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An Assessment of Inflation Modelling in India

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Abstract

This study analyses India's inflation using the Phillips curve theory. To estimate an open-economy Phillips curve, we need three variables: (1) inflation (2) the output gap and (3) the real effective exchange rate. In India, the incorrect measurement of variables causes much difficulty in estimating the Phillips curve. The study by Singh, B.K. et al (2011) found that the Phillips curve existed, after addressing the issues related to measuring the variables. They suggested that the composite consumer price index (CCPI) was the best measure of inflation, and should be used to construct the real effective exchange rate in India. In measuring the output gap, the paper found that the Kalman filter estimates of the output gap capture all the dynamics of the Indian economy. This study constructs the variables, using a method similar to that followed by Singh, B.K. et al (2011). During the period 2008 to 2011, a combination of adverse supply shocks and overheating of economy resulted in an inflationary situation.

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An Assessment of Inflation Modelling in India*

B. Karan Singh

1. Introduction**

One of the major pressures on India's macroeconomic climate following the global financial crisis is an uncomfortably high level of inflation. Between the period 2008-09 and 2011-12, inflation in India can be attributed to both microeconomic and macroeconomic factors. The microeconomic factors are primarily supply side problems, whereas the macroeconomic factors relate to the effectiveness of demand management through fiscal and monetary policies. Supply side problems refer to adverse supply shocks or cost-push inflation. One of the main sources of the adverse supply shock was the failure of the kharif season[1] production in 2008-09 and 2009-10. The other source was the high volatility in the prices of selected commodities in the global market, mostly fuel and basic metals.

Demand-side management had been a challenge during this period, not only because of the adverse spill over effect of global economic uncertainties on the Indian economy but also because of the political cycle (the general elections were held in 2009) that led to unsustainable fiscal expansion. During the financial years 2008-09 and 2011-12, both the fiscal and monetary stances were loose and there was little or no indication that these would be tightened.

In 2008-09, the need to stimulate the economy following the global financial crisis dictated the stance on fiscal and monetary policy. Although there was co-ordination of monetary and fiscal policies during this phase, the co-ordination weakened when the government sought to exit the fiscal stimulus. After 2008-09, fiscal consolidation was

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** This study is analyses recent inflation in India. It is an extension of my previous paper co-authored with A. Kanakaraj & T.O. Sridevi, which was published in the Journal of Asian Economics. The extension of the paper lies in the analysis of the interaction between supply shocks and demand management policies.

[1] *Kharif* season production refers to the months between October and December. The importance of this season is that during this season, the country harvests a maximum proportion of its food grains.

achieved at the state and central government levels in 2010-11 but the tightening of monetary policy was more gradual. Policy rates were raised several times in tiny doses that kept the real interest rate down; the interest rate was negative[2] in 2010-11. In 2011-12, though the real interest rate finally reached a positive level in a few months, the slippage in fiscal consolidation proves that the fiscal-monetary policy co-ordination was a failure.

What should be the monetary policy action when an economy is facing supply-side shocks?

The study by Rasche and Tatom (1981), which is based on international evidence, argues that though supply shocks are temporary in nature, monetary tightening is required. Blanchard and Gali (2007) found that improvements in monetary policy reduced the impact of the 2000s oil shock on the US economy. However, many monetary economists believe that for monetary policy considerations, core inflation[3] that excludes supply shock components should be used rather than headline inflation. It is believed that the removal of volatile and transient components (i.e. exclusion of supply shock components) from headline inflation can predict the monetary phenomenon of inflation. But Walsh (2011) found that in developing economies, shocks to food inflation transmitted to non-food inflation. He, therefore, argues that the use of core inflation as a measure of inflation is subject to severe bias. Blanchard, Ariccia and Mauro (2010) contend that inflation expectation could be anchored well if central banks target headline inflation rather than core inflation.

Studies by Rashes and Tatum (1981), Blanchard and Gail (2007) and Walsh (2011) found that if an economy is characterised by poor macroeconomic demand management, the effects of transient supply shocks would continue for longer than the time it takes for the shock to wear out, and create considerable inflationary pressures. India's recent inflationary situation suggests that the supply shock to inflation might have been poorly managed. Between Q1 2006-07 and Q2 2011-12, India's Consumer Price Index (CPI) based inflation was above 6 per cent. During this period, India also experienced adverse supply shocks to inflation. Reasons for the supply shocks, and what the government should have done in these circumstances, was widely discussed. Kaushik (2011a) argues that food inflation has been managed poorly through misguided government intervention in the food grains market. Kaushik (2011b) argues that focusing on removing supply side bottlenecks and adopting policies that would improve productivity would dampen inflation.

Apart from studies on supply side issues, differing views have also been expressed on the role of macroeconomic demand management to achieve a stable, low level of

[2] A negative real interest rate could attract investors to invest in commodities rather than in productive investments. As a result, it tends to fuel inflation further.

[3] Core inflation is a measure of price rise in the case of non-fuel and food commodities.

inflation. The report by Rajan (2009) on financial sector reforms recommended that the RBI should focus on the single objective of inflation control, i.e., it should try to maintain inflation close to a targeted low rate or to stay within a given range. The report concludes that by doing so, the RBI can achieve stability in growth as well as in inflation. Acharya (2009), in a counterargument, contends that given the frequent occurrence of supply shocks in the Indian economy, the single objective of inflation control is not the right choice for the RBI at this stage of development. Inflation due to supply side shocks proves a monetary response to be ineffective, and in such cases, the RBI would have to opt for a trade-off between inflation and growth.

There has been no empirical evaluation based on theoretical foundations of the recent inflation situation in India. RBI policy papers do not provide enough of a theoretical explanation for its recent policy actions. The possible reasons for the seeming inability of the RBI to contain the inflationary pressure are 1) divergence in inflation trends reflected by the WPI and CPI, which leads to misreading of the seriousness of the situation 2) the belief that monetary policy is not effective in controlling food inflation 3) global economic uncertainties and 4) the relatively lower GDP growth in India as compared to the pre-crisis level.

One of the most widely used theoretical models in monetary policymaking is the theory of the Phillips curve. The original theory of the Phillips curve published in 1958 by A.W. Phillip has been enriched over the years. The empirical relationship between inflation and the output gap – that is the Phillips curve – could guide monetary policy to achieve low and stable levels of inflation. Older Keynesians define the output gap as arising primarily due to inflationary pressures, though the New Keynesian Dynamic Stochastic General Equilibrium theory posits that the output gap arises primarily due to nominal rigidities. The classical model[4] by Lucas (1973) concludes that the output gap-inflation association is entirely contemporaneous. He also points to the existence of lagged effects, which are difficult to explore in a short-term time series. The paper concludes that the simple structure of the relationship between inflation and the output gap captures the main phenomenon predicted by the natural rate theory. To take globalisation into account, Ball (1998) added the real effective exchange rate in the Phillips curve equation. Gordon (2011) says that the contribution of post-Keynesian theory in the Phillips curve model is that inflation and output gap is no longer positively correlated. It could have any correlation depending on the relative importance of aggregate supply and demand shock.

[4] The model posits that the quantity supplied in each market will be determined by a normal component and a cyclical component, which vary from market to market. The model defines the output index in each market as z, and uses y_{nt} and y_{ct} to denote the logs of the two components. In the model, the supply in market z is given as $y_t(z) = y_{nt} + y_{ct}(z)$, where y_{nt} is the normal component, which reflects capital accumulation and population change, and y_{ct} is the cyclical component, which varies with perceived relative prices and also with its own lagged value.

How well the theory of Phillips curve has been used in monetary policymaking is analysed by Meade and Thornton (2010). They analysed the Federal Open Market Committee transcript to see how intensively the Phillips curve framework had been used in the policymaking process. They counted the keywords of the Phillips curve theory in the official transcript. The keywords were potential output, output gap and Phillips curve.

The RBI has also published papers on estimating the potential output (Bordoloi, Das & Jangili, 2009) and estimating the threshold inflation using the backward-looking Phillips curve framework (Mohanty, Chakraborty, Das & John, 2011). But the RBI did not use these keywords in its policy statement.

The purpose of this paper is to discuss the recent developments in estimating the Phillips curve in the Indian context. The remaining portion of this paper is structured as follows. Section 2 reviews the estimation of inflation and the output gap in the Indian context. Sections 3 and 4 discuss the best methods to measure inflation and estimate the output gap, respectively. Section 5 discusses the theory of the Phillips curve with reference to supply shocks. Section 6 discusses the existence and shape of the Phillips curve in India. Section 7 discusses the role of monetary and fiscal policies in containing inflation in recent times. Besides summarising the main arguments, the last section also outlines some policy recommendations.

2. Concepts and Their Measurement

The Phillips curve predicates the relationship between inflation and the output gap. Thus, it is critical to define these concepts and examine how they are measured.

Output Gap: The output gap is a measure of the gap between the actual output of an economy and the potential output it could achieve when it is operating at full capacity. In demand-side driven economies, a positive value for the output gap indicates inflationary pressure in the economy, i.e. it is operating at a higher marginal cost. In supply-side driven economies, a positive value for the output gap indicates a deflationary situation in the economy, i.e. it is operating at a lower marginal cost. In general, the output gap is measured on two scales – the deviation of the actual level of output from the potential output level, and the growth of output relative to potential growth (the latter is called 'speed limit policy'). In India, the RBI announces forecasts of GDP growth while designing the monetary policy. Since the RBI does not announce its forecast of the GDP level, it is possible to follow the speed limit policy.

This is not the first attempt to measure the output gap for the Indian economy. There have been several studies in this regard - Callen and Chang (1999), Ray and Chatterjee (2001), Kundan (2009) and Paul (2009), Srinivasan (2009), Dua and Gaur (2009). These studies suffer from drawbacks. One is that they use the index of industrial production to estimate the output-gap. However, since the contribution of IIP to the

total GDP is only 16 per cent (Central Statistical Organisation, India – National Accounts Statistics, 2012), using IIP as a proxy for growth allows at best a partial analysis. To overcome this, economists should use quarterly GDP data.

The second problem relates to the use of the HP model to estimate the output.gap. Ozbekand Ozlale (2005) points out that the HP filter cannot capture the excessive boom-and-bust cycle, which is a well-known characteristic of many emerging markets. Another serious problem with the HP method is that it defines the estimated smoothed series of GDP as potential output. Basu and Fernald (2009) say that so far, no macro economic theory has proven that potential GDP is a smoothed series. The present paper also contends that the HP method is inappropriate in the context of the Indian economy.

Virmani (2004) estimated the output gap using an unobserved components model for the Indian economy. This model is an extended version of the Kalman model. Although in the original estimation of the model, Kuttner (1994) used the consumer price index (CPI) as a measure of inflation to estimate the forward-looking Phillips curve, Virmani chose the wholesale price index (WPI).

Inflation: Inflation is defined as the rate of increase in the index of general prices, which is the other variable in the Phillips curve. Both the wholesale and consumer price index have been used as measures of inflation in economic literature. It is important to take into account the limitations of both the CPI and the WPI as measures of inflation while estimating the Phillips curve. Srinivasan T.N. (2008) describes the shortcomings of using the WPI as a measure of general inflation in India. The WPI is constructed for a given basket of goods in the economy. Data on prices comes from various sources – the farm gate, the factory gate, primary markets, secondary markets, wholesale markets and retail markets. The WPI, therefore, captures neither the supply side (producer price) nor the demand side (market price). On the other hand, Shapiro and Wilcox (1996) found that the CPI tends to overestimate inflation by 0.6 to 1.5 percentage points per year. This raises serious doubts about the appropriateness of using the CPI as a measure of inflation. The Boskin Commission Report (1996) also found a similar upward bias in CPI estimation, ranging between 0.8 to 1.6 percentage points per year. However, Shapiro and Wilcox (1996) conclude that the inaccurate measurement of the CPI has no implications for the output gap or natural employment. Technically, the CPI captures both demand side factors as well as agents' expectations.

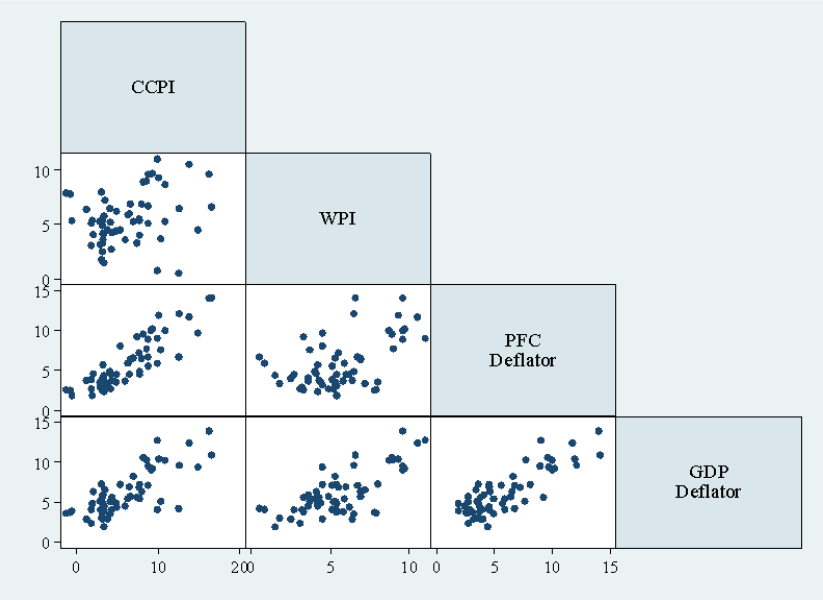
In the Indian context, the reliability of the CPI as a measure of inflation can be questioned. For instance, the base year for calculating the CPI for agricultural and rural labourers is still 1986-87. Therefore, it is unlikely to capture the price rise in items that have entered the consumption basket subsequently for the two income groups. Given that the structure of the Indian economy has been changing rapidly, the assumption that the consumption basket has remained unchanged over the last two decades raises serious questions about the reliability of the statistics. In this paper, it is assumed that continuing to use the old basket of products does not lead to time-varying biases. That

is, it is assumed the bias because of over or under estimation of inflation, because of the assumption that there is no change in the consumption basket, is assumed to be constant over the years. Further, since there is no better alternative to measure inflation, this paper uses the CPI as a measure of overall prices in the economy.

3. Measuring Inflation in India

For an economically diverse country like India, a single measure of inflation does not suffice. At present, India has three consumer price indices that account for three diverse groups, viz., agricultural labourers, rural labourers and industrial workers. Besides these, the wholesale price index is also used to measure inflation. The issue that arises is which of these four indices should be used by the RBI to formulate monetary policy. In the beginning of the nineties, central banks used the WPI as a measure of inflation. In recent years, however, many central banks have given up using the WPI, as it is not deemed an accurate measure of general inflation levels. Khatkhate (2006) presents a case for an aggregate measure based on the CPI for the country as a whole, which could then be used to design monetary policy. Although the government has come up with a CPI for the country as a whole, the data is available only from 2010. Hence, in this study, as an alternative, a Composite CPI (CCPI) has been constructed using CPI for agricultural labourers, rural labourers and industrial workers. Each income group carries equal weight in the CCPI. To check whether the constructed CCPI captures overall inflation the four measures of inflation - CCPI, WPI, the GDP deflator, and private final consumption (PFC) deflator - have been correlated. Figure 1 presents the correlation graph of the different measures of inflation.

Figure 1: Correlation between the Different Measures of Inflation from Q4 1996-97 to Q2 2011-12

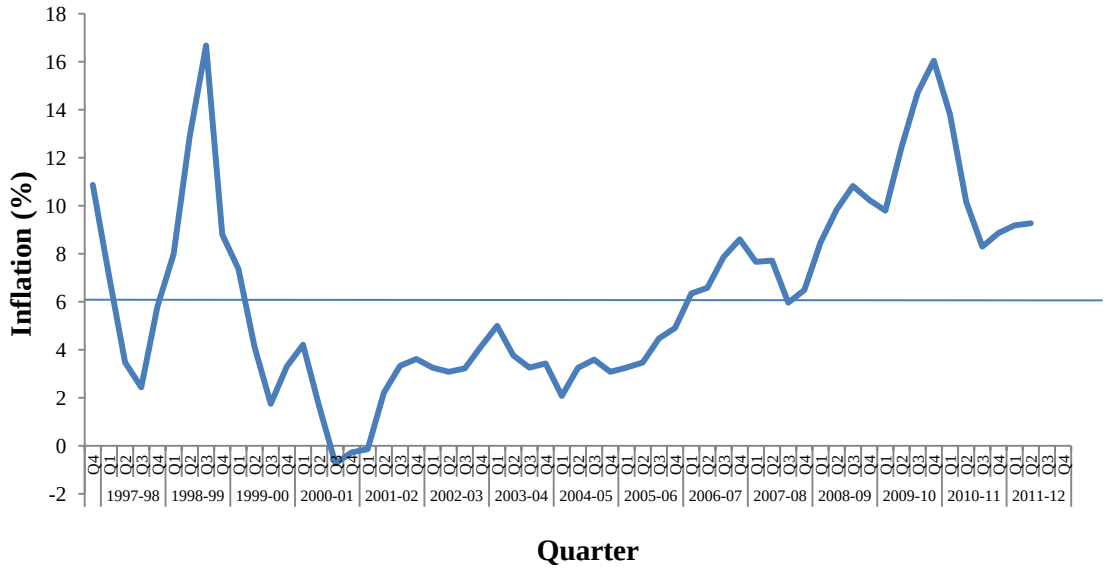


Source: *Author's own calculations using the Online Database on the Indian Economy, Reserve Bank of India*

As expected, the correlation between WPI and CCPI is nowhere near perfect. But the constructed CCPI and PFC deflator have correlated well. Since the PFC deflator is released with huge lags as compared to the CCPI, throughout this paper, the CCPI has been used as a measure of inflation.

Figure 2 shows that inflation based on the CCPI is above 6 per cent since Q1 2006-07, the period after the Indian economy saw significant adverse supply shocks. The shock pertains to food and fuel.

Figure 2: **Inflation in CCPI (%) from Q4 1996-97 to Q2 2011-12**

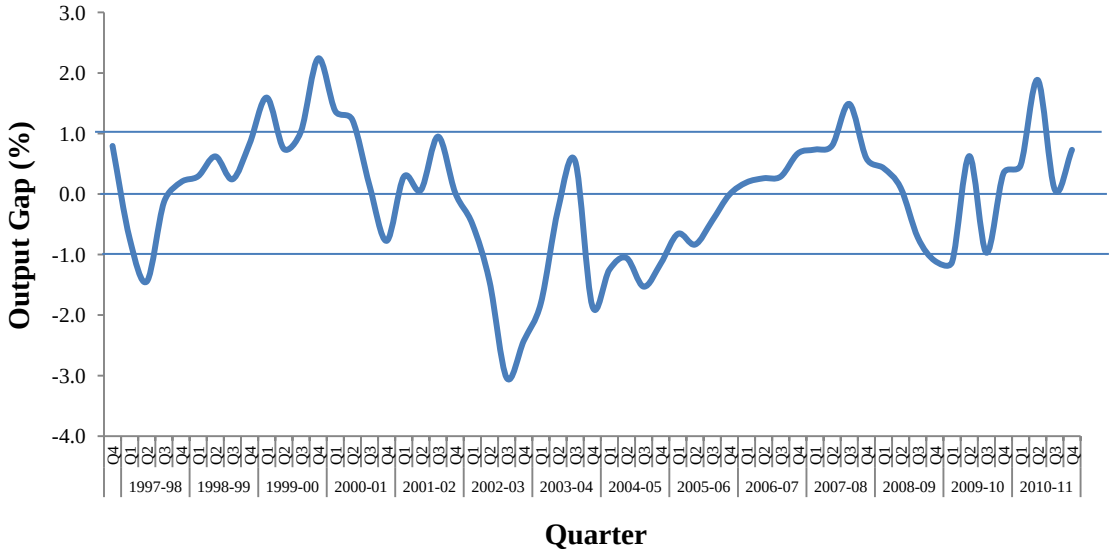


Source: *Author's own calculations*

4. Measuring Output Gap in India

The output gap is an unknown variable, which helps policymakers decide whether the economy is operating below its potential output or above it. There are a number of methods to estimate the output gap, although there is no theoretical consensus on how the gap should be estimated. In empirical macro modelling, the output gap is a crucial and basic variable. While there is considerable research on estimating the output gap, in practice economists use various methods of estimation. Two criteria have been used in this paper to evaluate the output gap: 1) how well it captures major economic events and 2) how well it explains inflation dynamics. As stated earlier, a number of studies have estimated the output gap for India by using the HP method, which does not yield reliable output gap estimates. Figure 3 presents evidence for the proposition that the HP method has severe limitations due to its smoothing assumptions. As a result, between Q3 2003-04 and Q3 2005-06, the HP method overestimates the potential GDP growth, while it underestimates the potential growth for the period between Q1 2006-07 and Q4 2007-08.

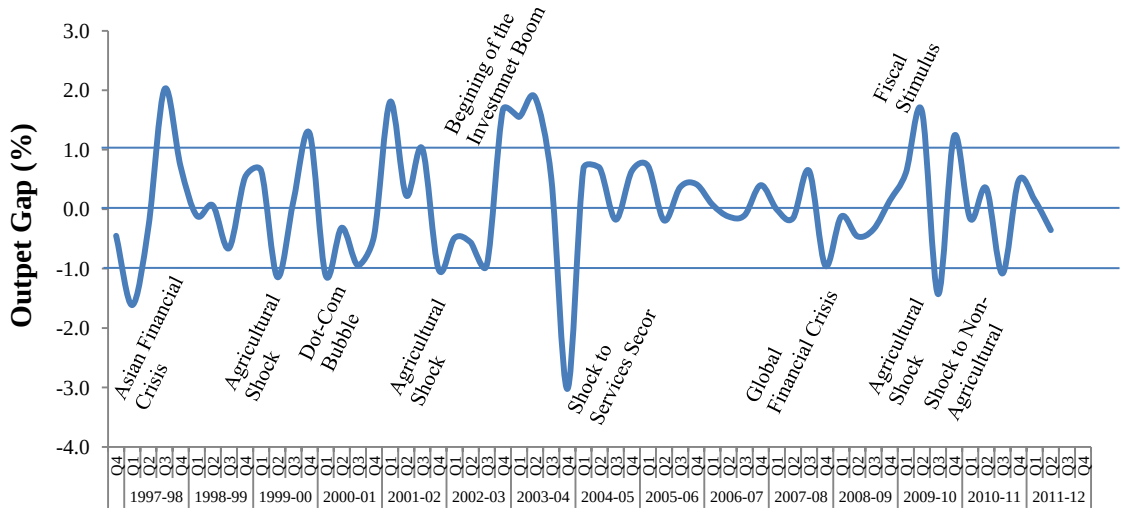
Figure 3: Output Gap – HP Method (per cent)



Source: *Author's own calculations*

These results are inconsistent with India's actual growth trajectory because the Indian economy is in transition and its growth is not a smooth series like that of a developed country. Hence, the application of the HP method in the context of developing countries like India does not reveal the changes in the economy. Figure 4 shows that the Kalman filter estimates that accurately capture important economic events in the Indian economy.

Figure 4: Output Gap – Kalman Method (per cent)



Source: *Author's own calculations*

As Figure 4 shows, the trend in the output gap during Q4 1996-97 and Q2 2003-04 was dynamic, and recorded very high levels of deviation. The prime factors behind this instability were the Asian financial crisis, the dotcom bubble burst, monsoon failures, a structural break as a result of the investment boom and a shock in the services sector. From Q4 2002-03 to Q2 2003-04, the output gap was recorded at an average of above 1.7 per cent because investment rates rose by 4 per cent of the GDP, which was a significant structural break in India's growth history. This has been clearly captured by the Kalman method. The HP method, however, fails to capture this, because of which the estimates for the following periods are inconsistent. After the structural break, the Indian economy entered a period in which the country achieved its highest consecutive five-year average growth since independence, i.e. 8.9 per cent between 2003-04 and 2007-08. Surprisingly, the output gap for the period following the structural break and until the global crisis impacted the Indian economy fell substantially. From Q1 2004-05 to Q3 2007-08, the output gap fell in the range of –1 and +1 per cent. The global financial crisis footprint on the Indian economy is captured in the revised version of the quarterly data based on 2004-05 as the base year, whereas in Q4 2007-08, the output gap was recorded at -1 per cent. In Q2 2009-10, the output gap reached 1.7 per cent due to the extended second round of fiscal stimulus, one of the main components of which was the Sixth Pay Commission, which raised the salaries of the central government employees substantially. In the following quarter, Q3 2009-10, the Indian economy witnessed a monsoon failure, and the output gap reached a level of -1.4 per cent. During Q3 2010-11, the output gap fell to -1.1 per cent due a shock in the non-agricultural sector. This could have been because of rising input costs, and a spill over of the slowdown in manufacturing to the services sector through the channel of inter-industry linkage. In the first half of 2011-12, the output gap values were negative.

5. New Keynesian Phillips Curve (NKPC) and Supply Shocks

Equations (1), (2) and (3) have been taken from Woodford (2003), which states the theoretical relationship between inflation and the output gap.

$$\pi_t = \kappa(\hat{Y}_t - \hat{Y}_t^n) + \beta E_t \pi_{t+1} \quad (1)$$

where

π_t = Inflation at time t

$\hat{Y}_t$ = Actual output at time t

$\hat{Y}_t^n$ = Potential or natural output at time t

$E_t\pi_{t-1}$ = Expected inflation for the time period t+1 at the time t

The reduced form of the New Keynesian Phillips Curve is

$$\pi_t = \kappa x_t + \beta E_t \pi_{t+1} \quad (2)$$

where

$x_t = \hat{Y}_t - \hat{Y}_t^n$ = Output gap

Woodford (2003) argued that in special circumstances, an economy is likely to face exogenous shocks.[5] However, equation 2 does not account for this. So equation 2 is transformed into equation 3, taking into account exogenous shocks occurring in the economy by adding an additional variable μ_t.

$$\pi_t = \kappa(\hat{Y}_t - \hat{Y}_t^n) + \beta E_t \pi_{t+1} + \mu_t \quad (3)$$

where

μ_t = Exogenous shock at time t

In early literature, Poole (1970) argued that the monetary policy objective of stabilisation should focus on both inflation and output. According to Woodford (2003), recent literature has arrived at a consensus that the objective of central banks should be to move away from output stabilisation and towards the output gap. From an efficiency point of view, and in normal circumstances, the role of output stabilisation means that the central bank intervenes only to limit the output gap. Since the output gap is a short-term deviation from natural output, an important role of monetary policy is to focus on the fall and rise in the temporal component of output.

On the one hand, this may lead to the conclusion that the target output gap should be zero at every point of time. On the other hand, in theory, according to equation 2, complete stabilisation of the output gap and future expected inflation should lead to lower inflation. But Woodford (2003) argued that equation 2 does not hold true in all circumstances. In special circumstances, the residual term μ_t, added in equation 2, might become critical due to exogenous shocks faced by the economy. As a result, equation 3 would be the appropriate model to explain the structure of the economy in

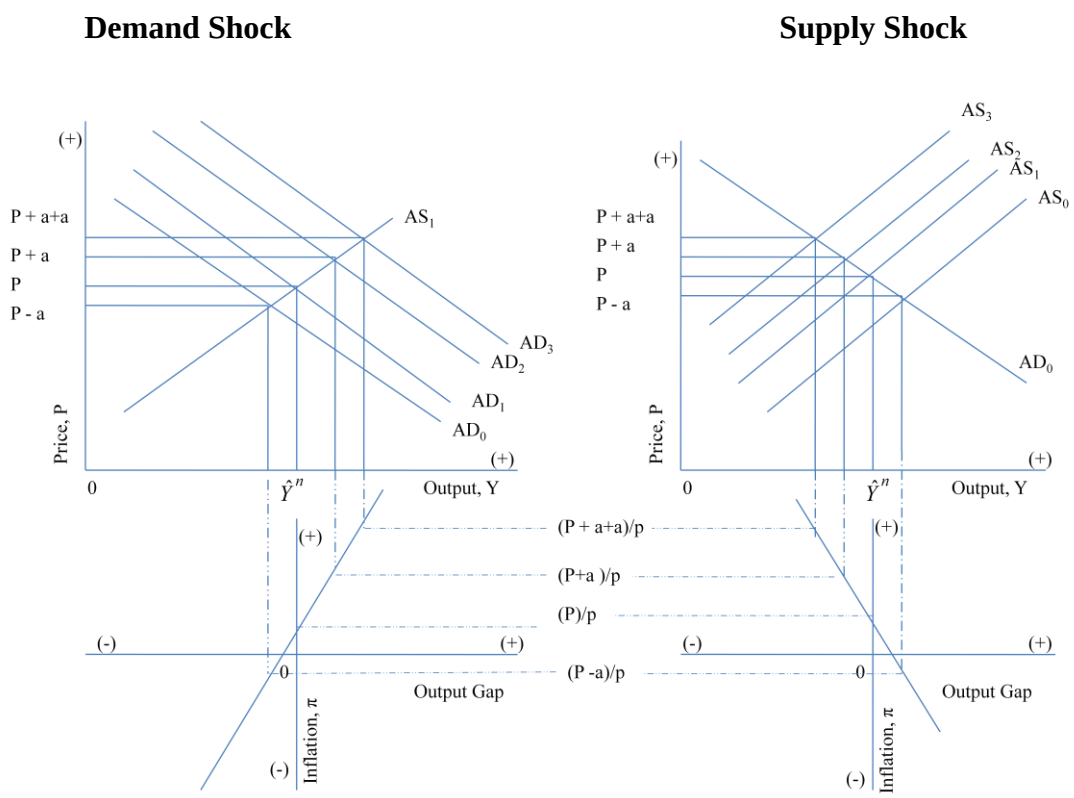
[5] Exogenous shocks arise from supply channels. Fall and rise in supply are called negative supply shocks and positive supply shocks respectively.

the presence of random shocks such as cost-push inflation and a zero lower bound on nominal interest rates. This is why, in practice, central banks have discretionary policies to decide the trade-offs between inflation stabilisation and output stabilisation.

In the Indian context, it would be interesting to examine whether there is an empirical relationship between inflation and the output gap, as stated by equation 2. Goyal and Pujari (2004) have found that the Indian economy is subject to large supply shocks. Inflation in India may be high due to negative supply shocks or because of the residual term. These negative shocks come from two main sources – the failure of monsoon, and high volatility in global crude oil prices.

Most macroeconomic textbooks discuss how the relation between the price level and output is affected by demand shocks and supply shocks. Here, however, the relationship between inflation and the output gap has been examined.

Figure 5: Shape of the Phillips Curve for Demand and Supply Shocks



The Phillips curve is based on the assumption that the aggregate demand curve (AD) is sloping downward and the aggregate supply curve (AS) is moving up. In the graph above, the initial price level is P, and its corresponding output level $\hat{Y}^n$ is the potential output. In the demand shock scenario, two positive demand shocks have been assumed, which result in the demand curve shifting outwards to the right from AD1 to AD2 and then to AD3. One negative shock has also been assumed, with the demand curve

shifting inwards from AD1 to AD0. The positive demand shocks raise the price level by a magnitude of 'a' in one case and by '2a' in the other case (where a>0). The negative demand shock results in a decline in the price level by '–a'. Based on the interaction points between the aggregate demand curve and aggregate supply curve, the equilibrium outcomes of the different situations have been mapped. Since the objective is to derive the Phillips curve, the equilibrium price level to inflation 'π' has been rearranged. Here inflation is defined as the percentage deviation of the equilibrium price level (points P - a, P, P +a. P+ 2a) from the initial price level P. The output gap is equal to the percentage deviation of the actual output ($\hat{Y}$) from the potential output (($\hat{Y}$ - $\hat{Y}^n$)/ $\hat{Y}^n$). In the case of a demand shock, mapping the relationship between inflation and the output gap shows a positive relationship exists between them. In the case of a supply shock of the same magnitude, the resulting relationship is negative. As a result, the central banks' job is easy whenever there is a demand shock. The central banks can stabilise the economy and bring it to a more efficient equilibrium with low inflation and an optimal level of output, by targeting the output gap level at zero. But for supply shocks, monetary policies can only target non-zero output gap levels. It is here that a trade-off between inflation and the output gap needs to be considered when formulating monetary policies. The optimality condition in choosing between the two goals depends upon the relative weights of the goals. In theory, the weights of the two variables are derived from a loss function (Woodford, 2003).

6. Empirical model and Results of the Phillips Curve in the case of India

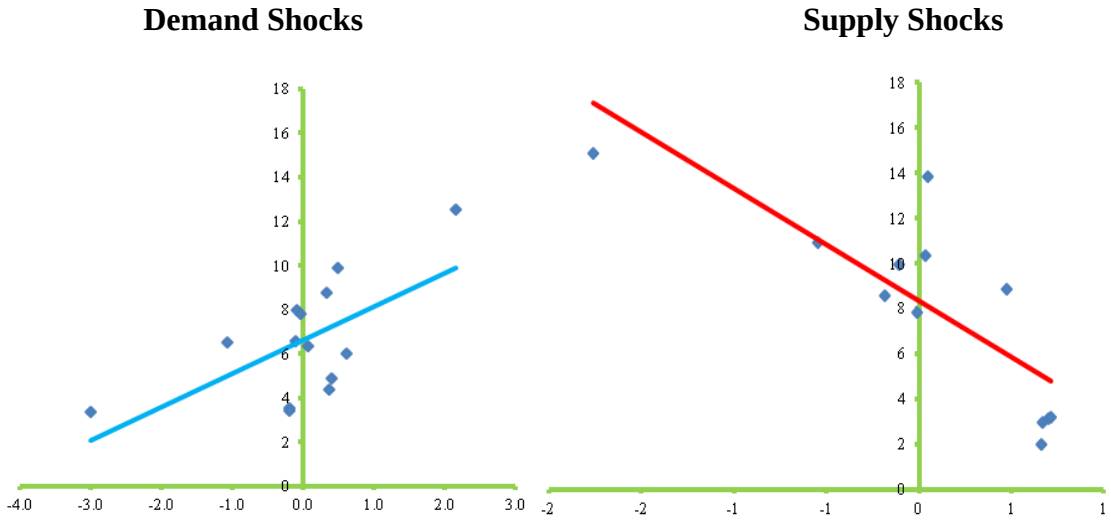
The study by Singh, B.K. et al (2011) found that correcting the measure of inflation and the output gap by the CCPI and the Kalman filter proves the existence of the open economy Phillips curve in India (refer Appendix A for the detailed regression results). This study has used the key finding of their paper. The main findings are as follows – the Phillips curve exists during the period after Q1 2004-05, the Phillips curve exists only after controlling for supply shocks and the real effective exchange rate does not affect the CCPI inflation. Supply shock periods are those in which agricultural production declines and the year-on-year change in fuel prices is above 15 per cent or below 0 per cent. Figure 7 presents the linear relationship between the output gap and inflation. As proposed by the theory, a positive relationship exists for the demand shock, and a negative relationship occurs for the supply shock. The positive relationship between inflation and the output gap shows that demand-driven inflation exists in the economy. Hence, policymakers have the option of bringing down the inflation level by sacrificing some level of output. How much of the output is to be sacrificed depends upon the slope coefficient. Cross-country evidence indicates that the slope co-efficient or sacrifice ratio is subject to changes (Anderson and Wascher 1999). They found the sacrifice ratio is smaller for countries that target inflation explicitly.

After the financial crisis, 2008-09 to 2011-12, the magnitude of the output gap in India was not at its minimum; at the same time, the inflation rate was also high. Available

evidence supports that the government missed the macroeconomic objectives of output gap and inflation stabilisation.

It would be worth the attempt to study what happened during this period. However, limitations in the quarterly GDP data pose problems in estimating key parameters. The quarterly GDP for the base year 2004-05 has been revised twice. This was because of a revision in the wholesale price index and the IIP, for both of which the base year was changed to 2004-05. But the government has released GDP based on the revised IIP series only for two years (2009-10 and 2010-11).

Figure 6: Relationship between Inflation and the Output Gap during Period 2 (Q1 2004-05 to Q2 2011-12)

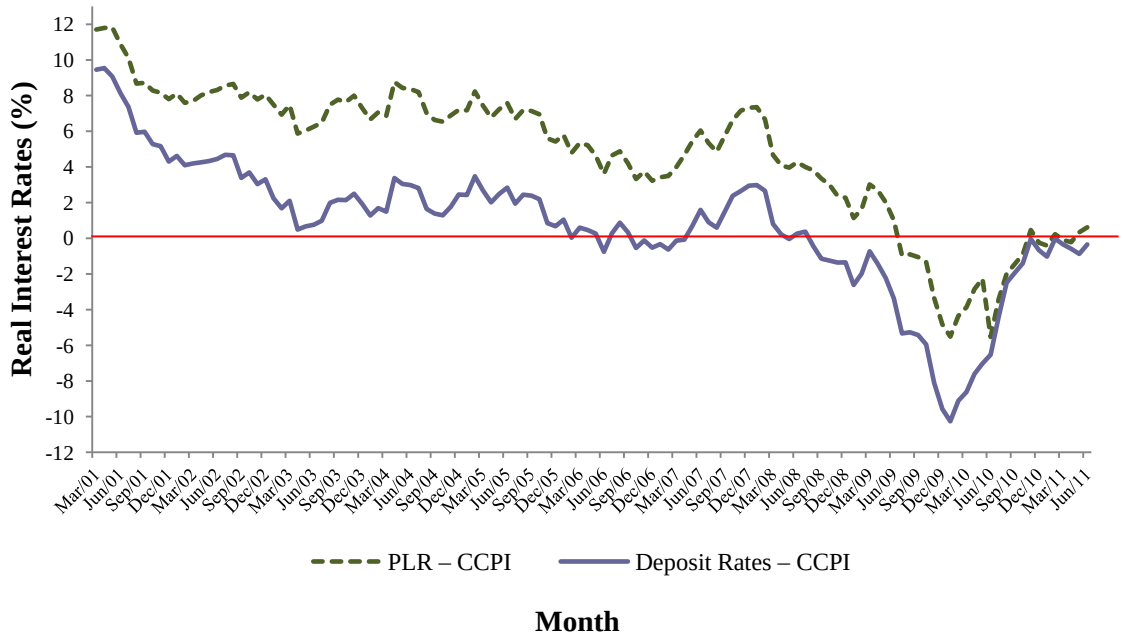


Source: *Author's own calculations*

7. Evidence of Failure in Co-ordination between Fiscal and Monetary policies

In the year 2008-09, the global financial crisis created turmoil in the Indian economy and worsened the slowdown in the domestic economy. As a result, the government introduced expansionary monetary and fiscal policies.

Figure 7: Real Interest Rates – CCPI



Note: *1. PLR – Prime Lending Rates for five major banks.*
2. Deposit Rates – Rates on deposits of more than one year maturity

Source: *Author's own calculation, using the RBI online database on the Indian economy*.

On the monetary side, the real prime lending rate was brought down by 300 basis points (see figure 8), while on the fiscal side, the fiscal deficit of the central government and state governments was raised by 3.5 per cent and 1.1 per cent of the GDP respectively (see Figure 9). The central government's fiscal stimulus was stronger partly because the slowdown occurred just before general elections to Parliament. Since a monetary policy makes its effects felt with a lag, the monetary policy of 2008-09 would have had an impact on the growth of the following year. As a result, 2008-09 did not witness a problem of overheating. However, in Q3 2008-09, there was an adverse supply shock because of the failure of food grains production in the kharif season, which caused inflationary pressure.

Figure 8: Change in Fiscal Deficits as a Percentage of GDP

Source: *Macroeconomic and Monetary Developments (July , 2011), RBI*

Inflationary pressures were much more visible in 2009-10 when the economy began to overheat because of the impact of monetary policies and the extended second round of fiscal stimulus. The output gaps for Q2 and Q4 2009-10 touched 1.7 per cent and 1.2 per cent respectively. This was worsened by an adverse supply shock arising from a second successive year of kharif crop failure in the third quarter of the year. The crop failure was more severe than that of 2008-09.

In 2010-11, fiscal tightening happened at both the central and the state level, but overheating continued because of the impact of monetary policy – real prime lending rates had been negative from June 2009 to September 2010 after which they began moving closer to zero. In the first half of the 2011-12, real prime lending rates reached a positive level, but the central government's failed attempt at fiscal consolidation for a second year has caused overheating of the economy.

The post-crisis policy environment suggests that the supply shock was handled inappropriately. Fiscal and monetary stimuli were not designed to achieve macroeconomic stability. While fiscal tightening was hindered by the impending elections, there was also a delay in tightening the monetary policy.

8. Policy Recommendations and Conclusions

The post-financial crisis period saw the government under immense pressure to tackle the inflationary situation while simultaneously facing the challenge of boosting the economy. The government could not progress on either front. This can be attributed to a possible misreading of the situation because of infirmities in the data used to arrive at

policy decisions. There are three major areas in which data infirmities are reflected. (1) There is a discrepancy in inflation as reflected in the WPI and CPI. The RBI should discontinue using WPI as a measure of inflation; a better way forward would be to replace WPI with Producers Prices Index (PPI), which captures prices of both goods and services and is more representative for supply side management. For monetary policymaking, which is essentially demand management, global experience suggests that countries use mostly CPI. It captures the agents' expectation and demand channel. (2) The second problem is the use of IIP as a proxy to measure overall economic activity. Even though IIP captures only 16 per cent of the contribution to total GDP, it has been frequently used in macro modelling merely because IIP data is available on a monthly basis. (3) Quarterly estimates of GDP, particularly in the post-crisis period, have proved unreliable. This data has been revised a number of times in the post-crisis period. Strengthening the statistical capacity to ensure more reliable estimates of quarterly GDP data will help improve policy formulation.

The consensus in recent literature is that stabilisation of the output gap helps lower inflation and hence, should be the major macroeconomic policy objective. However, the output gap is an unknown variable. Various methods have been suggested to estimate the output gap, of which, this paper found, the Kalman filter estimates yield an accurate result in the Indian context. There is still inadequate research on the estimation of the output gap in the Indian context. Further research on this will help calibrate policymaking more accurately.

Inflation in the post-financial crisis period was created by both supply and demand shocks. The inability to co-ordinate fiscal and monetary policies resulted in the failure of demand management. On the fiscal side, political constraints imposed by looming elections impeded fiscal consolidation while the tiny incremental steps towards monetary tightening by the RBI failed to have an impact on demand.

There was a failure to tackle the supply shocks as well. Monetary policy can be used effectively to dampen the effects of a supply side shock. Economic literature suggests that countries learn from earlier supply side shocks. Clearly, therefore, estimating the contribution of supply shocks to inflation will prove a useful instrument in policymaking. However, as this paper shows, such estimates need to look at the lagged effects of a supply shock since estimating it on the assumption of a simple contemporaneous relationship between inflation and the output gap would result in inaccurate estimates. Further research on the contribution of supply shocks to inflation in the recent post-crisis period is possible once the fully revised quarterly GDP data are released.

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Appendix 1

Table 1. Estimated Open-Economy Phillips Curve for Period 2 (Q2 2004 – Q4 2009)

	OLS		**IV Reg 2SLS**	
Time period 2	**Q2 2004 –Q4 2009**			
π_{t-1}	0.8	0.9	0.8	0.8
	(0.1) ***	(0.4)***	(0.1)***	(0.1)***
$(\hat{Y}_t - \hat{Y}_t^n)$	0.7	0.9	1.5	2.0
	(0.4) **	(0.09) ***	(0.7)**	(1.0)**
$(\hat{Y}_t - \hat{Y}_t^n) * sdum$	-1.7	-2.2	-2.6	-3.4
	(0.6)***	(0.6) ***	(0.95)***	(1.3)***
$X_1 WPI$	-0.08		-0.05	
	(0.04) **		(0.03)*	
$X_1 CPI$		-0.04		-0.05
		(0.02) ***		(0.02)***
C	1.4	1.1	1.5	1.4
	(0.6)***	(0.59)**	(0.6)***	(0.7)***
Number of Observations	23	23	23	23
Adj. R-squared	0.92	0.92	0.81	0.92
Durbin-Watson Statistic	2.3	2.6	2.0	2.3

Note:

1) Standard errors are given in parentheses.

*2) *, **, *** indicate significance at the 10 %, 5 %, and 1% level, respectively.*

3) We use one quarter lag of inflation (π_{t-1}) as a proxy for expected inflation.

Table 2. Data Definitions and Sources

Variables Name	Definition	Data Source
πt	*Year-over-year percentage change in the composite consumer price index (CCPI).*	*To construct the CCPI, we have followed the methods used by Singh, B.K. and Joseph, M. (2009). Data on consumer price indices of the four income groups (agricultural labourers, rural labourers, industrial workers and urban non-manual employees) has been taken from the Online Database on the Indian Economy, Reserve Bank of India.*
$\hat{Y}_t - \hat{Y}_t^n$	*Deviation of actual output ($\hat{Y}_t$) from potential output ($\hat{Y}_t^n$), derived using the Kalman filter method.*	*Authors' own calculations using quarterly real GDP data from the Online Database on the Indian Economy, Reserve Bank of India.*
$sdum_t$	*Supply shock dummy, which takes the value 1 for the periods of supply shocks; otherwise, it is equal to 0.*	*Authors' own calculations, crosschecked with monthly publications of the RBI Bulletin (1997 - 2009),*
$X_t CPI$	*Year-over-year percentage change in the trade-weighted real effective exchange rate, based on the CPI*	*Karan Singh, B. and Mathew, Joseph, Why Are Trade Deficits Worsening in the Case of India? (Unpublished)*
$X_t WPI$	*Year-over-year percentage change in the trade-weighted real effective exchange rate, based on the WPI*	*Online Database on the Indian Economy, Reserve Bank of India.*

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