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Monetary policy and financial stability: Should central bank lean against the wind?

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ABSTRACT

After the global financial crisis, it was observed that price stability alone would not ensure financial stability. The new paradigm indeed insists on the inclusion of financial stability as an additional macroeconomic objective. In this context, it is essential to understand how exactly is the new objective of financial stability will be placed in the existing framework. Also, the efficacy of monetary policy in this regard needs to be thoroughly discussed. This paper probes into the employability of monetary policy as a tool to achieve financial stability. We, therefore, compare between interest rates obtained from the standard Taylor rule and asset price augmented Taylor rule in the Indian context. The results suggest that targeting asset prices can be one of the effective ways to contain financial instabilities and consequent economic slumps.

1. Introduction

While the global economies were recovering from the 2008 financial crisis, the slowdown had already spurred economists to revisit the debate on the efficacy and future of monetary policy. Monetary policy had come under scrutiny across the world after the crisis. Many had argued that expansionary monetary policy had laid the grounds for the downturn. For instance, Taylor (2007) noted that the short-term interest rate path had deviated considerably between the years 2002 and 2005 from the observed short-term interest rates of the Great Moderation period. Markedly, low-interest rates had prompted financial institutions to over-leverage in order to reap high returns on risk capital. A key point at issue that emerged out of this dialogue was about the nature of the relationship between monetary policy and financial stability. Monetary policy and financial stability follow a complicated and conflicting relationship. An enormous body of literature has tried to observe these dynamics.

Consequently, two broad themes appear in the narrative. One is a more general theme on price stability-financial stability nexus and the second one is a definite argument for targeting asset prices in a central bank's reaction function. Though a precise consensus is yet to be established, we argue that it will be a mistake not to perceive the importance of financial stability. For example, the length and amplitude of financial cycles have increased in an era earmarked with financial liberalisation in developed economies (Drehmann et al., 2012). Rapidly opening-up emerging economies are likely to face a similar state of affairs. Accordingly, financial stability objective primarily met with prudential policies may not suffice in an intensely integrated phase of financial development. There are two reasons for this. Firstly, financial freedom underpins the interplay between perceptions of value and risk. Secondly, supply-side developments have raised growth potentials which resulted in fuelling credit and asset price booms (Borio, 2014). Thus, to effectively tame financial instabilities, we argue that monetary policy should step in as a tool for crisis prevention.

To investigate the role of monetary policy in limiting financial instabilities in an emerging economy like India, we assess, whether the central bank should lean against the wind by targeting asset

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prices. In order to check this question empirically, we employ an augmented Taylor rule incorporating asset prices estimated using the Generalised Method of Moments (GMM). Wholesale Price Index (WPI), Weighted Average Call Money Rate (CMR), Index of Industrial Production (IIP) and CNX Nifty 50 are the variables taken for scrutiny for the period between 1994 M4 and 2019 M3. Here, IIP stands as a proxy for real output growth and the CMR is the proxy for policy rates. In order to estimate the extended Taylor rule with housing prices, quarterly estimation for a relatively small sample size has been conducted. The empirical results indicate that asset prices are statistically significant in the feedback rule. The central bank can, therefore, allow the policy rate to react to the growth in asset prices to contain financial instabilities.[1]

There are four sections in this paper. The opening section is a brief background of monetary policy-financial stability dynamics, divided into three sub-sections: (i) monetary policy and financial stability nexus before and after the financial crisis, (ii) discussion from the literature on monetary policy targeting asset prices; and (iii) the discourse in the Indian context. Part two is the methodology. Part three deals with the empirical results and its discussion. Section four documents the conclusion.

2. Review of literature

2.1. Monetary policy and financial stability

The financial crisis was a wake-up call in many respects as it proved many of the conventional wisdom wrong. Firstly, in the aftermath of the stagflation of the 1970s, it was believed that the years of great moderation itself would ensure financial stability. Secondly, during regular times, prudential policies ensured financial stability while in the crisis period, monetary policy would clean the debris emanating from economic instabilities.

Monetary policy as an apparatus came under scrutiny post-2008 crisis. There was a shift from the widely held views and the prevailing strict division between prudential guidelines and monetary policy. Earlier, financial stability was ensured mainly by the regulation and supervision of individual institutions. However, in the changing economic environment, the crisis prevention mechanism is being redrawn in terms of the macroprudential policy framework.[2] Similarly, the debate on 'lean versus clean' has revived in this backdrop. The 'lean versus clean' discussion states two crucial points: (a) the cost of cleaning up after the crisis can be enormous (b) central banks took a benign neglect approach to asset prices and credit booms, relegating monetary policy to respond to macroeconomic outcomes of financial instabilities only when they occurred (IMF, 2015). A significant question that came up with this debate was whether monetary policy should be altered to contain financial risks.

Monetary policy and financial stability are inherently interlinked. Often this relationship is complex and mutual. Financial stability is essential for the conduct of monetary policy. This is because financial instabilities can curtail economic growth, as in the classic cases of bank panics. Likewise, it can also impede the effectiveness of monetary transmission (Billi and Verdin, 2014). Price stability continues to be the monetary policy stance of major Central Banks. Therefore, in the new consensus macroeconomics, monetary policy and price stability objective are treated as synonyms. In the absence of price stability (i.e. periods of deflation or hyperinflation), there is a higher likelihood of financial turbulence (Bordo et al., 2000). These arguments further strengthen the claim that financial stability and monetary policy are reinforcing in the long-run.

Nonetheless, there exists yet another strand of literature which refute price stability to be the necessary condition for financial stability (Borio and Lowe, 2002; Borio et al., 2003; Blinder, 1999). It is in light of this view, financial risks have grown beneath the surface of low-inflation by prompting optimistic ideas on economic growth. Also, compulsive interest in price stability for pinning the expectations of long-term economic stability may lead to increased financial instability as it creates indebtedness and discrepancies between assets of varying maturities (Shirakawa, 2012).

To sum up, there exists an unusual relationship between monetary policy and financial stability (Criste and Lupu, 2014). Though there is no consensus within academia on this relationship, the door must remain open as the link between monetary policy and financial stability (instability) is continuously evolving. Here, one needs to look at whether interest rates should be raised more than what is warranted to contain financial booms and should it be more accommodative while leaning against the wind in conditions of financial busts. We, therefore analyse three different perspectives, each supported by a group of theorists.

A class of economists firmly believe that price stability should continue to remain the primary mandate of monetary policy while leaning against the wind is not advisable. Svensson (2017a) for instance, states that "monetary policy should not have financial stability as a goal". He also argues that leaning against the wind is not justified without evidence based on a thorough cost-benefit analysis (2017b). Ferguson (2002) earlier, before the crisis, took note of whether financial stability is an explicit objective of monetary policy? He confronts the question of how 'activist' the central bank should be in pursuing financial stability objectives. Ferguson settles on implicitly observing financial stability. His study raises apparent concerns about an activist central bank. A financial stability objective actively pursued may impair the conduct of other goals of monetary policy also would attract the problem of moral hazard and may lead to volatility in other economic variables. Bernanke (2015) holds similar opinions. According to him, monetary policy is far from an ideal strategy to address financial threats.

Additionally, a monetary policy pursued to contain financial risks may have unintended repercussions and may drift the focus from near-term objectives of price stability and full employment. Added to this standpoint, Evans (2014) is of the view that it is not monetary policy, but macroprudential policies which are more appropriate to limit financial risks. An empirical analysis by Ajello et al. (2016) conducted in this context supports the central claim on why monetary policy should not actively pursue financial stability objective. They study optimal interest-rate policy in an economic model which is likely to experience a financial crisis based on credit conditions. Their results show that adjustments to the interest rate as a response to credit conditions are minimal.

On the other hand, another school of thought argue that monetary policy should be actively pursued to contain financial risks. Bank of International Settlements (BIS) has contributed significantly to the debate. Carauna (2011) for instance, is of the view that macroprudential policies are not sufficient to ensure the desired level of financial stability. According to him, the monetary policy needs to play a more active role in this regard. The compromise between monetary policy and macroprudential policies may be rare, and they can effectively complement each other to constrain financial anomalies. As noted earlier, Borio and Lowe (2002) approve of pre-emptive monetary policy because financial instabilities can even manifest in stable prices and close to the potential output. Borio (2014) noted that timid monetary policy followed to lean against the wind in case of financial booms and

[1] (Siklos et al., 2004) is one of the earliest attempts in this direction.

[2] Macroprudential policies are financial regulations that aim to mitigate risk to the financial system as a whole or systematic risk.

aggressive monetary policy supported before financial busts is a new instance of time inconsistency problem. The credibility of the central bank is then put to risk. The study, therefore, argues that monetary policy should lean against the wind deliberately during booms and less consciously during busts. Billi and Verdin (2014) with the help of a simple model of monetary policy and financial stability goes a step further to argue that financial stability should be an explicit objective of monetary policy. In the backdrop of the recent crisis, they explain that there exist secure connections between monetary policy and financial stability.

A third perspective is on how inflation targeting regime is to be modified to include financial stability objective. Roger (2009) is recommending a monetary policy that accommodates macro-financial interactions. According to him, monetary policy should explicitly target asset prices if the central bank's analytical framework fails to represent financial sector developments. Similar views such as monetary policy should lean against the wind by allowing for some trade-off between inflation and output to that of financial stability exist in the literature.[3] Inflation targeting, in particular, flexible inflation targeting, remains the right the regime according to this strand of literature.

2.2. Should central banks target asset prices?

A significant source of financial instabilities is asset prices. There are several arguments raised for and against the targeting of asset prices by the Central Bank. Most of the economists present the pronouncement of the Dutch econometrician Jan Tinbergen to justify why the Central Bank should not target the asset prices. In the most acclaimed Tinbergen Rule,[4] he noted that the number of achievable targets and the number of policy instruments deployed to achieve these targets have to be exact. In a simplified model and a correctly identified system, following Tinbergen Rule, price stability is ensured from a well framed monetary policy. Accordingly, it observes the objective of output growth implicitly. This is apparent; as in the long tradition of macroeconomics, monetary policy in the short run affects production and output. However, Vasudevan (2017) noted that Tinbergen had also pointed out that there cannot always be a priori, an exact n x n target-instrument compatibility matrix and that policy targets, instruments and framework often interact with one another.

Another argument against the targeting of the asset price is owing to the difficulty in targeting different asset prices. Which one of the asset prices are to be targeted is a crucial question. Gold and foreign currencies are few of the assets whose price the Central Banks targets. Other asset prices such as those of land, stocks and housing can also be aimed. A case is made for this with a combination of these assets or a more general aggregate asset price. Another reason stated for not targeting asset prices is the difficulty in identifying them until they burst, which also weakens the call to target prices.

Gertler and Bernanke (1999) are in strict opposition to the inclusion of asset prices in the policy reaction function. Their study suggests that monetary policy augmenting asset prices are likely to have undesired consequences. However, they are not in complete opposition in taking care of asset price movements, which they understand as to be essential signals for potential inflationary and deflationary forces. In contrast to this, Cecchetti et al. (2000) asked the same question as Bernanke and Gertler and came up with a different answer. Their inferences favour a monetary policy rule, wherein the Central Bank is not just hitting inflation and output gap, but also to the shifts in asset prices. They also pointed out that difficulty in measuring asset prices should not be an impediment or a reason to ignore the role of asset prices in monetary policy formulation.

2.3. Changing contours of RBI's monetary policy

This section analyses the interactions between monetary policy and financial stability in the Indian context. The Chakravarty committee (RBI, 1985) advocated first-ever formal monetary policy in India by implementing the monetary targeting regime. The monetary targeting regime was not a successful experiment in many of the advanced economies.[5] The monetarist method, which was taken up in the mid-1970s in these countries, was abandoned within a decade. This was majorly due to institutional changes and financial deregulation which by then had weakened the relationship between the intermediate target (monetary aggregates) and the final objectives of price stability and economic growth (Mishkin, 2001).

Consequently, there was a gradual shift towards indirect instruments of monetary policy. Market-oriented financial reforms and the surge in international capital flows following the liberalisation resulted in the instability in demand for money. Capital flows also disrupted the management of monetary aggregates. Since monetary targeting (actively pursued between 1990 and 1998) overlapped with the years of financial reforms, did not do well. Successful monetary targeting was also highly criticised for favouring price stability over economic growth. In the changing environment, the central bank (RBI, 1996–97) noted how financial stability concerns started appearing in official monetary policy formulation.

With these experiences, RBI switched over to Multiple Indicators Approach (MIA) in 1998–1999. MIA provided the Reserve Bank with the required flexibility to respond to the domestic and international changes in financial markets. Since years of monetary targeting, price stability was the informal mandate of RBI. The MIA observed all information about price stability. Kaushik Bhattacharya (2006) notes how the approach is similar to a soft and flexible version of inflation targeting. Differing from this view, Mohanty (2010) observes how the multiple indicator approach widely criticised as a 'checklist' approach can be the right stance in the context of challenging monetary management and period of uncertainty. He cites Goodhart (2007) to that supervising money and credit variables helps in tracking the asset market developments. According to Mohanty (2012), the ideal monetary policy framework for understanding the macroeconomic effects of financial imbalances would be an approach that factors in multiple indicators. Also, he suggests augmenting Taylor rule by adding financial variables in the reaction function. Mohan (2012) made a similar observation about the relevance of multiple indicator approach. The multiple indicators approach thus provides the encompassing and integrated set of data sufficient to limit the uncertainty prevailing in a financially integrated environment (RBI, 2004).

Multiple Indicators Approach lasted between 1998 and the adoption of flexible inflation targeting in 2016. Though the framework did not have an explicit financial stability objective, financial variables appeared as indicator variables in policy formulation. The adoption of the current regime of flexible inflation targeting attracted many critics on theoretical and methodological front. A notable argument posited against the inflation-targeting

[3] See for example (Woodford, 2012; Aydin and Volkan, 2011).
[4] See Tinbergen (1952).
[5] With the exception of Germany and Switzerland.

framework of RBI is about the non-discretionary nature of the policy stance. Secondly, the prime objective of inflation target overrules other significant goals, such as growth and financial stability (Chandrashekar, 2014; Kohli, 2015; Nachane, 2014). The Urjit Patel committee report (RBI, 2014) is rooted in the new consensus macroeconomics, which was highly criticised in the wake of the 2008 financial crisis (Nachane D., 2014). The FIT regime, therefore, does not explicitly concern asset prices as an issue. Instead, it draws on the pre-crisis consensus that price stability will ensure financial stability.

To summarise, both academicians and practitioners agree that financial stability is essential and that it should be an objective of central banking.[6] Factoring in financial stability objective, on the contrary, is a loose consensus. The current regime follows a traditionalist stance of observing macroprudential policies and keeping monetary policy counter-cyclical. At this juncture, it is essential to note a few problems of employing macroprudential policies. Macroprudential policies have costs in terms of less competition and less efficient resources allocation despite solving the adverse effects of market failures. As noted by Svensson (2017b), macroprudential policies may have "income and wealth distribution effects, including intergenerational effects". Likewise, they are discretionary, evoking the problem of time-inconsistency and efficiency in terms of communication. Thirdly, macroprudential policies are in their prime. The embryonic stage requires support; there is no single institution looking after the conduct of prudential policies.

In India, financial sector regulators, such as Securities and Exchange Board of India (SEBI), Insurance Regulatory and Development Authority (IRDA) and Pension Fund Regulatory and Development Authority (PFRDA) closely work together with RBI to supervise their respective markets. Financial Sector Development Council (FSDC) chaired by the Finance Minister is an institutional mechanism that coordinates the Government and the regulators. Earlier in this regard, recommendations were placed for the regulation of all trading of financial instruments and financial products to be brought under SEBI (GoI, 2009; GoI, 2007). There is, however, little worth in such a recommendation. As Subbarao (2009) had noted, interest rates, exchange rates and equity prices have implications for the conduct of monetary policy and macroeconomic stability.

3. Methodology

3.1. Standard and augmented taylor rule

We begin by stating the standard and augmented versions of Taylor rule. Extended Taylor rule equations encompassing asset prices are consequently detailed.

The standard taylor rule (Taylor, 1993) is of the following regression form:

$$i_t^* t = r^* + \pi^* + \beta(\pi_t - \pi^*) + \gamma z_t \quad (1)$$

Where, $z = 100^* \frac{(y_t - y^*)}{y^*}$

Here, 'i_t^*'is the targeted short-term interest rate; r* is the term equilibrium real interest rate; π is the per cent change in the price level; π* is targeted inflation rate; z is the output gap; y_t is the real output and y_t* is the real potential output. β and γ denote the sensitivity of interest rate towards deviations of inflation and output from their target and potential level respectively. In short, the rule assumes that the short term nominal interest rate (i_t^*) which captures monetary policy stance of the Central Bank has to be restrictive if (i) the actual rate of inflation is above the potential rate of inflation or if (ii) the actual real output is more than the potential real output. In steady-state ($\pi_t - \pi^* = 0, z_t = 0$), the desired short-term interest rate is thus the sum of equilibrium real interest rate and target rate of inflation.

The Taylor principles embedded in the rule is significant for observing macroeconomic stability. The first principle is satisfied if the coefficient on inflation gap is higher than and significantly different from one. In other words, a significant $\beta > 1$ means central banks observe restrictive monetary policy to curb inflation and stabilise the economy; on the other hand, a significant inflation gap coefficient less than one ($\beta < 1$) indicate pursuance of accommodative monetary policy. Second Taylor principle states that the coefficient on the output gap (z_t) has to be positive. A positive coefficient value indicates a lowering of interest rate while the actual output falls short from the potential level.

In an augmented taylor rule, the actual interest rate eventually adjusts itself to the desired interest rate. The following equation represents the interest rate smoothening (Castroa, 2008):

$$i_t = \left(1 - \sum_{j=1}^{n} \rho_j\right) i_t^* + \sum_{j=1}^{n} \rho_j (i_{t-j}) + v_t \quad \left[0 \leq \sum_{j=1}^{n} \rho_j \leq 1\right] \quad (2)$$

Here, 'ρ' is the degree of interest rate smoothing parameter. There are different explanations for interest rate smoothening. Uncertainties concerning the state of the economy, instabilities in financial markets and the credibility of monetary policy commitments are few of the theoretical explanations.

The estimable augmented Taylor rule is given as follows:

$$i_t = \alpha\left(1 - \sum_{j=1}^{n} \rho_j\right) + (1+\beta)\left(1 - \sum_{j=1}^{n} \rho_j\right)\pi_t + \gamma\left(1 - \sum_{j=1}^{n} \rho_j\right) z_t + \sum_{j=1}^{n} \rho_j (i_{t-j}) + u_t \quad (3)$$

Kindly note that equation (3) is not linear in parameters and hence ρ, α, β and γ are estimated using the non-linear least-squares method.

3.2. Forward looking taylor rule

An improvement over the original taylor rule is the forward-looking Taylor rule (Clarida et al., 1999). Instead of including actual or past values of inflation, the forward-looking taylor rule, complying with the practices of the central banks use expected inflation for the calculation of desired interest rate:

$$i^* = r^* + \pi^* + \beta[E(\pi_{t+k}|\Omega_t) - \pi^*] + \gamma\left[E(z_{t+p})|\Omega_t\right] \quad (4)$$

$$i^* = \alpha + \beta E_t\,(\pi_{t+k}|\Omega_t) + \gamma\left[E(z_{t+p})|\Omega_t\right] \quad (5)$$

Here, $\alpha = r^* - (\beta - 1)\pi^*$, π_{t+k} and z_{t+p}, are the forecast values of the inflation and output gap conditioned upon a vector of all the information (Ω) available in time period t.

Further, substituting equation (5) in equation (2), we get the forward looking augmented taylor rule. The specification for empirical estimation is thus given by:

[6] See for example (Nachane D. M., 2005; Goyal, 2011; Rangarajan, 2001; Subbarao D., 2011).

Table 1
Data and sources.

Sl.no	Variables	Nature of the Data	Source	Data available for the period
1	Weighted Average Call Money Rate (CMR)	Monthly	Database on Indian Economy (RBI)	1991M4 to 2019M3
2	Wholesale Price Index (WPI) [Spliced to the latest base year of 2011–12]	Monthly	Office of the Economic Advisor (Min. of Commerce and Industry)	1982M4 to 2019M3
3	Index of Industrial Production (IIP) [Spliced to the latest Base Year 2011–12]	Monthly	Ministry of Statistics and Planning (MOSPI)	1982M4 to 2019M3
4	S&P CNX Nifty (N50)	Monthly	Historical Index Data (NSE)	1991M4 to –2019M3
6	Real Gross Domestic at Market Prices [Spliced to the latest base year of 2011–12]	Quarterly	Database on Indian Economy (RBI)	1996Q1 to 2018Q4
7	Housing Price Index (HP) [Spliced to the latest base year of 2011–12]	Quarterly	Database on Indian Economy (RBI)	2008Q4 to 2018Q4

$$i_t = \left(1 - \sum_{j=1}^{n} \rho_j\right)\left[\alpha + \beta E_t\left(\pi_{t+k}|\Omega_t\right) + \gamma E_t\left(z_{t+p}|\Omega_t\right) \times\right] + \sum_{j=1}^{n} \rho_j\left(i_{t-j}\right) + u_t \quad (6)$$

3.3. Extended taylor rule

According to the objective of this paper, the forward-looking augmented Taylor rule is extended to include the asset prices (x_{t+q})that may influence the setting of interest rate:

$$i_t = \left(1 - \sum_{j=1}^{n} \rho_j\right) \times \left[\alpha + \beta E_t\left(\pi_{t+k}|\Omega_t\right) + \gamma E_t\left(z_{t+p}|\Omega_t\right) + \theta E_t\left(x_{t+q}|\Omega_t\right) \times\right] + \sum_{j=1}^{n} \rho_j\left(i_{t-j}\right) + u_t \quad (7)$$

θ, therefore, is the interest rate sensitivity towards growth in asset prices.

After removing the unobservable from equation (6), extended taylor rule in terms of the realised values is given by:

$$i_t = \left(1 - \sum_{j=1}^{n} \rho_j\right)\left[\alpha + \beta\pi_{t+k} + \gamma z_{t+p} + \theta x_{t+q}\right] + \sum_{j=1}^{n} \rho_j\left(i_{t-j}\right) + \varepsilon_t \quad (8)$$

Further, for the estimation of equation (7), a reduced form is considered:

$$i_t = \varphi_0 + \varphi_1\pi_{t+k} + \varphi_2 z_{t+p} + \varphi_3\, x_{t+q} + \sum_{j=1}^{n} \rho_j\left(i_{t-j}\right) + \varepsilon_t \quad (9)$$

Where, $\varphi_0 = (1 - \sum_{j=1}^{n} \rho_j)\alpha$, $\varphi_1 = (1 - \sum_{j=1}^{n} \rho_j)\beta$, $\varphi_2 = (1 - \sum_{j=1}^{n} \rho_j)\gamma$, and. $\varphi_3 = (1 - \sum_{j=1}^{n} \rho_j)\theta$

Estimation of the reduced form extended taylor rule has been carried out by employing the Generalised Method of Moments[7] (GMM). It imposes the following orthogonality condition:

$$E_t\left\{i_t - \left[\varphi_0 + \varphi_1\pi_{t+k} + \varphi_2 z_{t+p} + \varphi_3\, x_{t+q}\right] + \sum_{j=1}^{n} \rho_j\left(i_{t-j}\right)|v_t\right\} = 0 \quad (10)$$

Here, v_t is a vector of instrument variables available at time period 't' and is orthogonal to ε_t. Comprising of lagged values of realised time-series data that help predict inflation, output gap and asset price growth, instrument variables are uncorrelated with the current disturbance term u_t. They, however, are correlated with the explanatory variables.

3.4. The data and the variables

Certain aspects concerning the variables require a few insights before proceeding further. The calculation of equation (8) for instance, need a priori information on the inflation target, potential output, and equilibrium real interest rate.

Firstly, though no theoretical justifications exist as to why a 2 per cent inflation target is a benchmark for price stability, it is actively pursued by several prominent central banks. However, emerging economies with acute trade-offs between inflation and higher growth are more likely to adopt a flexible inflation target regime. In India, the Chakravarty Committee (RBI, 1985) had suggested 4.0 per cent tolerable level of inflation. However, Subbarao (2011), taking into account RBI estimates recommended 5.0 per cent tolerable level of inflation, which falls in a range between 4.4 and 5.7 per cent. Nevertheless, we take 4.0 per cent (±2 per cent) as the tolerable level of inflation following the recommendations made by the Urjit Patel Committee report.

The potential level of real output growth is on the other-hand estimated using the Hodrick-Prescott filter. HP filter is a two-sided linear filter. It computes a smoothened series $g_t$of a given time series y_t by minimising the variance of y_t around g_t, conditional on a penalty that constraints the second difference of g_t. Alternatively, it implies that HP filter chooses $g_t$to minimise:

$$\left\{\sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T}\left[(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})\right]^2\right)\right\}$$

Where λ is the smoothening parameter and $c_t = y_t - g_t$.The more substantial the value of λ, the smoother is the solution series.

Lastly, the equilibrium real interest rate is not readily available in real-time. In the original Taylor rule, this is 2 per cent. It is also the global practice. In the current study, this, however, is being estimated from the Taylor Rule formulation itself.

We use quarterly data for the estimation of an extended Taylor rule. The data ranges between 1994M4 and 2019M3, loosely covering the two monetary policy regimes of the Reserve Bank of

[7] For further information, please refer Hansen (1982), Hamilton (1994).

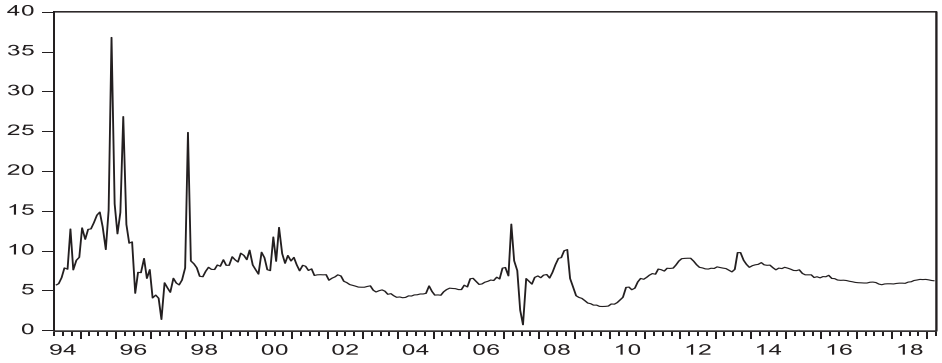

Fig. 1. Call money rate.

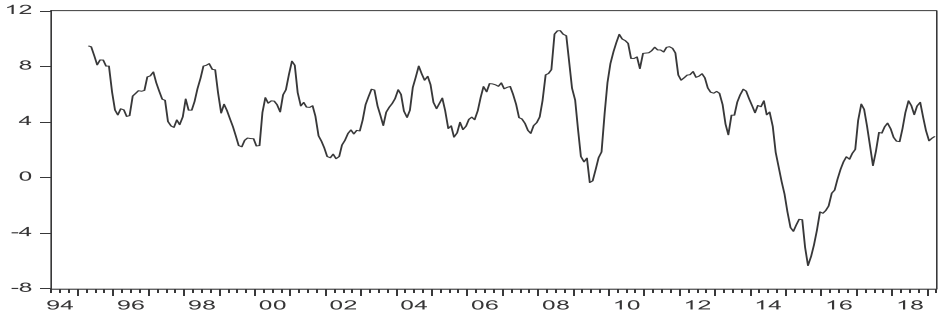

Fig. 2. Inflation rate.

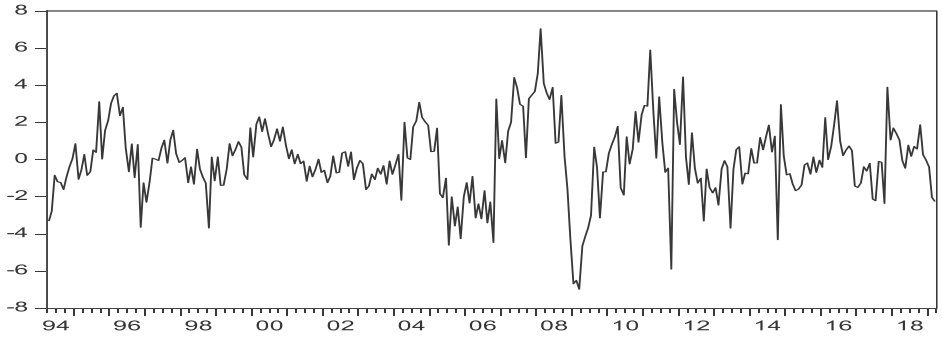

Fig. 3. Output gap.

India, i.e., the multiple indicators approach (19997-2016) and flexible inflation targeting (2016-till date). Weighted Average Call Money Rate (CMR), Wholesale Price Index (WPI), Index of Industrial Production (IIP)and CNX Nifty 50 (N50), are the variables used in the analysis.

Here, CMR is the proxied policy rate. A more appropriate estimation may involve the consumer price index (CPI). Since fewer observations with quarterly data and non-availability of CPI-combined for years preceding 2011 can result in biased GMM estimates; monthly frequencies are taken up. However, a sub-sample estimation for 2013Q4 to 2018Q4 with CPI-Combined and Housing Prices (HP) may reiterate the robustness of the results. Table 1 summaries the variables and sources of data.

3.5. Some stylised facts about the variables

Sharp volatility in the call money rate before 2000 seems to have receded over the years. After a dip following the global financial crisis, the CMR has remained in the band of 5–10 per cent. During the inflationary episode between 2007 and 2014 in India, the CMR though initially falling between 2008 and 2010 had remained restrictive. What is also interesting is that it has remained relatively accommodative between 2015 and 2017 (Fig. 1). It closely corresponds to the repo rate, which has reduced from 7.75 bps to

Table 2
Augmented Dickey-Fuller test.

Variable	Level	First Difference
WACR	−3.58 (0.03)	−17.57 (0.00)
IIP	−1.97 (0.61)	−5.05 (0.00)
WPI	−2.07 (0.55)	−4.23 (0.00)
N50	−0.85 (0.95)	−6.55 (0.00)

Notes: (i) *p values in the parenthesis.
(ii) WACR_SA, IIP_SA, WPI_SA, N50_SA denote Weekly Average Call Money Rate, index of industrial production, Wholesale Price Index, and S&P CNX Nifty Stock Price Index respectively.
(iii) The lags of the dependent variable for identifying white noise residuals is determined with the Akaike Information Criterion (AIC).

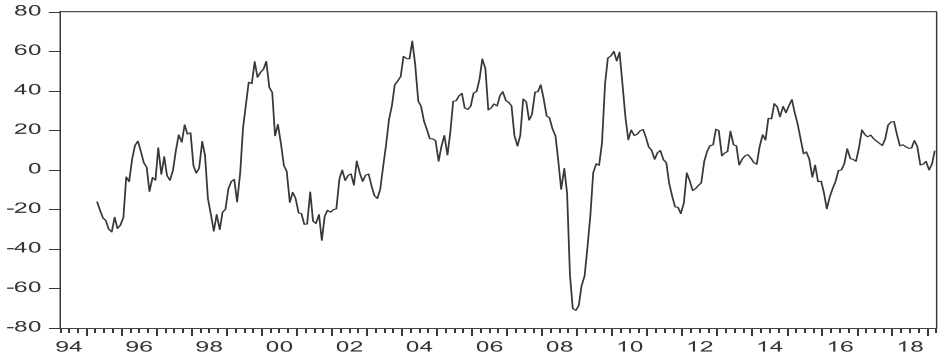

Fig. 4. CNX nifty 50 growth rate.

6.25 bps during the same period.

The WPI inflation rate has remained reasonably stable before the global financial crisis. It was the high inflationary episodes between 2007 and 2014 that made the RBI come up with the inflation targeting regime, a paradigm which was by then contested in the post-financial crisis period. As noted above, an inverse relationship between call money rate and WPI inflation is apparent (Fig. 2). Following the restrictive monetary policy stance of the Central Bank, for instance, the inflation rate had considerably reduced. To limit a possible slowdown thereafter, the central bank resorted to easy monetary policy.

2008 global financial crisis had resulted in a sharp negative output gap (Fig. 3). The dip again occurred in the second wave of the financial crisis and output growth has remained mostly stagnant ever since. A comparison of the output gap and inflation rate indicate that though there was a sharp decline in the inflation rate following restrictive monetary policy, output growth did not pick up between 2012 and 2015.

Since theoretically considering the potential equity prices does not make sense, in the extended Taylor rule, the growth rate of CNX Nifty 50 has been taken as the asset price variable 'θ'. There has been an absolute increase in the stock price over the years. A close examination of the asset price growth rate indicates that they did appreciate just before the crisis (Fig. 4).

4. Estimation and results

4.1. Augmented dickey-fuller test

The unit root test results of the variables report non-stationarity at their levels[8] and stationarity when first differenced (see Table 2). All the variables taken for scrutiny are seasonally adjusted. ADF statistic is obtained by:

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta i \Delta y_{t-i+1} + \varepsilon_t$$

Where, Δ is the difference operator, α, β and γ are the coefficients to be estimated, y is the variable whose time series properties are examined, and ε is the white-noise error term (Enders, 2010).

4.2. Linear and non-linear least-squares regression

To draw comparisons, besides an extended Taylor rule, this section reports the results of the standard and the augmented versions estimated using linear and non-linear least-squares regression, respectively (Table 3).

In the standard Taylor rule (row I of Table 3), the inflation gap is significant. In Comparison with the augmented Taylor rule (row III), though the inflation gap is still positive, it is no longer significant. The extended standard Taylor rule and augmented Taylor rule (row II and IV) show that the year-on-year growth rate of asset prices as both significant and negative. In all the four cases, the output gap is significant.

As noted in the methodology since both β is less than one and γ is positive, the results of standard Taylor rule indicate that for the period between 1994M04 and 2019M03, the central bank predominantly pursued an accommodative monetary policy. Since the growth rate of asset prices turned out to be significant and negative in an extended standard Taylor rule framework, it is apparent that the central bank did not lean against the wind and the policy rate continued to remain accommodative (see Fig. 5). The multiple indicator approach regime, where a set of variables besides inflation appeared as objectives of monetary policy mostly coincides with the period of analysis in this study. The multiple indicators may partly explain the insignificant inflation rate and significant stock price growth rate.

The results from the augmented Taylor rule also suggest that the central bank did not take into account the inflation concerns while determining the short-term interest rate. As the reported value of 'rho'(ρ) is 0.61, it is evident that the speed of adjustment of the short term interest to the desired level is low. In other words, the 'rho' parameter in the augmented Taylor rule is suggestive of high monetary policy inertia. However, explicit targeting of asset prices in the reaction function can speed up the adjustment from the short term interest rate to its fundamental determinants.

A deviation from the above analysis is the shift in policy response (Table 4) towards the inflation gap between 2000M4 and 2013M03. The period encompasses the years of high inflation, which also led to the adoption of inflation targeting regime in India.[9] While the output gap and asset prices are significant in the standard and extended Taylor rule, they are insignificant in an augmented taylor rule.

Comparing Figs. 2 and 5, it is apparent that the central bank resorted to countercyclical monetary policy during this period in the background of high inflation[10]. The importance of the interest

[8] Call money rate is stationarity at level.

[9] For more details, see Mohanty (2012)

[10] Between the 2008 Q2 and 2008 Q3, the Repo rate increased by 100 bps. Similarly from 2010 Q1 to 2011Q3, the repo rate increased by 350 bps. Also see Raj et al., (2011)

Table 3
Estimation results from standard and augmented taylor rules (1994M04 to 2019M03).

Sl.No	Parameters	ρ	α	β	γ	θ	Adj. R^2	DW Stat.
I	**Standard Taylor Rule**	NA	7.11 (36.99)***	0.11 (1.96)**	0.31 (3.34)***	NA	0.05	0.80
II	**Extended Standard Taylor Rule**	NA	7.52 (38.10)***	0.07 (1.33)	0.40 (4.50)***	−0.04 (−5.54)***	0.14	0.87
III	**Augmented Taylor Rule**	0.61 (13.27)***	6.35 (9.05)***	0.17 (1.37)	0.34 (1.81)*	NA	–	2.22
IV	**Extended Augmented Taylor Rule**	0.57 (11.83)***	6.92 (10.45)***	0.12 (1.11)	0.42 (2.45)***	−0.03 (−2.64)***	–	2.17

Notes: (i) Rows I and II present the least square estimates of the standard taylor rule (equation (1)), while rows III and IV are estimates of an augmented taylor rule without allowing for a forward-looking behaviour.
(ii) Desired inflation rate (π^*) is 4 per cent.
(iii) Potential output is estimated with HP filter.
(iv) $\alpha = r^*-(\beta-1)\pi^*$ for the given value of desired inflation.
(v) t-statistics are presented in the parenthesis; significance level at which the null hypothesis is rejected: ***, 1%; **,5%, and *,10%.

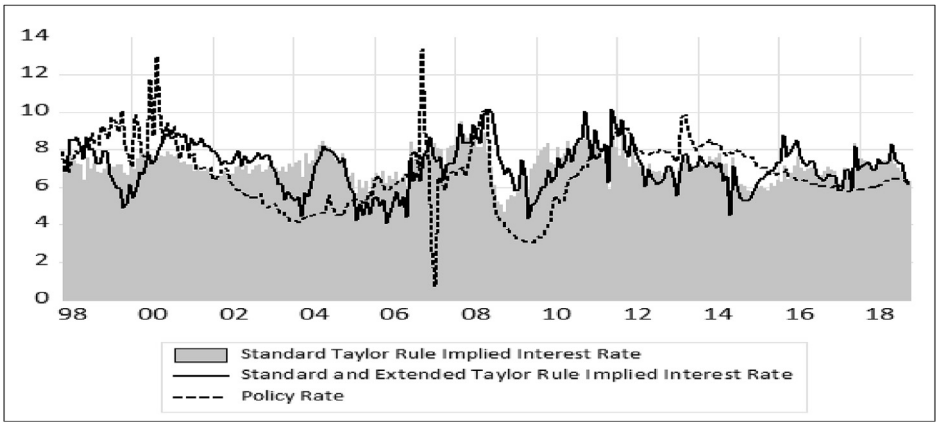

Fig. 5. Comparisons between policy rate and taylor rule implied interest rates.

rate channel of monetary transmission mechanism after the introduction of Liquidity Adjustment Facility (LAF) in early 2000 and the sensitivity of interest rate towards inflation shocks partly explains the shift in policy response towards inflation gap between 2000M04 and 2013M03. Another observation from this period is the phase of expansionary monetary policy (2000–2006) that coincides with the boom in India's financial cycle (Behera and Sharma, 2019). Also, it is interesting to note that the standard and extended Taylor rule derived interest rate is above the policy rate during this period. In other words, though the central bank incorporated inflation concerns in the monetary policy, the short term interest rate did not rise enough to guarantee a financial cycle of lesser duration and amplitude.

Two points require attention at this juncture. Foremost, the corporate leverage and asset markets bubble marked India's dream run between 2003 and 2008 (Nagaraj, 2013). Secondly, in the augmented Taylor rule setting, the high value of 'rho' indicate considerable interest rate smoothing or monetary policy inertia. Together, this signifies that the central bank should consider leaning against the wind when required in the expansionary phase in order to avoid subsequent sharp economic slowdown.

4.3. GMM regression

This section proceeds with the estimation of a forward looking Taylor rule. As noted in the methodology, a Generalised Method of Moments (GMM) regression estimates the forward looking Taylor rule (Table 5). Instruments are the four lags of each regressor. The Orthogonality C Test confirms that the instruments are valid while the Regressors Endogeneity Test indicates that the regressors are exogenous in the presence of these instruments. J statistic for the standard and extended Taylor rule estimation indicate exact identification.

Consistent with least square estimates of standard and augmented Taylor rule (Table 3), the GMM estimates of an extended Taylor rule show inclusion of asset prices as significant (row I). As noted above, the inflation rate is not significant in the estimated sample period between 1994m04 and 2019m03. Further, the proxy for asset price 'θ' in the sub-sample quarterly estimation (2011Q4 to 2018Q4) were chosen as housing prices (row II). In the latter case, the output gap is only significant at the 10 per cent significance level.

The results from a forward looking extended Taylor rule indicate that the monetary authority, by and large, did not take into account

Table 4
Estimation results from standard and augmented taylor Rules (2000M04-2013M03).

Sl.No	Parameters	ρ	α	β	γ	θ	Adj R^2	DW Stat.
I	**Standard Taylor Rule**	NA	5.02 (12.85)***	0.23 (3.54)***	0.12 (1.91)**	NA	0.12	0.41
II	**Extended Standard Taylor Rule**	NA	5.43 (14.36)***	0.21 (3.58)***	0.20 (3.29)***	−0.02 (−5.57)***	0.26	0.52
III	**Augmented Taylor Rule**	0.77 (16.24)***	4.32 (3.84)***	0.34 (1.93)**	0.17 (0.99)	NA	–	2.29
IV	**Extended Augmented Taylor Rule**	0.75 (13.90)***	4.57 (4.30)***	0.32 (1.97)**	0.20 (1.23)	−0.01 (0.39)	–	2.25

Table 5
GMM estimation for forward-looking and extended taylor rules.

Sl.No	Parameters	ρ	α	β	γ	θ	DW Stat.
Monthly Estimates 1994m04 to 2019m03							
I	**Augmented Taylor Rule_N50 [Instrument Variables: infl(-1 to -4) iip_gap(-1 to -4) n50_gr(-1 to -4)]**	0.87 (5.35)***	7.73 (12.30)***	0.01 (0.90)	0.74 (2.27) ***	−0.06 (−3.28) ***	2.12
Quarterly Estimates 2011Q4 to 2018Q4							
II	**Augmented Taylor Rule_HP [Instrument Variables: infl(-1 to -4) iip_gap(-1 to -4) hp_gr(-1 to -4)]**	0.59 (4.23)***	5.46 (10.36)***	0.09 (2.80)***	−0.45 (1.72)*	0.11 (3.49)***	1.80

inflation expectations while framing the monetary policy between the period in discussion. Though the asset prices are significant, they are negative, pointing to an accommodative monetary policy. The pursuance of accommodative monetary policy is also apparent from the positive and significant output gap.

The results from a forward looking augmented Taylor rule, including housing prices, reveals that the central bank indeed incorporated inflation expectations in short term interest rate calculations. The restrictive monetary policy pursued between 2013 and 2014 is an instance of a proactive central bank committed to inflation targeting. The restrictive and neutral monetary policy stances of the central bank captured by the policy rates were well above the standard and extended Taylor rule derived interest rates during this period (Fig. 5). Hence, it is evident that financial stability concerns have adequately appeared in the monetary policy. Further, the value of 'rho' suggests a relatively fast movement of interest rate towards its desired level. Regardless, it is essential to note that the short term interest rate overemphasised the importance of price stability at the expense of the output gap, as evident from the negative sign of the output gap. Post- 2015, a reversal of trend is evident with monetary easing. The accommodative monetary policy is likely to have implications for the financial market without igniting growth due to weak monetary transmission.

5. Conclusion

The basic premise of this study is to understand whether the central bank should target financial variables besides pursuing price stability and growth objectives. To address this question, we estimate an augmented and extended Taylor rule using the Generalised Method of Moments (GMM). The extended Taylor rules incorporate growth in asset prices, stock prices and housing prices. The short term interest rate for the period between 1994M04 and 2013M03 is predominantly accommodative as evident from the results of standard, augmented and forward looking Taylor rule estimation. However, the results of augmented and extended Taylor rule imply that the inflation rate is insignificant in determining the policy rate during the period of analysis.

Interestingly, a sub-sample estimation for the period between 2000M04 and 2013M03, coinciding with years of high inflation and financial cycle indicate that price stability appeared as a concern for the central bank during this period. The interest rate so formed nevertheless were not enough to warrant a financial cycle of lesser amplitude and duration. Since the results indicate considerable monetary inertia, our empirical results suggest that the central bank should consider a procyclical leaning against the wind. Further, the results from the forward-looking Taylor rule incorporating asset prices (housing prices) indicate that the objective of price stability at the expense of output growth had kept the interest rate well above the Taylor rule derived interest rate in the recent past (2011Q4 to 2018Q4). This has resulted in both the slowdown in the growth of output and housing prices. A proactive central bank that targets asset prices besides the inflation rate and the output gap is, therefore, a preferred alternative.

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