Monetary Policy in India and the U.S.: Is the Taylor Rule Irrelevant?

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Abstract

The present paper is about the monetary policy mechanism and transmission process as it relates to the economies of India and the U.S. While a vast amount of literature exists on monetary policy transmission mechanism in developed capitalistic countries, no distinct treatment is available for developing countries such as India. There are obvious limitations for monetary theory applied to countries such as India compared to a developed country such as the U.S. Most well-known amongst these limitations, is the dilemma embarked by the dichotomy of monetary versus non-monetary sectors of the Indian economy. The rural sector of the Indian economy, where majority of the population lives, is still dominated by private money lenders and by several other crude financial institutions. This financially under-privileged sector persists along with the financially well-developed urban sector where online transactions are common and almost all modern financing facilities are available. The case for "rule versus discretion" merits renewed discussion in monetary policy making both in India and the U.S. The paper argues that there is no deliberate or implicit application of any rule, such as the Taylor rule in India. In the U.S. the Federal Reserve in 1990 to 2001 period has supposedly followed the Taylor Rule. However, since the financial crisis of 2008, there has been no change in the discount rate and the focus is more

on the quantitative easing (QE). The Taylor rule is not only out of fashion but also has become irrelevant. This paper attempts to show that the Taylor rule does not help in explaining contemporary monetary policy behavior in either country.

Keywords: Monetary Policy; India and the U.S.; the Taylor rule.

Introduction

In recent monetary policy steps, there has been a serious question of monetary policy independence as it is practiced by the Reserve Bank of India (RBI hereafter) and even by the Federal Reserve System (FRS hereafter). The RBI lowered its benchmark interest rate to 7.75 % on January 15, 2015 followed by a further cut by 0.25 percentage point on March 4, 2015.What was the real reason for this important policy change? Was this surprise cut in interest rate based on lower than expected inflation which dropped to 5 % in December? Or any other reason. There was no explanation given by the authorities. The RBI's latest press release states that its goal is to reduce inflation to 4% by 2016-17 and in subsequent years (incidentally, Mr. Jaitley, the Finance Minister, referred to this rate of 4% in his budget speech as well). One can raise the question of "independence" of the RBI as proclaimed by Raghuram Rajan, the Governor of RBI. In essence, the RBI policy making does appear to be heavily influenced by the Finance Ministry. At the same time that Mr. Rajan strives to achieve a 4% inflation rate, he is committed to providing for a real interest rate in the range of 1.5% and 2.0%. This suggests that nominal interest rate target has to be around 6 %. The RBI's goal of simultaneously achieving both the 4% inflation and about 2% real rate of return will prove to be quite challenging. Not surprisingly, in its defense, the RBI has already

indicated that it will seek a 2% percentage point flexibility in either direction.

These policy targets raise a serious question about the selection of a policy instrument by the RBI since it does not seem to have a particular theory to follow and get guided by it. Should the RBI become "data dependent" and follow the Fed's model in the U.S. or explain its policy based on any macroeconomics model? Thus far the RBI has been aiming on multiple goals such as the interest rates, economic growth, exchange rates and liquidity creation.

Although Rajan's success on all counts, especially lowering the inflation rate is admirable, it leaves serious doubt about the continued success in the near future. It appears that the current success of lowering inflation rate is more of a matter of luck (lower commodity prices, especially oil prices that contributed to lower inflation) than of a sound monetary policy based on any theoretical model. In this paper we study whether or not the RBI uses (or has ever used) the Taylor rule as guide to its monetary policy. The RBI's goal of price stability and interest rate stability is supposed to go hand in hand and the Taylor Rule encompasses both. It incorporates real as well as monetary variables, more specifically, the Taylor Rule hypothesizes that the interest rate adjustment is dependent upon the difference between potential GDP and actual GDP and the difference between expected

and actual rates in the given year. In essence, it treats interest rate change as the main policy instrument and money supply level as the secondary policy instrument.

In the U.S. the Fed has practiced a policy of near zero interest rate since the financial crisis of 2008. Incidentally, that is what the Taylor Rule prescribes for the years after the crisis (Figure 2). Some policy makers are not convinced about its importance and we also believe that in the case of India as well as in USA, the Taylor rule may not have proved to be a dependable guide. In this paper, we propose to investigate whether the behavior of the RBI and FRS's monetary policy making is consistent with the prescribed rule.

This paper is organized as follows: Section 2 carries out the literature survey of the Taylor Rule and the theoretical under-currents it contains. Section 3 applies the Taylor Rule to the monetary policies of Reserve Bank of India's and the Federal Reserve Bank of the U.S. in practice. It also explains the use of statistical analysis and exhibit important graphs and charts further providing validation to our arguments. Section 4 includes the summary and conclusions.

II. Theoretical Background and Relevant Literature

Theoretically the monetary transmission mechanism can be summarized in a historical perspective. The very first and celebrated transmission mechanism for monetary policy effectiveness was analyzed by Irving Fisher in his old quantity theory of money which used the equation of exchange as follows:

1) $$MV = PY$$

As is very popular in any monetary economics textbooks, Fisher expected the velocity of money (V) [which he defined as the number of times one unit of money completes the circular flow in a given time period] to be a constant term. This is because he assumed that V is mainly decided by some psychological factors such as the habits of public in making transactions. If people make more cash transactions, Fisher expected V to be higher. He further argued that these habits do not change in the short run, so there is no reason for V to change in the short-run. Similarly following the classical economists' tradition of asserting that economy always produces full employment, Fisher expected the real GDP or Y in the above equation [which was supposed to be the predictor of total transactions of buying and selling in the economy] to be a constant term. With V and Y to be constant, Fisher and his quantity theory concluded that any increase in money

supply (M) would lead to an equi-proportionate increase in general price level (P). Thus we got the first argument for the "transmission mechanism of monetary policy" which essentially concluded that excessive increase in money supply only leads to high inflation and therefore it was thought to be not only unnecessary but also quite harmful for the economy. Since its development in 1905, the quantity theory of money dominated the policy making until the late 1930s, when the theory was severely criticised by John M. Keynes and other Cambridge economists. Of course the main criticisms of quantity theory argument arose from the naïve belief that V and Y would be constant in any economy. As Great Depression years witnessed, the real GDP can decline substantially for a long period of time, plus velocity does not have to be constant if people use money for hoarding (saving, or store of value) purposes too.

The second major explanation of transmission mechanism was provided by Keynes himself in his famous work, General Theory of Employment, Interest and Money (1936). This explanation floods the principles of macro textbooks and envisions a chain of events after an increase in money supply. In fact, as against the popular belief of classical economists that money cannot make changes in real GDP, Keynes argued that increase in money supply can in fact, lead to increase in real GDP by initially reducing the interest rate (r) and then

increasing real domestic gross investment (I). Thus, important to Keynes and to his umpteen followers (Keynesians) was the popular chain of event (sometimes referred to as the Keynesian Chain) that can be summarized as follows: As increase in money supply would make more credit available and banks will be forced to lower the interest rate. This lower interest rate will then increase the expected rate of returns from the use of the machine (or Marginal Efficiency of Capital, MEC). Producers then would not hesitate borrowing from the banks and buy more machine tools and equipment and to increase the construction activities. These activities, being a major part of real Investment, would increase the gross domestic real investment (I) and will start the famous Keynesian expenditure multiplier process. Hence the Keynesians would argue that an Increase in investment, via multiplier process would further increase the real GDP. Thus the effectiveness of monetary policy to Keynesians, was much clear and direct due to this chain, than it was to Fisher.

Then again, one other famous quotations of Keynes has been to say "Money does not matter". In other words, this implies that money supply cannot increase real GDP (and therefore does not matter). This, however, is relevant only in the unique case of liquidity trap. Liquidity trap is a special situation in the money market in which interest rate goes so low that any future expected interest rate is definitely higher

(and bond price is definitely lower). When the present interest rate is already low and the expected future interest rate definitely higher, then it is unworthy to buy bonds. In liquidity trap, therefore, the demand for bonds becomes close to zero and demand for money becomes close to infinity. In liquidity trap, any increase in money supply ends up being hoarded by the people creating no change in interest rate and therefore the above Keynesian chain explanation breaks down.

Thus the Keynesian advice was clear that money supply increase has the ability to raise the real GDP, but (only) in case of liquidity trap it is true that "money does not matter". Monetary policy is therefore sub-ordinate or secondary to fiscal policy which has no such limit to its effectiveness. According to Keynes and Keynesians (contrary to the advice of Fisherian quantity theory) there is no fear in raising money supply when interest rate is high because bringing the interest rate down (and pegging it at the minimum level) should be the objective of any rational monetary policy. No wonder then monetary policies all over the world, and especially in the U.S., raised the money supply tremendously when Keynesian advice was dominant in 1940s- 1960s. The problem arose when in late 1960s when two important developments occurred. First the tremendous increase in money supply increased the price levels and, second, a group of economists

from the University of Chicago, led by Milton Friedman, also known as the monetarists, started challenging the Keynesian advice that (in liquidity trap,) money does not matter.

Thanks to the magnificent theoretical work of Friedman (see 1956 and 1966 in bibliography), supported by empirical observations everywhere, that increases in money supply have led to increases in prices, we started seeing new arguments about monetary policy making. Friedman started arguing circa 1960 that, just because the tremendous increase in money supply of the last 30 years has raised prices, by now completely forgotten (and discarded), Fisherian quantity theory of money was not a bad theory after all. One of the most significant contributions of Friedman was to revise the quantity theory of money argument and show that velocity of money is a stable function of price level and real GDP. He further concluded that since both of these determinants of V are somewhat stable, V is also stable. In that case one can easily see that the money supply (M), by using quantity theory equation, does have an ability to change either price level (P) or real GDP (Y) or both P and Y. Monetarists therefore showed that “Money does matter” and it is wrong to argue that monetary policy is secondary to fiscal policy. Moreover, Friedman by showing different effects with increase in money supply proved the possibility of higher (instead of lower as Keynesians were sure of) interest rate. In

the 1970s, the U.S. and Indian money supply grew tremendously but both economies experienced higher interest rates, a phenomenon that monetarists could easily envision, but Keynesians were confused about.

Out came the monetary policy prescription by monetarists, namely, excessive increase in money supply is completely unacceptable as a policy option, better yet is the obedience of some kind of monetary rule (which will dictate monetary stability). The contemporary argument of inflation targeting is a by-product of this monetarists' belief.

So we are left with the Great Debate, since the 1970s, that implies that monetary policy should use its own "discretion" in changing money supply (of course supported by Keynesians and Neo-Keynesians) or follow the "rules" that dictate a stability of money supply irrespective of anything. The Federal Reserve, when headed by a strong Monetarist, Paul Volcker, tried to keep money supply under strict control in 1979 to 1982 duration (sometimes called the monetarist experiment) quickly gave it up after 1982 as interest rates sky-rocketed and economy went into a severe recession in 1982. Since 1982 there has been no clear indication of which way the Federal Reserve policy making is tilted. In fact, since 1987 when Allan Greenspan became the Federal Reserve Board Chairman, things

became so obscure that economic agents had to come up with several predictors of monetary policy behaviour. One such predictor was the theory that explained people inflationary expectations formation and the advised expectations control. Hence according to the expectations hypothesis, as long policy makers control people's expectations, their actions can be effective in changing the real GDP.

History shows that 1980s were dominated with this kind of Federal Reserve as well as Reserve Bank of India's behaviour. Second, there was a prediction that Federal Reserve should keep in mind "inflation targeting" and change money supply accordingly. While 1990s were full of incidences that support this behaviour, even if in modern times it is a suspect. In fact, recently (August 2014) as the RBI's Governor indicated that changes in interest rates should take place regardless of the inflationary situation. In 1990s, the Federal Reserve as well as RBI found a more suitable instrument of money supply management in changing the interest rate. Since 1991 up to 2006 Federal Reserve has changed the discount rate (Rate charged by Federal Reserve Banks to the Financial Institutions (hereafter FIS)) seven times a year. In 1990s and 2000s we were sure that interest rate change was the most popular instrument and inflation was the most important target to both US and Indian monetary policy makers. A classic example of this

international belief that inflation targeting is important is included in Bernanke et.al (1999).

The latest attempt to predict monetary policy behaviour is the pioneering work of John Taylor in proposing the equation for targeted interest rate (Federal Funds Rate, the rate charged by one Financial Institution (FI) for its loan to other FI) by the Federal Reserve. This equation has come to be known as the "Taylor Rule" of monetary policy. In its classic form is summarized as:

2) $$i_t = r_t + \pi_t + \frac{1}{2}(\pi_t - \pi_t^*) + \frac{1}{2}(y_t - \hat{y}_t)$$

Where i_t is a short-term nominal interest rate such as the Federal Funds rate, r_t is the real interest rate, π_t is the inflation rate, π_t^* is the inflation rate target, y is the log of real GDP, and $\hat{y}_t$ is the potential output. In short, Taylor rule in its classic form extends Fisher's equation by adding two correctors when there is disequilibrium in the form of inflation or output gaps.

The main question was, whether or not did the Federal Reserve make changes in Federal Funds rate based on this Taylor Rule? The answer at best is the mixture of Yes and No. Until 2001 Taylor rule idea did somewhat satisfactory job even if deviations of major degree did occur in periods 2002 onwards. The real blow to the Taylor rule which kind of

wiped out the whole concept, has been the start of financial crisis in 2008 and onwards. The Federal Reserve reacted to the crisis by taking the interest rate to a very low level (as low as .25% for the Federal funds rate target) and keeping it there until now (2014). For the last 6 years, therefore, there is no change in targeted federal funds rate. In fact, the quantitative easing attempts of 2009, 2010 and 2012 onwards have only brought back the money supply change as the major instrument of active monetary policy. In our paper therefore it will be interesting to see the relationship between money supply and interest rate, interest rate and investment, money supply and real GDP (income effect) and money supply and prices (Price effect) for the period when no single theory was tremendously dominant. The behaviour of the monetary policy makers in last 15 years is guided by their vision of how the economy is doing and what policy change is warranted rather than by prescription of any theoretical philosophy.

In a long, but exciting article, Malik and Ahmed (2010) consider the application of Taylor rule to the monetary policy making in Pakistan. Their graph of actual and Taylor Rule induced interest rates shows similar pattern but a strong series of deviations in the period from 1991 to 2006. They attempt in many different ways to compromise the deviations but most of their explanations are found to be in practical problems encountered by Pakistani economy rather than theoretical.

They conclude as follows: "One of the important findings of this study is that monetary policy has been generally conducted through discretionary measures rather than adopting a rule." They however do not blame the rule instead argue that "Commitment to the Taylor-type rule would have significantly improved macroeconomic performance". We could not have disagreed more with this conclusion.

Instead they could have rightly concluded that Taylor rule is a theoretical brainchild of an imaginary policy guide without much relevance to the realistic behavior of any monetary policy either in a developed country such as the U.S. or a developing country such as Pakistan. In this paper we intend to do that after discussing the behavior of the Reserve Bank of India's monetary policy.

Virmani (2001) is another useful but somewhat outdated study of the relevance of the Taylor Rule. In a short but applied paper he tests the Taylor rule application to Indian economy.

III. The Taylor Rule and the Monetary Policy Making

A. The Recent American Experience:

The original paper by John Taylor (1993) was essentially to explain the behavior of the Federal Reserve's monetary policy in the U.S. since the 1980's. Thus its initial objective was to examine whether or not a

simple equation incorporating the twin goals of maximum employment and price stability can explain the Fed's policy.

While the Taylor rule does indeed explain the performance of the Fed and was primarily descriptive in nature, subsequent studies by John Taylor and several other economists at the Fed assigned it a prescriptive role and by the 1990's it had become integrated into all policy deliberations. The Taylor rule was modified further and with two objectives in mind: first, to explain how monetary policy was set in the past, and second, how should it be set in the future.

Assuming that the real ex-post rate of interest is two percent (2%), the Taylor rule entails the federal funds rate according to whether or not the inflation rate and the output rates are on target.

While some have claimed that the Taylor rule has revolutionized the way the monetary policy is formulated and also suggest that the Taylor rule should be incorporated in macroeconomic models; others have expressed serious reservations in accepting that the policy can solely be depended on the simple rule. According to them, the simple rules are unlikely to be optimal since they may not be able to capture all of the important factors that influence monetary policy.

The Taylor rule, however, did become prominent in the U. S. monetary policy deliberations up to the mid 1990's. In 1998, however, the FOMC (Federal Open Market Committee) became concerned on the outcome

of the zero bound nominal interest rates. This concern necessitated adjustments to the Taylor rule. In the presence of a significant downward trend on interest rates, one alternative suggested was to increase the coefficients on the inflation rate and the output gap. Again in 2002, this issue was raised once again at the FOMC meetings and it was strongly suggested that alternative models can provide additional information in policy making. It was also realized that in the Taylor rule type models, evidence suggests that the federal funds rate is highly sensitive to how inflation and output rates are measured. As expected, the Taylor's rule recommendation differed a great deal when compared to alternative models such as the FRS/US.

Again in 2003 – 2006, the policy deviated from the Taylor rule. The federal funds rate was kept well below what the rule suggested in order to off-set incipient deflationary environment. John Taylor, however, criticized this easy monetary policy and pointed to the surge in housing demand and house price inflation as a direct result of the policy. During the great recessions of 2008 – 2009, the forward-looking Taylor rule implied a federal funds rate as low as negative 5 percent (-5%). The original 1993 Taylor rule, however, suggested federal funds rate close to zero (0). Ben Bernanke pointed out that since 2011, according to the Taylor rule the Fed's policy was "too easy". Taylor rule would suggest the interest rate somewhere between

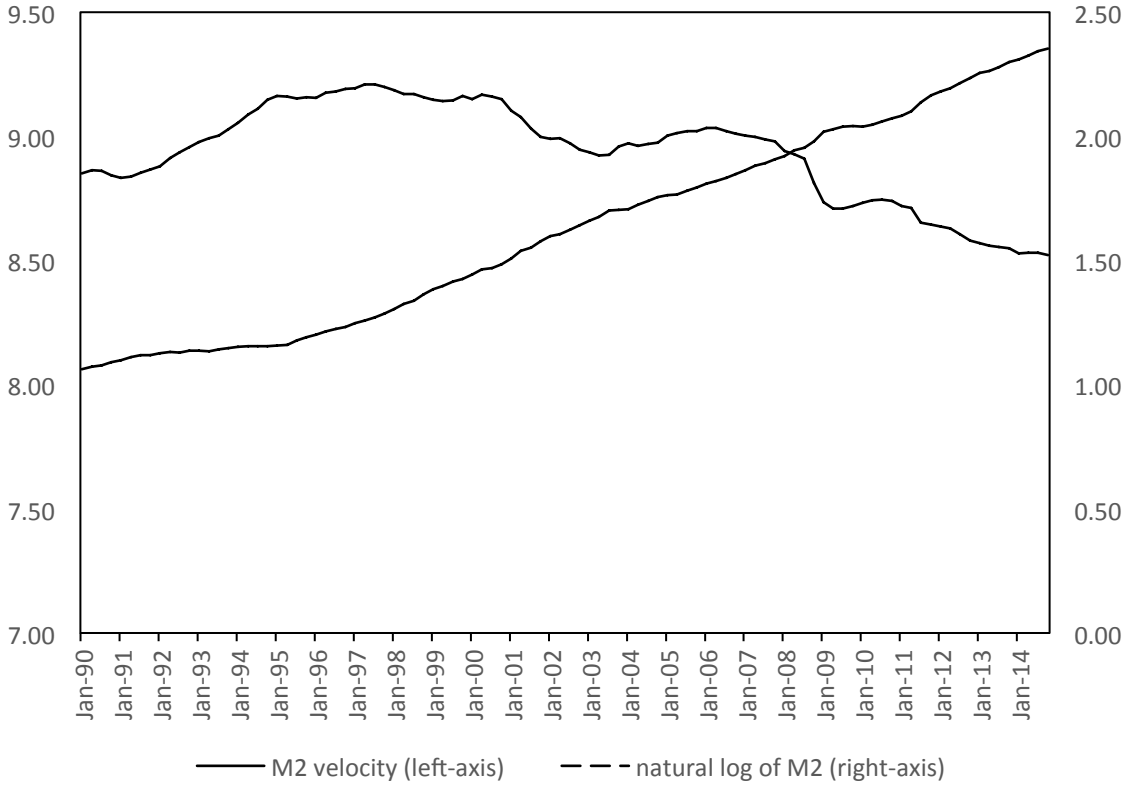
1% and 2%. He firmly believed that the Taylor rule doesn't provide any policy guidance when the predictive rate is negative.

To fight great recession, policy makers would have favored negative interest rate but the federal funds rate could not fall below zero and therefore, the Fed resorted to the policy of quantitative easing. The policy makers became disenchanted with the Taylor rule and pointed out the weakness of the rule. In particular, it was mentioned that the output gap and the real equilibrium interest rates are not observable and their estimation is a real complicated task. The Taylor rule is not strictly implementable on theoretical as well as operational grounds. According to Ben Bernanke, monetary policy making is quite complex, particularly in a dynamic economy such as the U.S.

In may be argued that in the presence of zero interest rate bound, the Taylor rule is dead. Bernanke, however, suggest that some variant of the Taylor rule may still be considered as one of the inputs in monetary policy decision process. In the end, however, Bernanke's position is against the adoption of a rule. He states that, "the adoption of the original Taylor rule would disguise the complexity of the underlying judgements that FOMC members continually make if they are to make good policy decisions. Monetary policy should be systematic, not automatic." He further states, "I don't think we will be replacing the FOMC with robots anytime soon, I certainly hope not."

The recent growth in money supply in U.S. economy has created many confusing consequences. While the Quantitative Easing (QE) attempts since 2009 have made unprecedented increase in US money supply, the result of expected inflation has not materialized in 2014. In fact, the link between price level and money supply has become spurious in nature. This is a direct challenge to monetarism but may be in the long run many economists are expecting QE attempts to create more harm than good. Moreover, the QE attempts have not really made too many change sin M2 money supply. In other words, the U.S. base money had the unprecedented increase, but not money aggregates like M2. This is partly because, the Fed's policy lowers V by paying interest on reserves, and therefore MV does not grow as fast as the base money. Figure 1 shows the U.S. natural log of M2 and its velocity for the period 1990 – 2014.

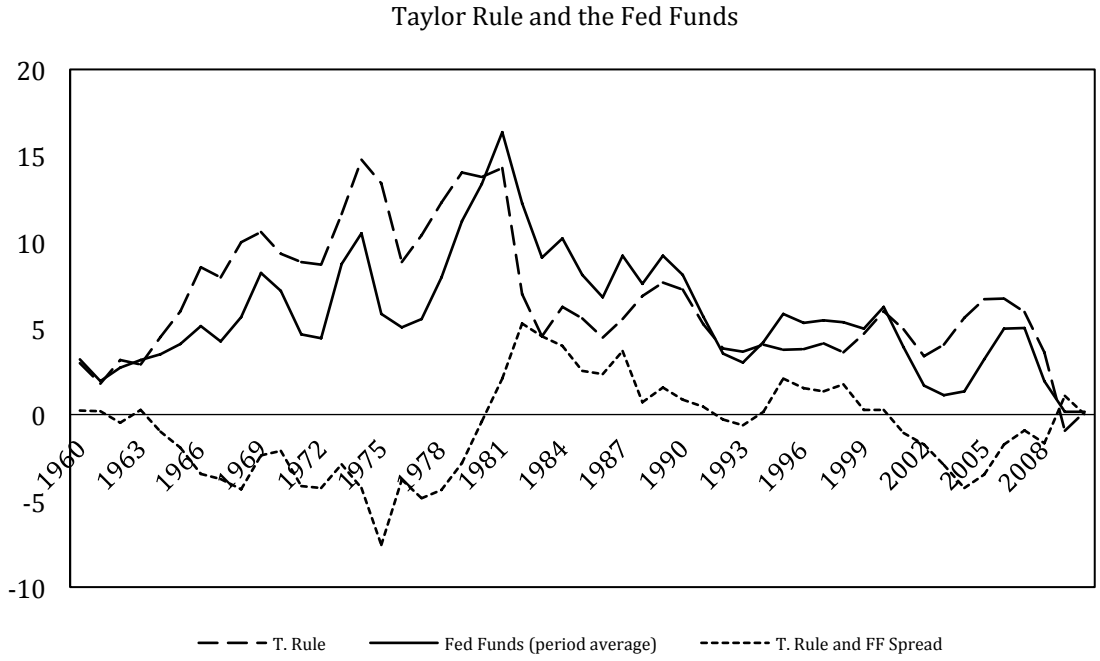
Figure 1. Natural log of M2 and M2 velocity, U.S., 1990 - 2014



Source: St. Louis FRED ®

Figure 2 depicts the Taylor rule, the Federal funds rate, and the spread between these two series for the period 1960 – 2010. A spread is observed between 2001 and 2008.

Figure 2. Taylor rule, Federal funds rate, and Taylor rule – Federal funds rate spread



Source: St. Louis FRED ® and calculations by the author

B. The Indian Experience

Close scrutiny of RBI does not support the Taylor rule as a valid tool to explain monetary policy in India since 2000. At first sight the short term interest rate seems to follow Taylor's rule (figure 3), but closer scrutiny casts doubt on the Taylor rule being the informing rule of the RBI.

Figure 3: Short term nominal interest rate and Taylor rule for India

The Taylor rule is constructed with (1) quarterly data, (2) CPI inflation, (3) the real interest rate is the difference between the nominal interest rate and inflation, (4) output gap is calculated by applying the HP filter to the GDP series, (5) and we assume an annual inflation rate target of 4%. However, because the real interest rate is calculated from *observed* interest and inflation rates, it is expected that both series will look similar. If we estimate the inflation target that would minimize the sum of squared errors between the nominal interest rate and Taylor rule's prescription, then the inflation target should be a

significantly high 106.96% annually. This suggests that the Taylor rule is not informing the IRB.

A closer scrutiny should observe changes in interest rates as inflation and output gap changes. To do this we rewrite Taylor rule in the following way:

3) $$i_t = \beta_0 + \beta_1 \cdot \pi_t + \beta_2 \cdot (y_t - \hat{y}_t)$$

Where $\beta_0 = r_t + \pi_t - \frac{1}{2}\pi_t^*$, $\beta_1 = 1 + \frac{1}{2}$, and $\beta_2 = \frac{1}{2}$. According to this representation, it is expected for the nominal interest rate to move in the same direction than inflation and the output gap. The inflation rate series depicts seasonality (see figure 2). It is feasible, then, that the RBI follows a seasonally adjusted (SA) inflation series instead of the non-seasonally adjusted (NSA) series. Therefore, we work with both, a SA and the NSA inflation series.[1] Table 1 show the contemporaneous and one quarter lagged correlation (ρ) between the interest rate and NSA inflation (π), SA inflation $(\tilde{\pi})$, and output gap $(\dot{y})$.

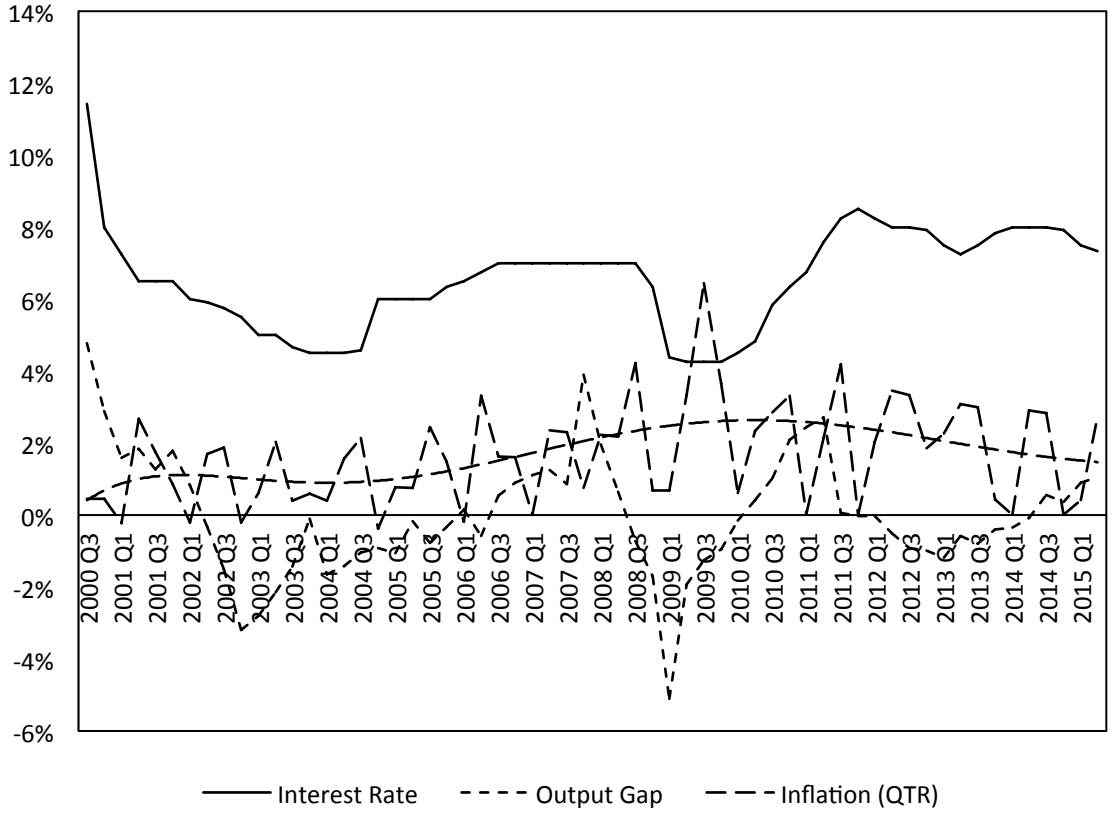
Table 1: Correlation between the nominal interest rate and inflation and output gap.

$\rho(i_t, \pi_t) = -0.05$	$\rho(i_t, \pi_{t-1}) = 0.05$
$\rho(i_t, \tilde{\pi}_t) = 0.17$	$\rho(i_t, \tilde{\pi}_{t-1}) = 0.32$
$\rho(i_t, \dot{y}_t) = 0.56$	$\rho(i_t, \dot{y}_{t-1}) = 0.54$

[1] The SA series is 6th degree exponential smoothed NSA series.

Correlation values suggest that the RBI pays more attention to output gap than inflation. In term of the latter, the SA inflation series seems to be more relevant than the NSA series. The NSA inflation series has a standard deviation of 1.40%, similar to the output gap standard deviation of 1.65%. The SA inflation series has a standard deviation of 0.62% which can explain the lower correlation between interest rates and inflation with respect to the correlation between interest rates and output gap because output gap requires more adjustments to the interest rate than inflation. Figure 4 shows the nominal interest rate, the output gap, and the NSA and SA inflation rate.

Figure 4: Nominal interest rate, output gap, and inflation



The graph depicts that interest rate follows closer movements of the output gap than SA inflation. After 2011, however, it is unclear if the interest rate is following or not movements in the output gap. If we observe the first quarter of 2009 output gap and inflation move in opposite directions. In in AD-AS framework, the fall in output and the rise in inflation suggests a negative AS shock instead of a negative AD shock in which case the Taylor rule has no definite prescription regarding which way the interest rate should move. However, the

sharp fall in interest rate suggests RBI is not paying much attention to inflation, or that it has an unrealistic high inflation target.

The data shown so far offers a weak support for the interpretation that RBI is following Taylor rule. A more robust analysis consists in running a regression based on equation 3 to estimate values for β_1 and β_2. Table 2 shows six regressions. The first one includes the contemporaneous effects of inflation and output gap. The second regression adds a quarter lag for inflation and output gap to account for a delayed reaction of RBI to economic data. Regressions three and four add dummy variables to control for quarter seasonality. Regressions five and six replace SA inflation for NSA inflation series in regressions 1 and 2.

Regressions in Table 2 neither show strong support for Taylor rule being a good fit for RBI's monetary policy. Note, first, that coefficients are not consistently statistically different than zero. Second, output gap coefficients are not consistently in the ballpark of the expected value of 0.5. This includes the addition of the contemporaneous and lagged coefficients. Third, the inflation coefficient also falls outside the ballpark of the expected value of 1.50. The only exception is regression number six. The addition of these two inflation coefficients equals 0.492. This model, however, shows coefficient values that are too high in absolute terms and is also the regression which residuals

deviate more from the normal distribution. The six regressions presented in table 2 do not show strong support in favour of the Taylor rule being the guide of IRB's monetary policy.

Table 2. Taylor rule regression models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	0.0657*** (0.0024)	0.0632*** (0.0027)	0.0634*** (0.0032)	0.0625*** (0.0033)	0.0597*** (0.0043)	0.05635*** (0.0032)
Output gap	0.4651*** (0.0926)	0.0983 (0.1412)	0.4610*** (0.0953)	0.0819 (0.1501)	0.4629*** (0.0907)	0.0507 (0.1110)
NSA Inflation	-0.0073 (0.1095)	0.0212 (0.1020)		0.0269 (0.1414)		
Output gap (-1)		0.3407*** (0.1320)		0.3541** (0.1400)		0.3001*** (0.1033)
NSA Inflation (-1)		0.0812 (0.1021)		0.0799 (0.1377)		
Dummy Q2			-0.0006 (0.0051)	0.0011 (0.0050)		
Dummy Q3			0.0033 (0.0053)	-0.0002 (0.0052)		
Dummy Q3			0.0006 (0.0045)	0.0014 (0.0047)		
SA Inflation					0.3453 (0.2426)	-8.5248*** (1.7221)

SA Inflation (-1)						9.0400*** (1.7164)
Schwartz criterion	-352.9447	-351.3608	-341.5674	-339.3604	-355.0350	-380.2670
Akaike criterion	-359.2277	-361.7485	-354.1335	-355.9807	-361.3180	-390.6547
Hannan-Quinn	-356.7701	-357.6936	-349.2182	-349.4928	-358.8604	-386.5998

Numbers in parenthesis are standard deviations.

Regression results can be compared to Taylor rule as shown in equation number 3. Namely, we can compare an Indian Taylor rule with the reaction functions estimated by the regressions. This is shows in table 3. It can be seen that even if taking all coefficients as statistically significant their values do not match a prescribed Taylor rule for India. For β_0 we assume an inflation target of 4%. For the real interest rate we calculate the average and subtract/add one standard deviation giving a range of values for β_0. For models with more than one inflation or output gap coefficient (when there is a lag included) we use the average of both coefficients (even if we add these coefficients their values do not match India's Taylor rule.)

Table 3. Taylor rule and estimated reaction function by the RBI

	Taylor rule	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
β_0	6.86% - 10.90%	0.07	0.06	0.06	0.06	0.06	0.06
β_1	1.50	-0.01	0.05	-	0.05	0.35	0.26
β_2	0.50	0.47	0.22	0.46	0.22	0.46	0.05

IV: Conclusions

From the above tests, it is clear that the relevancy of the Taylor rule is questionable in USA and in India. Neither country has ever adopted the monetary policy to be consistent with any rule. Our results show that India uses no pre-determined strategy to change money supply, at the most the policy makers keep in mind that excessive inflation is unacceptable and the money supply growth is moderated in case of expected inflation getting out of bounds. Interest rates have been at a high level in India and the non-monetary sector's existence puts a limit to the effective monetary policy. We do not see any relevancy of the Taylor rule in monetary policy making in USA either. The interest rate has been exceptionally low, since 2008 discount has been close to zero which means interest rate is not seen as the policy tool for last whole decade. The monetary policy making is done more to the tune of data observation and there is no a priori perception to the money supply change. Changes in money supply are more instinctive and spontaneous. In fact, attempts of quantitative easing of recent years have shown that any kind of rule for making change in interest rate is not applied.

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