* (emphasis added); 3) an information inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments;

13. See, for example, Buiter (2004).
14. Fraga, Goldfajn, and Minella (2003); Mishkin and Schmid-Hebbel (2005).

> 4) increased transparency of the monetary policy strategy through communication with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and 5) increased accountability of the central bank for attaining its inflation objectives.[15]

Mishkin also notes the macroeconomic features of developing or emerging market economies that make them different from those with developed capital markets: "These are: 1) Weak fiscal institutions, 2) Weak financial institutions including government prudential regulation and supervision, 3) Low credibility of monetary institutions, 4) Currency substitution and liability dollarization; and 5) Vulnerability to sudden stops (of capital inflows)."[16]

Exogenous shocks are magnified in emerging economies because of their underdeveloped markets. Broner and Rigobon look at twenty-three developed and thirty-five emerging market economies and find that capital flows to the emerging market countries are 1.79 times more volatile than those to the developed countries, while the (left) skewness (that is, proneness to crises) is 1.5 times as high.[17] In addition to "fundamentals," emerging market economies experience more contagion and persistence.

It is important to note that most of the emerging market economies that have embraced inflation targeting have had a (recent) history of high (even hyper-) inflation. Among them, at least the Latin American countries are very open and suffer (more) from dollarization. Building credibility is very important for them because lack of credibility acts as a distortion and could cause reversal of very sensible policies.[18] But because of weak financial markets (and institutions, generally), the central bank cannot ignore fluctuations in interest rates, exchange rates, supply-side variables, and (of course) output. It is very difficult to claim that it is a regime of inflation targeting only—Mervyn King would rather not be an "inflation nutter," but at least he may have the choice that developing country policymakers often do not.

Thus is there a case for India adopting inflation targeting? Does one size fit all? In the Indian context one does not need to worry too much about low credibility of the central bank and dollarization (points three and four above). India's fiscal institutions have shown themselves to be very weak in the recent past and that could compromise the credibility of the Reserve

15. Mishkin (2004, p. 3).

16. Mishkin (2004, p. 5).

17. Broner and Rigobon (2004). Note that their data is annual (as is Chand and Singh's) and goes back to 1965. This perhaps understates the volatility in recent times as the emerging market economies have opened up their capital accounts.

18. Calvo has drawn attention to this in a macroeconomic context for over twenty years.

Bank of India in the future. This could be compounded by the further opening up of the capital account. In that scenario capital flow reversals (the fifth point above) could become important, but right now it is not a source of headache. But if credibility of the RBI is not an issue today and if, even with an inflation-targeting regime, we would need to look at "other things" (other than inflation, that is), where is the need for such a regime? This is not to deny that the RBI should be given functional independence and its policies should be less opaque.[19]

Let me turn to Chand and Singh's empirical work. It is motivated by Svensson, who sets up a model for expository reasons and shows what an inflation-targeting regime could achieve.[20] Chand and Singh accuse him of looking at only demand variables and neglecting the supply side. While that is literally true, it is not a criticism against inflation-targeting models in general. Fraga, Goldfajn, and Minella discuss both supply shocks and inflation of administratively priced goods—the message seems to be that the original supply shocks should be accommodated (one time only).[21]

Chand and Singh use annual data since 1972 to estimate the inflation process in India. Annual data—that is, what is available—is not very useful for the authorities interested in inflation. This is even more true of a developing economy—the structure has changed so much that to pretend that the data set represents the same "model" is far-fetched. Also the strict distinction between a demand-side and a supply-side variable becomes blurred as the collection of data becomes more infrequent.[22]

Chand and Singh's preferred model (D3) of (a backward-looking) Phillips curve has a term representing excess demand, and various terms denoting cost push effects, apart from the lagged endogenous variable. The supply-side variables are wage increases of public sector employees, inflation in world oil prices and the domestic market price of oil, world inflation, and changes in rainfall and foreign exchange reserves. Statistical fit notwithstanding, if this is all we can say about the inflationary process in India, then it is not very much.

Aggregate demand is captured by the lagged fiscal deficit and the nominal interest rate. Now, fiscal deficit is a very poor indicator of the fiscal stance of

19. Chand and Singh discuss monetary targeting and exchange rate targeting. Hence I do not repeat these points.

20. Svensson (1997).

21. Fraga, Goldfajn, and Minella (2004).

22. See their lagged fiscal deficit entering aggregate demand. Even in India, a road can be constructed in a year's time—is the expenditure on the road demand-side or supply-side?

the government, and the determinants of nominal interest rates have undergone substantial liberalization. Thus from the viewpoint of conduct of monetary policy, these indicators do not add much. Chand and Singh also claim that changes in foreign exchange reserves can be viewed as a supply-side phenomenon! It might have been better to write out a parsimonious model and test the price implications of it, rather than the kitchen-sink approach in the paper.

General Discussion

T. N. Srinivasan expressed frustration that much of the discussion of macroeconomic policy lacked the framework that a strong theoretical model anchored in general equilibrium would provide. At the same time, he agreed that many of the more coherent models, such as real business cycle, appeared to have little to do with reality. But the lack of a clear underlying model made it difficult to evaluate the policy, he said. Others argued that the inflation-targeting framework incorporated many elements of the Keynesian model, something that was thought to be out of fashion. Some participants questioned whether India's nontraditional labor markets precluded a Phillips-curve type analysis.

Participants noted a very large decline in inflation since the 1980s in numerous countries in all parts of the globe. To what extent was that the result of a greater emphasis by policymakers on reducing inflation, or could it be traced to other factors, such as depressed commodity markets and, until recently, low energy prices? Countries that experienced significant declines in inflation relied on a wide range of different monetary policies.

Several participants were concerned about the focus on the interest rate as the primary tool for implementing the inflation-targeting framework. In India the two most important interest rates were the bank loan and deposit rates, neither of which was directly influenced by the Reserve Bank. India did not yet have large financial markets with market-determined rates. There were doubts that financial asset markets in Indian had sufficient depth to absorb large changes in interest rates without the risk of a meltdown.

An additional concern was the adequacy of the price index that would be used. The wholesale price index had the broadest commodity coverage, but it excluded a lot of services. It also lacked adjustments for technological innovations and quality improvements.

Others questioned how the policy would affect the ability to respond to other concerns, such as price bubbles in asset markets or large exchange

rate movements. Conversely, it was pointed out that bubbles in equity markets were very hard to define, particularly in India where some firms had experienced very high rates of earnings growth. One participant noted that the uncertainty over India's future growth potential meant nominal income targeting was unlikely to be a viable alternative for setting monetary policy.

Some participants were struck by the weak influence of aggregate demand on inflation and questioned whether monetary policy had sufficient impact on the economy to be effective in controlling inflation. They thought that India in its current stage would be better served by a coordination of fiscal and monetary actions.

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