POLICY

Indian Economic Reforms

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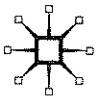

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Issues in the Choice of a Monetary Regime for India

Warwick J. McKibbin and Kanhaiya Singh

1. Introduction

In the face of ongoing economic reform, the choice of the appropriate monetary regime for India is a fundamentally important question. Many developing countries including India are considering adopting inflation targeting as the basis for monetary policy, yet there are concerns as to whether a regime that works well in developed economies, should also work well in a developing economy. This chapter summarizes the state of the current policy debate on selecting a monetary regime for India and presents estimates from an empirical model of India,[1] of the impact of alternative monetary regimes in the face of a variety of shocks to the Indian economy. The impacts of shocks to aggregate demand, productivity growth and country risk premia are considered under the three policy regimes of money targeting, inflation targeting and nominal income targeting. It is concluded that a monetary target performs worst among the three regimes while the results of income targeting are most encouraging. Inflation targeting performs well for demand shocks but causes greater volatility in real output under both productivity shocks and risk reassessment shocks. Although nominal income targeting works well in the model, the way this could be implemented in a developing economy needs more research. It is often argued that because nominal income targeting has not been observed in practice in any countries it should not be considered. However, much the same could have been said about inflation targeting until the end of the 1980s.

There have been two broad objectives of monetary policy in India: (1) to maintain a reasonable degree of price stability and (2) to help accelerate the rate of economic growth (Rangarajan 1998, p. 60). However, the relative

[1] Based on McKibbin and Singh (2002).

emphasis between the two objectives has been changing. The policy statement of Reserve Bank of India (RBI) by Governor Bimal Jalan, on Monetary and Credit Policy for the year 1999–2000 (RBI 1999b) brought the issue of price stability into the fore. The main basis of monetary policy in India since the mid-1980s is due to the Chakravarty Committee Report (RBI 1985), which recommended a monetary targeting approach. The intermediate target was chosen to be the supply of broad money aggregate M3[2] instead of the interest rate under the contention that the demand function for money in India has remained fairly stable with respect to 'select set of variables' (Rangarajan 1998, pp. 63–4). The Chakravarty Committee (RBI 1985) had presumed a target of 4 per cent for inflation. However, annual inflation as measured by wholesale price index (WPI) was 9 per cent during 1970s, 8 per cent during 1980s and 10 per cent during 1990–95 (Rangarajan 1998, p. 63).

The report of the Chakravarty Committee (RBI 1985), while recommending monetary targeting qualified that 'mechanical application of constant money supply growth rule has no place' due to significant structural changes required to facilitate the growth process. It is clear from Table 2.1 that the RBI does not follow an absolutely fixed growth rate of money supply. The money supply growth target in India is derived from the long-run money demand function, where income is represented by the exogenously given 'anticipated' growth rate and 'tolerable' rate of inflation. Applying these projections to a long run income elasticity of the demand for money leads to a projection of money supply growth for one year (Vasudevan 1999).

Since 1960, the Reserve Bank of India (RBI) has had a range of monetary policy instruments at its disposal including direct (quantity) and indirect (price) instruments.[3] The main direct instruments included cash reserve ratio (CRR),[4] Statutory liquidity ratio (SLR),[5] quantitative controls on reserve bank lending to the banks and the commercial sector ('refinance'),

[2] M3 =Currency with public+Demand deposit with the banking system+Other deposits with the RBI+Time liability portion of savings deposits with the banking system+Certificates of deposits issued by banks+Term deposits (excluding FCNR (B) deposits) with contractual maturity with the banking system+Call borrowing from 'Non-Depository' financial corporations by the banking system

[3] For a comprehensive detail see Joshi and Little (1994), Sen and Vaidya (1997)

[4] Since 1962 the RBI is empowered to vary the CRR between 3 per cent and 15 per cent of total demand and time liability. It rose to 15 per cent in 1994–95 but since then it is brought down to below 10 per cent. CRR in excess of 3 per cent is currently remunerated at 4 per cent per annum (Reddy 1999b).

[5] Over and above the CRR banks are required to maintain a minimum amount of liquid assets in cash, gold, and government securities that amounted to at least 25 per cent of their demand and time liabilities.

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and quantitative credit controls. The indirect instruments had been operating through the administrative setting of various interest rates. The CRR and SLR have been quite powerful instruments in the hands of the RBI. While the CRR affects adjusted reserve money directly by immobilizing banks' cash holdings, the SLR affects reserve money indirectly by reducing the monetisation of the fiscal deficits. The government finds a 'captive' market for its securities in the form of SLR. This leads to diversion of large amount of bank resources to government; as a result it rose to 37.4 per cent in 1992.

Table 2.1: Performance of Monetary Targeting in India

Year	M3 (% growth)[5]		GDP (% growth)[1]		Inflation (%)[2]	
	Target	Actual	Target (objective)	Actual	Target (objective)	Actual
1983–84	< 16.2	18.2	-	8.3	-	7.6
1984–85	<18.2[3]	19.0	-	3.8	Curb Inflation	6.0
1985–86	<19.0[4]	16.0	~3.8	4.1	Avoid resurgence	4.8
1986–87	<17.5	18.6	> 4.1	4.8	Continue check	5.1
1987–88	<18.6	16.0	5.0	4.3	Avoid re-emergence	10.7
1988–89	<16.9	17.8	-	10.6	-	5.7
1989–90	<17.1	19.4	4-5	6.9	-	9.1
1990–91	<15.4	15.1	~5.0	5.4	-	12.1
1991–92 (April)	<14.0[5]	19.3	4.0	0.8	Max 7.0	13.6
1991–92 (Oct)	<13.0		3.0		Max 9.0	
1992–93	<11.0[6]	15.7	-	5.3	8.0	7.0
1993–94	~12.0	18.4	5.0	6.2	Further Moderation	10.8
1994–95 (April)	14.0–15.0	22.3	5.0	5.3	~ 6.8	10.4
1994–95 (Oct)	16.0 (Max)		5.5			
1995–96	15.5 (Max)	13.7	5.5	7.2	~ 8.0	5.0
1996–97	15.5–16.0	16.2	6.0	7.5	6.0	6.9
1997–98	15.0–15.5	17.6	6.5–7.0	5.1	5.0-6.0	5.3
1998–99	15.5–16.0		6.0–7.0		~5.0	

Notes: Some of the values specifically before 1990–91 are taken from the implied statements like 'less than previous year' or 'less than average of last four years' etc.
1 GDP: Gross Domestic product at factor cost at 1980–81 prices.
2 Inflation: Based on wholesale price index.
3 Growth of liquidity and primary money creation
4 Liquidity Growth.
5 M3 Target was made consistent with the containment of gross fiscal deficit to 6.5 per cent of GDP in 1991–92
6 M3 Target was made consistent with the containment of gross fiscal deficit to 5.0 per cent of GDP in 1992–93

Sources: (1) Mohanty and Mitra (1999); (2) Reserve bank of India Annual Report, various issues; (3) Circulars issued by Credit Planning Cell/Monetary Policy Department, Reserve Bank of India.

Table 2.2: Central Bank Independence, Seigniorage, and Indicators of Financial Deepening in Selected Countries, 1980–95

Country	CBI Rank 1980s (%)	Seigniorage to GDP* (%	Inflation Tax# (%	Real Interest Rate on deposits 1980–89 (%)		Broad Money to GDP (%)	Nom. GDP per Capita (US$) 1995
				Geometric Average	Standard Deviation		
New Zealand	12	0.23	7.5	2.1	4.2	47.9	16650
Canada	4	0.22	4.7	4.3	1.5	49.6	19249
U.K.	7	0.25	5.7	0.7	2.1	70.0	18986
Sweden	6	0.47	6.4	2.5	2.6	51.4	26070
Finland							
Australia	8	0.32	5.8	3.1	2.9	49.9	19257
Spain	11	1.30	7.7	0.9	2.4	76.1	14465
Israel	24	1.60	33.1	N/A	N/A	78.8	15689
India	**21**	**1.30**	**8.7**	**-0.3**	**2.7**	**45.7**	**345**
Chile	36	1.34	15.9	7.8	9.6	37	4868
Korea	28	0.51	6.8	4.0	4.6	37.5	10146
Mexico	32	3.22	29.6	-6.2	13.3	26.1	3164
Indonesia	26	0.52	8.5	5.4	6.1	29.8	1034
Philippines	18	0.95	11.1	-0.3	10.9	32.6	1072

Notes: * Annual Monetary base multiplied by the inflation tax and divided by nominal GDP, except for Israel where foreign currency deposits were excluded from the monetary base.

\# Defined as: (CPI inflation/(100+CPI inflation)), a bounded measure of the real losses on holding of money balances.

Sources: (Masson, et al. 1997), Table 4; CBI rank from (Cukierman 1992), Table 21.1.

Following economic liberalization and financial sector reforms[6] the RBI has been moving away from quantitative controls towards an interest rate channel for monetary transmission. The central bank actively uses a combination of Open Market Operations (OMO), auction of Government Securities and Private Placements to maintain medium and long-term interest rates. This is particularly important in view of the management of government borrowings, which has increased since abolition of automatic monetisation. It is considered that monetary policy in India is neither wholly subsidiary to fiscal policy nor it is heavily constrained by the balance of payments.[7] Cukierman (1992) placed India at 21st position in ranking of central bank independence (see Table 2.2). The extent of the

[6] The reforms include inter-alia free floating exchange rate, decontrol of interest rate, development of securities markets, greater reliance on open market operations, auctions of government securities, phased decontrol of capital account. For a comprehensive details see Reddy (1999b; Sen and Vaidya (1997). Also see IMF (1998); Rangarajan (1995); Rangarajan (1998); Reddy (1999a); Reddy (1999c); Reddy (1999f)

[7] Joshi and Little (1994).

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Real Interest Rate on deposits 1980–89 (%)		Broad Money to GDP (%)	Nom. GDP per Capita (US$) 1995
ieometric Average	Standard Deviation		
2.1	4.2	47.9	16650
4.3	1.5	49.6	19249
0.7	2.1	70.0	18986
2.5	2.6	51.4	26070
3.1	2.9	49.9	19257
0.9	2.4	76.1	14465
N/A	N/A	78.8	15689
-0.3	2.7	45.7	345
7.8	9.6	37	4868
4.0	4.6	37.5	10146
-6.2	13.3	26.1	3164
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monetisation of the fiscal deficit as percentage of gross domestic product has fallen from an average of 2.28 per cent for the period 1985 to 1990, to 0.61 per cent for 1991 to 1997. Subsequently the automatic monetisation of fiscal deficit was abolished (RBI 1998).

The RBI now heavily relies on OMO including repo operations in conjunction with the Bank Rate, however more conventional instruments such as CRR, and sectoral refinance (export) continue. The reserve requirements are considered a tax on intermediation and therefore, in the process of financial sector reform, they are systematically being reduced, while the structure of administered interest rates has been almost[8] totally dismantled since 1994. The statutory minimum for SLR has been brought down to 25 per cent since then, yet many banks hold SLR more than the statutory prescription (Reddy 1999b). The quantity control through ratios of this type impairs the profitability of banks and introduces inefficiency in resource allocation and deprives the private sector of capital in favor of government. To minimize the role of quantity variables the RBI took initiatives to activate the rate variables through development of government securities market as part of its policy reform in 1992. With the development of a voluntary government securities market the RBI can now effectively buy and sell government securities as a part of its open-market operations, depending on its assessment of liquidity requirements in the system. According to the current RBI annual report (RBI 1999) a number of measures taken to improve securitization of the money market, including permission to foreign institutional investors to invest in Treasury Bills (TB), are helping to deepen the securities market.

A market based exchange rate system has been operational since March 1993 with occasional intervention from the RBI against speculative attacks. There have been significant steps towards Capital Account Convertibility (IMF 1998). In addition to relaxing restrictions on banks' overseas borrowing and investment activities, norms for Indian investment overseas have been liberalized.

Clearly the Indian economy is passing through a stage where monetary policy needs to be re-examined. The success of monetary targeting as stated earlier depends upon (i) the reliability of relationship between the monetary-aggregate being targeted and the goal variables (output and inflation) and (ii) control by the central bank of the target monetary aggregate so that credibility of the central bank is maintained. During the pre-reform period these conditions were largely met with fully

[8] Currently there is a prescribed rate of 4.5 per cent for saving bank accounts. Interest rate on smaller advances up to Rs. 200,000 should not exceed prime lending rate, which each bank is statutorily required to announce.

administered interest rates, liquidity ratios, exchange rate and capital flows. With reforms in place and the opening up of the economy, a complete break down of monetary targeting and its abandoning cannot be ruled out.

There is a vigorous debate on the appropriate monetary regime in India. Vasudevan (1999) observes that the fact that the actual money supply (Table 2.1) has exceeded the announced targets in most years raises doubts about the stability of the money demand function or the correctness in adapting the operating procedure of targeting bank reserves. Reddy (1999d), also recognizes that in a dynamic setting with continuous evolution in technology and financial systems, stability of the demand for money function may be undermined. In a similar vein Mohanty and Mitra (1999) observe that, with increasing market orientation of the financial structure and international capital flows, it needs to be considered whether a monetary targeting approach could ensure internal and external stability. Even if the money demand function show some kind of stability, it cannot be guaranteed that in a changing environment of external and financial sector reforms which enhance the sensitiveness of quantity variable to their market-determined price, money growth rate targeting would remain optimal. In was inevitable that inflation targeting would be considered. Kannan (1999) reviewed this possibility in the Indian context and argued for accomplishing the financial sector reforms before implementing inflation targeting.

2. The Theory of Monetary Regime Design

A monetary policy regime is concerned with the choice of instruments, operating targets and intermediate targets with the objective of meeting the ultimate goals of policy. This process results in a systematic rule (either simple or very complex) for adjusting the instrument (quantity or price) in response to new information. The goal variables are the ultimate variables of interest to policymakers and typically include inflation, output or unemployment. Intermediate targets include exchange rates, broader monetary aggregates, nominal output, and more recently inflation forecasts. Operating targets could be bank reserves or overnight inter-bank short-term rates (like call money rates). The instruments are the variables which the central bank finds in its direct control and which are easily manipulated to achieve a desired value for the operating targets and the intermediate targets. Instruments include interest rates on borrowings from the central bank (interest rate on reserve money like overnight rates, 'repo' rates or 90 days bill rates) or a reserve requirement ratio (like cash reserve ratio, CRR) or central banks' holding of government securities (treasury bills, TB). The problem facing the monetary authorities is to choose an appropriate

instrument and intermediate target/targets, and a rule defining their interrelationship. This is what constitutes the regime of monetary policy. The problem that arises is which regime performs better in a given economic environment? Many answers are theoretically ambiguous and thus the ultimate answer is to be found by empirical analysis of the regimes in simpler models like that demonstrated in de Brouwer and O'Regan (1997), Cecchetti (1998), Svensson (1998) among others or global models like the McKibbin–Sachs Global (MSG2) model.[9] These models are used to generate profiles of inflation and output variability that can be compared across regimes. For a current discussion on performance of different monetary policy regimes reference see Mishkin (1999) and McCallum (1999).

Why should the central bank follow rules at all? This question has been discussed in the literature on the discretion vs. rule debate. Cecchetti (1998) gives two important arguments in support of rules. A) The now established finding that when policymaking is based on pure discretion rather than rules, dynamic inconsistency can lead to high steady state inflation is relevant (Walsh 1998, pp. 321–35). B) Policy transparency is helps establish central bank credibility. If the central bank follows a rule it appears directly accountable. Such arguments have found favor in Australia, Canada, New Zealand, Spain, United Kingdom, Sweden, and Israel.

There are several approaches followed in the literature on implementing monetary regimes. These range from simple ad hoc rules[10] to analytically derived optimal feedback rules. We now discuss the theory behind some of the popular instruments and the rules for a monetary policy regime.

2.1 The Instrument Choice Problem

Modern central banks work through a fractional reserve banking system where the two most common modes of operations are legislative controls and OMO. In several economies the central bank holds the power to specify CRR requirements within legislative specified limits, which allows it to have direct quantitative control on the monetary aggregates. In OMO the central bank buys or sells government securities to influence the operating targets. The central bank has the choice to use either quantity or price of the securities as the instrument. Since the price of the security is inversely related to the interest rate and changes in the stock of securities determines the changes in the reserve money and hence monetary aggregates, the choice is between monetary aggregate and the interest rate

[9] See for example Bryant, et al. (1993); McKibbin (1993), Henderson and McKibbin (1993); Henderson and McKibbin (1993a); McKibbin (1997); McKibbin, et al. (1998).

[10] Nominal money rule, 'Taylor rules' (Taylor 1993b), Henderson and McKibbin (1993) (or CC) rule, nominal-income targeting rules (McCallum 1989); and inflation forecast targeting (Svensson 1996a; Svensson 1998a).

as the instrument. The classic analysis of this question (Poole 1970) which has since been extended in a number of other articles and has been useful in a variety of settings even beyond monetary policy issues like fixed versus flexible exchange rate and nominal versus indexing of wages.[11].

The choice of an instrument is an endogenous decision and it would become more complicated when more than one variable is included in the objective function of the central bank. For example a policy maker may be interested in minimizing the variance of output as well as inflation with some weights assigned to them. Similarly when expectations and the supply disturbances are also included in the model and monetary policy affects both real and nominal magnitudes, various tradeoffs emerge. The choice of the instrument does not appear to be model invariant. A good survey of several supply-demand models including neutrality and non-neutrality of monetary policy is Friedman (1990). Another issue is the problem of price level indeterminacy (Sargent and Wallace (1975)). This result, due to the assumption of complete market clearing and rational expectations, lead them to conclude that the interest rate instrument was not only inferior to a money instrument but was implausible on an *a priori* basis. This lead to the notion that only money could be the instrument, until McCallum (1981) demonstrated that this indeterminacy of prices under an interest rate instrument would follow only in the case in which the central banks' policy rule placed no weight on price (case of 'pure interest rate peg' where money is entirely disregarded). As long as some weight is placed on price in the policy rule function of the central bank, determinacy would prevail. A similar outcome has been demonstrated by Henderson and McKibbin (1993a). In addition to the above purely theoretical reasons, the role of nominal anchor has been emphasized in the literature ((Barro and Gordon 1983; Kydland and Prescott 1977; Mishkin 1999)), particularly as a constraint on the discretionary policy that helps in reducing the time-inconsistency problem.[12]

2.2 Intermediate Target Problem

Traditionally, central banks appear to use some kind of intermediate target for conducting their monetary policy. The most common variable for an intermediate target has been growth of broader aggregates of money, nominal income or the nominal exchange rate. Inflation forecasts have also been adopted as targets by some central banks. The intermediate target

[11] For example see Roper and Turnovsky (1980), Aizenmann and Frenkel (1985), Gray 1976, Fischer (1977b)

[12] Walsh (1998) defines a policy as time-consistent if an action planned at time t for time t+i remains optimal to implement when time t+i actually arrives. If it was not optimal to respond as planned originally then such policy is time-inconsistent.

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variables are in fact endogenous. As noted by Svensson (1996a, pp. 14–5), an ideal intermediate target 'is highly correlated with the goal, easier to control than the goal, easier to observe by both the central bank and the public than the goal, and transparent so that central bank communication with the public and public understanding and public prediction of the monetary policy are facilitated'. Observations for such variables are available on a more timely and continuous basis than the ultimate target variables like output and prices. The main idea behind using an intermediate target is the fact that these variables are more up-to-date in information content than the ultimate target variables. The selected instrument, whether an interest rate or non-borrowed reserves or base money itself and the intermediate target, together form a policy rule in a form that the intermediate target could be systematically influenced by the instrument variables. Several such variables can provide potentially useful information but selecting a variable for an intermediate targets is an empirical problem. The choice of a monetary policy regime is all about choosing intermediate target and the instrument, which give minimum variability to the ultimate target variables in a complete model of the economy.

The information contained in the intermediate target variable could be used in two ways. One way obviously is to choose the instrument setting in such a way that the expected deviation in the intermediate target variable from its target be minimized. The second way of using the information content of an intermediate target is to use the information to derive an optimal feedback rule by relating the value of the policy instrument to the observed value of the information variable. Under the optimal feedback rule, the information in the intermediate target is used to choose the value of the policy coefficient that minimizes the loss function itself. Thus the stress here is to minimize the expected deviation of the goal variable from its target instead of minimizing the expected deviation of the intermediate target variable from its target. This use of the information variable dates back to Kareken, et al. (1973). Friedman (1975, 1977) demonstrated that intermediate targeting is inefficient compared to optimal feedback rule with both an interest rate as the instrument or reserves as the instrument. Rules obtained in the case of the former did not minimize the variance in the output when compared to the later. Walsh (1998) draws similar conclusion where the objective function is to minimize expected squared deviations of the inflation rate around a target level. It is shown that the optimal feedback rule out-performs intermediate money targeting, however an intermediate target does better than a policy which does not respond to new information so long as money-demand shocks are small. The results of the intermediate-target problem are also not model invariant. In a comparison of nominal income targeting with money supply targeting, Bean (1983) used a rational

expectation model and measured the desirability of policies by their effect on variance of output around a certain full information level and concluded that monetary policy based on nominal income as an intermediate target is likely to be preferable to a policy based on exogenously determined money provided elasticity of aggregate demand with respect to real balances be less than one. However. West (1986), showed that, if the objective of monetary policy is to minimize the unconditional variance of output, then nominal income targeting can be preferred to fixed money stock if and only if the elasticity of aggregate demand with respect to real balances is greater than one, a completely opposite result to Bean (1983). In the case of an inflation forecast as the intermediate target, Svensson (1996a) claims it to be an ideal intermediate target as it is by definition the current variable that is most correlated with the goal.

2.3 Representation of Regimes by Simple Rules

Calculating An Optimal Feedback Rule Requires a complex process of constrained optimization in which the policy instrument is supposed to respond to a range of information in a given time period. In practical models there could be vector of targets or goal variables, a vector of predetermined state variables, a vector of forward looking variables and a vector of innovations to the state variables. This brings about uncertainty about the true model and complicates the derivation of the optimal feedback rule. McKibbin (1997) indicates the difficulty in distinguishing between discretion and a complex rule and advocates the use of simple rules as an alternative. At the same time he cautions that such rules must be robust to different models of the economy in addition to the model in which that was developed. Some of the popular rules are summarize in table 3.

3. An Overview of the MSG2 Multi-Country Model

Full documentation of the MSG2 model and an analysis of its properties and tracking performance can be found in McKibbin and Sachs (1991). Information on the latest model can be found on the world wide web at www.sensiblepolicy.com. A summary of the key features of the model are presented in table 4 and the coverage of the model used in the current article are listed in table 5. The version used in this chapter is the 'India model' version 44M (see McKibbin 1998b). The theoretical structure of the model is outlined in McKibbin and Singh (2002).

The MSG2 multi-country model is a fully specified dynamic intertemporal general equilibrium model (DIGEM) with careful treatment of stock-flow relations such as the accumulation of investment into capital stocks and the accumulation of fiscal deficits into net asset stocks. Both the

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or of forward looking variables and a
riables. This brings about uncertainty
cates the derivation of the optimal
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ılar rules are summarize in table 3.

ulti-Country Model

odel and an analysis of its properties
und in McKibbin and Sachs (1991).
be found on the world wide web at
/ of the key features of the model are
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998b). The theoretical structure of the
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el is a fully specified dynamic
odel (DIGEM) with careful treatment
cumulation of investment into capital
deficits into net asset stocks. Both the

short run demand and supply sides of the major economies are incorporated. In the long run, supply is determined by neoclassical growth theory. The model incorporates a number of financial markets such as share markets and markets for short and long bonds in each of the industrial regions where prices are determined by intertemporal arbitrage relations as well as long run sustainability conditions on fiscal deficits and current account positions. In addition, the assumption of rational expectations in these financial markets as well as some forward looking behavior in real spending decisions means that the effects of anticipated policy changes are well handled. The regimes that are included in the model are explicitly modeled and since we use a structural model with rational expectations, the model is essentially immune from the Lucas (1976) Critique.

Table 2.3: Alternative Instrument Rules

Money Rule:	$i_t = \bar{i}_t + \beta(m - \bar{m}_t)$	(1)
Nominal-Income Rule:	$i_t = \bar{i}_t + \beta(p_t + y_t - \overline{p_t + y_t})$	(2)
Bryant-Hooper-Mann Rules:		(3)
Henderson-McKibbin (or CC) Rule:	$i_t = \bar{i}_t + \alpha(\pi_t + y_t - \overline{\pi_t + y_t})$	(3a)
Taylor Rule:	$i_t = \bar{r}_t + \pi_t + 0.5(\pi_t - \bar{\pi}_t) + 0.5(y_t - \bar{y}_t)$	(3b)
Inflation-only rule:	$i_t = \bar{r}_t + \pi_t + \gamma_1(\pi_t - \bar{\pi}_t)$	(4)
Change rule:	$i_t = \bar{i}_t + \pi_t + \gamma_1(\pi_t - \bar{\pi}_t) + \gamma_2(y_t - \bar{y}_t)$	(5)
Constant-real-interest rate rule:	$i_t = c + \pi_t$	(6)

Where:

i = nominal interest rate;
r = real interest rate;
π = inflation rate;
p = log of price level;
y = log of output;
m = log of money and
c = constant
a bar over a variable indicates a desired value

Sources: McKibbin 1997 #8; Brouwer, 1997 #5

Table 2.4: Main Features of the MSG2 Model

- both the demand and supply side of the major economies are explicitly modelled;
- demand equations are based on a combination of intertemporal optimizing behavior and liquidity constrained behavior;
- the supply side takes explicit account of imported intermediate goods especially the role of imported capital goods in investment in economies;
- major flows such as physical investment, fiscal deficits and current account imbalances cumulate into stocks of capital, government debt and net external debt which in turn change the composition and level of national wealth over time.
- Wealth adjustment determines stock equilibrium in the long run but also feeds back into short-run economic conditions through forward-looking share markets, bond markets and foreign exchange markets.
- Asset markets are linked globally through the high international mobility of capital.

Table 2.5: Regional Coverage of the MSG2 Model used here (version 44M)

Regions

Structural
United States
Japan
Canada
Ger many
United Kingdom
France
Italy
Rest of the Euro Zone (denoted REMS)
Mexico
Rest of the OECD (denoted ROECD)
India

Non-Structural
Oil exporting countries (denoted OPEC)
Non-oil developing Countries (denoted LDCs)
Easter European economies and the former Soviet Union (denoted EEFSU)

Sectors
one good in each country/region

It is important to note that investment and consumption behavior is modeled as a weighted average of intertemporal optimizing behavior (with rational expectations of the future path of the global economy), and backward looking behavior based on current income. Thus expected changes in policy and changes in future stocks of assets leads to an initial (although quite damped) response of households and firms. Investment is based on the cost of adjustment approach of Lucas (1967) and Treadway (1969), which yields a model with investment partially determined by Tobin's q, along the lines of Hayashi (1982). A full derivation of the model can be found in McKibbin and Sachs (1991).

Apart from the shocks and underlying model structure, the results also depend on the assumptions about fiscal and monetary closure, or more specifically the fiscal and monetary regimes in place in each economy. In this chapter, policy regime assumptions are changed in all countries at the same time as changing these regimes in India. In all countries, fiscal policy is assumed to be implemented such that all governments maintain a fixed share of government spending to GDP and adjust taxes to service any changes in debt. The fiscal deficit adjusts endogenously to any changes in real activity or interest rates.

4. Implementing Alternative Monetary Regimes in the MSG2 Model

We now discuss the properties of three monetary regimes in a model of India. The model used in this chapter has contributed to the literature on regime choice, both from the point of view of a single country or region (Argy, et al. 1989), as well as from a global perspective (Henderson and McKibbin 1993; McKibbin and Sachs 1991; McKibbin and Sachs 1988). Rather than focus on optimal rules, as in the above studies, we focus on the impact of three simple rules for monetary policy.

Monetary policy in this model is assumed to be implemented with a feedback rule for interest rates on some target variable (either the stock of money relative to target, the level of nominal income relative to target, or the rate of inflation relative to target). Here we take an extreme value for each feedback coefficient such that the target variables are targeted exactly in each year. An alternative approach is either to use an arbitrary coefficient to capture partial adjustment or one can calculate an 'optimal' feedback coefficient such that some objective function written in terms of ultimate target variables is optimized (McKibbin 1993). In that earlier article the 'optimal' degree of adjustment for a monetary target rule, given the historically estimate variance covariance matrix of shocks, was found to be exact targeting on money.

The three monetary regimes used in this chapter are summarized in equations (1), (2) and (4) in Table 2.3. Take equation (1) for example. This says that the short term nominal interest rate (i) equal to the baseline nominal interest rate plus a coefficient times the gap between the actual stock of money (m) and the target stock of money (m_t^{bar}). The range of alternative regimes could be explored but are not done so in the current paper. This will be the focus of future research.

5. The Consequences of Alternative Monetary Regimes for India

In this section we subject the model to 5 shocks: a persistent rise in domestic demand in India; a temporary rise in domestic demand in India; a persistent rise in domestic supply in India; a temporary rise in domestic supply in India; and a permanent increase in the perceived risk of investing in Indian assets.[13] The demand shocks are a rise in private consumption of 1 per cent of GDP and the supply shock is a rise in the level of labour productivity of 1 per cent. The results for each simulation are summarized in six figures — one figure for each variable: real GDP, Inflation (defined in terms of a consumer price index); the nominal exchange rate (defined as $US/Rupee); short term nominal interest rates; trade balance and the stock market value. Each figure contains results under the three alternative regimes of a monetary target, and inflation target and a nominal income target.

We first solve the model from 1996 to 2070 given exogenous assumptions about tax rates, productivity growth and population growth by country as well as a range of other exogenous variables under alternative monetary regimes. Each shock is then imposed on the model as a surprise in the year 2000. In the results, all variables are expressed as deviations from what otherwise would have occurred along the baseline of the model. The deviation units differ across variables: GDP, exchange rates and stock market values are expressed as per cent deviation from baseline; inflation and interest rates are all expressed as percentage point deviation from baseline; and the trade balance is expressed as per cent of baseline GDP deviation from base.

5.1 Persistent Demand Shock

The results for a persistent rise in domestic demand are shown in figures 2.1 through 2.6. Note that although the shock to the exogenous component

[13] We also simulated a shock to money demand but due to space limitations don't report these results in detail. As expected from the theoretical literature, the money rule performs very badly for this shock relative to the other regimes, which can almost offset the shock completely.

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Monetary Regimes for India

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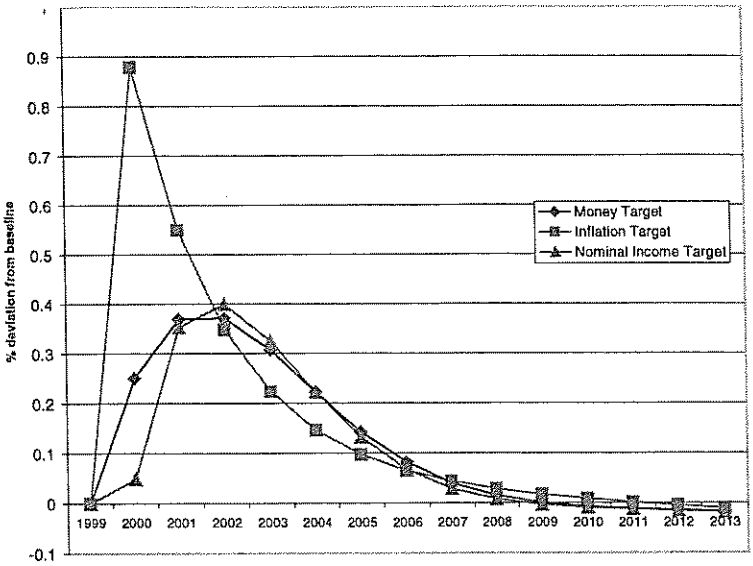
of consumption is permanent, the endogenous components of consumption tend to fall over time so that aggregate private consumption is not permanently higher forever (it can't be given budget constraints in the model). This shock should be considered as just more persistent than the temporary demand shock.

Figure 2.1: Real GDP Under a Permanent Domestic Demand Shock

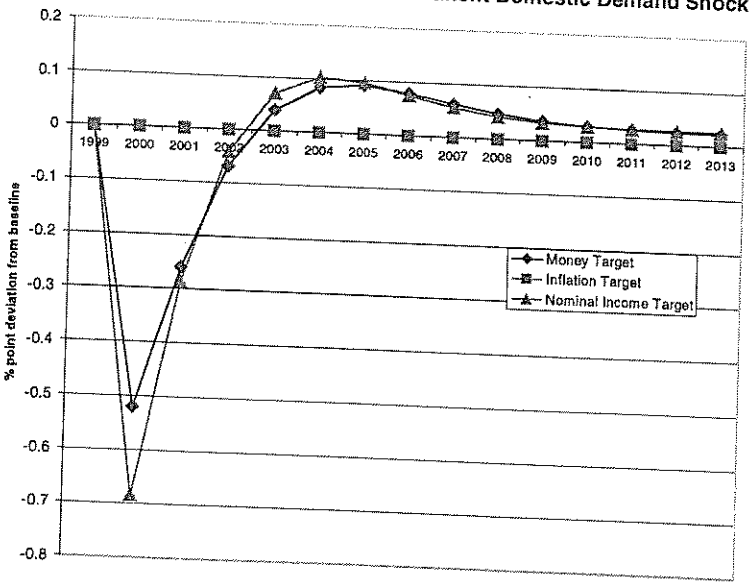


The rise in domestic demand leads to an immediate policy response under each monetary regime. The excess demand causes interest rates to rise under the money target as well as the nominal income target. Extra demand in the economy increases the demand for money, which for a given supply of money must imply a rise in nominal interest rates. Both real GDP and domestic producer prices rise and thus interest rates must rise under a nominal income target. It is interesting that interest rates fall slightly under an inflation target. This is because the inflation rate (defined in terms of the consumer price index) actually falls. The rise in domestic demand causes a capital inflow, which leads to an appreciation of the nominal exchange rate and a fall in import prices. The import price fall dominates the rising domestic prices and the consumer price inflation falls initially. As domestic prices respond to the demand stimulus over time inflation tends to rise and interest rates rise over time.

It appears that the inflation target accentuates the fluctuations in real output, although this depends importantly on the nature of the targeted inflation rate. If a domestic price had been used in the inflation rule, the outcome would have been more like the nominal income target.

The difference between the money target and the nominal income target can best be understood with reference to the money demand function in the model. Money demand in nominal terms is a function of the nominal income (with a unitary elasticity) and a negative function of the short-term nominal interest rate. Thus the difference between a nominal income target and a money target depends on what happens to the short-term interest rate in response to a shock. If interest rates rise with prices and output, then a money target will be more easily met (with less subsequent output contraction) than a nominal income target. This in illustrated in Figure 2.1 in which the GDP rise for a nominal income shock is less than the rise in GDP for a money target.

Figure 2.2: Inflation Under a Permanent Domestic Demand Shock



In terms of volatility of inflation, the opposite ranking of regimes is found. Under the inflation target, obviously the inflation rate does not deviate from baseline, whereas the nominal income target yields the largest deviation in inflation. The exchange rate changes as a result of the shock are driven by the interest rate responses. The nominal income target leads

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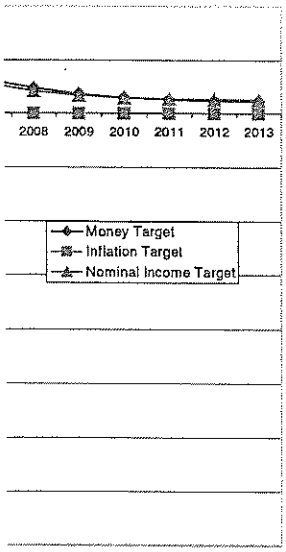

posite ranking of regimes is
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anges as a result of the shock
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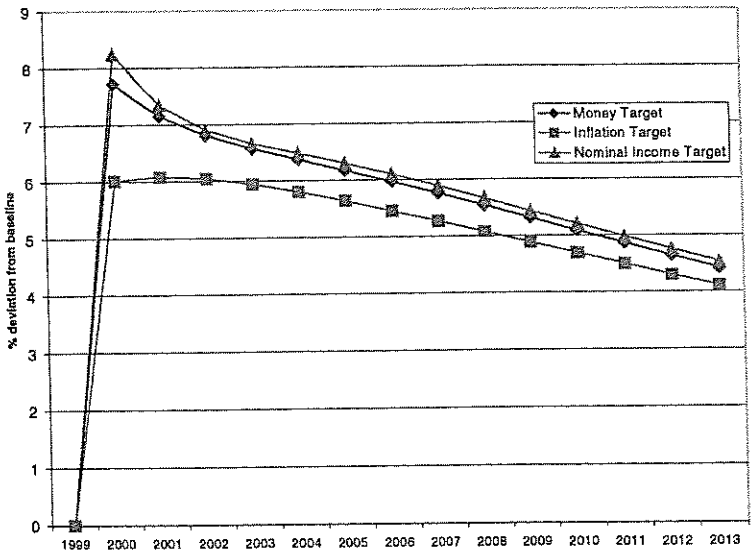
to the largest rise in interest rates as the central bank acts to reduce both the rise in real output as well as the rise in domestic prices. The higher interest rate causes a larger initial exchange rate appreciation. Note that the interest rate results in the long run are similar because the longer run inflation results are the same across regimes, and the higher nominal interest rate reflects the permanently higher real interest rate in India. The higher real interest rate reflects the fact that households and firms do not fully internalize the implications of higher exogenous consumption, due to the discount rate of future income being higher than the risk free government bond rate. Thus real interest rates must rise to crowd out other expenditure in order for the permanently higher exogenous spending to be maintained.

Figure 2.3: $US/Rupee Exchange Rate Under a Permanent Domestic Demand Shock



The effect of the monetary regime on the trade balance outcome is minor. This is consistent with the standard Mundell–Fleming results that the change in the trade balance due to any change in monetary policy under a flexible exchange rate and international capital mobility are insignificant. It is worth noting that Figure 2.5 shows that the rise in domestic demand is initially financed by borrowing from abroad reflected in a current account deficit. This capital inflow turn is achieved via an appreciation of the real exchange rate which increases imports and dampens exports and thus via a deterioration in the trade balance. Gradually over time the trade balance must move towards surplus in order to service the higher foreign debt.

Figure 2.4: Interest Rate Under a Permanent Domestic Demand Shock

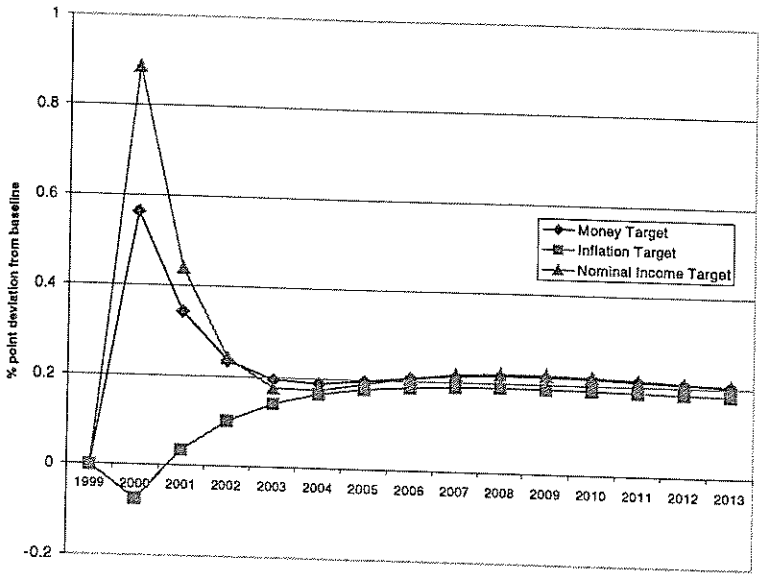
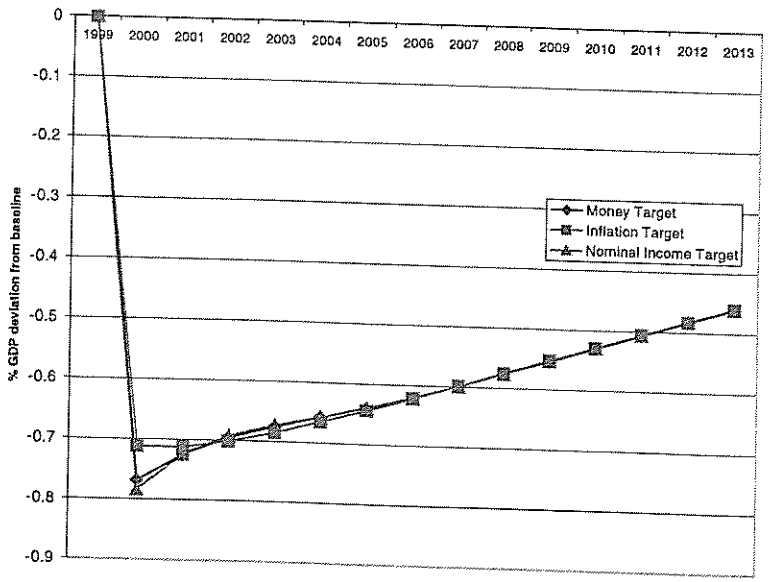


Figure 2.5: Trade Balance Under a Permanent Domestic Demand Shock



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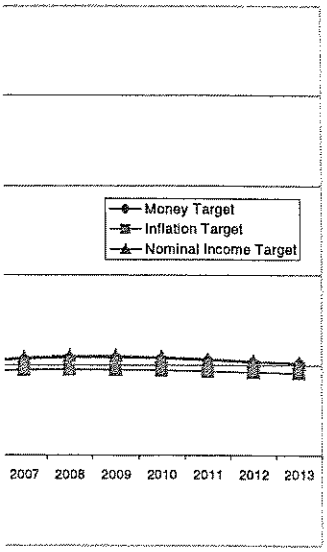

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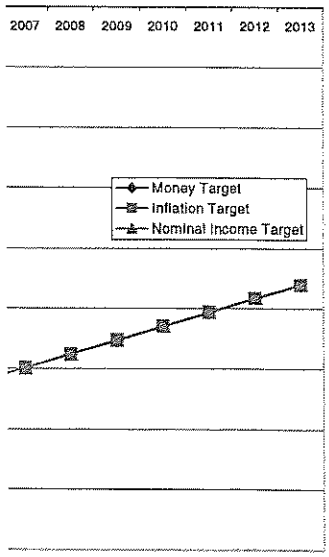
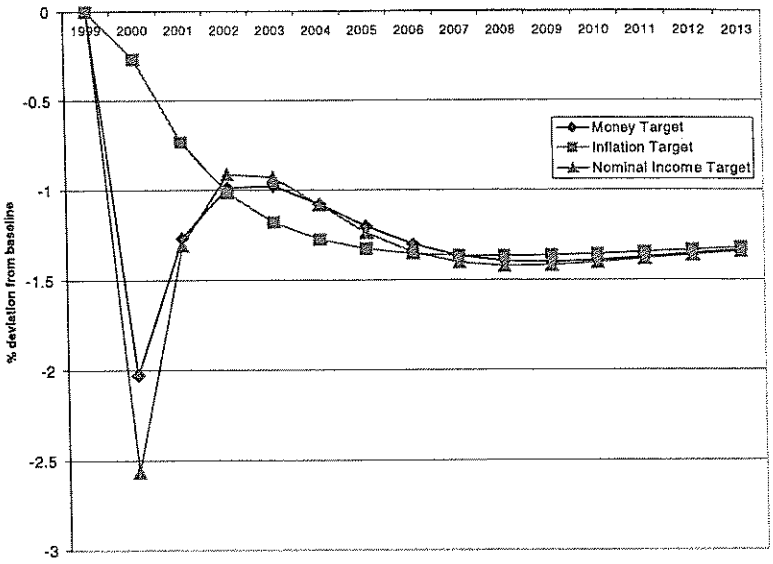


Figure 2.6: Stock Market Value Under a Permanent Domestic Demand Shock



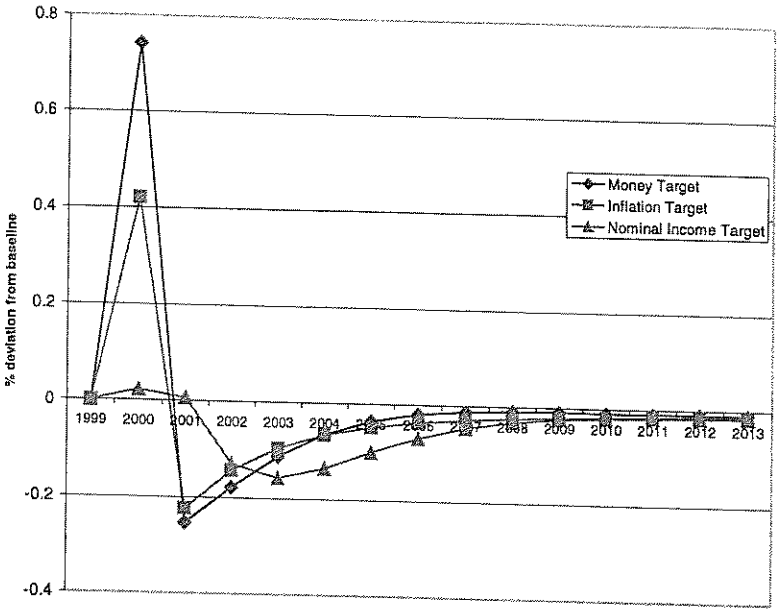
5.2 Temporary Demand Shock

Results for a temporary rise in domestic demand are shown in Figures 2.7 through 2.12. Because the shock is temporary, these figures are the impulse responses most often explored in the econometric literature on the monetary transmission mechanism (see McKibbin, et al. 1998).

It is clear that many of the insights are similar to those for the permanent demand shock although there are some important differences. It is useful to translate these impulse responses directly into volatility measures. As in Bryant, et al. (1993), the money target regime leads to the largest output volatility and the nominal income regime to lowest output volatility. Note that the ranking of regimes in terms of GDP volatility between inflation and money targets switches under the temporary versus the permanent shocks. The key difference is in the extent of appreciation of the exchange rate under the two shocks. For a temporary shock, the exchange rate appreciation is much less and therefore imported price effects are much smaller than under the permanent shock. Thus under the inflation target regime there is no longer an expansion of monetary policy induced by falling import prices because overall prices rise under the temporary demand shock (the fall in import prices is small because the exchange rate appreciation is small under a temporary shock). Thus the positive output effects from the inflation

regime are smaller than for the money target regime. In terms of inflation, clearly the inflation target dominates with the nominal income target leading to the most volatile inflation.

Figure 2.7: Real GDP Under a Temporary Domestic Demand Shock



5.3 Permanent Supply Shock

Results for a permanent rise of 1 per cent in the level of labor productivity are shown in Figures 2.13 through 2.18. This shock is a rise in the level of labor productivity, which translates, into a rise in labour productivity growth of 1 per cent in the year 2000 and zero thereafter.

It is clear from Figure 2.13 that GDP fluctuates more under the inflation target than under the alternative regimes. This is a familiar result found in many other theoretical papers and modeling studies of industrial economies. The rise in productivity lowers prices (Figure 2.14), which induces a monetary relaxation (Figure 2.16). This monetary relaxation further increases the rise in output and thus leads to more output volatility than other regimes. Inflation targets work well for demand shocks but are counterproductive (in terms of output) for supply shocks. This is an important lesson for an economy such as India in which structural change

target regime. In terms of inflation, with the nominal income target

and productivity shocks are likely to be important during a period of economic reform.

emporary Domestic Demand Shock

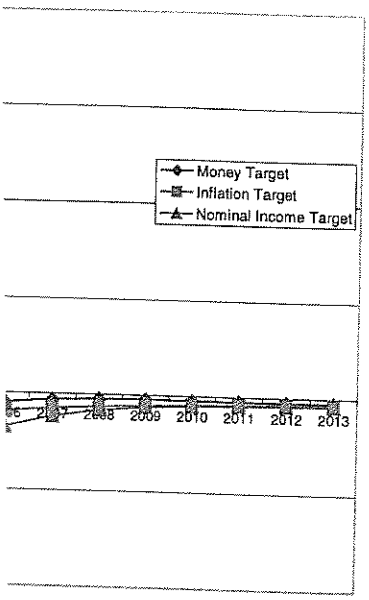


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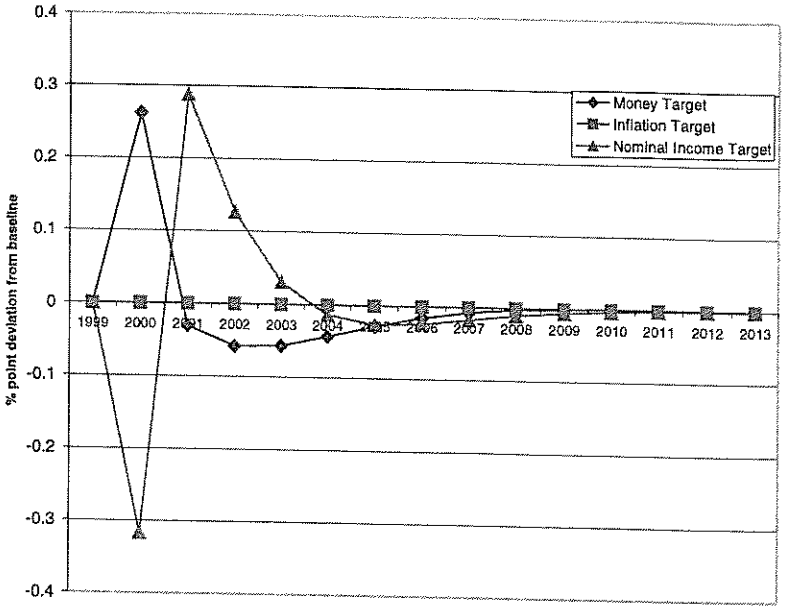
Figure 2.8: Inflation Under a Temporary Domestic Demand Shock



Note from Figure 2.18 that in contrast to the results for the demand shock in Fgure 2.6, a rise in GDP due to enhanced productivity has a much more positive effect on the stock market than a rise in GDP due to higher demand. The stock price is dominated by the higher expected future labour productivity.

5.4 Temporary Supply Shock

Results for a temporary supply shock are shown in Fgures 2.19 through 2.24. Although the profiles are very different to the permanent shock to supply, the rankings of regimes are very similar. Again the results for the temporary shock should be thought of in terms of volatility measures. The inflation-targeting regime causes greater volatility in real variables than the alternative regimes for the same reasons as it did for the permanent supply shock. As prices fall a monetary loosening further exacerbates the rise in real output.

Figure 2.9: $US/Rupee Exchange Rate Under a Temporary Domestic Demand Sho

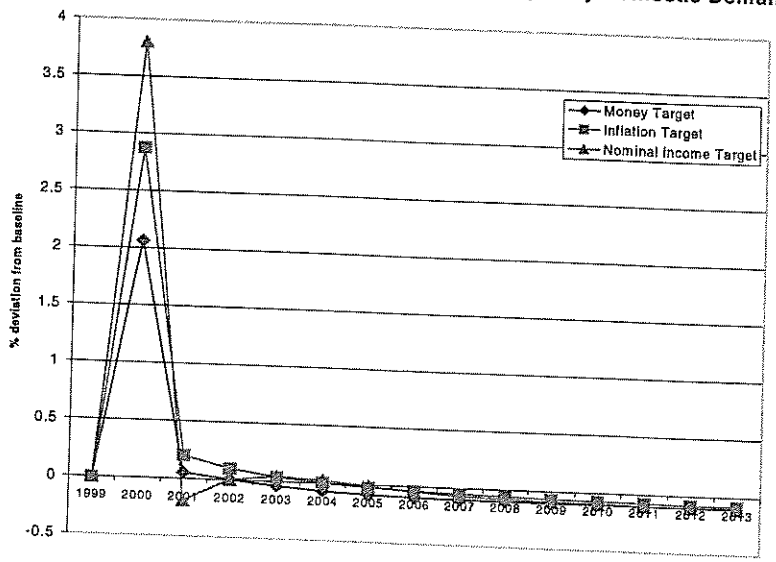
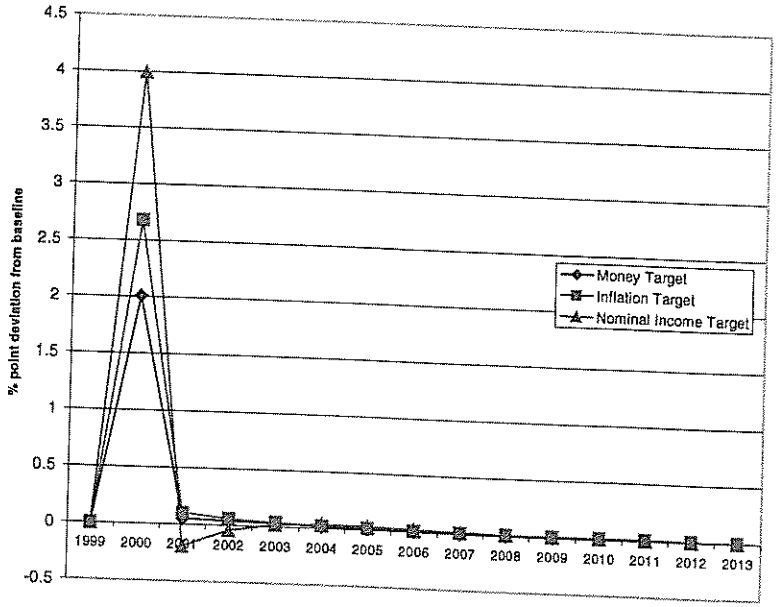


Figure 2.10: Interest Rate Under a Temporary Domestic Demand Shock



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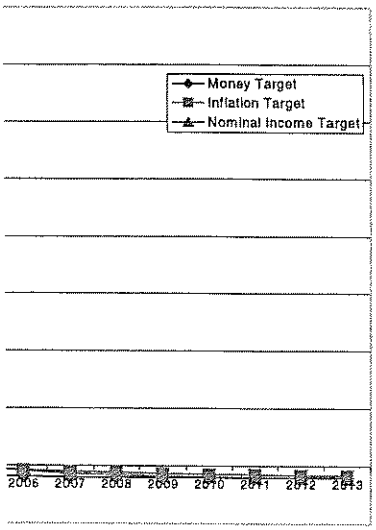


Temporary Domestic Demand Shock

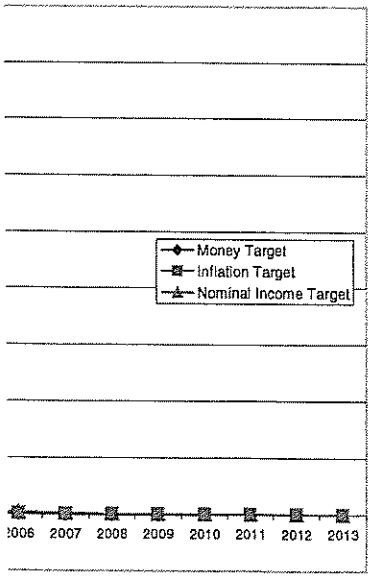


Figure 2.11: Trade Balance Under a Temporary Domestic Demand Shock

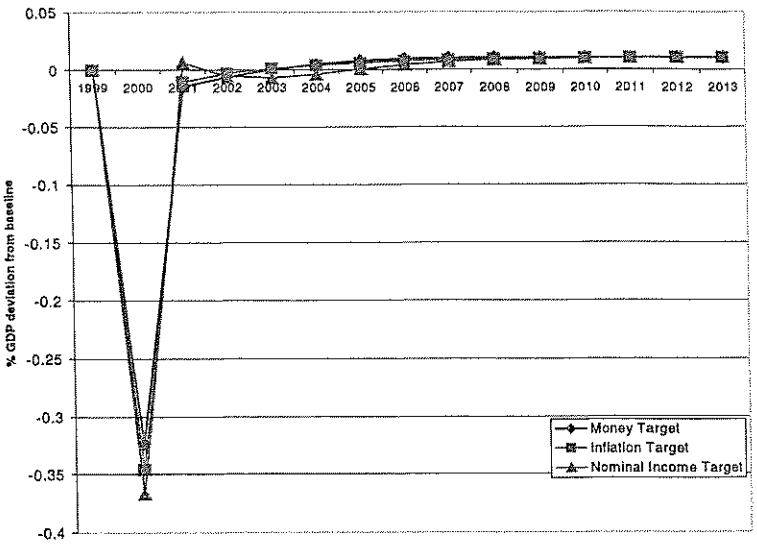


Figure 2.12: Stock Market Value Under a Temporary Domestic Demand Shock

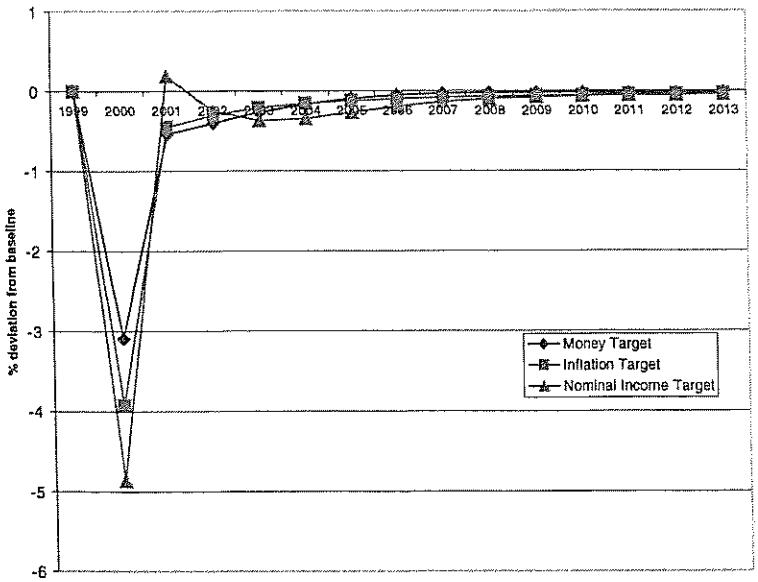


Figure 2.13: Real GDP Under a Permanent Domestic Supply Shock

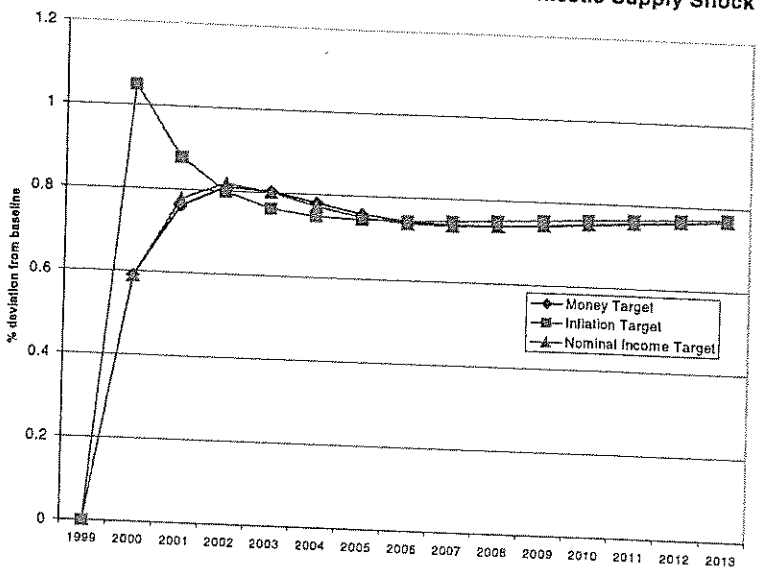
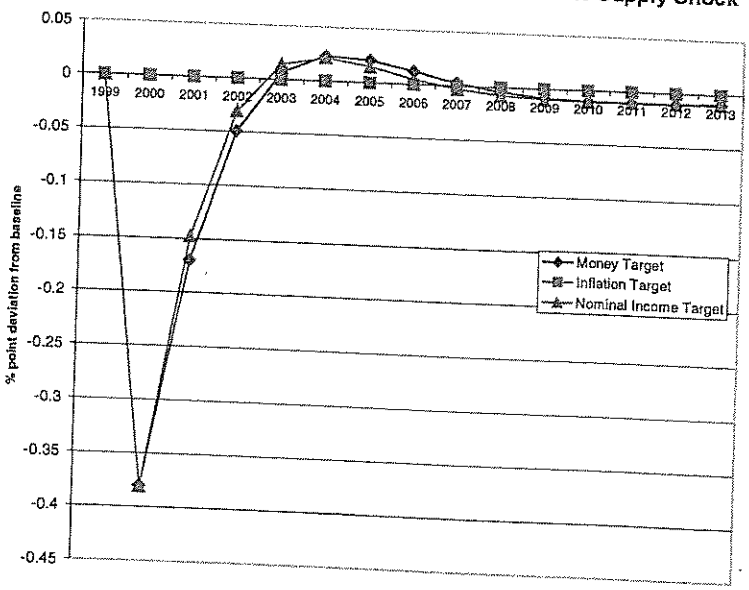


Figure 2.14: Inflation Under a Permanent Domestic Supply Shock



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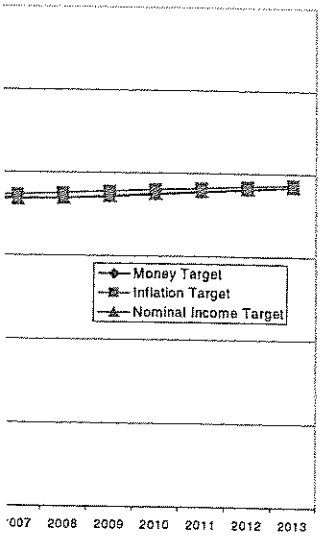

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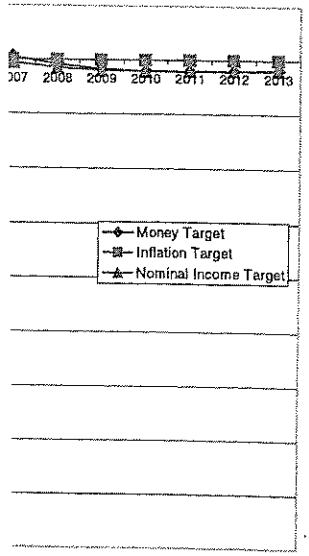


Figure 2.15: $US/Rupee Exchange Rate Under a Permanent Domestic Supply Shock

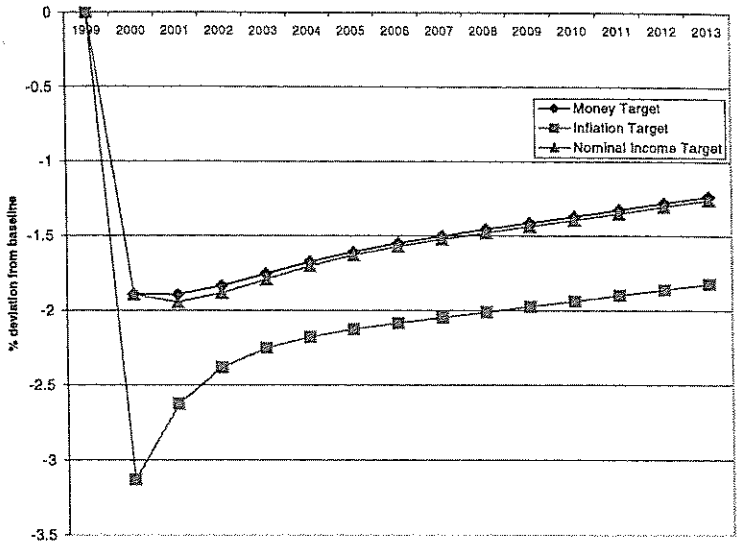


Figure 2.16: Interest Rate Under a Permanent Domestic Supply Shock

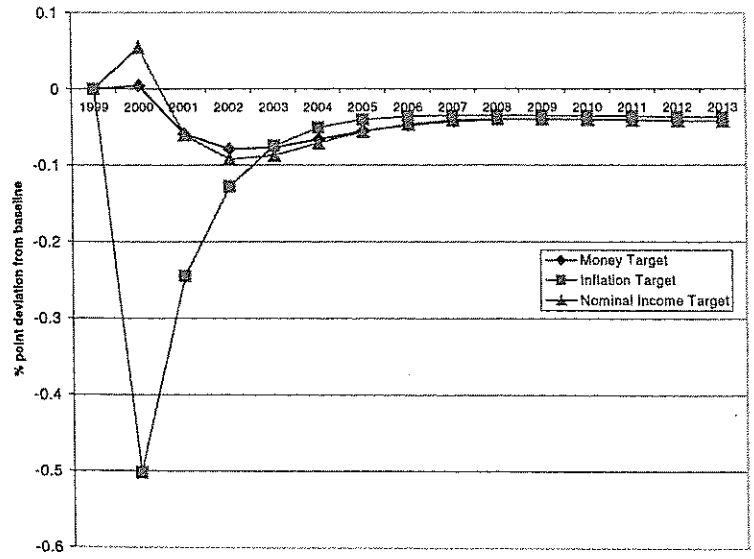


Figure 2.17: Trade Balance Under a Permanent Domestic Supply Shock

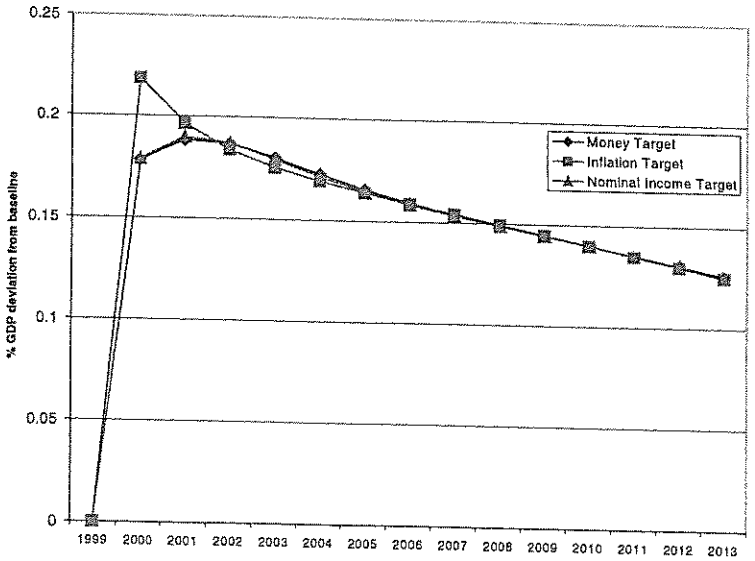
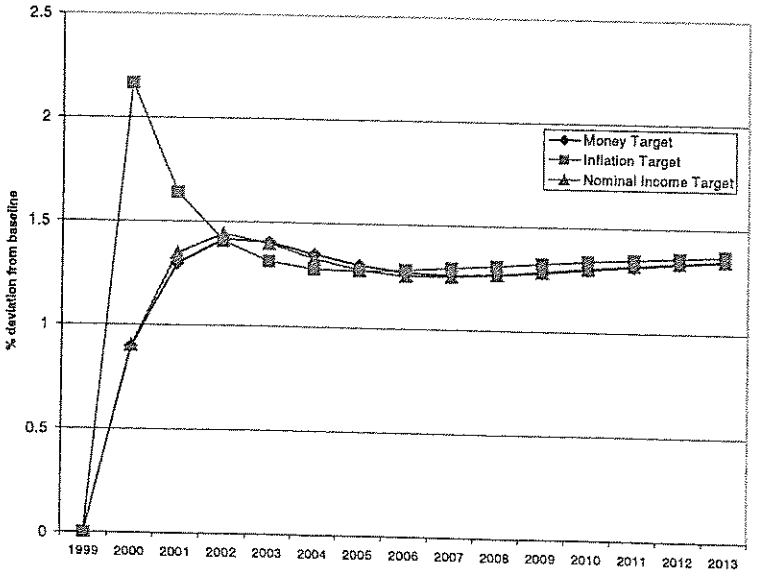


Figure 2.18: Stock Market Value Under a Permanent Domestic Supply Shock



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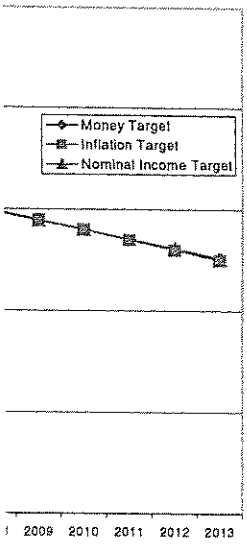

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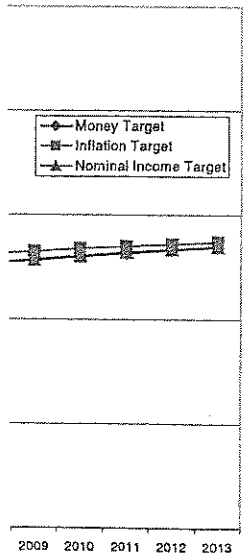


Figure 2.19: Real GDP Under a Temporary Domestic Supply Shock

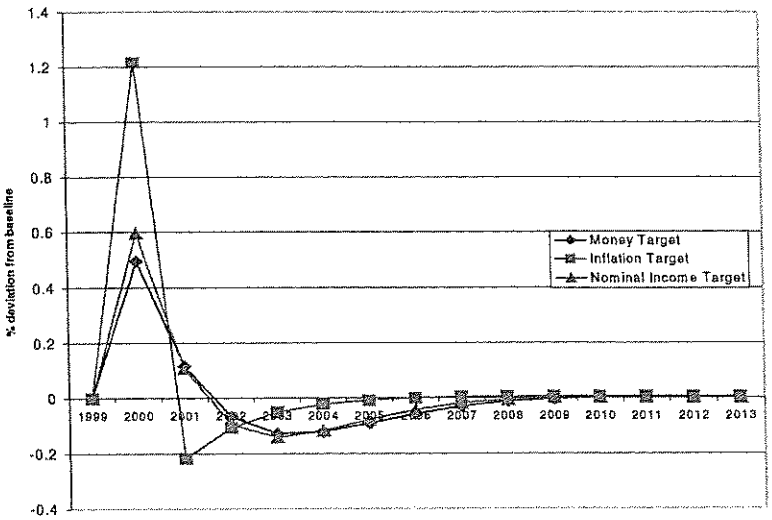


Figure 2.20: Inflation Under a Temporary Domestic Supply Shock

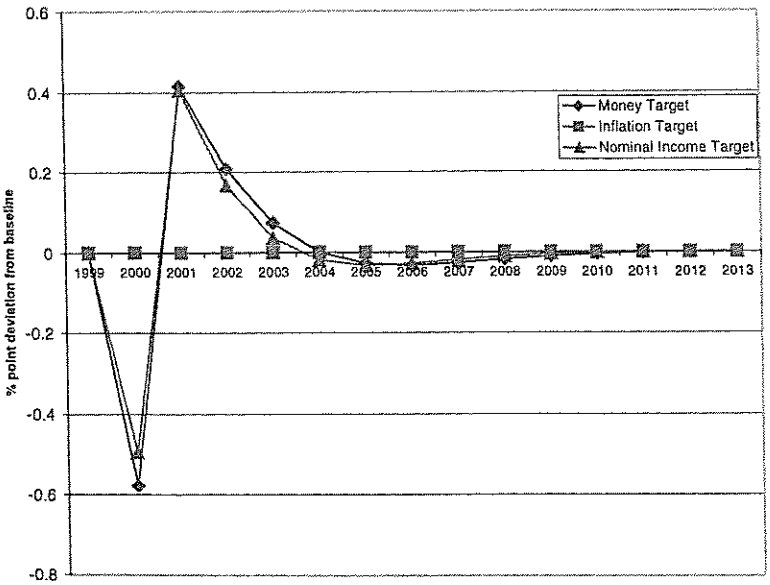


Figure 2.21: $US/Rupee Exchange Rate Under a Temporary Domestic Supply Sho

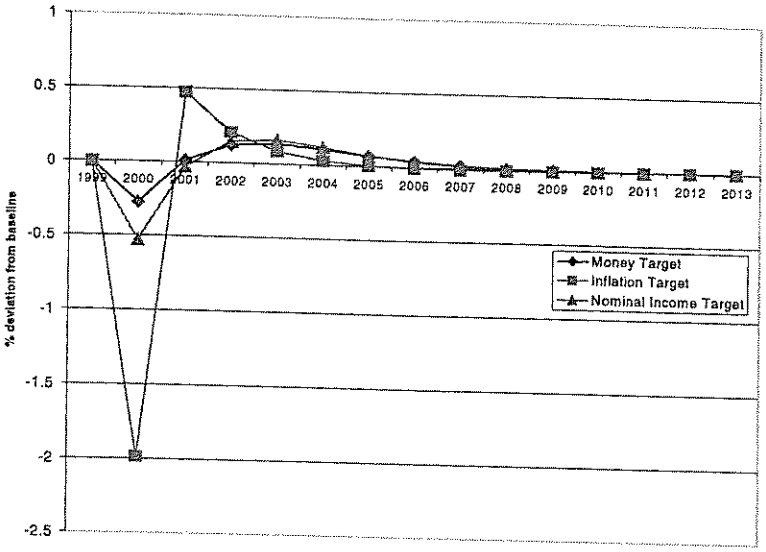


Figure 2.22: Interest Rate Under a Temporary Domestic Supply Shock

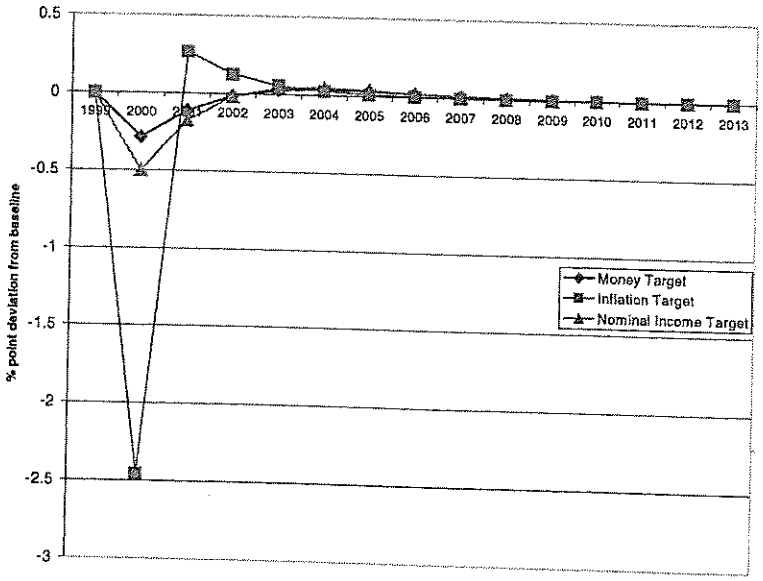


Figure 2.23: Trade Balance Under a Temporary Domestic Supply Shock

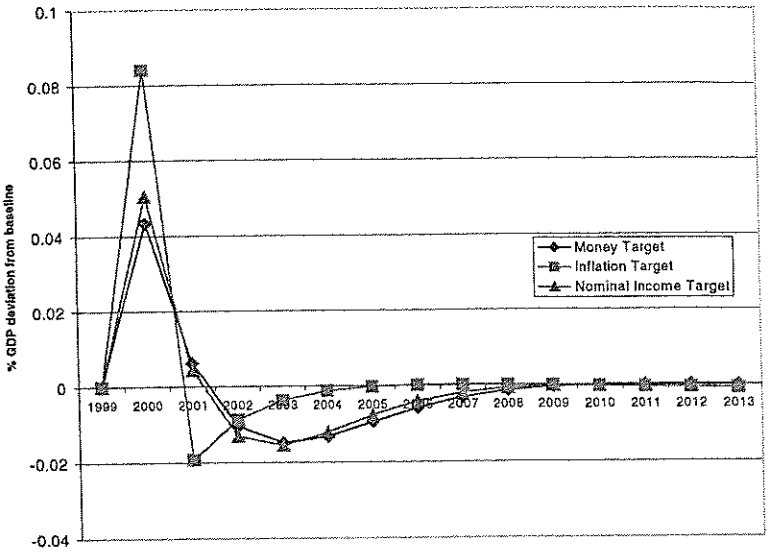
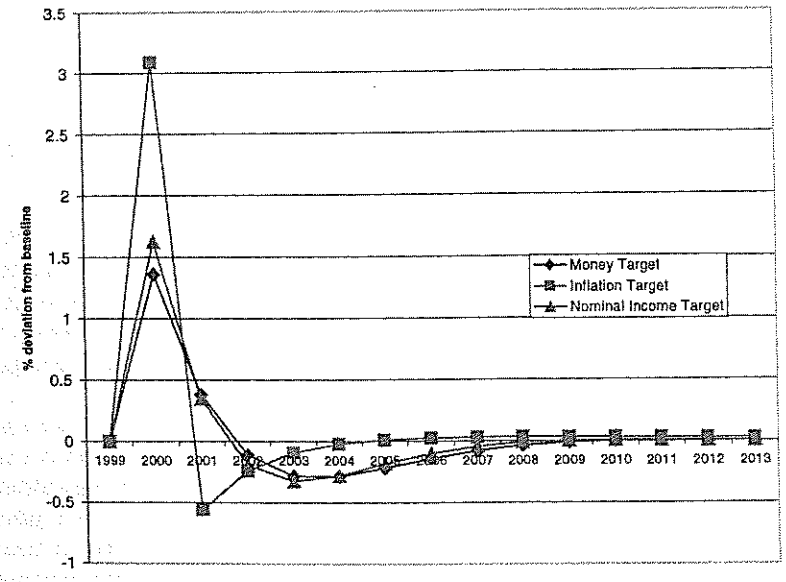


Figure 2.24: Stock Market Value Under a Temporary Domestic Supply Shock



5.5 Permanent Increase in Risk of Investing in Indian Assets

In this section we model a rise in the risk of investing in Indian assets. This is not considered in the theoretical literature but is likely to be an important issue for a country such as India that is going through structural reforms. The approach to modeling a risk shock follows the approach in McKibbin (1998). To see more precisely how a re-evaluation of risk is modeled, consider the uncovered real interest parity assumption relating the returns to government debt in each country that is used in the model. This is shown in equation (7):

$$r_t^i = r_t^U + {}_t e_{t+1} - e_t + \xi_t \tag{7}$$

Here the real interest rate (r) in country i in period t is equal to the interest rate in the United States (r^U) in period t, plus the expected rate of depreciation in the bilateral real exchange rate between country i and the United States (${}_t e_{t+1}$-e_t) where e_t is the log of the real exchange rate in period t and ${}_t e_{t+1}$ is the expectation, formed in period t, about the exchange rate to prevail in period t+1. We calculate the term ξ so that equation (7) holds exactly in the data in the base year (1996) given the model generated expectation of exchange rate changes.

ξ measures a range of factors including sovereign risk, impediments to financial flows, the degree of departure from rational expectations in actual data as well as a range of other factors. Suppose for expositional reasons that some fraction of ξ represents risk.

Equation 7 can also be interpreted differently. Solving for e_t it can be shown that:

$$e_t = \int_t^T (r_s^U - r_s + \xi_s)\, ds + {}_t e_T \tag{8}$$

The real exchange rate in any period t is the sum of future expected interest rate differentials as well as the expected future risk premium on assets denominated in the home currency plus the equilibrium (period T) value of the real exchange rate. In the following results we assumed that the component of ξ that represents risk, rises by 1 per cent per year forever.

These results are shown in Figure 2.25 through 2.30. Just as we saw during the Asia crisis, the increase in risk causes a deflation of asset prices. Financial capital flows out of the Indian economy putting downward pressure on the exchange rate. Under the money rule, the asset price deflation associated with rising real interest rates causes the demand for money to fall, which for a given supply of money causes nominal

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interest rates to fall slightly (Figure 2.28). Falling prices for domestically produced goods and slowing economic activity also induces a relaxation of monetary policy in an effort to stabilize nominal income. Under the inflation target regime the exact opposite occurs. Because the exchange rate depreciates sharply, import prices rise quickly and the monetary authorities are forced to raise interest rates to prevent the exchange rate depreciation from feeding into domestic inflation. The effect of this is a sharp decline in real GDP relative to the other regimes. Indeed this is exactly the same policy mistake made by the New Zealand Reserve Bank during the Asia crisis that ultimately caused a recession during 1998. Just as we demonstrated above for a supply shock, an inflation target is not a good policy in the face of a shock to country risk.

It is important to note that this model and these results ignore the issue of credibility in policy that may be important in an actual situation of crisis. Nonetheless, there are some important lessons from these model results for Indian monetary policy during a structural reform period in which some shaking of confidence is likely to periodically accompany reform.

Note from the results, that the long run effect of a higher risk premium (which could also be interpreted as capital controls or taxes on capital inflow) is a permanently lower real output in the economy. This is not surprising because the higher risk premium artificially raises the marginal product of capital above the world interest rate so output must be lower. The monetary regime does make a real difference to the economy for up to 8 years from the start of the shock but then tends to peter out.

In terms of inflation (Figure 2.26), both the money target and nominal income target lead to a large positive inflation shock, primarily reflecting the larger exchange rate depreciation (Figure 2.27). The general deflation of asset prices and capital outflow is reflected in the improvement in the trade balance shown in Figure 2.29. This capital outflow is made consistent with the trade balance through the large depreciation in the real and nominal exchange rate and therefore strong rise in exports and fall in imports.

Finally the results for the stock market are shown in Figure 2.30. The general decline in asset prices in the Indian economy includes a collapse in the value of capital. Note that the stock market collapse is largest under the inflation target because of both a larger short-term fall in real GDP as well as a larger rise in real interest rates.

The ultimate choice of monetary regime for a risk shock depends on the relative weight policy makers place on the ultimate targets of inflation and real output. The problems with inflation targeting under a risk shock are similar to those faced under a supply shock.

Figure 2.25: Real GDP Under a Permanent Increase in Risk Premium on Indian Ass

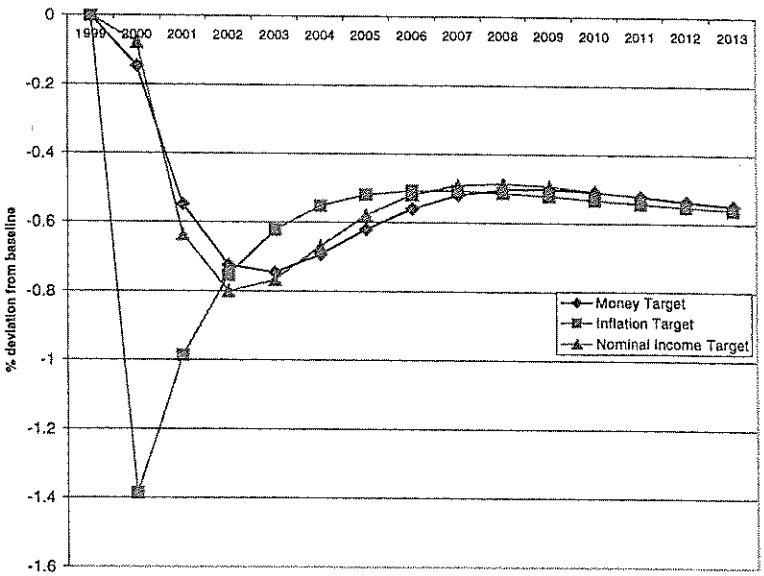
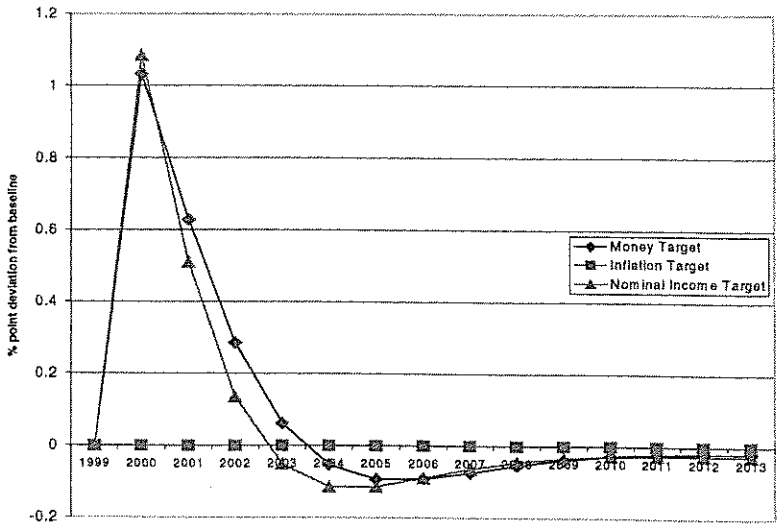


Figure 2.26: Inflation Under a Permanent Increase in Risk Premium on Indian As



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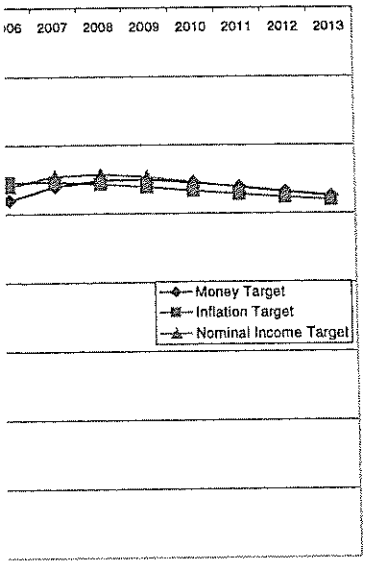

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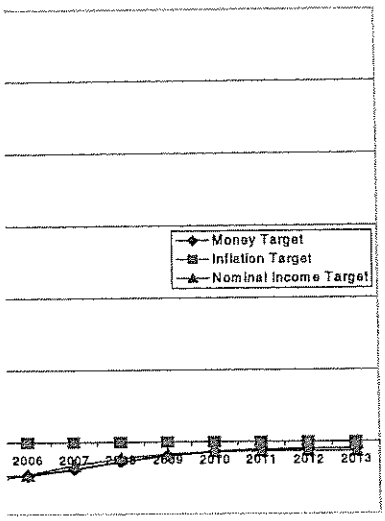


Figure 2.27: $US/Rupee Exchange Rate Under a Permanent Increase in Risk Premium on Indian Assets

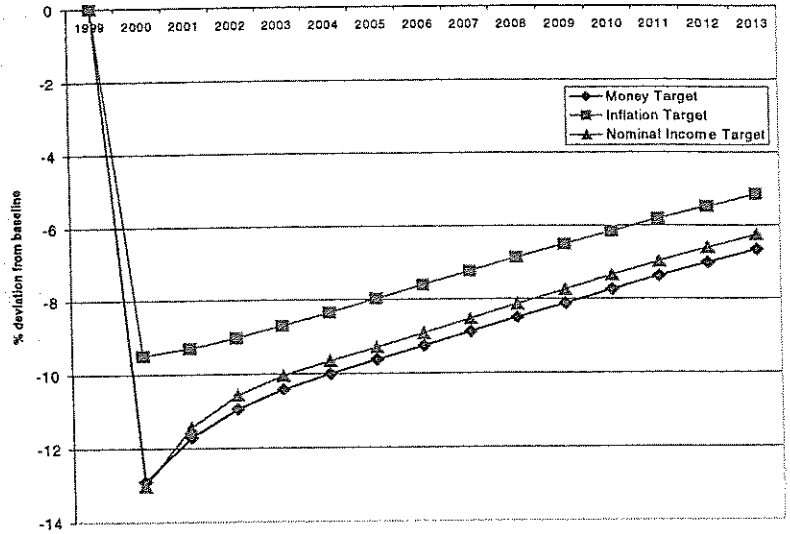


Figure 2.28: Interest Rate Under a Permanent Increase in Risk Premium on Indian Assets

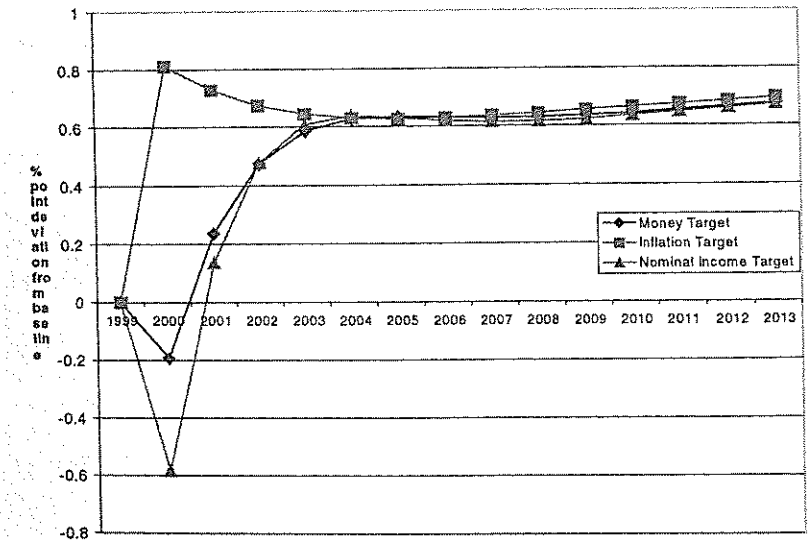


Figure 2.29: Trade Balance Under a Permanent Increase in Risk Premium on Ind Assets

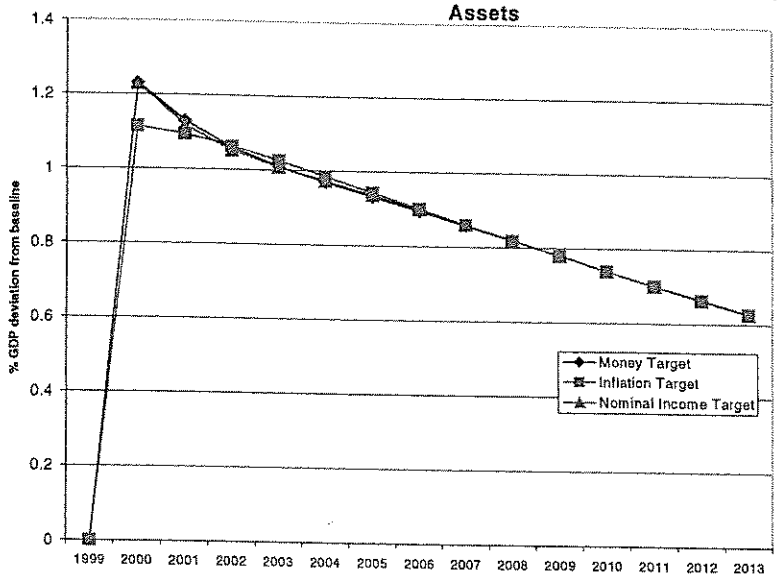
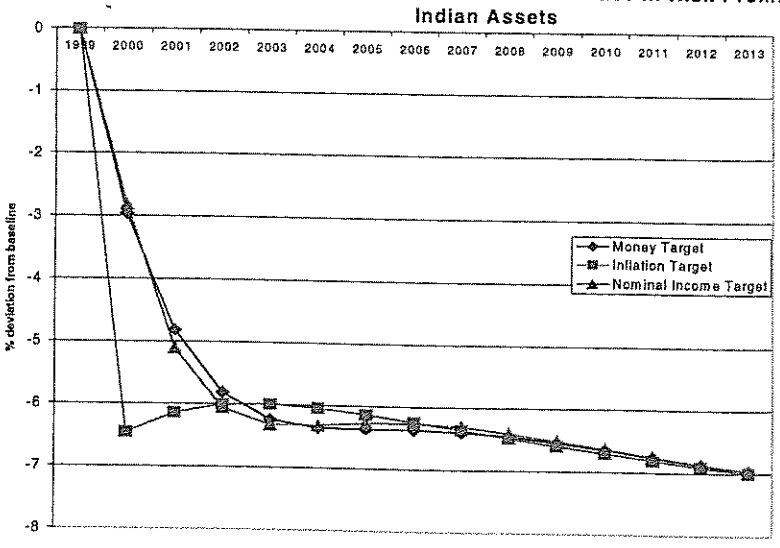


Figure 2.30: Stock Market Value Under a Permanent Increase in Risk Premium Indian Assets



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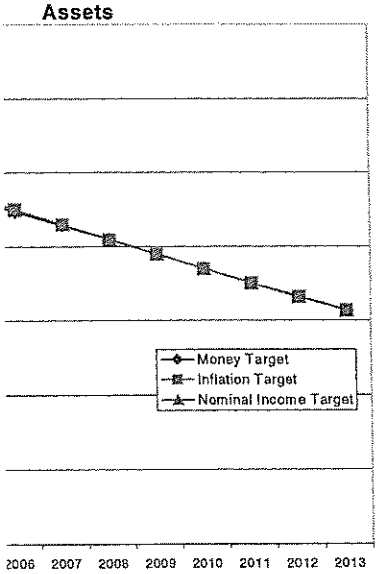

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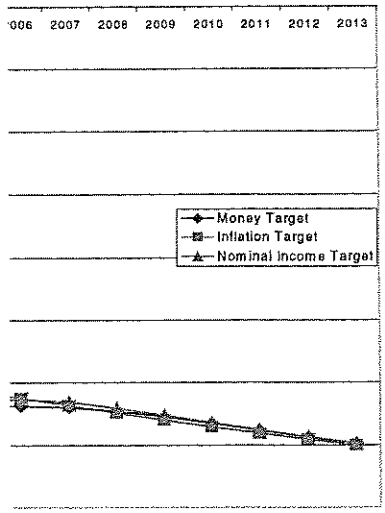

6. Conclusion

This chapter summarizes the current policy debate on selecting a monetary regime for India as well as draws some insights on the key issues from the burgeoning theoretical literature on policy regime choice. Many of the issues are ultimately empirical. To contribute to this aspect of the debate in India we have presented results from a new model of the Indian economy developed as part of the latest version of the McKibbin–Sachs Global (MSG2) simulation model. In exploring the impact of shocks to aggregate demand, supply and risk perceptions under the three policy regimes of a money target, inflation target and nominal income target we find a number of results. First in only considering the adjustment to shocks we find the inflation target regime works quite poorly in terms of output volatility for permanent demand shocks, both permanent and temporary supply shocks and shock to risk perceptions. This depends importantly on the concept of inflation used in the inflation rule and the degree to which exchange rate changes feed into prices. However, the results are consistent with the theoretical literature that in open economies, an inflation target can lead to an inappropriate response to supply side shocks. The risk shock explored in this paper has to our knowledge, not been explored in the theoretical literature on monetary regime choice but represents a real issue for many developing and developed economies.

Overall the money and nominal income rules seem to be very similar under the shocks considered here apart from money demand shocks. If the money demand function is unstable then the nominal income rule clearly dominates the money rule because it does not depend on stability of money demand. Clearly there is room for a great deal more empirical research over a wider range of possible scenarios and a wider set of rules for monetary policy in India.

It should also be stressed that we have not dealt with the issue of credibility in the analysis presented in the empirical part of this paper. It is clearly possible that the inflation target regime may have beneficial effects on credibility especially relative to the money rule. It is not clear why an inflation target would be more or less credible than a nominal income target. However, the actual implementation of the nominal income regime does rely on observing nominal income or at least having a reasonably good forecast of nominal income if used in the way specified in this paper. However if credibility is the argument for an inflation target relative to a nominal income target then the gains from this need to be large in order to offset the fundamental losses in following an inflation target for anything but temporary demand shocks.

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