The New Monetary Policy Framework – What it Means

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It is a great honour to be invited to deliver this year's Chakravarty Memorial Lecture. Prof. Sukhamoy Chakravarty was one of India's outstanding economists. His main interest was in real growth and investment planning. He wrote extensively in these areas and some of his writings are treated as path breaking. His interest in matters of money and finance were minimal. However, the position changed when he was appointed as the Chairman of the Committee to Review the Working of the Monetary System in 1982. I was a member of the Committee and worked closely with him. The Committee, as you all know, recommended regulating money supply in tune with the expected rate of real growth to achieve price stability.

Even though the Report reflected many of the ideas that I had been talking about earlier, it had the real imprint of Chakravarty. It was not a passive endorsement of the recommendations but a positive one, he having spoken on several occasions emphasizing the significance of the recommendations.

In Sir Purushotamdas Thakurdas Memorial Lecture (Chakravarty, 1986) he said:
 "What is the basic conceptual framework that the Committee uses? As I understand it, the Committee does assume that there is a reasonable degree of stability in the demand for money in India in a *functional* sense. If this assumption was to be denied, then many recommendations will lose their significance and it is doubtful whether with a grossly unstable demand function for money, there is a major role left for monetary policy itself from the point of view of inflation management". On monetary targeting (Chakravarty, 1986) he said:
 "Even granting that the approach of the Committee represents an acceptable solution to the problems of regulating monetary expansion, the recommendations of the Committee in regard to monetary targeting have occasioned fears that the monetary authority will gain an unintended control over the scale of public expenditures. This impression needs to be dispelled. The phrase monetary targeting is not necessarily to be equated with the rigid targets. Only a pure monetarist might view monetary targeting as being nothing other than an inflexible rule. What the Committee has advocated is 'monetary targeting with feedback'. It has taken care to specify several qualifications to the monetary target as might be derived from the demand for money function or a more comprehensive econometric model providing for a study of interrelationship between money, output and prices on the one hand, and

between credit and output on the other. Keeping in view the limitations of empirical investigations of economic phenomena in the context of policy induced structural changes and strong exogenous supply, institutional and other factors, the Committee has taken as its starting point expansion of M^3 within a targeted 'range' rather than a precise targeted increase. Further the Committee visualizes that the 'range' will be computed each year. These are major departures from rigid monetary targeting or from an inflexible money supply growth rule. A clear appreciation of this feature of monetary targeting recommended by the Committee is central to the correct interpretation of the Committee's recommendations".

It is important to note that the recommendation of the Chakravarty Committee is very different from what Friedman advocated. Friedman wrote, (Friedman, 1983) "Changes in the quantity of money which are erratic mean that the economy will be subject to a great deal of uncertainty and will have a very erratic pattern of behaviour. That is why those of us who are called monetarists have always believed that it is very desirable to have a steady rate of monetary growth and not to have it highly erratic".

Varying rates of growth in money supply according to Friedman were introducing an additional element of uncertainty. Therefore, he wanted a steady rate of growth. The Chakravarty Committee recommendation moves away from this approach but links monetary growth to expected growth in real output.

Much water has flown under the bridge since the Chakravarty Committee submitted its Report. 1991 saw dramatic changes in India's financial and monetary system. The fiscal dominance has come down a bit. Automatic monetization of fiscal deficit has gone. Administered structure of interest rate has been withdrawn. Government borrows from the market at market-determined rates. This has made possible the use of interest rate as a policy variable. Using money target was justifiable at one point when the system operated with administered structure of interest. Also, Bernanke and Mishkin point out, (Bernanke & Mishkin, 1997) "Using an intermediate target such as money growth is acceptable in an optimal control framework only if the intermediate target contains all information relevant to forecasting the goal variable; in this extreme case, using the intermediate target is equivalent to targeting the forecast of the goal variable". But as we shall discuss later, quantity (money) and price (interest rate) are interrelated.

Enunciation of Objectives

In any monetary policy framework, a key ingredient is the enunciation of its objectives as its actions are guided foremost by the objectives. A recurring question in this context is whether monetary policy should be concerned with all the goals of economic policy. The issue of 'objective' has become important because of the need to provide a clear guidance to monetary policy makers. Indeed, this aspect has assumed added significance in the context of the increasing stress on the autonomy of Central Banks. Autonomy goes with accountability

and accountability, in turn, requires a clear enunciation of the goals. Thus, an accountable central bank is one with clearly articulated and publicly stated objectives.

In talking of the objectives of monetary policy in India, I had said in 1997. (Rangarajan, 1998a) "In a broad sense the objectives of monetary policy can be no different from the overall objectives of economic policy. The broad objectives of monetary policy in India have been: (1) to maintain a reasonable degree of price stability and (2) to help accelerate the rate of economic growth. The emphasis as between the two objectives has changed from year to year, depending upon the conditions prevailing in that year and in the previous year". In fact what I had said was a version of the Taylor's rule (Taylor, 1993) in its most discretionary form.

The choice of a dominant objective arises essentially because of the multiplicity of objectives and the inherent conflict among such objectives. Faced with multiple objectives that are equally relevant and desirable, there is always the problem of assigning to each instrument the most appropriate objective. This "assignment rule" favours monetary policy as the most appropriate instrument to achieve the objective of price stability. The fundamental reason to adopt price stability as the dominant objective is that inflation is economically and socially costly. While attempts have been made to estimate the economic costs, the social costs are difficult to estimate. Quite clearly inflation hits harder the poor than the rich. Of course policy makers also need to take into account the cost of output loss flowing from a disinflationary policy.

Trade-off between Growth and Price Stability

A crucial issue that arises in this context is whether the pursuit of the objective of price stability by monetary authorities undermines the ability of the economy to attain and sustain high growth. A considerable part of the relevant research effort has been devoted to the trade-off between economic growth and price stability. Empirical evidence on the relationship between growth and inflation in a cross-country framework is somewhat inconclusive because such studies include countries with an inflation rate as low as one to two percent to those with inflation rates going beyond 200 to 300 percent. (Rangrajan, 1998b) These studies, however, clearly show that growth rates become increasingly adverse at higher rates of inflation.

The trade-off between price stability and economic growth has also been discussed in the framework of labour and output markets. The well-known Phillip's curve postulated an inverse relationship between unemployment and wage rate. Several economists have challenged the basic microeconomic underpinning of the wage and price mechanism that leads to the possibility of trade-off between inflation and growth. Several studies have established that in the long run there is no trade-off between the two. The Phillip's curve becomes purely vertical at the natural rate of unemployment, if the role of expectations is

explicitly included. As Friedman put it, (Friedman, 1975) "As people adjust their expectations of inflation, the short-run Phillips curve will shift upwards and the final resting place would be on that short-run Phillips curve at which the anticipated rate of inflation equals the current rate". An environment of reasonable price stability is more conducive to economic growth; price stability is thus a necessary condition for long-run growth. However, there is a possible trade-off in the short run. It is, nevertheless, important not to over use this opportunity as it can undermine the long-term imperative. The long run implications of short run actions need to be kept in view. There is also an argument that is going on in the developed economics whether the short run Phillip's curve has become flatter. A flatter Phillip's curve will enable a Central bank to support employment aggressively during downturns.

In resolving the short-run trade-off between price stability and output growth, in the industrial countries, a solution is sought through the adoption of Taylor's rule which prescribes that the signal interest rate be fixed taking into account the deviations of inflation rate from the target and actual output from its potential. The rule is specified as follows:

$r = p + .5y + .5(p – 2) + 2$
where,
r   is the federal funds rate
p   is the rate of inflation over the previous four quarters
y   is the percent deviation of real GDP from a target.
The last term 2 is the `equilibrium' real rate.

The rule requires the federal fund's rate to be raised, if inflation increases above the target or if real GDP rises above trend GDP. In the original version, the weights of deviation from target inflation and potential output were assumed to be the same at 0.5. While the rule is intuitively appealing, there are serious problems in determining the values of the coefficients. There is also a lot of judgment involved in determining the potential output and target inflation rate. However, the rule offers a convenient way of determining when the Central Bank should act. The dilemma of Central banks, however, arises if inflation rate is above its target and the actual output is below potential. The first situation would require the Central bank to raise the policy rate while the latter phenomenon would require to lower the rate. In this context the value of the parameters matters very much.

Threshold Level of Inflation

Another way of reconciling the conflicting objectives of price stability and economic growth in the short run is through estimating the "threshold level of inflation", a level beyond which costs of inflation begin to rise steeply and affect growth. It is this inflation threshold which will provide some guidance to the policy makers. Below and around this threshold level of inflation, there is greater manoeuvrability for the policy makers to take into account other considerations. Interestingly, the Chakravarty Committee regarded the acceptable rise in prices as 4 percent. This, according to the Committee, will reflect changes in relative prices necessary to attract resources to growth sectors. I had estimated that in the Indian context,

inflation rate should not exceed 6 percent, if we had to avoid adverse consequences[†]. There is some amount of judgment involved in this, as econometric models are not in a position to capture all the costs of inflation. This approach provides some guidance as to when the policy has to become tight or to be loosened. Possibly we need to re-estimate the equations from time to time to see if the same relationship holds. It is also necessary for the policy makers to note that this order of inflation (around 6%) is higher than what the industrial countries are aiming at. This will have some implications for the exchange rate of the currency. While the open economy helps to overcome domestic supply shocks, it also imposes the burden to keep the inflation rate in alignment with other countries.

Inflation Targeting

The concept of a threshold level of inflation leads to another critical issue that is being debated in many countries – whether countries should adopt inflation targeting as a goal of monetary policy. Inflation targets give in a sense greater precision to the concept of price stability. This framework would require that the monetary authorities should keep inflation within the target level. Since 1990 when it was first adopted by the Reserve Bank of New Zealand there has been a widespread adoption of inflation targets by several central banks. Some 28 central banks since then have adopted inflation targeting. Many regarded such a system to be quite durable, until 2008 international financial crisis. Writing before the crisis Goodfriend had titled his essay (Goodfriend, 2007) as "How the world achieved consensus on monetary policy?". In fact, he wrote "The spread of explicit or implicit inflation targeting has demonstrated its virtues. The new working consensus on monetary policy has helped to reduce the volatility of both inflation and output". With respect to price stabilization, a question that is sometimes raised is whether the target of stabilization is the inflation rate or price level. Obviously, price level targeting and inflation targeting have very different implications for the time path of the variance of prices. In inflation targeting, bygones are bygones. It does not require overshoots or undershoots to be fully made up. It is easier to operate inflation targeting than targeting a price level.

The adoption of inflation targeting by India has given rise to many doubts and concerns. The new monetary policy framework requires Reserve Bank to maintain consumer price inflation at 4 percent with a margin of + or – 2 percent. Thus in a sense, it is flexible targeting. The amendment to RBI Act also provides for the setting of a Monetary Policy Committee which will determine the policy interest rate in order to abide by the inflation mandates.

Conflict with Other Objectives

Does the focus on inflation targeting by monetary authorities mean a neglect of other objectives such as growth and financial stability? Hardly so. What inflation targeting demands is that when inflation goes beyond the comfort zone, the exclusive concern of monetary policy

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[†] The annexure to the paper provides the methods followed to estimate the parameters.

must be to bring it back to the target level. When inflation is within the comfort zone, authorities can look to other objectives. This at least is my interpretation of inflation targeting. It is sometimes said that the crisis of 2008 has sounded the 'death knell' of inflation targeting. It is not so. Many monetary authorities in the West failed to grasp the true meaning of inflation targeting. Rise in asset prices which happened prior to 2008 should have alerted monetary authorities and they should have taken action to raise the interest rate even though consumer prices were low. It is a different question whether a rise in interest rate in those circumstances would have worked. As I said earlier, control of inflation becomes the exclusive concern only when inflation goes beyond the limits set.

It is also important to observe that the objective of control of inflation is not independent of the objective of growth. For example, the amendment Act of 2016 relating to RBI says (GoI, 2016) "whereas the primary objective of monetary policy is to maintain price stability while keeping in mind the objective of growth". This is more or less the statement in almost all countries which had adopted inflation targeting. It is interesting to see the minutes of the Monetary Policy Committee of RBI. Before taking a decision on price rates, discussions have centred round output gap, extent of liquidity, likely trends in GDP and possible supply shocks on prices. Without taking away the importance of price stability as prime objective, there is no exclusion of considerations of growth.

Ability to Control Inflation

Can the RBI or for that matter any Central Bank effectively implement an inflation mandate? Do they have enough instruments to achieve the goal? The ability of the Central Banks to control inflation when such inflation stems from excess demand is normally conceded. It is when inflation is triggered by supply shocks, some doubts are raised. Such supply shocks are most common in countries like India where agricultural production is subject to the vagaries of nature. Even when inflation is triggered by food inflation, monetary policy and fiscal policy have a role to play. If food inflation lasts long, it gets generalized. Wages rise leading to general cost-push inflation. If the head line inflation exceeds the acceptable level, monetary policy must act at least to ensure that the return on financial assets is positive in real terms. In a situation of supply shocks, it may take longer for monetary policy to bring inflation down. Our experience with inflation post 2009-10 is a good example of this. That is why the inflation mandate as already mentioned must provide for a range and a time frame for adjustment which should not be too short. Nevertheless, monetary policy must act irrespective of what triggered inflation. Obviously, supply-side management is needed in situations of supply stock and that should be the responsibility of the government.

There is however an asymmetry in the way monetary policy functions. Monetary policy is able to handle better rise in inflation than deflation. There is the famous observation of which says that the central banking system is equipped with efficient brakes but the accelerator is uncertain. It is basically a case of the old sayings "you can take the horse to the pond but cannot compel it to drink". Most developed countries today are concerned more with the role of monetary policy in reviving the economy. There is a general belief that

inflation continues to remain low despite expansionary policies to stimulate the economy – a slope in the shape of the Phillips curve.

The natural interest rate is also deemed to have fallen. As the Vice Chairman of Federal Reserve System said recently (Clarida, 2019), "All else being equal, a fall in natural rates increases the likelihood that a central bank's policy rate will reach its effective lower bound (ELB) in future economic downturns. That development, in turn, could make it more difficult during downturns for monetary policy to support spending and employment, and keep inflation from falling too low".

The possibility of inflation rising to unacceptable levels is not ruled out in developing economies. Obviously, a generally low inflation globally has its complications. Central banks in developing economies have still to be vigilant on the inflation front.

Transmission Mechanism

The transmission mechanism plays a critical role in the conduct of monetary policy. There are two components in this mechanism. First is how far the signals sent out by the central bank are picked up by the commercial banks and the second is how far the signals sent out by the banking system influence the real sector. The former is called the 'inside leg' and the latter the 'outside leg'. In advanced economies, the banks' reaction to the signals sent out by central banks is immediate. In fact, the financial structure is so well knit that even changes in the short end of the market spread quickly to a long end. Banks in India normally react fastly to RBI's signals. But it does happen as it is happening now that for a variety of reasons including balance sheet problems, the banks may be unlikely to act according to the signals of RBI. The burden of NPAs is not giving enough space to banks to lower interest rate, even when the signal from the central bank is to lower it. The impact of banks' actions on the real sector is a much larger question. The speed and extent of change depends on a variety of factors. Recently, in the Indian context, questions have been raised whether a change in interest rate will have the expected effect on prices or output. Many studies have been done in India and elsewhere to understand the impact of interest rate on investment demand and consumption demand. It is normally found that interest rate affects those sectors like housing where repayments extend over a long period. Even with respect to price variable, it is not clear whether the relevant interest rate is short term or long term. This was the old controversy between Hawtrey and Keynes, the former arguing that monetary policy works through changes in inventories and according to the latter through investment.

In studying the impact on prices, most econometric models use money supply or an equivalent liquidity measure to understand the impact of monetary policy. Until recently such liquidity measures in the Indian context have been found to be good explanatory variables. Post 2008, when interest rate fell close to zero in developed economies, 'quantitative' easing became the prime instrument. Even when monetary authorities signal changes through adjustments in the policy rate, steps will have to be taken by them to act on liquidity. Central banks cannot act like King Canute. They cannot order interest rates. They must act on

liquidity such that the proposed changes in policy rate stick. Thus 'availability' and 'price' are interrelated. RBI must choose an appropriate measure of liquidity to monitor. In steering monetary policy, the two – liquidity and price (interest rate) must be taken together.

Very often liquidity is being talked in terms of funds placed by banks with RBI or borrowed from RBI. These are for very short periods and can be treated as temporary liquidity. But the focus must also be on 'durable liquidity'. (Rangarajan and Samantaraya, 2017) The older term for durable liquidity was money supply. To bring about significant changes in the system, RBI must pay attention to durable liquidity. Some measure of durable liquidity is very much needed. The best choice is reserve money. Despite many changes, reserve money or money supply along with GDP continue to be good predictors of price change[‡].

The choice of policy variable whether it should be quantity or price depends on a number of factors. As John Taylor mentioned (Taylor, 1995), "While quantities are no less important than prices in models of financial markets – as in the most basic supply and demand model of any market – it turns out that measurement problems have forced econometric modelers away from the quantity of credit and foreign exchange toward the prices of these items". As mentioned earlier, changing the policy rate will be an empty gesture unless action is taken to affect quantity.

The monetary policy framework adopted by India and many other countries is correctly described as 'flexible inflation targeting'. Most of these countries set not only an inflation target but also provide a range within which it can fluctuate. This flexibility is extremely important because it emphasizes the uncertainties against which central bank have to operate. The range implies two things. First, there can be sudden and unexpected supply shocks. This has special implication for developing economies like India where agriculture is still a significant part of the economy. Advanced countries think mostly in terms of 'oil' when they talk about supply shocks. In fact, some countries to avoid the impact of supply shocks look at 'core' inflation which excludes oil or any other item that may be subject to supply shocks. But supply shocks do have an effect not only on items directly affected but also on other components in the retail price index. This is particularly true in the case of food

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[‡] Using annual data for the period 1990-91 to 2016-17, the following equation (Inverted money demand function) was estimated.

$$\text{Log W} = \quad 4.04 \quad - \quad 0.59 \log \text{GDP}^* + 0.62 \log \text{M}^*$$
$$\qquad\qquad (3.45) \quad (-3.03) \qquad (7.29)$$
$$\bar{R}^2 = 0.99$$

where,
W – Wholesale Price Index
GDP - Gross Domestic Product at constant prices
M - Money supply measured by M_3 outstanding on March 31.
T values are given in parenthesis
Significant at 5 per cent level.
The substitution of M by Reserve Money gives similar results.

inflation in countries like India. On the whole, it is better to deal with headline inflation with a range than excluding certain items. The range also underlies the fact that there is always a lag between monetary policy decisions and the impact on inflation. The range thus provides flexibility in terms of the time required to bring inflation back to the desired level when it deviates. It is for this reason Bernanke and Mishkin (1997) argue that flexible inflation targeting is not a rule but a framework, a case of 'constrained discretion'.

Annexure

Estimating the threshold level of Inflation

To estimate the non-linear relationship between inflation and growth three methods have been adopted.[§]

Method 1

Here we used a model, where the inflation itself captures the non-linearity. The annual GDP growth is regressed on Inflation, square of inflation and growth in Gross Domestic Capital Formation (GDCF).

$$GDPgrowth_t = C + \beta_1 Inflation_t + \beta_2 Inflation^2{}_t + \beta_3 GDCFgrowth_t + \varepsilon_t$$

The estimated equation is applied for different levels of inflation to find out the inflection point, or threshold, beyond which inflation has a negative impact on GDP growth

Using the data for the period 1982 to 2009, the following equation was estimated

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$GDPgrowth_t = $ -2.29 +1.90*$Inflation_t$-0.150* $Inflation^2{}_t$+0.30* $GDCFgrowth_t + \varepsilon_t$

S.E	(3.2)	(0.86)	(0.06)	(0.03)
t- Value	(-0.73)	(2.2)	(-2.5)	(9.6)
R-Square	0.89			

* denotes significant at 5%

Based on the equation the following relationship between growth and inflation is derived
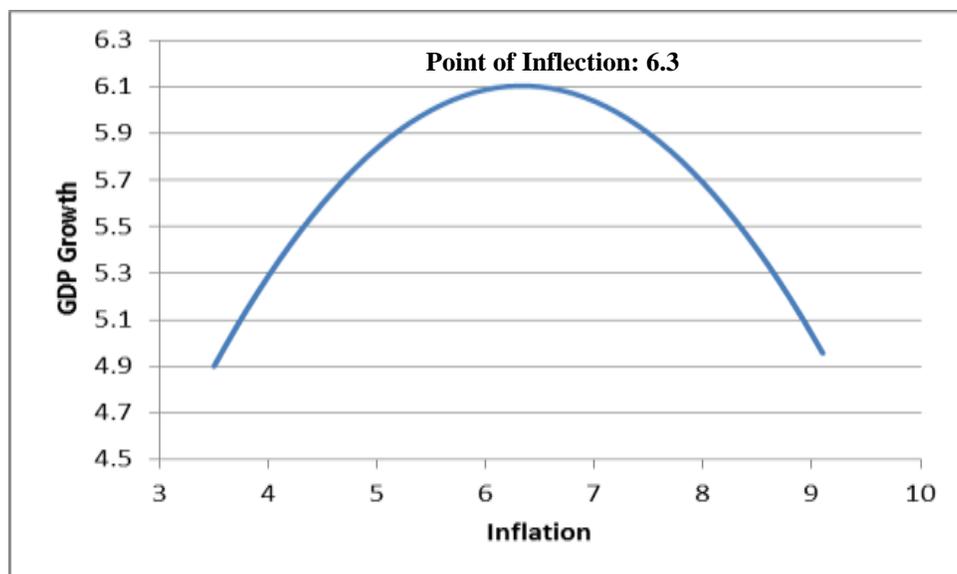
The point of inflection occurs at an inflation of 6.3 per cent.

Method 2

The method developed by Khan and Senhadji (2001) (by using GDP growth as endogenous variable and inflation and Growth of Gross Domestic Capital Formation as exogenous variables) is used to estimate the threshold level of inflation.

The equation estimated is of the following form

$$GDPgrowth_t = C + \beta_1 GGDCF_t + \beta_2 Inflation_t + \beta_3 D_t(k) + \varepsilon_t$$

Where $D_t(k)$ is a Dummy variable defined as,

$$D_t(k) = \begin{cases} 1 & \text{if inflation}_t > k \\ 0, & \text{other wise} \end{cases}$$

The parameter k helps to determine the threshold inflation level. In the estimated relationship β_2 captures the impact of the inflation on growth, β_3 explains the impact of inflation exceeding threshold on growth. At the threshold level of inflation, not only both β_2 and β_3 should be statistically significant but also that β_2 should be positive, β_3 should be negative and sum of two coefficients, $(\beta_2 + \beta_3)$, should be negative and statistically significant. While the value of k is given arbitrarily for the estimation, the optimal k is obtained by finding that value of k that minimizes the residual sum of squares (RSS). Thus, the threshold level is that which minimizes the residual sum of square (RSS). Inflation at this level has a significant negative impact on economic growth.

Estimated equation for the period 1982 to 2010

$$GDPgrowth_t = 2.8^* + 0.29^* \ GGDCF_t + 0.20^{**} \ Inflation_t - 1.1^*D_t(\ 7\%) + \varepsilon_t$$

S.E	(0.86) (0.03)	(0.12)	(0.27)
t value	(3.2) (10.3)	(1.7)	(-3.9)

R-Square   0.88

Minimum Residual Sum of Squares: 3.6

Test, $\beta_2 + \beta_3 = 0$ Value: -0.87, P value: 0.01

*, ** denotes significant at 5% and 10% level respectively

The sign of $\beta_2 + \beta_3$ become negative when k crosses 6 per cent and reach the least Residual Sum of Squares at optimum when k=7.0 per cent. Therefore, we can conclude that the threshold level of inflation for this period was between 6% and 7%.

Method 3

The threshold regression model is a simple form of non-linear regression featuring piece wise linear specification that occurs when an observed variable (inflation) crosses unknown threshold. It allows the parameters to differ across regions which are identified by the threshold variable being above or below the threshold value. Among applications of threshold regression are models for sample spitting, multiple equibria, threshold autoregressive (TAR) model, SETAR model etc. (see Hansen (2011) and Tong (2011) for surveys).

Consider a threshold regression with two regions defined by a threshold, γ. The model is written as:

$$GDPgrowth_t = \beta_1 X_t + \varepsilon_t \text{ if } -\infty < w_t \leq \gamma$$
$$GDPgrowth_t = \beta_2 X_t + \varepsilon_t \text{ if } \gamma < w_t \leq \infty$$

Where X is a variable or constant or vector of variables with region specific (Vector of) coefficients β_1 and β_2 and w_t is a threshold variable (inflation). If X is lag of GDP growth, then it is the TAR model and if w_t is lag of GDP growth, then it is SETAR model. When X is a constant, based on threshold value of inflation the model gives the average GDP growth before and after the threshold value. When X is inflation, then it is also the threshold variable. Conditional

least square is used to estimate the parameters of this model. The threshold value is estimated by minimizing the RSS obtained by all tentative threshold values. [**]

In general, a threshold regression may have m thresholds with m+1 regions. The thresholds are estim ated sequentially as follows. Let γ_1^*, γ_2^*,..., γ_m^* represent m thresholds. Gonzalo and Pitarakis (2002) show that the thresholds estimated sequentially are T consistent. The first threshold (γ_1^*) is estimated assuming a model with two regions. Conditional of the first threshold, the second threshold is estimated as the value that yields the minimum RSS over all observations in that model excluding the first threshold. The estimates of the second threshold γ_2^* is obtained by minimizing the least square of the regression with three regions conditional on the first estimated threshold. In general, the ith threshold minimizes the RSS conditional on the i-1 estimated thresholds. Thus, the threshold regression model is more flexible and better alternative to quadratic growth regression and Khan and Senhadji (2001) model.

The study period is: 1991-92 to 2017-18. The annual GDP real growth is computed from the new (2011-12) base GDP data and the annual inflation is from WPI (2011-12 base) series derived using splicing method. Given 27 years data, a maximum of one threshold is obtained. Two alternative specifications are tried: one with X as a constant (Model A) and other with X as inflation (Model B). The threshold inflation is estimated at 6.5856.

Model A: Intercept Only	Model B: Inflation Only
Threshold: 6.5856 RSS: 78.1394	Threshold: 6.5856 RSS: 355.17

Region 1: $\textbf{\textit{GDPgrowth}}_{\textbf{\textit{t}}}$ **= 7.039* +** $\boldsymbol{\varepsilon_t}$
  (t value)   (16.42)
Region 2: $\textbf{\textit{GDPgrowth}}_{\textbf{\textit{t}}}$ **= 5.165*+** $\boldsymbol{\varepsilon_t}$
  (t value)   (9.24)
	Region 1: $\textbf{\textit{GDPgrowth}}_{\textbf{\textit{t}}}$ **= 1.321*Inflation +** $\boldsymbol{\varepsilon_t}$
	  (t value) (6.44)
	Region 2: $\textbf{\textit{GDPgrowth}}_{\textbf{\textit{t}}}$ **= 0.514*Inflation+** $\boldsymbol{\varepsilon_t}$
	  (t value) (4.13)

* denotes significant at 1% level	* denotes significant at 1% level

In Model A, up to the threshold inflation, the average growth is 7.04% and beyond this the average growth declined to 5.16%. In Model B, before threshold, the inflation coefficient is 1.321, implying that 1% increase in inflation leads to 1.32% increase in growth rate and after threshold, a 1% increase in inflation leads to only 0.5% increase in growth. Thus, the results imply that beyond the threshold inflation of 6.586%, the average growth has declined by about 2 percentage points and the marginal impact of inflation has declined from 1.3 to 0.5.

[**] To estimate the threshold, the least squares of following regression with T observation and two regions is minimized: GDP growth$_t$ = X$_t$ β_1 I($-\infty < w_t \leq \gamma$) + X$_t$ β_2 I($\gamma < w_t \leq \infty$)+$\boldsymbol{\varepsilon_t}$ for a sequence of T$_1$ values in w$_t$, where T$_1$<T.

References

Bernanke, B. S., & Mishkin, F. S. (1997), "Inflation Targeting: A new Framework for Monetary Policy?", *The Journal of Economic Perspectives, Vol 11, No. 2, American Economic Association*.

Chakravarty, S. (1986), "*Report of the Committe to Review the Working of the Monetary System: A Re-examination"*, Bombay: Sir Purshotamdas Thakurdas Memorial Lecture, The Indian Institute of Bankers included in Sukhamoy Chakravarty, Selected Economic Writings, Oxfor University Press, 1993.

Clarida, R. H. (2019), "The Federal Reserve's Review of its Monetary Policy Startegy, Tools, and Communication Prcatices:, *The Bank of Finland Conference on Monetary Policy and Future of EMU (Economic and Monetary Union).* Helsinki.

Fischer, S. (1996), "Why Are Central Banks Pursuing Long run Price Stability", *Proceedings - Economic Policy Symposium* (pp. 7-34). Jackson Hole : Federal reserve Bank of Kansas City.

Friedman, M. (1975), "Unemployment versus Inflation: An Evaluation of the Phillips Curve", London: IEA Lecture No. 2 Institute of Economic Affairs.

Friedman, M. (1983), "A Monetarist View", *The Journal of Economic Education, Vol 14, No. 4*.

Gonzalo, J., & Pitarakis, J. (2002), "Estimation and Model Selection based Inference in Single and Multiple Threshold Models", *Journal of Econometrics, Vol. 110,* , 319-352.

Goodfriend, M. (2007), "How the World Achieved Consensus on Monetary Policy", *The Jorunal of Economic Perspectives*.

Government of India (2016), RBI Amendment Act.

Hansen, B. E. (2011), "Threshold Autoregression in Economics", *Statistics and Its Interface, Vol. 4*, 123-127.

Khan, M and Senhadji (2001), "Threshold Effects in the Relationship between Inflation and Growth", *IMF Staff papers, Vol 48, No 1*.

Rangarajan, C. (1998a), "Dimensions of Monetary Policy", in C. Rangarajan, *Indian Economy: Essays on Money and Finance.* New Delhi: UBSPD.

Rangarajan, C. (1998b), "Development, Inflation and Monetary Policy", in I. Ahluwalia, & I. Little, *India's Economic Reforms and Development: Essays for Manmohan Singh.* New Delhi: OUP.

Rangarajan, C., & Samantaraya, A. (2017), "RBI's Interest Rate Policy and Durable Liquidity Question", *Economic and Political Weekly, Vol 52, No. 22*.

Taylor, J. B. (1993). Discretion versus Policy Rules in Practices. *Carnegie-Rochester Conference Series on Public Policy 39*, (pp. 195-214). North Holland.

Taylor, J. (1995). The Monetary Transmission Mechanism: An Empirical Framework. *Jounal of Economic Perspectives,* American Economic Association, Vol. 9 ®, pages 11-26.

Tong, H. (2011). Threshold Models in Time Series Analysis-30 Years On. *Statistics and Its Interface, Vol. 4*, 107-118.

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- Kelkar, V., (2020). Convocation Address at Banaras Hindu University delivered on 23 December 2019, by Dr. Vijay Kelkar, Chairman, NIPFP, WP No. 295 (January).

- Tandon, S., (2020). Is the tax system neutral in India: An analysis of tax treatment of select funds, WP No. 294 (January).

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