

Statistics in RBI's Policy Making Conceptual and Empirical Issues¹

We have gathered here today to celebrate the seventh Statistics Day Conference of the Reserve Bank. The Reserve Bank instituted the Statistics Day Conference to honour the memory of Prof. P. C. Mahalanobis, who has had an enduring influence on planning and policy making in India. This annual conference has developed into an important forum for the Reserve Bank's Research Departments to meet with researchers and engage on a specific theme of statistical analysis. The theme for this year's conference is: 'Challenges to Policy Making and Evolving Role of Statistical Analysis'.

2. I am happy to acknowledge the participation in today's conference of several renowned statisticians: Prof. Bimal Roy, Director, Indian Statistical Institute; Prof. Richard Smith, University of Cambridge; Prof. B.L.S. Prakasa Rao, C R Rao Institute, Hyderabad and Prof. Subhashis Ghoshal, North Carolina State University. It is my pleasure to extend a warm welcome to each one of you.

3. Over the last five years that I have served in the Reserve Bank, we have confronted a host of conceptual issues in statistical analysis in the course of policy making. As I am preparing to leave the Reserve Bank, I thought the best way I can add value to this conference is to present some of these conceptual issues, and

¹ Inaugural address by Dr. Duvvuri Subbarao, Governor, Reserve Bank of India at the 7th Statistics Day Conference of RBI, Mumbai on August 30, 2013.

the dilemmas that we have faced in resolving them. In particular, I will address five issues.

Inflation Measure for Monetary Policy in India: WPI or CPI?

4. An important - and in some countries the predominant - objective of monetary policy is price stability, which is measured in terms of inflation. There are, however, several measures of inflation which are prevalent, for example, inflation indices based on consumer prices and wholesale prices. Determining the appropriate inflation measure to be used for the purpose of calibrating monetary policy is, therefore, critical. Central banks typically tend to articulate the price stability objective in terms of a consumer price index (CPI) as CPI is considered to be a better indicator of the cost of living and hence is seen to be better reflecting the welfare objective of monetary policy.

5. As far as inflation measures go, the problem in India is not of deficit, but of excess. Ours is a tale of many indices. They include the wholesale price index (WPI); three legacy measures of CPI inflation, viz., CPI (Industrial Workers) , CPI (Agricultural Labour) and CPI (Rural Labour); and the new CPIs, viz., CPI(Urban), CPI(Rural) and CPI-combined.

6. What should be the preferred measure for calibrating monetary policy in the Indian context? The traditional practice in the Reserve Bank has been to use WPI as the headline measure of inflation. The primary reason for this is that the legacy CPIs were not representative enough for the entire population. Further, in India, WPI has been more extensively researched by way of its empirical

relationship with other relevant variables such as output, monetary aggregates and interest rates therefore, presents richer analytical insights. I must add though that even as we use WPI as the headline measure of inflation, we also study the trends in CPI inflation and the findings of household inflation expectation surveys for calibrating our monetary policy.

7. Several analysts have argued that the use of WPI inflation by the Reserve Bank is flawed on the ground that in India, the WPI proxies producers' prices rather than consumer prices. Moreover, it is contended that WPI does not adequately capture the movement in the prices of services, which constitute close to $2/3^{\text{rd}}$ of our economic activity.

8. The inflation dynamics that WPI and CPI project are quite different. This results in considerable divergence between the CPI and WPI, at least in the short term. For example, WPI based inflation was significantly higher than inflation based on the CPIs during 2003-05. Subsequently, till June 2008, inflation based on CPIs was much higher than that of WPI. The gap between WPI and CPI narrowed thereafter but has widened again in the recent period. While WPI is currently below 6 per cent, CPI is near double digits. In the long run, however, RBI's in-house research suggests that the gap between WPI and CPI tends to narrow.

9. To some extent, the divergence between WPI and CPI can be attributed to statistical differences stemming from coverage, classification of items and the relative weights of their constituents. However, there could be other reasons for

this as well. For example, higher transaction costs, taxes, etc. are reflected in the CPI but not in the WPI. Regardless of the reasons, the large magnitude of the short term divergence between the two indices poses a major challenge for assessing inflation dynamics in the short term.

10. An increase in wholesale prices, if sustained, results in an eventual increase in retail prices and/or a squeeze in trade margins. When demand is strong, a greater burden of the increased prices will be shifted to the consumer. Conversely, when demand is weak, traders will have to absorb the burden through lower margins. Even as this logic is clear, we do not yet have a full understanding of the process by which wholesale price changes are transmitted to retail prices or of the magnitude of the associated pass-through and lags.

11. Going forward, is there a case for shifting to CPI for the conduct of monetary policy in India? There are several issues which will need to be considered in this context. First, the new CPI inflation series has only 19 data points which is not sufficiently long for statistically robust analysis. Second, in the new CPI, food prices comprise nearly 50 per cent of the index, making the movement of CPI relatively more sensitive to food price changes. This implies that the influence of supply-side factors could dominate the trends in CPI. Also, house rents comprise about 10 per cent weight in the new CPI. With house rents being largely imputed, there could be concerns about the efficacy of their measurement. These issues are not unique to us. Several central banks emphasize monitoring CPI inflation excluding housing, food and energy, but in our case

similar exclusion would leave the CPI bereft of substantial coverage and information content.

12. Before moving to use of new CPI, we will also need to satisfy ourselves on several other fronts. Does the new CPI ensure sufficient national representativeness in terms of coverage and current consumption baskets? Does it adequately cover prices of services? Is the number of price quotations being obtained for computation of the index sufficiently large?

13. Finally, if and when we move to the CPI for calibrating monetary policy, will we make a clean break and abandon the WPI altogether? I believe not. As I said at this conference last year, analytically it would be useful to develop a series of producer price index (PPI) that would help us to gauge how price momentum builds up in the economy.

Potential Output, Threshold Inflation and Taylor Rule

14. The second conceptual challenge I want to address relates to the measurement of two important macroeconomic variables in the context of monetary policy: potential output and threshold inflation. Understanding the divergence of actual output and inflation from potential output and threshold inflation respectively is critical for the formulation of monetary policy. Reliable estimates of these variables are necessary for formulating the central bank reaction function in the form of Taylor type rules for setting interest rates.

15. Conceptually, the potential output of an economy is defined as the maximum sustainable level of output that is consistent with stable inflation. If the demand for goods and services exceeds supply at a given level of prices, prices will rise and vice versa. But, what level of demand is consistent with stable prices? It is this unobserved number which determines how the pulse of the overall economy is assessed. Any estimation error could result in inappropriate monetary policy action with potentially significant consequences for the economy.

16. In practice, potential output cannot be observed directly, but has to be estimated using statistical techniques. Estimates of potential output are susceptible to errors for several reasons. First, real GDP data is subject to frequent revisions. Second, there is considerable uncertainty about the level of productivity growth at any point in time. Third, there is what economists call the Knightian uncertainty with respect to the choice of the appropriate modelling approach to measuring potential output (Mishkin, 2007). Fourth, in India, we have an additional constraint by way of lack of comprehensive and consistent data on employment. Finally, potential output is time varying. For example, it is widely recognised that the global financial crisis has resulted in a loss of potential output in several economies, although by varying magnitudes. Whether such loss is permanent or temporary remains a matter of debate.

17. In practice, the probability of error in the estimation of potential output is sought to be minimized by juxtaposing estimated potential output with other

available real time information. For example, to assess if there is slack or excess capacity in the economy, at the RBI, we estimate output gaps based on various models with a wide range of indicators, including the findings of forward looking surveys of macroeconomic changes. In its Annual Report for 2009/10, the Reserve Bank had reported that the potential output growth of the Indian economy may have dropped from 8.5 per cent pre-crisis to 8.0 per cent, post-crisis. Our latest assessment suggests that potential output growth may have further declined to around 7.0 per cent.

18. Let me now turn to the challenges in estimating the second important variable for monetary policy i.e. the threshold level of inflation. The threshold level of inflation is defined as the rate of inflation beyond which inflation itself becomes a drag on growth. Estimating threshold inflation is no less daunting than estimating potential output. Like potential output, threshold inflation is also unobserved and is time-varying. Its estimates are, therefore, model dependent with the associated potential for errors.

19. In the mid-1980s, the Chakravarty Committee (1985) had suggested a tolerable level of inflation of 4.0 per cent per annum for India to facilitate changes in relative prices necessary to attract resources to growth sectors. The Reserve Bank's current assessment suggests that the threshold level of WPI headline inflation for India is in the range of 4.4 - 5.7 per cent, implying a mid-point rate of 5.0 per cent.

20. Estimates of output and inflation gaps are critical inputs for central banks for using the Taylor rule for calibrating the interest rate policy. The Taylor rule is an interest rate feedback rule which aids in determining the short-term interest rate to achieve the twin objectives of stabilizing the economy and achieving price stability. The rule recommends that the short-term interest rate should be changed according to the deviation of inflation from its threshold or predetermined target and of output from its potential level. Essentially, given the real interest rate of the economy, the combination of inflation and output gaps should determine the appropriate policy rate that would return the economy to its potential level without causing excessive inflation.

21. Implementation of Taylor type rules essentially requires an a priori assessment of three indicators: output gap, inflation target and the equilibrium real interest rate. Once we understand and measure the level of potential output and threshold level of inflation, it becomes feasible to investigate a Taylor-type rule. Of course, countries have modified the Taylor rule and extended it in a variety of ways for adapting to their specific country contexts. I have attempted to outline today some of the challenges associated with these estimations.

22. The Reserve Bank explicitly targets the overnight interest rate as the operational objective using the policy repo rate as the instrument. The relevant questions for us in this context are: How should the policy interest rate be determined? Should interest rate calibration follow a rule or should it be left to the central bank's discretion?

Neutral Interest Rate

23. The third issue I want to address is the concept of neutral interest rate, which is also closely linked to the Taylor Rule. Theoretically, the neutral interest rate is generally understood as a real variable, and it is common practice to add the inflation objective - the implicit or explicit target inflation rate - to determine the neutral nominal policy rate. Neutral real interest rate has the simplest interpretation in terms of a rate that is neither expansionary nor contractionary. When Wicksell first conceptualized it in 1936², it was coined as the *natural* rate of interest. According to Wicksell, if the money or market determined rate fell below the *natural* rate, then demand would increase leading to higher prices. Conversely, if the money or market rate is higher than the *natural* rate, then demand will decline and prices could fall.

24. As I said earlier, Reserve Bank's estimates suggest that in recent years, India's potential growth has declined. The domestic savings rate has also moderated. What then is the relevant neutral real rate that should be used for the conduct of monetary policy, and also for assessing the stance of monetary policy? Can statistical analysis provide any answer to this?

25. The challenge in answering these questions is that the neutral rate is invisible, and no single empirical estimate can be unconditional and free of errors. Blinder (1998)³ had noted in this context that "... *the neutral real rate of interest is difficult to estimate and impossible to know with precision. It is therefore most*

²Wicksell, Knut, "Interest and Prices", London: Macmillan, 1936, translation of 1898 edition by R.F. Kahn.

³A S Blinder (1998), "Central Banking in Theory and Practice", MIT Press.

usefully thought of as a concept rather than as a number, as a way of thinking about monetary policy rather than as the basis for a mechanical rule”.

26. The task statisticians confront is how to make this invisible concept less invisible? The practical answer would obviously be to determine with a reasonable degree of statistical robustness the potential growth and threshold inflation. The assessment of both is obviously empirical and country specific. And consistent with that, researchers generally refer to an interest rate path implied by the Taylor Rule and compare that with the actual policy rate. If the actual policy rate is lower than the implied path, then the monetary policy stance is viewed as accommodative.

27. Using similar analysis, the recent BIS Annual Report (June 2013) highlights that nominal policy rates in EMEs have remained below the Taylor rule implied path on a sustained basis since 2003, almost for a full decade now. Accommodative monetary policies in both advanced and emerging economies have played a role in accentuating global vulnerabilities.

28. The 2013 Article IV Report of the IMF for India adopts a similar approach to suggest that the repo rate (as on September 14, 2012) was less than the rate implied by the Taylor rule, and therefore, that RBI's monetary policy stance has been accommodative. Contrast this with the criticism in several quarters in the past that monetary policy was tight.

29. Despite the known limitations of statistical methodologies in providing a reliable reference neutral policy rate that can inform policy formulation, it is important to have reasonable estimates to reduce the risk of a completely discretionary monetary policy. Acknowledging the logic of this argument, we have, in recent times emphasized internal research on assessment of monetary policy stance based on alternate monetary policy rules.

30. What is the challenge for statisticians here? If the potential growth of India has declined, should the neutral real interest rate also correspondingly decline? Given the negative spillovers from globalisation for almost five years now and domestic supply constraints, should India's neutral real interest rate be lower than that during the pre-crisis high growth period?

Equilibrium Exchange Rate - Why No Single Statistical Measure has a Consensus Reference value?

31. Let me now turn to the fourth issue on my list which relates to exchange rates. I do so with some trepidation since my staff in the Reserve Bank often caution me against speaking on the subject of exchange rate. Notably, it is not common practice for central banks to speak much on exchange rate. It is easy to understand though why, even in this age of forward guidance and transparent communication of monetary policy, central bankers, in both advanced and emerging economies, are so reticent on the subject of exchange rate.

32. So far as my remarks today are concerned, let me say upfront that they relate to the statistical challenge of estimating an equilibrium value of the rupee

from an empirical perspective. It will not be useful to interpret them in the context of currency market developments over the last few months and RBI's response to those pressures.

33. Can improved statistical methods and better data help us in improving our understanding of the concept of fair value, if not the equilibrium value of the rupee? This is a wide and involved topic. So, I will restrict myself to a few major issues.

34. In a market determined exchange rate regime, any level of exchange rate at any point of time is an equilibrium value, reflecting the interactions of demand and supply. A market equilibrium exchange rate, however, is different from a fundamental equilibrium exchange rate (FEER), as the latter can tell how misaligned the market exchange rate may be at any point of time.

35. John Williamson, who pioneered the concept of FEER, emphasised that the equilibrium rate is the rate which is consistent with internal balance - meaning full employment or full potential growth with low and stable inflation - and external balance - meaning a sustainable external balance position. The FEER approach, however, ignores cyclical and speculative factors in determining the exchange rate path in the short-run. Therefore some analysts view FEER only as a medium-term concept. This being a normative approach, some also see it as the Desired Equilibrium Exchange Rate (DEER) - internal and external balance being the obvious desires or objectives of policy.

36. There is another approach to estimating equilibrium exchange rate - known as the Behavioural Equilibrium Exchange Rate (BEER), which tries to explain the behaviour of the exchange rate by accounting for sources of cyclical and temporary movements, while focusing on current fundamentals, unlike the sustainable external balance and internal balance focus of the FEER.

37. Given these conceptual building blocks of an equilibrium exchange rate, the IMF's Consultative Group on Exchange Rates (CGER) uses three alternative methodologies to estimate fair values of exchange rates: (i) the Macroeconomic Balance (MB) approach, (ii) the Equilibrium Real Exchange Rate (ERER) approach, and (iii) the External Sustainability (ES) approach.

38. The macroeconomic balance (MB) approach first estimates the difference between the projected current account balance (CAD) position over the medium term at prevailing exchange rates, and the CAD norm which is believed to be sustainable. Then, the exchange rate adjustment that could eliminate this difference over the medium-term is estimated. The reduced-form equilibrium real exchange rate (*ERER*) approach estimates directly an *equilibrium* real exchange rate for each country as a function of medium-term fundamentals such as the net foreign asset (NFA) position of the country, relative productivity differential between the tradable and non-tradable sectors, and the terms of trade. The external sustainability (*ES*) approach aims at calculating the difference between the actual CAD position and the balance that could stabilize the NFA position of the country at some benchmark level.

39. What if these three alternative estimates throw up different results? Take, for example, the IMF's different estimates for India. According to the Article IV Report released in February 2013, the macroeconomic balance approach suggested India's real exchange rate to be undervalued by 3.5 to 4.5 per cent, the EREER approach suggests the rupee is overvalued by around 12 per cent, and the external sustainability approach pointed to the real exchange rate remaining broadly in line with its medium-term economic value. This varying range of estimates leaves scope for judgment, undermining the faith on statistical models.

40. The IMF's position on this has been that *"...it should be recognized that such assessments are unavoidably subject to large margins of uncertainty. These relate to a number of factors, such as the potential instability of the underlying macroeconomic links, differences in these links across countries, significant measurement problems for some variables, as well as the imperfect "fit" of the models. Some of these problems may be more severe for emerging market economies, where structural change is more likely to play an important role and where limitations in terms of data availability and length of sample are more acute."*⁴

41. Moving the concept of FEER from theory to practice, therefore, is not so easy. As per the assessment of one US Department of the Treasury paper *"... It is difficult for any model to describe adequately all features of modern economies that are relevant to determining exchange rate movements, especially of*

⁴ Methodology for CGER Exchange Rate Assessments, November 8, 2006, Page no. 4, Para No. 8.

*economies fully integrated into the international economic and financial system. Some economists argue that misalignment cannot be measured at all because empirical techniques are unable to capture the continuous evolution of structural economic relationships that drive exchange rates.”*⁵

42. How do we deal with this lack of unanimity and precision? One solution is a simpler concept that is easy to understand and also relevant. The purchasing power parity theory (PPP) clearly stands out as the most conventional but still relevant approach to assess equilibrium exchange rates. PPP is based on the principle of a “law of one price”, which suggests that in the absence of frictions such as transaction costs, taxes, and transportation costs, the same commodity must sell for the same price, when expressed in a common currency.

43. The more commonly used version of PPP is called “relative purchasing power parity,” which emphasises the relationship between changes in the price level or inflation and changes in exchange rates. A country having relatively higher inflation over successive years should experience currency depreciation, but for market frictions. Empirically, however, relative PPP may not hold in the short-run, because of capital flows, and asymmetric adjustment of goods and asset markets to both monetary and real shocks, leading to either overshooting or undershooting of exchange rates. REER, which is an indicator of the extent of deviation of the exchange rate from PPP at any point of time, therefore, should have a medium-term perspective.

⁵ Equilibrium Exchange Rate Models and Misalignments, Department of the Treasury, Occasional Paper No. 7, March 2007.

44. The construction of a relevant REER index for a country is not easy because of the diverse range of possibilities, each having its own merits and demerits. Three important considerations in this regard are: (i) choice of a proper price indicator, (ii) selection of a base year that could represent a condition of both internal and external balance so that deviations from that base could be interpreted as the degree of misalignment, and (iii) use of relevant weighting procedures.

45. On the choice of the price indicator, practices range from use of CPI to PPI, unit labour costs, and prices of exports and imports or tradables. On the choice of base, it is difficult to pick a particular point of time when both external and internal balance may be perfectly attained. More importantly, even if one such point can be identified from the past, because of structural changes taking place in the economy, that base may become irrelevant over time. An alternative solution to this could be using an average of the REER as the proxy for the long-term trend, assuming that on an average a country achieves both internal and external balance over the medium-run. Another important adjustment that is often ignored is the role of changing and divergent productivity across tradables and non-tradables, *a la* the Balassa Samuelson effect.

46. My intention in presenting the above debate is to underscore the point that no single statistical measure of equilibrium exchange rate can be an acceptable reference point for all purposes. The estimation of REER is sensitive to the methodology. The challenge for statisticians would be to design one or more

constructs which provide the “best” possible measures of equilibrium exchange rates.

Financial Stability and Stress Indicators

47. Let me finally turn to financial stability and stress indicators. The challenge of preserving and bolstering financial stability has come centre stage post crisis. We now know that price stability and macroeconomic stability do not necessarily guarantee financial stability and that financial stability needs to be pursued as a policy objective in its own right. This post crisis thinking has presented statisticians with a new set of challenges - that of developing additional matrices to monitor financial stability. Indeed, the crisis has highlighted the importance of developing relevant statistics that are timely, internally consistent, and comparable across countries.

48. By far the biggest challenge both for policy makers and statisticians is that there is as yet no universally acceptable definition of financial stability. Financial stability is also multi-dimensional, encompassing as it does, economies, markets, the financial sector institutions and financial market infrastructure, and hence is more difficult to measure.

49. Several techniques are employed to assess financial stability and a host of quantitative measures are in the process of being developed for assessing systemic risks and for potentially predicting systemic events. The development of these models / techniques is in a nascent stage and each of them has its merits and demerits. Some of the commonly used quantitative methods for financial stability

assessment include early warning systems, macro-stress testing, and financial stability indices.

50. Early warning systems are constructed from potential leading indicators to predict the probability of a financial crisis. Macro stress testing models / techniques attempt to estimate the resilience of the financial system to adverse macroeconomic scenarios. Aggregate financial stability indices represent another class of quantitative methods which aim at measuring the stability of a financial system at any given point in time. Absence of specific benchmarks however, limits the use of such indices for predicting stress conditions/ crisis more effectively.

51. As I mentioned earlier, financial stability is multi-dimensional and it can be impacted through different channels. Signs of instability or vulnerability could thus manifest in different variables or indicators. There are thus challenges in first identifying a set of indicators which need to be monitored for financial stability and then identifying the level at which each indicator reflects stress conditions. The task becomes challenging given the interdependence and the complex interactions of different elements of the financial system among themselves and with the real economy. Further complications arise from the time and cross-sectional dimensions of interactions. There are also limitations relating to availability of data - the kind of data needed to assess risks to financial stability and the timeliness and frequency of such data. There are, in fact, several

initiatives underway internationally to improve the availability of data for systemic risk assessment.

52. Considerable progress has been made, over the past two decades, by researchers from central banks and elsewhere to capture conditions of financial stability through various indicators of financial system vulnerabilities. Indeed, many central banks, through their financial stability reports (FSRs), attempt to assess the risks to financial stability by focusing on a small number of key indicators. Broadly, the challenges involved in development of stress indicators are: (i) identification of suitable variables, (ii) developing composite indicators, (iii) testing the ability for detecting vulnerabilities at an early stage, and finally (iv) benchmarking.

53. In India, we started publishing Financial Stability Reports in March 2010 and have issued seven reports so far. The reports present the several quantitative techniques that we are using within the Reserve Bank to assess risks to financial stability. They include stability maps, which show quantitative shift in risk perception between two periods, and macro-stress testing to assess the resilience of the financial system to adverse macroeconomic conditions. These indicators / models are being continuously reviewed and upgraded within the Reserve Bank.

54. In a nutshell, considerable research effort should be devoted to development of indicators for financial stability analysis, which in conjunction with sound judgment must be employed for comprehensive assessment of the risks to the stability of the economy and the financial system.

Conclusion

55. Let me now conclude. I have raised the following five conceptual issues:

- (i) Inflation measure for monetary policy in India: WPI or CPI?
- (ii) Potential output, threshold inflation and Taylor Rule for monetary policy reaction function
- (iii) Neutral interest rate and assessment of monetary policy stance
- (iv) Equilibrium exchange rate - Why no single statistical measure is acceptable as a consensus reference value?
- (v) Financial stability and stress indicators - way forward

56. Through these issues I have tried to highlight the formidable challenges confronting statisticians in a world which is becoming increasingly integrated and complex. Simultaneously, the demands on statisticians are increasing as policy makers are looking towards them for robust and reliable technical analysis to guide policy making. I hope you will reflect on some of these issues during the deliberations over the day. I wish the conference all success.