What Causes Inflation in India?
A Cost-Push Alternative to Mainstream Explanations

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List of Acronyms

CPI	Consumer Price Index
GDP	Gross Domestic Product
GVA	Gross Value Added
HP	Hodrick-Prescott
OMO	Open Market Operation
MSP	Minimum Support Price
MGNREGS	Mahatma Gandhi National Rural Employee Guarantee Scheme
NAIRU	Non-Accelerating Inflation Rate of Unemployment
RBI	The Reserve Bank of India
WPI	Wholesale Price Index

Abstract

Earlier this year, the Indian central bank formally adopted inflation targeting, which is a means of controlling inflation by influencing the demand for goods and services. Against this backdrop, this paper examines whether inflation in India is primarily caused by excess demand, or by the cost of producing goods and services. Accordingly, it categorizes the existing literature into demand-pull and cost-push categories, with the role of demand in the inflation process seen as the distinguishing feature between the two. Demand-pull approaches see a causal role for demand, while cost-push approaches see a secondary role for it. The prominent approaches under the demand-pull and cost-push categories are analysed. Both the demand-pull approaches, New Keynesian and monetarist, are found to be theoretically weak, and also do not perform well in empirical tests. The structuralist approach under the cost-pull category performs better on both theoretical and empirical fronts, particularly in the period following the global financial crisis of 2008-09. This inference points to the unsuitability of inflation targeting as a monetary strategy for the Indian central bank.

Keywords

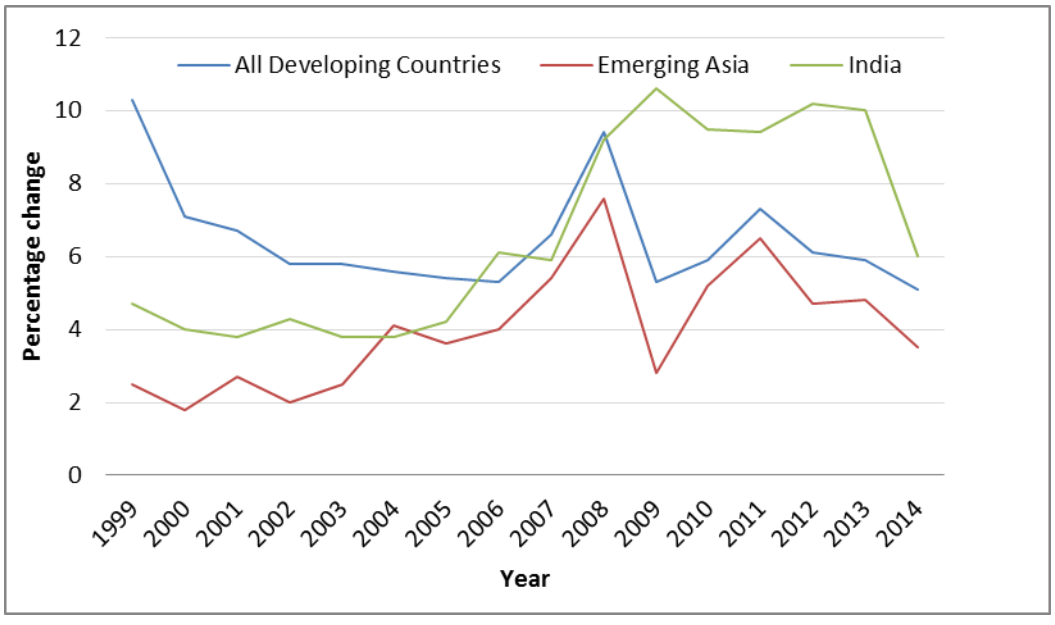
Inflation, Demand-pull, Cost-push, Monetarist, New Keynesian, Structuralist, Central Banking, Monetary Policy

Chapter 1: Introduction

The Indian economy had a "dream run" from 2003 to 2008 (Nagaraj 2013), with gross domestic product (GDP) growth averaging 8.8% even as inflation was moderate. This led many analysts to predict that the country would soon rival China in its pace of economic growth. However, the years following the global financial crisis saw a reversal of this trend, with GDP growth slowing to a nine-year low of 4.7% in the financial year ending March 2014, and inflation rising sharply. Balakrishnan (2014: 29) termed this trend in the Indian economy as "The Great Reversal".

The growth slowdown is not unusual, given that most emerging-market countries have struggled to regain their pre-crisis growth rates. What perplexed Indian policymakers is the steep rise in prices during the period. Indian policymakers also struggled to explain the marked divergence in inflation between India and other emerging countries from 2008 to 2013 (see figure 1).

Figure 1: Comparison of inflation in India with other developing countries



Source: IMF World Economic Outlook, April 2007 and April 2015 (Statistical Appendix; Table A5). https://www.imf.org/external/pubs/ft/weo/2014/01/pdf/statapp.pdf. Accessed on 5 July 2015.

The Reserve Bank of India (RBI) tightened monetary policy to contain inflation, raising the repo rate by 3.75 percentage points between March 2010 and October 2011. However, inflation as measured by the Consumer Price Index (CPI)—the RBI's preferred price gauge—remained close to 10% from 2008 to 2013, only falling to 6.0% in 2014 following the crash in commodity prices. Such was the concern over high inflation that India's former finance minister blamed it for his party's defeat in the last Parliamentary election in 2014 (Press Trust of India 2015).

Instead of questioning the efficacy of a strategy that had failed to contain inflation, the RBI doubled down on it. In February 2015, it formally adopted inflation targeting, with the target for consumer-price inflation set at 6% for 2016, and at 4% with a two-percentage-points tolerance band for subsequent years (Ministry of Finance, Government of India and RBI 2015). The move was seen as a historic shift in the monetary policy of the RBI to a sole focus on inflation from the previous "multi-indicator approach" under which the central bank considered various other variables, such as economic growth and the exchange rate, while framing its monetary policy stance (Nam and Kumar 2015).

1.1 Why Another Study On Inflation?

Inflation targeting is a policy that relies on "output gap monetarism", which is the use of monetary policy to contain aggregate demand-driven inflation (Congdon, as cited in Gabor 2011: 43). The implicit assumption is that excess aggregate demand is the primary cause of inflation, although supply-side factors are also acknowledged to play a role. But, is this really the case in India?

Much of the extensive literature on inflation in India glosses over this question. This is possibly because many authors neglect to examine the theoretical validity of mainstream inflation models and, instead, restrict themselves to testing the models using quantitative tools such as vector auto-regressions. Differences among authors thus come down to differences in econometric models or in the variables used, with variables added to estimating equations in an almost random manner. Inadequate attention to the variables can often lead to theoretical inconsistencies. For instance, Mohanty and John (2015) use the output gap and the fiscal deficit as separate variables in their structural vector auto regression. However, according to New Keynesian theory, the only way in

which a large fiscal deficit contributes to inflation is by widening a positive output gap, and the two variables should not be considered separately.

In contrast, this paper will critically analyse mainstream inflation models, most of which are derived from the Phillips curve and its various modifications. The main aim of this paper is to examine what causes inflation and how the various variables that are said to cause inflation interact in the process of inflation. This necessarily entails a focus on the theory of inflation. To this end, this paper will categorize the existing literature on inflation in India into two analytical categories—demand-pull and cost-push. Such a categorization will help flesh out the theoretical underpinnings of the different approaches and highlight the similarities and differences between them. This will be followed by empirical analyses of the mainstream models as well as of a cost-push alternative.

1.2 Research Question

The main question that this paper seeks to answer is whether inflation in India is a demand-pull phenomenon, as posited by the RBI and mainstream literature, or a cost-push phenomenon. In the process of answering the main question, the following additional questions will be addressed:

1) Do the most frequently used gauges for inflation—the consumer price index and the wholesale price index--reflect the general price level or sectoral prices?
2) Is inflation-targeting likely to be effective in controlling inflation in India?

1.3 Hypothesis and Theoretical Framework

The hypothesis of this research paper is the structuralist approach, which falls under the cost-push category, does a better job of explaining inflation in India than traditional demand-pull models. The two dominant demand-pull models—monetarist and New Keynesian-- emphasize the money supply, the output gap and inflation expectations as the primary determinants of inflation. Supply-side factors such as oil-price or food-price shocks do play a role insofar as they influence inflation expectations, affect the output gap or are accommodated by loose monetary policy. On the other hand, the structuralist model emphasizes structural bottlenecks in certain sectors of the economy as the main

driver of inflation and seeks to explain how changes in sectoral prices affect the general price level. Structural bottlenecks are the causal factor for inflation, while demand is the propagating factor.

The time period chosen for this analysis is 2001 onwards. The reason is the RBI formally abandoned money-supply targeting in 1998 and introduced repo borrowing through the Liquidity Adjustment Facility in 2000 (Mohanty 2010), which is still how it operationalizes its monetary policy stance. Hence, choosing 2001 as the starting year allows for comparison within the same monetary policy regime. The difficulty with analysing long periods of inflation data is that the basket of goods used to calculate price indices changes with the base year. For eg., the base year for the Consumer Price Index for Industrial Workers (CPI-IW) is 2001. Hence, comparing different base periods entails comparing different baskets of goods.

1.4 Structure of Paper

The rest of the paper is divided into four sections—a theoretical section (literature review), a descriptive section, an empirical section and the conclusion. Accordingly, the theoretical bases of the different inflation approaches are examined before they are tested empirically. Chapter 2, the literature review, separates the literature on inflation into demand-pull and cost-push categories. From the demand-pull school, the New Keynesian and monetarist approaches are analysed, while from the cost-push camp, the strucuturalist approach is examined. It is shown that the main point of distinction between the demand-pull and cost-push camps is the role ascribed to demand in the inflationary process. Demand-pull approaches see demand as playing a causal role, while cost-push approaches believe demand doesn't cause inflation but only propagates inflationary pressures. The third chapter gives a description of inflationary trends in the Indian economy and the RBI's policy response over the years. This chapter also includes a description of the various measures of inflation and their suitability. The fourth chapter analyses the monetarist and New Keynesian theories of inflation using exploratory data techniques and time series econometrics. The fifth chapter examines the structuralist theory of inflation using the same research techniques, while the sixth chapter concludes.

1.5 Scope and Limitations

Firstly, this paper will not examine government policy in sectors such as food and other institutional factors that could potentially play a substantial role in determining inflationary trends.

Secondly, this paper will restrict itself to the causes of inflation and will not examine the effects of inflation on the broad economy. Inflation, which is the internal price of money, has a significant impact on exchange rates and other economic variables. There is also a vast amount of literature which looks at the connection between economic growth and inflation, with many economists positing that low inflation is a pre-condition for sustained rapid economic growth. In addition, inflation has developmental consequences, especially if it is driven by high food prices. High food prices disproportionately affect the poor, who spend proportionately more of their income on food than the better-off. However, this paper will not be looking at any of these issues.

Chapter 2: Literature Review

To say that inflation is a complex and controversial phenomena would be a truism. But as a result of this complexity, research on inflation approach the subject from a number of different theoretical angles, and some of the more empiricist work doesn't explicitly state a theoretical framework. To try to make sense of this maze of research approaches, this section will classify the literature on inflation in India into demand-pull and cost-push categories. This approach is inspired by Vernengo (2007: 490-492) and Hagger (1964). Some authors classify the literature on inflation in India into monetarist and structuralist categories. eg. Sahu (2013), Ghatak (1995), Balakrishnan (1994). However, such a categorization ignores the currently dominant New Keynesian approach which is distinct from the monetarist approach, although both come under the demand-pull school. Monetarists such as Milton Friedman, who favoured money-supply targeting, expressed doubts about the efficacy of inflation targeting on the grounds that the link between interest-rate changes and price changes in the short term is not precisely known (Goodfriend and King 1997: 273).

Machlup (as cited in Hagger (1964:117)) defines demand-pull inflation as when "autonomous expansions of demand (government spending, business spending, consumer spending) are followed by responsive (competitive) price increases", while cost-push inflation is said to have occurred when "aggressive increases of wage rates and/or material prices are followed by induced and/or supportive (compensatory) demand expansions". To be sure, demand-pull approaches take account of supply-side factors, while cost-push factors consider demand-side factors. According to Solow and Samuelson, it is difficult in practice to distinguish between demand-pull and cost-push inflation, not least because it is hard to tell whether a price increase or cost increase came first (as cited in Forder (2010: 12)). However, it is possible to identify differences in the theoretical approaches of the two camps. The key difference between the two categories is whether they see demand as what Nicholas (1988: 34-35) calls a "causal" factor or a "propagating" factor of inflation. The other point of difference is the belief of most demand-pull proponents in the existence of a "natural" or equilibrium state of the economy characterized by a natural level of output, a natural rate of unemployment or a

natural rate of interest. This premise is absent in most cost-push variants, as will be shown further on in this section.

2.1 Demand-Pull Approaches

This category includes most of the mainstream approaches on inflation in India, including that of the Reserve Bank of India. While, as Vernengo (2007: 491) points out, there are many schools that fall under the demand-pull category, only the two schools that have enjoyed prominence in the Indian and international literature—monetarists and New Keynesians—will be discussed here. As Nelson and Schwarz (2008: 859) point out, both these camps have several key features in common, such as the distinction between the real and nominal spheres of the economy and the advocacy of monetary policy to control inflation. Both schools also believe that money has no effect on real economic output in the long-run as prices and wages fully adjust to changes in money supply. However, monetarist believe "unanticipated" changes in money supply can increase output in the short-run (Frisch 1983: 93-94) whereas New Keynesians believe changes in nominal interest rates[1] can affect output in the short-run due to nominal price and wage rigidities (Clarida et al. 1999: 1667). The monetarist approach, which was popular among central banks till the early 1990s will be discussed first, followed by the currently dominant New Keynesian approach.

Monetarist Approach

The monetarist approach is premised on the notion of a stable real[2] demand for money balances among the public (Ghatak 1995: 96). This means that the real demand for money balances depends on the rate of growth of real income and the opportunity cost of holding money instead of other assets, which is represented by the real interest rate and the expected rate of inflation (Ibid). The higher the rate of inflation, the higher is the demand for income-generating assets, while the demand for money falls as money

[1] Changes in nominal interest rates affect real interest rates because of price and wage rigidities. Nominal interest rates (eg. Fed funds rate) are adjusted by changing the money supply. Both monetarist and New Keynesians advocate manipulating the money supply, but the former advocates a money supply target, whereas the latter advocates an interest-rate target.

[2] The "real" here refers to the demand for a particular quantity of goods. The value of that quantity of goods would be determined by the price level and is known as the nominal demand for money.

doesn't earn interest[3]. The real demand for money balances is translated into the nominal demand for money balances by including the price level (Nicholas 1988: 9). A stable demand for money implies a stable relationship between nominal GDP and the money stock, which is represented by the famous quantity theory of money equation as M x V = P x Q or M x V = pY, where M is the money supply, V is the velocity of money and P is the price level, Q is quantity of goods produced and pY is nominal GDP (Ibid). Velocity of money reflects the number of times money changes hands to facilitate transactions.

Singh and Pandey (2010: 2923) surveyed the literature on the demand for money function of India. According to the survey, most of the authors found co-integrating relationships between real or nominal money stock and real GDP and interest rates and used statistical techniques to show that the co-integrating relationships were stable. However, the literature takes the stability of the income velocity of money as a given.

Under the monetarist approach, inflation is said to occur when money supply exceeds money demand. According to the quantity theory of money equation, when money supply is increased, since V is stable, nominal GDP increases. Since output is assumed to be at or near full-capacity, the adjustment has to occur in prices. According to Frisch (1983: 93-94), monetarists believe output can be increased in the short-run by "unanticipated changes" in the money supply, or by "fooling" the public. This is because workers mistake the rise in nominal incomes following the increase in money supply for a rise in real income even though prices have increased, and offer more employment while producers make the same mistake and increase output beyond the natural rate of unemployment level[4]. However, once they realize real incomes haven't increased, output falls back to its natural level. Hence, changes in money supply only affect prices and not output in the long-run, which is the concept of long-run neutrality of money. In monetarist models, inflation is the result of seignorage, which means generating revenue by printing money (Sargent and Wallace 1984: 2). In economies where the fiscal authority dominates the monetary authority, the monetary authority must accommodate the portion of the government's funding requirement that cannot be met by new bond sales to the public. This is done by printing money (Ibid). In most countries now, the

[3] As Ghatak points out, this is not strictly true because demand and time deposits do earn interest.
[4] The concept of the natural rate of unemployment will be explained in the next chapter

monetary authority is barred by law from buying new bonds directly from the government[5]. However, a heavy government borrowing programme can cause liquidity shortages in the money markets which are usually tackled by so-called open-market operations (OMOs), or printing money to buy existing government bonds, which increase the money supply. Hence, monetarists stress the need for fiscal restraint.

According to Nicholas (1988: 20), an example of the standard monetarist model is given as:

$$P_t = a_0 + a_1 M^*_{t-1} + a_2 M^*_{t-1} + a_3 p_t^e + u_t$$

where a_0 is the constant term, P_t is the inflation rate at time t, M* is the rate of change of money supply in excess of the rate of change of real GDP and p_t^e is price expectations at time t. The inclusion of price expectations adds the opportunity cost of holding money to the equation. It is argued that the higher the expected rate of inflation, the greater the incentive to hold physical assets instead of money. In the literature on India, a more elaborate model from Callen et al (1999: 12) considers an open economy

$$\Pi_t = b_0 + b_1(L)\,\Pi_t + b_2(L)\Delta m_t - b_3(L)\Delta y_t + b_4(L)\Delta i_t + b_5(L)\Delta e_t + b_6(L)\Delta p_{tf} - b_7 ECM_{t-1} + u_t$$

Where Π_t is the inflation rate at time t, (L) is the lag operator, Δy_t is the change in real income between time t and t-1, Δm_t is the change in money stock, Δi_t is the change in the real interest rate, Δe_t is the change in the exchange rate, Δp_{tf} is the change in foreign prices and ECM is an error-correction mechanism representing the deviation of prices from their estimated long-run equilibrium. The authors found that excess high-powered money growth and excess money supply growth had a high power of predictability in forecasting inflation. However, both regressions run with wholesale inflation as the explained variable had an adjusted R^2 of just 0.4, indicating that the model failed to explain a major portion of the dependent variable. In any case, as Balakrishnan (1991: 180) points out, a statistically significant relationship between inflation and money supply growth is also consistent with the view that money supply responds to changes in

[5] India also implemented the Fiscal Responsibility and Budget Management Act in 2004 which banned the central bank from buying newly issued government bonds and automatically monetizing the fiscal deficit from 2006 onwards.

nominal income rather than the other way around. Also, the wholesale price index, which is used by the authors as the dependent variable, cannot be said to reflect the general price level, as will be made clear in the next chapter.

The other assumptions underpinning the practice of monetary targeting are that of an exogenously-determined money supply and a stable money multiplier. This means that the central banks control high-power money M0[6], and by implication broad money or M3[7], because a stable relationship exists between M0 and M3.

The idea that central banks can target or control the money supply has faded in popularity over the years. Bank of England economists (McLeay et al. 2014:) have challenged the exogenous money theory which holds that the central bank creates reserve money which is "multiplied up" by commercial banks, or that loans are made from money the public deposits with banks. The authors say commercial banks determine the money supply as they create new bank deposits when they make new loans. Hence, the money supply is a function of the demand for loans and of whether commercial banks are willing to make loans. The central bank can decide the cost of money, but not the quantity of money.

Some authors say features specific to countries with underdeveloped financial markets result in exogeneity of money supply. Mitra and Abhilasha (2012: 45) say foreign investment in Indian stocks and bonds and government financial flows result in an "autonomous" money supply. However, capital inflows add to the money stock only if the central bank buys the incoming foreign exchange with newly printed money, thereby sterilizing the inflows. Also, it is unclear how capital inflows can be considered as independent of the state of the economy, given that a fast-growing economy needs more capital and is likely to attract more capital.

[6] Defined as cash and currency with the public and commercial banks' reserves with the central bank. This equals the liabilities of the central bank

[7] Defined as M0 plus demand and time deposits. This includes the liabilities of the entire banking system.

New Keynesian Approach

This section will elaborate the concepts of the Phillips curve, the output gap and inflation expectations--which are integral to the New Keynesian approach—before examining a New Keynesian inflation model.

Phillips Curve

According to Forder (2010: 2), prior to the ascendancy of the Phillips curve in the 1960s, the accepted view was that wages were indeterminate. While the need to attract labor and the profit aims of firms might set a lower and upper limit on wages, respectively, within those bounds institutional factors, such as the bargaining power of workers, rather than economic factors had a bigger role to play in wage determination (Ibid). Phillips' statistical observation of a regular negative relationship between the nominal wage rate and unemployment in England since 1861 was given theoretical form by Samuelson and Solow and christened as the Phillips Curve[8] (Gordon 2011: 14-16). Samuelson and Solow propounded the idea that policymakers face a choice between increasing inflation and accepting higher unemployment. The Phillips curve has been endlessly modified, and debate has abounded about the shape of the Phillips curve, how it varies with time, whether it only applicable in the short-run etc. The empirical and theoretical basis of the Phillips curve and its various incarnations is shaky, according to Atkeson and Ohanian (2001: 10), who found that Phillips-curve models did no better at forecasting U.S. inflation than "naïve" models that assumed that inflation in the following 12 months would be the same as in the preceding 12 months. But, the basic idea that there is a *determinate*, and even stable, negative relationship between unemployment and inflation (or positive relationship between output and inflation) continues to live on in most mainstream inflation models. Indeed, without the existence of this stable relationship, there would be no basis to use monetary policy to control aggregate demand in the pursuit of price stability.

[8] Forder (2010: 13) says this was, in fact, a "modified" Phillips curve because it posited a relationship between inflation and unemployment rather than wage change and unemployment as Phillips had. According to Gordon (2011: 7) the rate of changes of wages was translated to the inflation rate by using an equation that related inflation to the rate of wage changes adjusted for trend productivity.

The fundamental objection of cost-push theorists to the Phillips curve is not that the level of demand doesn't have an impact on prices, but a) the relationship is not stable or determinate b) it is not important. This view is elaborated by Forder (2010: 14-15):

> One does not doubt that excessive demand raises the price level... The question is not whether it is broadly plausible that deeply buried there is some sort of Phillips relation. It is whether there is any evidence or reason to believe, or whether it is anything more than a passing fancy, that there exists such a relation which is definite enough, and stable enough, and vital enough, to be worth anyone's notice.

Azad and Das (2015) argue that globalization has flattened the Phillips curve in advanced countries as the transfer of manufacturing jobs to poorer countries has reduced the bargaining power of workers. The authors estimate two separate inflation equations based on data from U.S. and Mexico for pre- and post-globalization time periods and find that the wage rate and the capacity utilization rate are statistical significant in the pre-globalization period but not post globalization. This is taken as evidence of a flattened Phillips curve. However, all their explanatory variables go from being statistically significant to statistically insignificant in the post-globalization period, including lagged inflation, which most schools of thought see as an important predictor of inflation. The authors do not explain this puzzling outcome.

Some authors such as Fitzgerald (2004: 2) claim that Phillips curve is not a convincing model for inflation in developing countries due to the existence of "disguised unemployment" or underemployment, which is a situation where workers are employed in jobs that don't provide a sustenance living and would, given a choice, take up another job. Without full employment, a rise in aggregate demand might not bid wages higher as more people will be drawn into employment at the same wage. According to Azad and Das (2013: 44-45), the Phillips curve is horizontal for developing countries until the full-employment limit because they have huge reserves of labor, giving workers in those countries very little bargaining power. However, it must be noted that an educated labor force is more important than the total labor force in the case of manufacturing jobs.

In the literature on inflation in India, there appears to have been a shift in consensus over the existence of a Phillips curve[9]. According to Paul (2009: 479), several studies, mainly in the 1980s and early 1990s, such as Bhalla (1981), Chatterji (1989), Rangarajan (1983), and Dholakia (1990) failed to find the existence of a Phillips curve. On the other hand, most recent research (Singh et al. 2011, Paul 2009, Kumar and D.C.Vashist 2012) finds that a positive inflation-output relationship does exist in India. However, as Paul (2009: 482) points out most of the research doesn't explicitly model a relationship between inflation and unemployment, but between the output gap and unemployment. This is mainly due to the lack of reliable and timely employment data, even in the organized manufacturing sector (Sincavage et al. 2010: 4). However, there are many other problems with the research on the existence of the Phillips curve. Firstly, the concept of the output gap presumes the existence of a Phillips-curve-type tradeoff, as will become clear in the next section. Hence, using the output gap to prove the existence of a Phillips curve becomes a mere statistical exercise without any theoretical grounding. If the statistical evidence were overwhelming it would make the existence of the Phillips curve more plausible. However, this is not the case. For instance, Paul (2009) found the existence of a Phillips curve only with industrial production data and not with overall GDP data. In addition, the relationship was found to hold only when the crop year was used and not with the fiscal year. Mazumdar (2011) also used industrial production data instead of GDP data, even though companies covered in the index of industrial production only account for 18% of GDP (Singh et al. 2011: 248). Another point of weakness is that most of the research uses filtering techniques such as the Hodrick-Prescott (HP) filter to estimate the output gap. The shortcomings of such approaches will be discussed in the next section.

Output Gap

The concept of output gap[10] is borrowed from literature on developed countries and is consistent with both monetarist and traditional Keynesian approaches, as pointed out

[9] Given that data on employment is scarce, most authors mean an inflation-output tradeoff when they speak of the Phillips curve.
[10] Some authors distinguish between the output gap and the employment gap.

by Congdon (2008: 147-148). Under Okun's Keynesian conception of the output gap, the gap is said to open when aggregate demand exceeds the full-employment level of output (Ibid). With the Keynesian assumption that output remains fixed in the short-run, an increase in aggregate demand increases the value of this output in the form of higher prices, according to Hagger (1977: chp 2). However, this conception of the output gap was displaced in the 1970s by Friedman's monetarist conception in which an output gap opens when aggregate demand exceeds or undershoots the level of output associated with the "natural" level of unemployment (Congdon 2008: 147). The non-accelerating inflation rate of unemployment (NAIRU), which is a popular term in modern economics literature to signify the rate of unemployment below which prices rise, is "approximately a synonym" of the natural level of unemployment (Ball and Mankiw 2002: 115). The concept of NAIRU assumes that unemployment can only be reduced in the short-term below the NAIRU at the cost of higher inflation (Ibid).

However, while the output gap and NAIRU play a central role in monetary policy in the U.S. (Jahan and Mahmud 2013: 38), the concept is not easily transferred to developing countries such as India, as shown in the discussion on the Phillips curve.

The concept of natural level of unemployment is analogous to Wicksell's natural level of interest and output (Friedman 1968: 9). Both attempt to separate "real forces" in the economy, such as tastes and technology, from monetary forces in the economy (Ibid). Accordingly, Woodford (2003: 8), defines natural output as the level of output that would be achieved in *equilibrium* with "flexible wages and prices, given current real factors (tastes, technology, government purchases)". The actual level of output is subtracted from the natural level of output, or potential output, to arrive at the output gap.

A detailed examination of how potential output is measured is beyond the scope of this paper, but a brief summary will be presented. Potential output measurement techniques can broadly be defined into structural techniques, which involve calculating potential output based on structural relationships between output and labor and capital inputs, and stochastic filtering techniques, which involve smoothing time series output

data[11]. A popular technique is the HP filter which separates shocks that disturb output from its trend into supply shocks which are assumed to be long-lasting and demand shocks which are temporary (Gibbs 1995: 86). This is the most popular technique for measuring potential output in the literature on India and is used by, among others, Mohanty and John (2015), Ranjan et Al (2007) and Paul (2009). However, a key criticism of the HP filter is there is no theoretical or empirical evidence to show that potential output is a smoothed series (Basu and Fernald 2009: 187). In addition, it is unclear how a purely statistical technique can yield a measure of potential GDP, which is the non-accelerating inflation level of output. This point is stressed by Williamson (2012):

> The HP trend was arrived at through a purely statistical procedure. I did not use any economics to arrive at the two charts above - only a few lines of code. How then could the HP trend be a measure of potential GDP? To measure potential GDP requires a model.

Another sign that the HP method of calculating potential GDP is invalid is the omission of specification of a rate of inflation consistent with potential output, as Mishkin (2007) points out. This zero output-gap inflation rate is necessary if one uses the output gap as a measure of demand-side inflationary pressures, as this inflation rate would serve as an inflation target. Such an inflation rate level would have to be generated within the potential output model for it to be valid.

Structural techniques to measure potential output are seen as deficient because "although economists have a broad grasp of the relationships between macroeconomic activity and such observables as potential output, the structural form of these relationships remains elusive" , according to Laxton and Tetlow (1992, as cited in Gibbs 1995: 86). According to Gibbs (1995: 89) almost all techniques to measure potential output suffer from "serious deficiencies". According to Woodford (2008: 1591-1592), real-time measures of the output gap are "notoriously controversial, because of the difficulty of recognizing changes in the "natural" (or potential) level of output at the time that they occur".

Post-Keynesian authors have criticized the concept of natural output for failing to take into account the concept of hysteresis in the economy, according to which fiscal and

[11] This classification is inspired by Gibbs (1995), but I compress his four categories into two categories for simplicity.

monetary policy changes made to close the output gap affect the actual level of output as well as the "natural" level of output (Rochon 2004: 17). As a result, an economy that has deviated from natural output cannot return to the same level of natural output. This criticism is grounded in a belief in the concept of long-run non-neutrality of money which holds that monetary changes affect both prices and output in the long-run.

Inflation expectations

Another key feature of the New Keynesian approach is the focus on inflation expectations. According to former U.S. Federal Reserve chairman Ben Bernanke (2007), "undoubtedly, the state of inflation expectations greatly influences actual inflation and thus the central bank's ability to achieve price stability". The reasoning is if workers and employers expect a high level of inflation in the future they will take actions such as demanding higher wages and raising product prices which will make high inflation a self-fulfilling prophecy.

Traditionally, there were broadly two schools of thought on the nature of inflation expectations— i) backward-looking or adaptive expectations which assume that agents base their expectations on the current level of inflation ii) Rational expectations.

The concept of adaptive expectations is similar to the notion of "inertial" inflation that many cost-push schools subscribe to (Vernengo 2007: 483). In other words, inflation tends to be persistent, and future inflation is likely to be highly correlated to current inflation. According to Debabrata Patra and Ray (2010: 12), adaptive expectations was the dominant model until Lucas in 1970 propounded the rational expectations hypothesis that "expectations are….essentially the same as predictions of the relevant economic theory". According to Sargent (as cited in Frisch (1983: 27)) the rational expectations hypothesis amounts to "supposing that the public expectations, depend in the proper way, on the things that economic theory says they ought to".

Rational expectations have been criticized for assuming that all agents hold the same beliefs, but failing to explain how those beliefs are formed (Orphanides in comments on Sims (2009: 32)). It also doesn't account for the presence of different inflation models and the "heterogeneity of beliefs … in the real world". According to Debabrata Patra and Ray (2010: 13) "imperfect information" models "proliferated" in response to the shortcomings of the rational hypothesis models. Imperfect information can lead to

staggered price-setting, and can explain "sticky prices", which is a key component of New Keynesian models of inflation (Ball and Cecchetti 1988: 1027-1029). Staggered price-setting is said to occur when only a fraction of firms change prices in response to demand or cost changes at a given time. Since prices are sticky and firms have imperfect information, future expectations affect current price-setting behaviour and, consequently, current inflation (Debabrata Patra and Ray 2010: 13).

The concept of inflation expectations is of little analytical use unless it can be proven that policymakers can influence these expectations. Hence, the concepts of "credibility" and "communication" of the central bank are important. The idea is that central banks influence inflation expectations by communicating their inflation targets and inflation forecasts to the public, which adjusts its price-setting and wage-setting behaviour accordingly. But, this policy only works if the public believes the central bank will not cheat on its inflation targets (Svensson 2010: 2). There is a vast literature which posits that central banks that are not independent of the government or are not bound by monetary policy rules are likely to increase output in the short-run by increasing inflation, according to Clarida et Al (1999: 1675).

The literature on India can be divided into backward looking inflation-expectations models eg. Kapur (2013); forward-looking models eg. Cristadoro and Veronese (2011) and Debabrata Patra and Ray (2010); and hybrid models eg. Sahu (2013). The focus on inflation expectations has increased following the spurt in inflation in India after the global financial crisis. Cristadoro and Veronese (2011) found a high degree of correlation between expected inflation and actual inflation in India in the aftermath of the financial crisis, leading them to conclude that inflation expectations had come "unhinged" during that period. However, since they use inflation forecasts as a proxy for forward-looking inflation expectations, all it means is inflation forecasts are highly correlated with the current level of inflation.

Critics of these approaches, such as Rakshit (2007: 99), question whether the factors driving inflation expectations are different from those that generate actual inflation.

> Because of estimation difficulties no concrete evidence is adduced relating to such expectations in the years under review; but the RBI hammers on (a) how the inter-relation between the actual and the expected inflation under an accommodative monetary policy

regime can make the inflationary forces get out of control; and (b) the urgent need of monetary tightening before such expectations gather strength (Ibid).

Even supporters of the inflation expectations approach accept the difficulties in estimating what is inherently a subjective parameter. According to Debabrata Patra and Ray (2010: 12), a majority of surveys of inflation expectations among the pubic have a large number of non-respondents.

New Keynesian Model

Taylor (2000: 90) sums up the five core assumptions which form the basis of New Keynesian models:-

i) Potential GDP can be understood through the Solow growth model[12]
ii) Monetary policy affects only inflation in the long-run, not other real variables
iii) There exists a short-term trade-off between inflation and unemployment as wages and prices are sticky; they do not adjust instantly to changes in economic conditions.
iv) Inflation expectations are "endogenous and quantitatively significant"
v) Monetary policymakers adjust short-term nominal interest rates "in response to economic events".

Central banks can influence real interest rates through monetary policy because wages and prices do not instantly adjust to changes in monetary conditions (Clarida et al. 1999: 1665). This theory is inspired by Knut Wicksell, who distinguished between the "bank rate" controlled by central banks, and the "natural rate of interest" which depends on the productivity of capital (Woodford 2003: 49). Inflation is said to occur when the bank rate is held below the natural rate of interest (Ibid). This is because a money interest rate lower than the rate of return on capital would incentivize investment and disincentivize saving, leading to overheating of the economy and setting off inflation.

[12] The Solow model holds that long-run growth depends on population growth and technical innovations (Rochon 2004: 5)

A fairly typical representation of a basic New Keynesian output gap model is given below, from Srinivasan et al (2006: 48-49).

$$\Pi_t = \alpha(L)\,\Pi_t + \beta(L)y_t + \gamma(L)u_t + \varepsilon_t$$

where Π_t is the rate of inflation at time t, y_t is the output gap, u_t is a vector of supply shocks, ε_t is a normally distributed random error, and $\alpha(L)$, $\beta(L)$, and $\gamma(L)$ are coefficients of the respective lags. Depending on the model chosen, $\alpha(L)\,\Pi_t$ signifies lagged inflation/adaptive expectations or forward-looking expectations, as in the case of rational-expectations models. The supply-side variables are usually crude oil prices and the exchange rate, as with Mohanty and John (2015).

The key difference between monetary models and New Keynesian models is the emphasis on price rigidity and the absence of money supply as a separate variable in the latter. Some New Keynesians such as Woodford (2008) go so far as to say that monetary aggregates need not play any role in monetary policy calculations, in keeping with the long-run neutrality of money thesis. However, many central banks such as the European Central Bank play close attention to monetary aggregates (Woodford 2008: 1561).

As money-supply targeting fell out of favour and New Keynesian models gained ground, economists stopped trying to provide purely monetarist explanations for inflation[13]. New Keynesians believe that aggregate demand is inversely related to real interest rates and directly related to the level of government spending (Clarida et al. 1999: 1665). Increased government spending can cause inflation by raising effective demand beyond the potential output of the economy (Hagger 1977: Chp 2), and opening up an output gap. The rise in spending, which is equal to the rise in the value of output, will result in a rise in incomes, causing a self-perpetuating cycle of rising incomes and prices (Ibid).

[13] India also implemented the Fiscal Responsibility and Budget Management Act in 2004 which banned the central bank from buying newly issued government bonds and automatically monetizing the fiscal deficit from 2006 (Fiscal and Monetary Coordination in India: An Assessment 2013) https://rbi.org.in/Scripts/PublicationsView.aspx?id=14939

A wide swathe of recent literature on India fixes the blame for inflation on loose monetary and fiscal policies. According to empirical work by Khundrakpam and Pattanaik (2010: 703) for the years 1953 to 2009, a one percentage point rise in India's fiscal deficit increased wholesale price inflation by a quarter percentage point. Kapur et al. (2014: 8) attribute the spurt in inflation from 2009 onwards to demand stimulus policies taken to cushion the Indian economy from the impact of the global financial crisis. The RBI's monetary measures released cash equalling 10% of GDP, while the government's budget deficit rose from rose to 6% of GDP in the fiscal year ending March 2009 from 2.5% in the previous year (Ibid). Mohanty and John (2015: 95) also found that the fiscal deficit was a key determinant of inflation in India in 2011-12. However, India was hardly the only country to stimulate demand in the wake of the financial crisis. According to Prasad and Sorkin (2009), almost all G-20 countries announced fiscal stimulus packages following the financial crisis, with the combined measures totalling 1.1% of world GDP.

The view that the jump in the fiscal deficit following the global financial crisis caused inflation in India is contested by Balakrishnan (2014: 31). The positive relationship between inflation and the fiscal deficit is explained by the endogenous nature of the fiscal deficit[14]. "That is, as inflation gathers pace, public expenditure may be expected to rise almost immediately, while tax revenues increase only with a lag" (Ibid).

Structuralist approaches to inflation, which will be elaborated in the next section, reject the idea that the output gap is a driver of inflation in India. Regressions run by Rakshit (2011: 43-44) on data from 2006 to 2010 showed that the output gap and other macroeconomic factors such as the GDP growth rate, broad and narrow money aggregates leave unexplained an "overwhelming" portion of the variation in both consumer-price and wholesale-price inflation.

2.2 Cost-push Approaches

According to Vernengo (2007: 482), the common thread linking cost-push theories of inflation is the belief that distributional conflicts over income that are an intrinsic part of market economies have a role to play in the inflation process. He categorizes cost-

[14] As government salaries and welfare payments are often tied to the level of inflation

push theories into three schools of thought—Marxists, structuralists, and Post-Keynesians. The Marxists' conflict theory emphasizes conflict between industrialists and workers over their respective shares of income and monetary accommodation by the government of these competing claims as the source of inflation (Saad-Filho 2000: 337-338). The Post-Keynesian theory of inflation posits that money supply is endogenous and that prices of goods are not market-clearing but administered as they include a profit mark-up over costs (Wray 2001: 92-93). The structuralist theory can be seen as an offshoot of the Post-Keynesian theory of inflation adapted to developing economies, and according to Sahu (2013: 2635), is the main alternative approach in the literature on India. Among the cost-push approaches, this paper will only examine the structuralist approach.

Structuralist Approach

The key feature of structuralist explanations is the analytical focus on relative or sectoral price movements rather than general price movements (Canavese 1982: 523). The theory is changes in the structure of the economy cause changes in the price of certain products relative to others which are propagated to the general price level due to downward rigidity of wages and prices. Depending on what causes the changes in sectoral prices, structuralist theories can be divided into four categories, according to Argy (1970: 74-80). These are:

i) Demand-shift hypothesis: Demand in one sector rises while that in another sector falls, possibly as a result of rapid industrialization. However, wages in the sector facing declining demand do not adjust downwards due to government policy, trade unions, etc.

ii) Export instability hypothesis: Increasing export receipts lead to a rise in wages in the export sector, which spreads to other sectors, causing inflation.

iii) Agriculture bottleneck hypothesis: This is the "tendency for food supply to lag behind the demand generated by expansion of income in the non-agricultural sector" in developing countries (Ghatak 1995: 99). The fall in real income of non-farm labourers as a result of higher food prices leads them to demand wage increases, triggering an inflationary process.

iv) Foreign exchange hypothesis: A lack of foreign exchange, which is common in developing countries, causes depreciation of the exchange rate. This leads to

> an increase in the price of imports in domestic currency terms, causing inflation (Argy 1970: 74-80).

In the case of India, which has long struggled with low agricultural productivity, structuralist explanations of inflation have traditionally relied on the agricultural bottleneck hypothesis. However, more recent research also considers the price of crude oil as one of the factors. Eg. Rakshit (2011).

A key feature of structuralist explanations is the distinction between price-setting behaviour in the agricultural and non-agricultural sectors. The theory is outlined as follows by Balakrishnan (1994: 678-679):

> It is held that agricultural prices are demand-determined, whereas industrial prices are cost-determined. In fact, it is this structure of the economy that implies inflation is a result of continuing excess demand for agricultural products. Excess demand causes the price of agricultural goods to rise, leading to a rise in industrial prices because agricultural goods are inputs into industrial production.

Structuralists explanations thus differ from demand-pull explanations in how they explain the formation of prices. In the mainstream Neoclassical approach, prices are assumed to be market-clearing under the assumption of perfect competition (Wray 2001: 91). New Keynesian models include a mark-up that varies with inflation expectations[15](Goodfriend and King 1997), but do not distinguish between agricultural and non-agricultural prices. In the structuralist view, agricultural production is supply-determined while agricultural prices are demand-determined and industrial production is demand-determined, while industrial prices are cost-determined plus a mark-up (Rakshit 2011: 45, Balakrishnan 1994: 678-

[15] Post-Keynesians such as Lavoie are suspicious of New Keynesian reinterpretations of administered pricing. They point out that New Keynesian pricing theory still focusses on marginal costs, while Post Keynesians focus on average unit costs.

679)[16]. However, one shortcoming of structuralist explanations is it doesn't explain how the mark-up[17] is determined and whether or how it varies with time.

Inflation occurs because the food supply cannot keep up with the increase in demand resulting from rapid growth in the non-agricultural sector. The consequent rise in food prices results in workers in the industrial sector demanding wage increases to maintain their real wages. This, in turn, raises costs for the manufacturing sector and prices of manufactured goods.

Balakrishnan (1991) carried out a comprehensive study of inflation in India using a structuralist framework. He specified a model of inflation as:

$$\Delta p = \Upsilon_1 \Delta p_f + \Upsilon_2 \Delta p_m + \Upsilon_3 \Delta p_i$$

where p is the general price level and p_f, p_m and p_i refer to the prices of foodgrains, raw materials and industrial products, respectively. The equation for each sectoral price as well as a wage equation was specified separately. Food grain prices were modelled as inversely proportional to per capita food grain output and directly proportional to per capita real income of the non-agriculture sector and net procurement by the government. Raw material prices were modelled as directly proportional to industrial output and the unit value of unit raw materials and inversely proportional to the output of non-food products in the non-agricultural sector. Industrial prices were modelled as inversely proportional to productivity and an index of activity in the sector and directly proportional to unit wage costs. Wage inflation was modelled as directly proportional to overall inflation and productivity. Based on these sub-equations, the overall inflation model was estimated as

$$\Delta p_t = c_0 + c_1 (\Delta p_{f)t} + c_2(\Delta pr_m)_t + c_3 \Delta a_t + c_4(w\text{-}p)_{t-1} + c_5(w - a - p_{rm})_{t-1} + c_6(p_i - p_{rm})_{t-1} + c_7 D_{t-1} + z_t$$

[16] This is similar to Post-Keynesian pricing theory which rejects the notion that prices are market-clearing (Wray 2001: 12). As New Keynesian price theory assumes that firms are monopolistically competitive and apply a mark-up over marginal costs, the New Keynesian mark-up is based on expectations of future real marginal costs, and not on market power, as in post-Keynesian theory.

[17] Post-Keynesians have a theory of mark-up, but structuralists don't specify whether it is also applicable to developing countries.

Where a is productivity of workers in the manufacturing sector, w is unit wage costs, D is an index of activity in the manufacturing sector. The terms of the coefficients c_4, c_5 and c_6 are error correction terms that represent co-integrating relationships as the concerned variables are I(1), which means that they attain stationarity when differenced once. In empirical tests, the above model performed better than the monetarist model in explaining inflation, according to Balakrishnan (1991: 196). However, the author considers the wholesale price index as an indicator of the general price level, which is not valid, as will be shown in the next chapter.

Rakshit (2011) used a similar sectoral approach for the years 2006-10, but also included crude oil prices, which were taken as exogenous since India imports most of the crude it uses. He found that variations in fuel prices explained a large part of the variation in wholesale prices, whereas variations in agricultural GDP explained a substantial part of the variation in consumer prices. Prices in the manufacturing sector were largely independent of the sector's output, leading him to reject the excess aggregate demand hypothesis. However, he also found that the sharp rise in food prices wasn't the result of rapid growth in the non-food sector, or vice versa, in contravention of the structuralist hypothesis. The increase in food prices appeared to be driven by higher spending by government on food programmes for the poor. Sasmal (2015), on the other hand, found that rising per capita incomes in India increased the demand for food significantly, which outstripped the supply of food. No long-run relationship between money supply and food prices was found (Ibid).

2.3 Summary

The key difference between cost-push and demand-pull approaches is whether they consider demand as a causal factor or a propagating factor. In the demand-pull camp, the monetarist and New Keynesian schools have several features in common such as a belief in a "natural" or equilibrium level of output, interest rates and unemployment and the long-run neutrality of money. They differ in their treatment of money supply, with monetarists believing money supply is exogenous and the primary cause of inflation, while New Keynesians do not explicitly consider money

in their models. Monetarists believe increasing the money supply beyond the needs of the real sector leads to inflation, while New Keynesians believe excess government spending or holding real interest rate below the "natural" rate lead to an inflationary output gap. In the cost-push school, structuralists emphasize structural bottlenecks as the primary cause of inflation, with demand seen as a propagating factor rather than a causal factor. The bottlenecks in India's case are low agricultural output and the price of imported commodities such as crude oil. They believe that money supply is endogenous.

Chapter 3: Inflation Trends and Monetary Policy in India

This section is a prelude to the analytical section. It will detail how inflation is measured in India, the merits and drawbacks of the various indicators, inflationary trends in the country and the India central bank's monetary stance.

3.1 Measuring Inflation

One of the challenges of analysing inflation in India is deciding which gauge to choose. India currently has four main gauges—the wholesale price index, the consumer price index (rural), the consumer price index (urban) and a combined consumer price index. The wholesale price index is published monthly and the current series has 2004-05 as its base year, with the weights and basket revised every 10 years. It is dominated by the manufactured products category, which has a weight of about 65% in the index. The other major subgroups are food and other primary articles with a weight of about 20% and fuel and power with a weight of about 15% (Ministry of Commerce and Industry 2015).

The three CPI indices have only been published since January 2011 with 2010 as the base year, and hence cannot be used for historical analysis. There are four legacy CPI indices—CPI for industrial workers (CPI-IW), CPI for rural labourers, CPI for agricultural labourers and CPI for urban non-manual employees[18]. These CPI indices have a weight of 46%-69% for food (Ministry of Statistics and Programme Implementation 2010).

Traditionally, the wholesale price index has been used as the main gauge for inflation analysis in India on the grounds that the legacy consumer price indices weren't representative of the whole population (Subbarao 2013). However, a major shortcoming of the wholesale price index is that it doesn't include prices of services, which is the largest sector of the Indian economy. Also, it isn't strictly a measure of producer prices, as it is supposed to be. According to the National Statistical Commission's (2001) report, "in many cases, these prices correspond to farm-gate, factory-gate or mine-head prices;

[18] CPI UNME is no longer published.

and in many other cases, they refer to prices at the level of primary markets, secondary markets or other wholesale or retail markets" (as cited in Srinivasan (2008: 219)).

The argument for using the CPI instead of the WPI is that the former is a better indicator of changes in the cost of living and "hence is seen to be better reflecting the welfare objective of monetary policy", according to the previous RBI governor, D. Subbarao (2013). With the publication of the new series of the CPI from 2011, the emphasis has shifted to the CPI from the WPI, with the RBI specifying its inflation target in terms of the CPI. However, given the heavy weight of food in the CPI, it is more reflective of sectoral (food) prices rather than the general price level. In the same vein, the wholesale price index can be seen as a sectoral price indicator of manufactured products. As shown in the literature review, neither the monetarist nor the New Keynesian approach explains sectoral prices. Only the structuralist approach explains food and industrial prices separately. In fact, one of the criticisms of cost-push approaches by Humphrey (1999: 54) is that they explain sectoral or relative price movements rather than movements in the aggregate price level[19]. The implication is that demand-pull approaches explain movements in the aggregate price level. Hence, the aggregate price level should be used to evaluate demand-pull approaches.

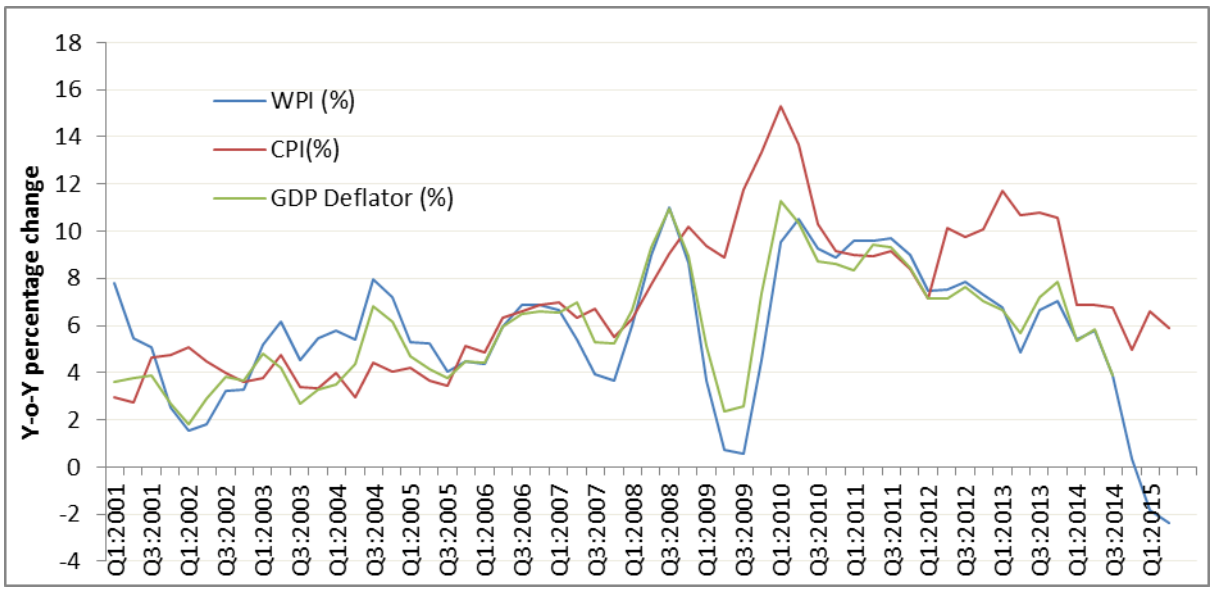
The broadest measure of inflation is the GDP deflator. The GDP deflator is the percentage difference between real GDP growth, which reflects growth in the quantity of goods and services produced, and nominal GDP growth, which includes both quantity and price changes. While the GDP deflator is not officially published, it can be calculated as a ratio of GDP at market prices to GDP at constant prices.

However, the measure of GDP deflator is not without its own set of problems in India's context. The RBI says the GDP deflator calculated by the government of India is not the "comprehensive measure" of inflation that it is supposed to be" (Fourth Bi-Monthly Policy Statement 2015-16). According to the RBI, "services, which account for over 60 per cent of GVA (gross value added), are not covered in WPI; yet the WPI is used as deflator for several services activities such as trade, hotels and restaurant, real

[19] As we have seen in the literature review, this criticism is not valid for the structuralist approach, which has a theory for how changes in sectoral prices propagate to the general price level

estate and transportation" (Ibid). This is borne out by Figure 2, which plots the GDP deflator calculated from gross value added GDP[20] along with WPI and CPI inflation. It can be seen that there is a high correlation between the GDP deflator and the WPI (correlation coefficient 0.88) compared to the CPI (correlation coefficient 0.68). However, given that inflation calculated with the GDP deflator falls in between CPI and WPI inflation for most of the period between 2001 and 2015 (figure 2), it can be considered a broader measure of inflation compared to the official price indices.

Figure 2: Different price gauges of India



Source: RBI Handbook of Statistics on Indian Economy; Tables 164,166,171, 172, author's own calculations http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 3 September, 2015.

In the analysis, the WPI sub-index for manufactured products is used as an indicator of industrial prices, while the WPI sub-index for food is used as a gauge of agricultural prices. Year-on-year[21] inflation rates based on quarterly inflation data are used, which is the standard in most inflation studies, according to Mishra (2012: 149). Because inflation

[20] The GDP deflator is calculated from gross value added GDP rather than from expenditure-side GDP because the former is considered more accurate. The terms GDP and GVA deflator are used interchangeably in this paper.

[21] Year-on-year comparisons involve comparing a time period with the same time period in the previous year. For eg, an inflation rate of 8% in the first quarter indicates that the price index rose by 8% during the quarter compared to its value in the first quarter of the previous year.

data are published monthly, quarterly values of the indices are calculated by averaging monthly values. Since the new series of the WPI starts from January 2005, inflation rates up to December 2005 are calculated according to 1994-95 series, and according to the 2004-05 series from 2006 onwards.

3.2 Inflation Trends in India

Much has been made of the divergence between the WPI and CPI in recent years. The previous RBI governor, D. Subbarao, said the divergence posed a "major challenge to assessing short-term inflation trends" (BS Reporter 2013). The divergence is even more puzzling if one were to assume that both price gauges are influenced by the same factors, which is the premise of demand-pull approaches, as pointed out in the literature review. In the fourth quarter of 2009, the difference between CPI and WPI inflation was almost 12 percentage points (see figure 2). Another phase of sharp divergence between the CPI and WPI was from the first quarter of 2012 to the fourth quarter of 2013. The last phase of divergence is from the second quarter of 2014, when WPI inflation began to fall sharply and entered negative territory in the beginning of 2015. CPI inflation, however, has remained above 5%.

Table 1 shows period averages for the WPI, the CPI and the GDP deflator. It can be seen that the difference between average CPI and WPI inflation rose to 2.5 percentage points in 2006-10 from about 1.0 percentage points in 2001-05.

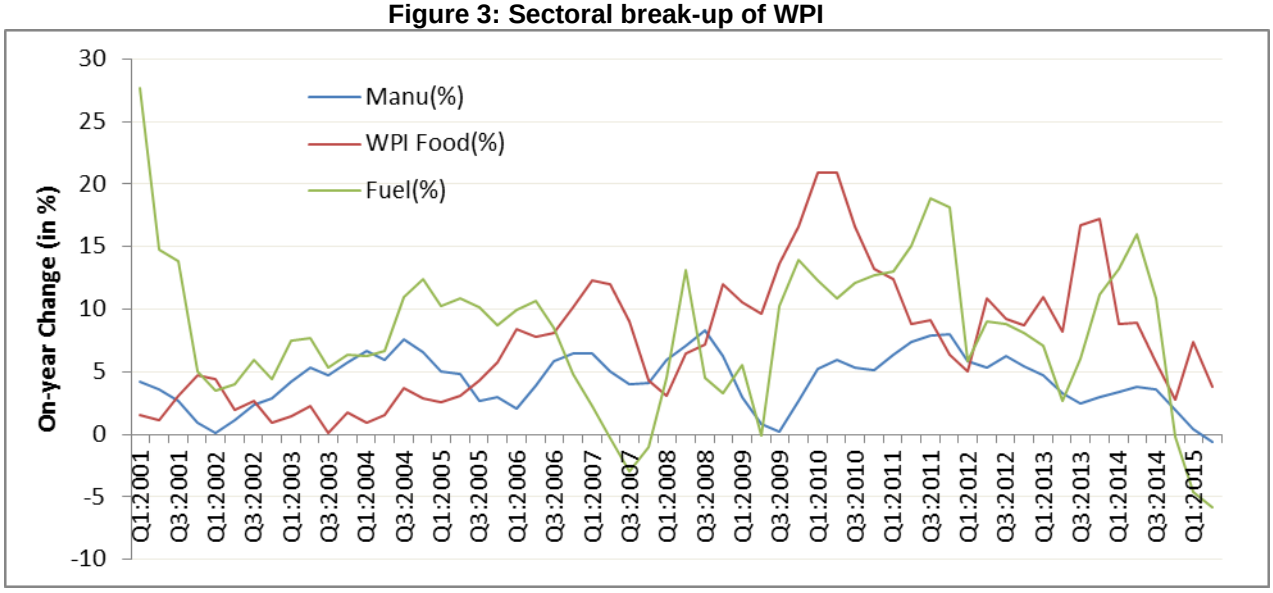
Table 1: Inflation period averages

Period	WPI (%)	CPI (%)	GDP Deflator (%)
2001-2005	4.87	3.98	3.95
2006-2010	6.31	8.76	6.99
2011-	5.81	8.57	7.12
Pre-crisis	5.30	5.33	5.00
Post-crisis	6.16	9.49	7.42

Source: RBI Handbook of Statistics on Indian Economy; Tables 164,166 author's own calculations http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 8 September, 2015.

If one were to split the timeframe into before and after the global financial crisis[22], it is observed that WPI and CPI inflation were identical before the crisis, but diverged by 3.30 percentage points after the crisis.

Figure 3: Sectoral break-up of WPI



Source: RBI Handbook of Statistics on Indian Economy; Tables 164,166
http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 20 September, 2015.

The RBI's explanation for the rise in inflation in the post-crisis period involves the following factors (Reserve Bank of India 2012a).

Demand-side Factors	**Supply-side factors**
Rise in fiscal deficit	Rise in Crude Oil Prices
Post-crisis monetary stimulus	Rural Employee Guarantee Program
	Low agricultural output due to droughts in 2009 and 2012
	Rupee depreciation

[22] July-September 2009 is taken as the first quarter of the post-crisis period because India's GDP grew by 9.3% on-year in the quarter compared to 5.2% in the April-June quarter, indicating a rebound in economic activity.

The explanations for the demand-side factors have already been covered in the literature review. On the supply-side, RBI research says food inflation has been stoked by the Mahatma Gandhi National Rural Employee Guarantee Scheme (MGNREGS), a right-to-work programme that guarantees 100 days of paid work per year in rural areas. The programme has boosted rural wages, leading to an increase in consumption of protein items such as milk and meat, according to Sonna et al. (2014). As it would be deemed unacceptable to say that rural Indians poor should eat less protein items to contain inflation, the RBI argues that food inflation raises "inflationary expectations" among the public, which could lead to a "wage-price spiral". According to Subbarao (2011):

> That monetary policy should respond if there is inflation, meaning there is sustained increase in the general price level, is beyond question. But high food prices often result from adverse supply shocks or large increases in input costs... If it (the supply shock) is permanent, then the change in relative prices caused by it can result in higher general inflation, in the first round by the higher input costs, and in the second round through the impact on inflation expectation and wage bargaining… the direct role of monetary policy in combating food price pressures is limited, but in the face of sustained high food inflation, monetary action may still be warranted to anchor inflation expectations.

The output gap in the Indian economy has been negative since the October-December quarter of 2012 according to consensus estimates, with some estimates saying that the output gap has been negative since April-June 2011 (Reserve Bank of India 2015: 24). In the presence of a sustained negative output gap, a tight monetary policy is justified as essential to keep inflation expectations unleashed by supply-side shocks in check.

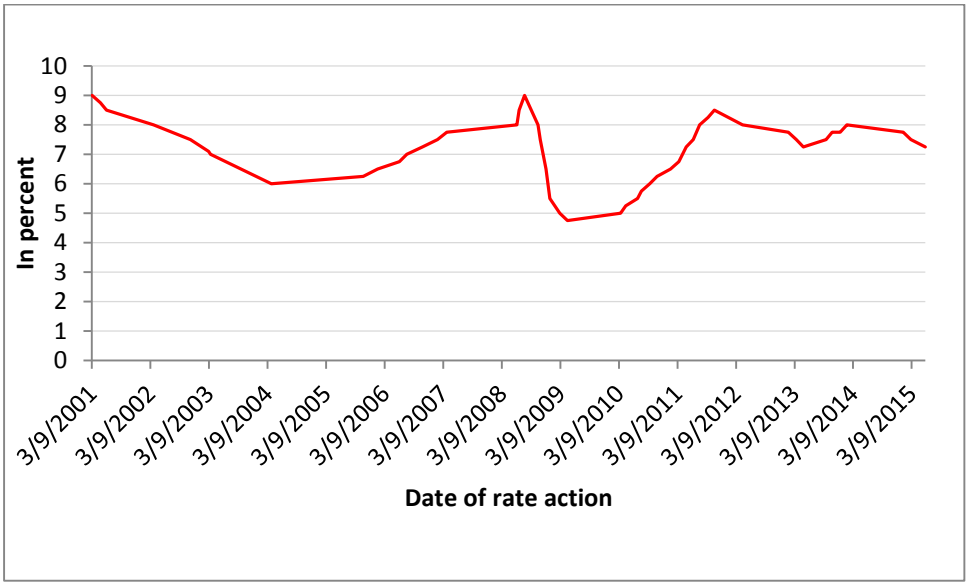
3.3 RBI's Policy Stance Over The Years

The evolution of the RBI's monetary policy over the years is set out in Mohanty (2010). Until the 1980s, the RBI relied on controlling credit for inflation-prone commodities to prevent speculation in them and also to influence their production. In 1985, a committee set up by the RBI to examine monetary policy recommended that the RBI target money supply to keep inflation under control. This was the RBI's policy until the late 1990s, although the RBI was flexible in its approach and made concessions for

feedback loops between monetary and real variables. Following the financial sector reforms of 1991, it became increasingly difficult for the RBI to meet its monetary targets. At the same time, most major central banks were abandoning monetary targeting for interest-rate targeting. In 1998, the RBI formally abandoned money-supply targeting in favour of a "multiple-indicator approach" because "the experiences with monetary targets in other countries following financial deregulation, and India's own limited success in meeting its announced targets, raised doubts about the continued usefulness of the monetary target" (Callen and Chang 1999: 4). The multiple-indicator approach entails looking at the movement of various variables, such as GDP growth, exchange rates, industrial production, while framing monetary policy, but emphasizes the interest rate channel of monetary policy. Earlier this year, the RBI formally adopted inflation-targeting, as mentioned earlier. The RBI continues to have purely monetarist tools, such as the cash reserve ratio and the statutory liquidity ratio, at its disposal, although it now claims it uses these only for liquidity management. It also conducts open market operations (OMOs) to manage liquidity in the system. However, given that all liquidity operations also influence short-term interest rates, it is difficult in practice to distinguish between liquidity and monetary operations.

The RBI's operational target is the overnight call money rate which banks charge each other in the interbank market. The call money rate moves in a corridor between the RBI's repo rate and the reverse repo rate. The repo rate is the rate at which the RBI lends funds to banks overnight against the collateral of government bonds, while the reverse repo rate is the rate at which banks park funds with the RBI. The corridor between the repo rate and the reverse repo rate is fixed at 100 basis points. How changes in short-term rates influence long-term rates and, consequently, investment and consumption decisions is beyond the scope of this paper.

Figure 4: RBI's repo rate over the years



Source: Allbankingsolutions.com http://www.allbankingsolutions.com/Banking-Tutor/Chronology-Repo-Rate-India.shtml. Accessed on 8 October 2015

RBI's Theoretical Rationale

It is unusual for central banks to spell out the theoretical framework governing their interest-rate decisions, and the RBI is no exception. However, its theoretical rationale can be gleaned from its statements. For instance, the RBI has said it considers potential output and the "threshold" level of inflation as "important variables", reliable estimates of which are "necessary for formulating the central bank reaction function in the form of Taylor type rules for setting interest rates" (Subbarao 2013). The concept of potential output has already been covered in the literature review. The Taylor rule is not an inflation equation but a central bank rate-setting rule. Taylor (1993: 202) specified it as follows:

$$r = p + 0.5y + 0.5(p-2) + 2$$

where r is the nominal rate of interest targeted by the central bank, p is the inflation rate over the past four quarters, (p-2) is the deviation of inflation from an assumed target of 2%, y is the deviation in GDP from target GDP or the output gap, while the last term on the right-hand-side of the equation is the equilibrium "real" rate, in the tradition of Wicksell's "natural" rate (Rochon 2004: 6), which is assumed to be 2% here. The coefficient on y and p-2 indicates the relative weight given to either parameter by the central bank, and the 0.5 indicates that the above equation gives equal weight to them.

Hence, setting interest rates requires three variables—the output gap, an inflation target[23] and an "equilibrium" real rate of interest. The definition of output gap is unclear in the equation, because the central bank can simultaneously target inflation and output. This is contrary to the concept of potential output as the non-accelerating-inflation level of output. In addition, supply shocks are not accounted for in the model. The implication is central banks should take a "balanced" approach to supply shocks (Asso et al. 2010: 6), which possibly means they should ignore them. On the other hand, some versions of the Taylor rule convert it into a "forward-looking" function, substituting actual inflation for inflation expectations (Clarida et al. 1999: 1696). Supply shocks could thus be incorporated through their effect on inflation expectations, which is consistent with the RBI's statement quoted above. How these supply shocks precisely affect inflation expectations is unclear.

[23] The threshold level of inflation is the level of inflation above which inflation hurts economic growth. Hence, the inflation target should ideally be close to the threshold level of inflation, if not equal to it.

Chapter 4: Analysis of Monetarist and New Keynesian Views

This section will analyse demand-pull models of inflation, distinguishing between monetarists models of inflation in which money supply or other monetary aggregates are key variables, and New Keynesian output-gap models, which do not explicitly consider money supply.

4.1 Monetarist model

As mentioned in the literature review, one of the key assumptions of monetarist theories of inflation is that the real demand for money balances should be stable. As a detailed analysis of the money demand function is beyond the scope of this paper, it will restrict its focus to the stability of the income velocity of money and the money multiplier. The velocity of money is the ratio of nominal income to money supply, according to the quantity theory of money identity M x V = P x Q or M x V = Py, where M is the money supply, V is the velocity of money and P is the price level, Q is quantity of goods produced and Py is the nominal GDP.

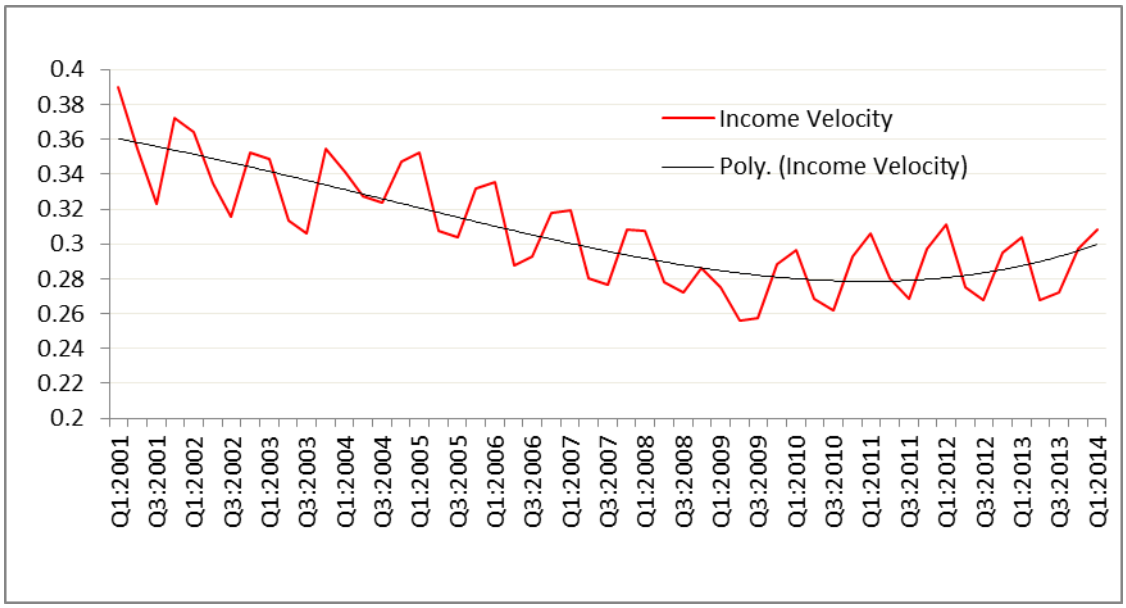
Figure 5 is a plot of income velocity money based on quarterly data from 2001 to 2014. Income velocity could differ depending on which measure of nominal GDP is used. Income velocity is calculated using expenditure-side nominal GDP as well as nominal GDP at factor cost (gross value added). The correlation coefficient between the two measures of income velocity is found to be 0.99, and hence only income velocity based on expenditure-side GDP is used. It can be seen that there is heavy seasonal component in income velocity of money as well as a long-term declining trend. A 95% confidence interval is obtained using the software package STATA 13. The results are shown in table 2.

Table 2: Descriptive statistics of Income velocity

Variable	Mean	Standard Deviation	95% CI	Minimum	Maximum
Income Velocity	0.307	.032	.298-.315	.256	.390

The results show that the mean income velocity is 0.31 and 95% of the values are located between 0.30 and 0.32. However, there are significant outliers with the minimum at 0.26 and the maximum at 0.39. In addition, a polynomial trendline plotted in figure 5 shows a declining trend between 2001 and 2010 and a slight uptick thereafter.

Figure 5: Income velocity of money



Source: RBI Handbook of Statistics on Indian Economy; Tables 174, 175
http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 30 September, 2015.

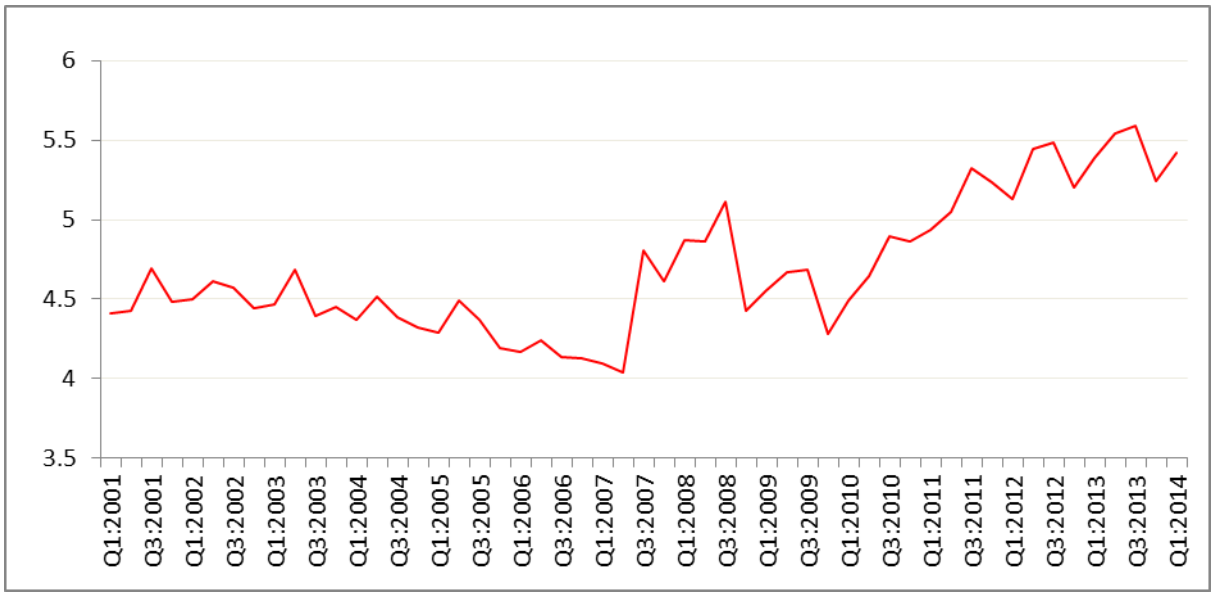
The second concept underpinning the monetarist approach is that of exogenous money supply. As seen in the literature review, this assumes that the central bank has control of base money M0 and that the money multiplier is stable. The description of how the RBI conducts its monetary policy in Chapter 3 shows that the RBI only controls the price of base money and not the amount. It doesn't set a limit on the amount of money banks can borrow from its repo window, save for exceptional circumstances. To be sure, it buys and sells government bonds on the secondary market through open market operations, which directly changes the amount of base money. However, as the RBI itself says, OMOs are its preferred tool for liquidity management, rather than for monetary policy purposes (Reserve Bank of India 2012b: 26). Hence, it cannot be said that the central bank has full control over base money or broad money.

To test the second assumption, the money multiplier, defined as the ratio between M3 and M0, is plotted. The mean value of the multiplier is 4.69 and 95% of the values lie between 4.57 and 4.81 while the minimum and maximum values are 4.04 and 4.59, respectively. The period average rises to 5.31 for 2011 onwards from 4.45 in 2001-05 and 4.53 in 2006-10.

Table 3: Descriptive statistics for money multiplier

Variable	Mean	Standard Deviation	95% CI	Minimum	Maximum
Money Multiplier	4.69	.42	4.57-4.81	4.04	5.59

Figure 6: Money multiplier



Source: RBI Handbook of Statistics on Indian Economy; Tables 174, 175
http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 30 September, 2015.

Hence, it is difficult to draw an inference about the stability of the money supply, not least because stability is an inherently subjective parameter. While large fluctuations are not seen in income velocity, it shows a declining trend for most of the period. In any case, the concept of income velocity has little use unless central banks can control the

money supply through a constant money multiplier. However, the money multiplier shows large fluctuations, as figure 6 shows.

The next step is to analyse monetarist models using regression analysis. Since regressing non-stationary variables can lead to spurious regressions, the Augmented Dicky-Fuller Test for unit roots is carried out on all the variables,[24] using four lags as the data is quarterly and including the drift term . According to the results of the test, M0 growth, real GDP growth, Excess money growth (difference between M3 growth and real GDP growth), GDP deflator, industrial inputs prices are stationary or I(0) at the 5% confidence level, while CPI inflation, WPI inflation and M3 Growth are I(1).

We test the standard monetarist model, as specified in Nicholas (1988: 20), using Ordinary Least Squares regressions.

$$P_t = a_0 + a_1 M^*_{t-1} + a_2 M^*_{t-1} + a_3 p_t^e + u_t$$

The price level is represented by the GDP deflator as the monetarist model explains the aggregate price level and not sectoral prices, as pointed out in the descriptive chapter. Price expectations are represented by one-quarter lagged inflation on the assumption that expectations are adaptive.

The results indicate that excess money growth and its lags are not statistically significant in any of the specifications. In addition, excess money growth has a negative sign in all the specifications except the last. The Durbin-Watson d-statistic for the first two specifications is significantly lower than 2, indicating a high probability of auto-regressive errors. The DW d-statistic only improves when the one-quarter GDP deflator is included in the specification.

In summary, there doesn't appear to be a link between the general price level and excess money growth in any of the regressions.

[24] Results of ADF test are provided in the Appendix.

Table 4: OLS Regression results of monetarist model

Dependent variable: GDP Deflator			
Time Period	**Full**	**Full**	**Full**
Explanatory Variables		**Coefficient**	
Excess Money Growth	-0.015091	-0.0229	-0.0599
	(0.0589)	(0.0594)	(0.0518)
L.Excess Money Growth	-0.1178	-0.0785	-0.0695
	(0.0590)	(0.0752)	(0.0647)
L2. Excess Money Growth		-0.0492	0.0451
		(0.0594)	(0.0558)
L. GDP Deflator			0.8417***
			(0.2009)
Rsquare	0.1639	0.1818	0.2747
Adjusted Rsquare	0.1298	0.1296	0.0515
Durbin-Watson statistic	0.46674	0.4334	1.2263
Standard errors in ()			
***, **, * indicate statistical significance at 5%,1% and 0.1%, respectively			

4.2 New Keynesian Model

As elaborated in the literature review, New Keynesian explanations posit the output gap and inflation expectations as the major determinants of inflation, with supply-side factors also thought to play a role in developing countries. A fairly typical representation of a basic New Keynesian output gap model is given below, from Srinivasan et al (2006: 48-49).

$$\Pi_t = \alpha(L)\,\Pi_t + \beta(L) y_t + \gamma(L) u_t + \varepsilon_t$$

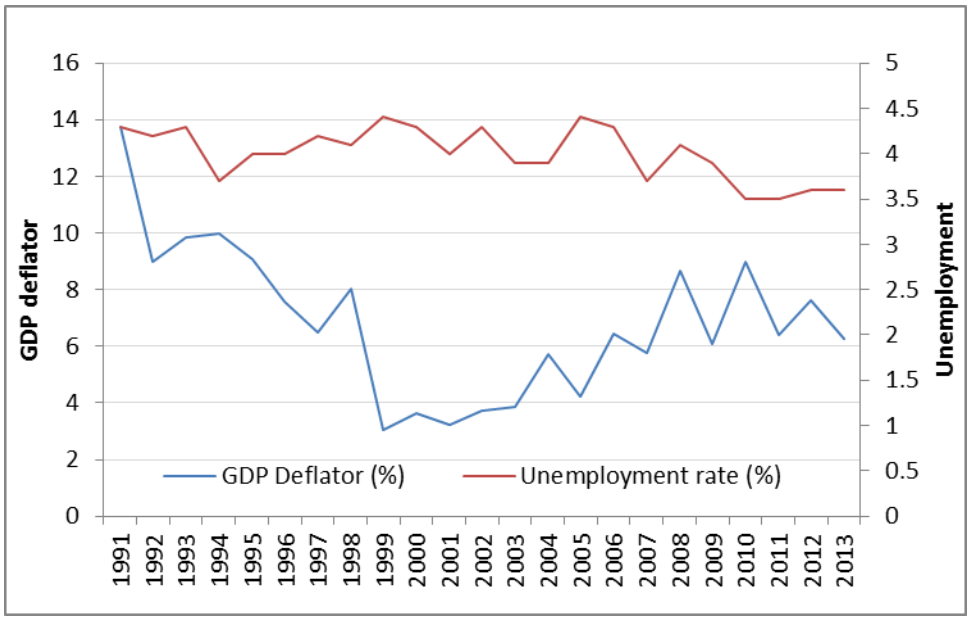
where Π_t is the rate of inflation, y_t is the output gap, u_t is a vector of supply shocks, ε_t is a normally distributed random error, and $\alpha(L)$, $\beta(L)$, and $\gamma(L)$ are coefficients of the respective lags. Depending on the model chosen, $\alpha(L)\,\Pi_t$ signifies lagged inflation/adaptive expectations or forward-looking expectations, as in the case of New Keynesian models. Before an output gap model is analysed, an analysis of the Phillips curve will be carried out.

Phillips curve

As noted in the literature review, virtually none of the literature exploring the existence of a Phillips curve in India examines a relationship between unemployment and inflation due to a paucity of reliable data. Instead, the output gap is used as a proxy for unemployment, which renders such analyses indistinguishable from New Keynesian inflation models. A detailed examination of the Phillips curve is beyond the scope of this paper. However, a rudimentary analysis based on annual data on inflation and unemployment is carried out, with the qualifier that the data is unreliable. The relationship between inflation and unemployment based on annual data from the World Bank is shown in figure 7.

The correlation coefficient between the two series for the entire period is -0.17 while for the 2001-13 sub-period it is -0.48. This indicates a negative relationship between inflation and unemployment as posited by the Phillips curve. However, a negative correlation between inflation and unemployment is not enough to prove the existence of a Phillips curve. The relationship must also be stable and determinate.

Figure 7: Relationship between inflation and unemployment



Source: World Bank Databank. Indicators: Economy & Growth, Social Protection & Labor http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG/countries. Accessed on 7 October 2015.

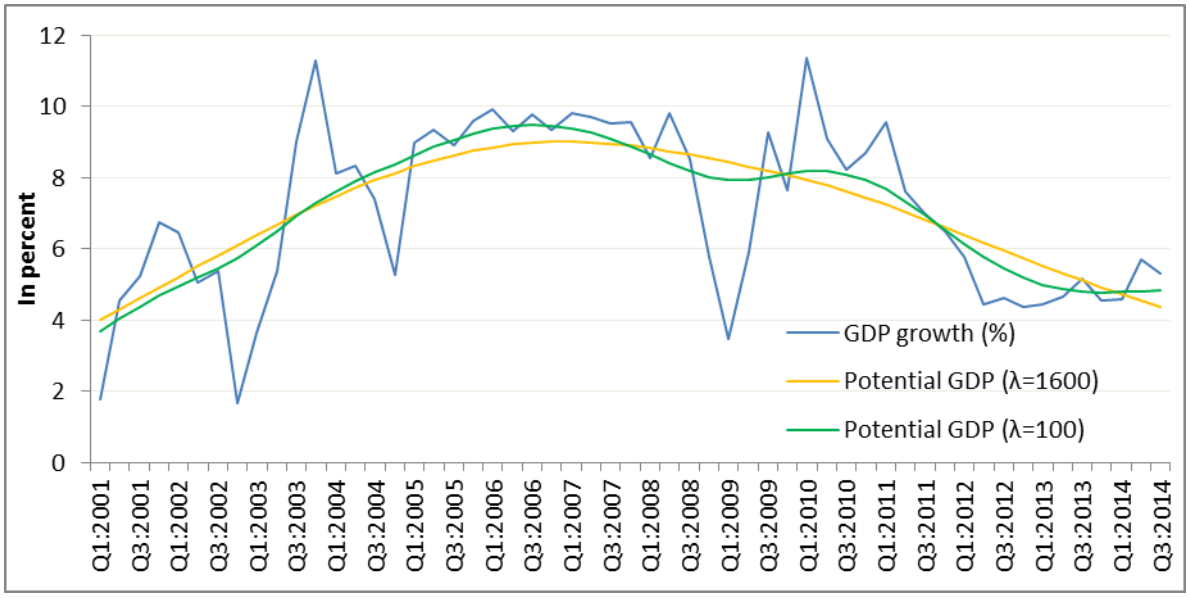
Output Gap

As we have seen in the literature review, the output gap is seen as the gap between actual output and the output tied to the natural rate of unemployment in the monetarist conception, or the output which would have been achieved had all wages and prices been perfectly flexible in the New Keynesian conception. These conceptions are analogous because they see natural output as determined by "real" factors such as technology and tastes, and not by monetary factors.

The theoretical inadequacy of the concept of potential output has already been elaborated in the literature review. It has also been pointed out that most of the literature on India measures the output gap using statistical smoothing techniques, of which the HP filter is the most popular. Statistical smoothing techniques have no theoretical basis. However, for the sake of comparison, this method of measuring the output gap is replicated here. Figure 8 shows the two measures of potential output plotted against actual real GDP. The measure of potential output is sensitive to the smoothing parameter λ . For quarterly data, Hodrick and Prescot (1997) recommend a smoothing parameter of 1,600. However, there is no theoretical basis for a specific smoothing parameter. Hence, we estimate potential GDP based on a smoothing parameter of 1,600 and 100 in STATA 13.

We next estimate a simple version of the New Keynesian output gap model stated at the beginning of the section. Both measurements of the output gap are I(0), according to the ADF test for unit roots. The output gap with $\lambda = 1{,}600$ is used for the first two specifications, while $\lambda = 100$ is used for the last specification.

Figure 8: Potential GDP vs Actual GDP



Source: RBI Handbook of Statistics on Indian Economy; Tables 164, 166
http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 1 November, 2015.

The results of the regression analysis are shown in Table 5. It is observed that output gap and lagged output gap in the basic specification (not reported in table) have virtually no explanatory power without the lagged GDP Deflator as a proxy for adaptive inflation expectations. The explanatory power of the model increases when supply factors such as one-quarter-lagged crude oil prices and one-quarter-lagged agricultural GDP growth are added to the model. The one-quarter lagged output gap becomes statistically significant at the 1% level only when supply factors are added. Lagged crude oil is statistically significant at the 0.1% level and with the expected positive sign, while lagged agricultural output growth is significant at the 5% level. The negative sign is in line with the expectation that a fall in agricultural output growth increases food inflation. The results are qualitatively similar when the output gap computed with $\lambda = 100$ is used in the last specification. Hence, we see that the output gap has little explanatory power in comparison with supply-side factors.

The result is consistent with Singh et al. (2011), who found that a relationship between the output gap and inflation emerges only when supply shocks are accounted for. However, the authors use a different filtering technique (Kalman filter) to arrive at the output gap. Paul (2009) considers supply shocks and uses a HP filter to find an

inflationary output gap, but uses industrial production data instead of GDP data and yearly data instead of quarterly data.

Table 5: OLS regression results of New Keynesian model

Dependent variable: GDP Deflator			
Time Period	**Full**	**Full**	**Full**
Explanatory Variables	**Coefficient**		
	(λ=1600)	**(λ=1600)**	**(λ=100)**
Output Gap	0.86872	0.0788	0.1209
	(2.3135)	(0.1235)	(0.1322)
L.Output Gap	-0.6509	0.4837**	0.4904**
	(2.3424)	(0.1637)	(0.1710)
L.Crude Oil		0.0326***	.0314***
		(0.0079)	(0.0079)
L.Agricultural Growth(%)		-.1408*	-.1309*
		(0.0541)	(0.0532)
L.GDP Deflator	0.8091***	0.5405***	0.5629***
	(0.0847)	(0.0950)	(0.0950)
Rsquare	0.6484	0.755	0.7514
Adjusted Rsquare	0.6273	0.7295	0.7255
Durbin-Watson statistic	1.2760	1.3206	1.3105
Standard errors in ()			
***, **, * indicate statistical significance at 5%,1% and 0.1%, respectively			
λ indicates smoothing parameter of HP filter for output gap			

4.3 Inferences from Analysis

In the monetarist approach, while the income velocity of money shows some degree of stability, the money supply fluctuates heavily. Hence, even if one were to assume that the real demand for money is stable, the key monetarist assumption that central banks can control the money supply doesn't stand up to scrutiny. In any case, the analysis of the monetarist model of inflation failed to find a positive link between excess money supply and inflation. In the New Keynesian school, the one-quarter lagged output gap became statistically significant only when supply-side factors were included. The theoretical

shortcomings of the model coupled with the lack of clear empirical evidence make it an unconvincing model to explain inflationary trends in India.

Chapter 5: Analysis of Structuralist View

This chapter will analyse the structuralist view of inflation. As seen in the literature review, the key feature of the structuralist approach is the focus on sectoral prices rather than prices at the aggregate level as the belief is that structural constraints in specific sectors, such as the agriculture sector or the import sector, are the drivers of inflation.

Among imported commodities, the variable that deserves special attention is crude oil prices, as pointed out in the literature review. According to Kazmin and Shivkumar (2011), India imports about 70% of its crude oil requirement, the demand for which is considered price inelastic[25]. Most major inflationary episodes in India in the 10 years to 2006-07 were driven either by poor agricultural output or by surging crude prices, according to Rakshit (2007).

This chapter will first analyse the hypothesis that prices are cost-determined in the industrial sector. It will then analyse whether prices are demand-determined in the agricultural sector. Our analysis is limited by the absence of data on wages in the industrial sector. The wholesale price sub-index for manufactured products is used as a gauge for industrial prices, while the wholesale price sub-index for food products is used as a measure of food prices.

Pricing in the industrial sector

While Balakrishnan's (1991) study is very elaborate, it is difficult to replicate it here because many of the variables such as manufacturing-sector wages are not available on a quarterly basis. Instead, Rakshit's (2011) approach on industrial prices and food prices is used, although he didn't specify a model.

$$\Delta p_{it} = a_0 + a_1 \Delta \text{oil}_t + a_2 \Delta \text{inputs}_t + a_3 \Delta \text{rupee}_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (5.1)$$

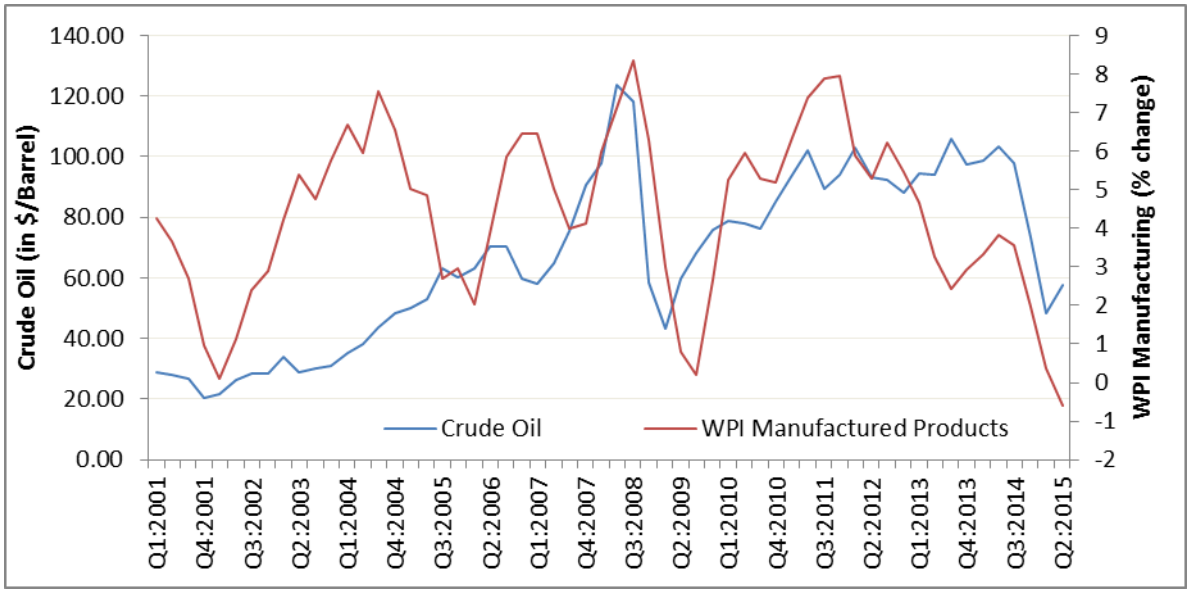
$$\Delta p_{ft} = b_0 - b_1 \Delta \text{agriculture\_ouput}_t + b_2 \Delta \text{non-agricultural\_output}_t + u_t \quad \ldots\ldots\ldots (5.2)$$

[25] The government has consistently reduced fuel subsidies over the past few years, increasing the sensitivity of domestic fuel prices to international crude oil prices.

Where Δp_{it}, Δp_{ft} are industrial prices and food prices, respectively, Δoil_t is the average quarterly price of one-month crude oil forwards traded on the New York Mercantile Exchange, $\Delta rupee$ is the year-on-year change in the value of the rupee currency against the U.S. dollar, $\Delta inputs_t$ is the year-on-year change in the quarterly values of the IMF commodity index that tracks non-crude commodity prices[26], while ε_t and u_t are error terms.

A major shortcoming of equation 5.1 is that it doesn't include manufacturing wages, which presumably account for a substantial portion of costs in the manufacturing sector. Figure 9 shows a graph of crude oil and WPI manufacturing inflation. A clear correlation can be observed between the two variables, especially during the oil price spikes of 2008 and 2011, and the oil price plunges of 2009 and 2015.

Figure 9: Relationship between crude oil and industrial prices



Source: WPI Manufactured Products: RBI Handbook of Statistics on Indian Economy; Tables 171 http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 30 September, 2015. Crude Oil: Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/DCOILWTICO. Accessed on 4 October, 2015

The next step is the regression analysis. ADF tests for unit roots show that Agricultural growth, WPI Manufacturing Inflation, crude oil prices, non-crude industrial

[26] The index includes agricultural raw materials and metal prices. Quarterly price changes are calculated by averaging monthly price. http://www.imf.org/external/np/res/commod/index.aspx

inputs prices and the first difference of the spot rupee price are I(0) at the 5% confidence level, while non-agricultural growth is I(0) at the 10% confidence level and hence can be considered as a weakly stationary series. The results of the OLS regression show that crude oil and one-quarter-lagged industrial input prices are statistically significant at the 5% and 1% level, although the absolute level of the coefficients is low. Both variables also have the expected positive sign. The first difference of the spot rupee has the unexpected (negative) sign and neither is it statistically significant. To estimate the contribution of crude oil in industrial costs, a rough calculation is carried out using India's crude oil consumption and expenditure-side GDP data. It is seen that oil consumption accounted for about 11% of GDP at constant (2011-12) prices in 2013-14 and about 9% of GDP at current prices in the same financial year. While this is an imprecise estimate at best, it is a reasonable assumption to make that oil accounts for a substantial cost for industry. Thus, industrial prices are likely driven by input costs, with the caveat that manufacturing wages were not included in the analysis.

Table 6: OLS regression results of structuralist model (industrial prices)

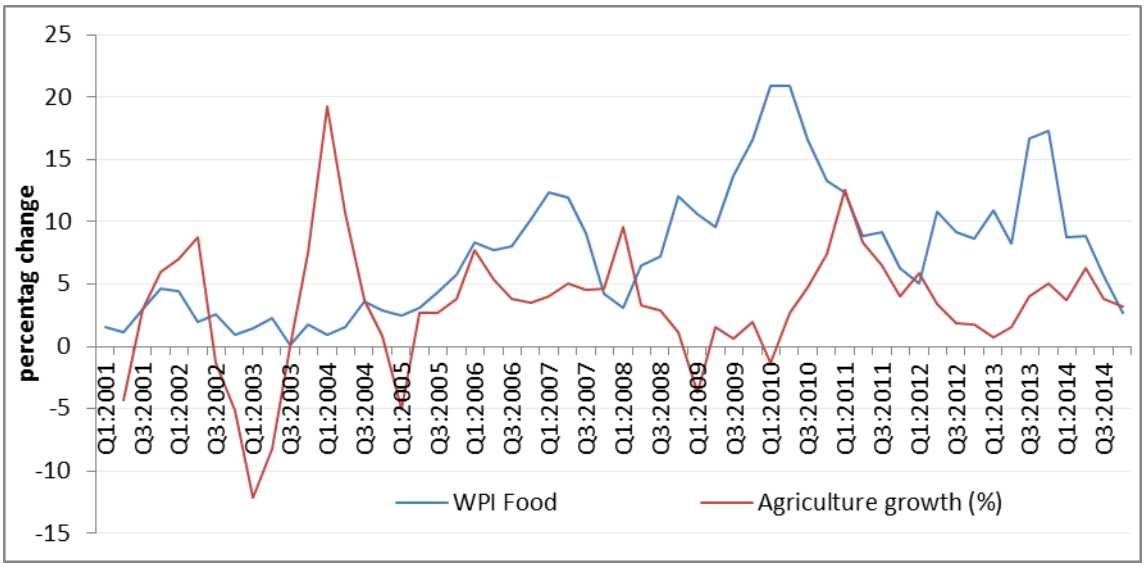
Dependent variable: WPI Manufacturing Inflation		
Time Period	**Full**	**Full**
Explanatory Variables	**Coefficient**	
Crude Oil	.01184*	.01445*
	(0.0056)	(0.0058)
L. Industrial Inputs Price	.0305***	.02520623**
	(0.0080)	(0.0081)
Spot Rupee		-0.0361
		(0.0316)
L.WPI Manufacturing	0.6961***	0.6357***
	(0.0077)	(0.0813)
Rsquare	0.7562	0.7433
Adjusted Rsquare	0.7424	0.7223
Durbin-Watson statistic	1.128244	1.203488
Standard errors in ()		
***, **, * indicate significance at 5%,1% and 0.1%, respectively		

Pricing in agricultural sector

The second part of the structuralist thesis is the view that production in the agricultural sector is supply-determined, while prices are demand determined. We also test the impact of agricultural output on agricultural prices to test the "agricultural

bottleneck" hypothesis. Figure 10 plots WPI food inflation against one-quarter-lagged agricultural GDP. It appears that the two series are negatively correlated, especially in the second half of our time period, as one would expect because a fall in the growth of agricultural output is likely to increase food prices.

Figure 10: Relationship between WPI food inflation and one-quarter lagged agriculture growth



Source: RBI Handbook of Statistics on Indian Economy. Tables 164, 166 and 171 http://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications. Accessed on 15 October, 2015.

The regression results are reported in Table 7. Various lags are tested, but for the sake of brevity, only the configurations which are the statistically significant and have a reasonable amount of explanatory power are reported. The model is kept as parsimonious as possible.

It is observed that the second lag of agricultural growth and unlagged non-agricultural growth are statistically significant in the post-crisis period and the coefficients have high absolute values and the expected signs. The cut-off between the post-crisis and pre-crisis period is the same as outlined in Chapter 3. For the full period, both coefficients have the expected signs but are not statistically significant. For the pre-crisis period, neither coefficient is statistically significant, and the coefficient for lagged agricultural growth has a positive sign, which is unexpected.

Hence, in the post-crisis period, both supply and demand appear to play a role in prices. The model is unable to explain the evolution of food prices in the pre-crisis period.

Table 7: OLS regression results of structuralist model (agricultural prices)

Dependent variable: WPI Food Inflation			
Time Period	**Full**	**Post-crisis**	**Pre-crisis**
Explanatory Variables	**Coefficient**		
L2.Ag growth	-0.0487	-.5531*	0.0156
	(0.0759)	(0.2137)	0.0611
Non-ag growth	0.2384	.7435*	0.1828
	(0.1667)	0.3055	0.1895
L.WPI Food	0.8498***	.4215*	0.8442***
	0.0720	0.1637	0.0968
Rsquare	0.7409	0.6735	0.7469
Adjusted Rsquare	0.725	0.6158	0.7198
Durbin-Watson statistic	1.7887	2.1041	1.5036
Standard errors in ()			
***, **, * indicate statistical significance at 5%,1% and 0.1%, respectively			

The second part of the hypothesis that agricultural production is supply-dependent is tough to prove empirically. However, according to Rakshit (2011: 45-46),

> Since agricultural production occurs with a time lag after producers have decided on the acreage and intensity of resource use, the *short-term* supply of agricultural goods is also largely exogenous, though speculative hoarding or dishoarding, the Food Corporation of India's (FCIs) open market operations and the government's export import policies can have some impact on supply and prices.

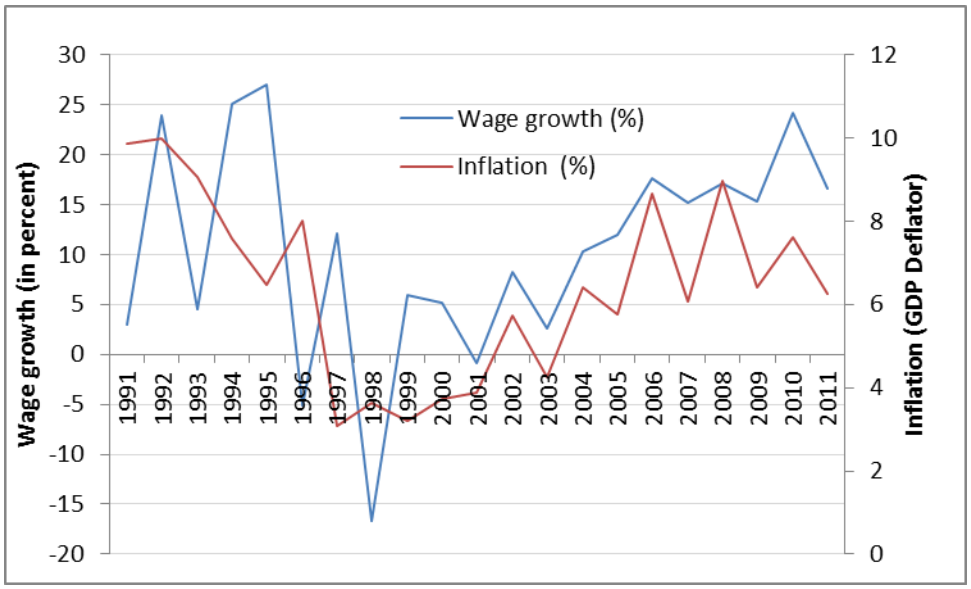
The findings for both the industrial sector and the agricultural sector are consistent with Rakshit (2011) who used quarterly data from 2006 to 2010 and found that the WPI inflation is positively correlated with crude prices and CPI inflation is negatively correlated with agricultural output. Rakshit failed to find a positive correlation between non-agricultural output and inflation, which this paper found in the post-crisis period. However, this paper failed to find a negative relationship between agricultural output and food inflation for the pre-financial crisis period.

One key limitation of this analysis is it doesn't take institutional factors and the government's food policy into account. Both these factors could have a substantial

impact on food prices and could possibly be the reason a link between agricultural production and food prices in the pre-crisis period wasn't found.

Finally, the link between manufacturing wages and inflation is examined based on annual data from 1991 to 2011. It is seen that there is a high correlation between manufacturing wages and inflation from 2001 onwards. While the correlation coefficient between the two series for the full period is 0.39, it is **0.82** for the post-2000 period. This supports the structuralist view that manufacturing wages rise in response to higher prices. However, this could also be explained from a demand-pull position that a rise in nominal wages as a result of an increase in money supply is inflationary.

Figure 11: Relationship between manufacturing wages and inflation



Source: Wage growth: RBI Handbook of Statistics on Indian Economy. Table 34. https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16475. Accessed on 1 November, 2015.
Inflation: World Bank Databank. Indicators: Economy & Growth http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG/countries. Accessed on 7 October 2015

Inferences from Analysis

The analysis shows that industrial prices appeared to be determined to a substantial extent by the cost of crude oil and other industrial input prices for the latter half of the time period chosen. The exchange rate doesn't appear to play a significant role in industrial prices. Agricultural prices are negatively correlated with agricultural output and positively correlated with non-agricultural output in the post-crisis period. This corroborates the structuralist hypothesis of cost-determined industrial prices and

demand-determined agricultural prices. However, no clear links are seen in the pre-crisis period. Both industrial and output prices are observed to be persistent, given the large and statistically significant coefficient on their lagged values.

Chapter 6: Conclusion

This paper aimed to examine the causes of inflation in India and explored a cost-push alternative to mainstream demand-pull explanations. The findings indicate that the dominant demand-pull approaches—monetarist and New Keynesian—have shaky theoretical foundations but continue to live on. If there were clear empirical evidence to support demand-pull inflation approaches, it would give them some credibility. However, this is not the case, as was shown in the paper.

The structuralist variant of the cost-push school, which was posited as the alternative, performed better than both the mainstream approaches on the empirical front. Prices in the industrial sector appear to be determined by costs, rather than by the output gap or excess money growth. In the post-crisis period, prices in the agricultural sector appeared to be influenced by supply conditions in the agricultural sector as well as demand from the non-agricultural sector. To be sure, the structuralist approach has its own shortcomings, such as the lack of an explanation for how the mark-up is determined in the industrial sector. However, it is theoretically more sound than the demand-pull approaches, not least because it takes into account the structural differences between developing and developed countries.

Ideally, monetary policy should be based on a theory of inflation, but it seems that mainstream approaches take the validity of the dominant New Keynesian monetary policy framework as a given and try to explain inflation on this basis. Hence, instead of inflation theory informing monetary policy, monetary policy appears to inform inflation theory. This reduces inflation research to a statistical exercise. For instance, it was shown that while the concept of the Phillips curve has shaky theoretical and empirical foundations, it remains popular in one or another of its many forms because aggregate-demand approaches to controlling inflation are premised on a determinate positive relationship between inflation and aggregate demand. Much of the literature examining the existence of the Phillips curve in India tests whether the output gap is the main driver of inflation. However, the concept of the output gap is itself based on the existence of a Phillips-curve-type trade-off between inflation and output.

Modern central banks pride themselves on their so-called independence from the political process and their almost exclusive focus on price stability. However, if the dominant monetary policy paradigm shapes inflation research instead of being shaped by it, it bears asking which are the factors that shape the dominant monetary policy paradigm? The answer may lie beyond the confines of mainstream macroeconomics and in the field of political economy. Political economy approaches to monetary policy and central banking have gained in popularity after the global financial crisis. Eg. Gabor (2011); Dickens (2013). Such approaches are seldom seen in the literature on developing countries such as India, possibly because developing countries haven't suffered a crisis of the magnitude of the global financial crisis, which prompted some soul-searching in rich countries and a re-examination of monetary policy rules that had enjoyed the status of received wisdom. Given the weak growth outlook, high levels of private debt and increasing signs of speculative investment bubbles in these countries, the possibility of an economic or financial crisis in coming years cannot be dismissed as unrealistic. But, whether there is a crisis or not, the political economy of central banking in the context of developing countries is an interesting area for future research given the outsized role of monetary policy in shaping economic outcomes.

An interesting observation is that the structuralist model did a better job of explaining inflation in the post-crisis period than in the pre-crisis period. This implies the possibility of a change in the institutional environment in recent years. India's move towards a more deregulated and market-oriented economy—through cutting subsidies, reducing restrictions on trade, making changes to agricultural policy—might have a large impact on inflationary trends in the country and is an interesting topic for inflation research. To be sure, mainstream authors do pay some attention to institutional factors, but their analysis is mostly limited to the influence of institutional factors on the fiscal deficit or on inflation expectations. In addition, the absence of data on wages precludes an analysis of institutional trends in the labor market.

The shortcomings of the RBI's policy approach were also highlighted in the paper. While the RBI pays lip service to supply-side factors, it still uses inflation-targeting, which is an unambiguously demand-pull approach to controlling inflation. It justifies this practice by saying that inflation expectations have to be contained in the face of supply

shocks, but doesn't explain how the supply-side shocks affect inflation expectations. In any case, the concept of inflation expectations is extremely vague and hard to quantify. Another mistake is the use of the consumer price index as an indicator of the general price level. This paper showed that the theories of demand-pull approaches explain the general price level, and not sectoral prices. In fact, some mainstream authors criticize cost-push approaches for focussing on sectoral prices instead of the general price level. Hence, it is puzzling that the inflation target is set out in terms of the consumer price index, which is dominated by food items. The RBI is essentially trying to target food prices by tweaking short-term nominal interest rates. In the same vein, the assessment of recent price trends in India need to be reconsidered. India's problem seems to be more of high food prices than of high inflation, and monetary policy might not be a suitable tool to tackle it.

References

Argy, V. (1970) 'Structural Inflation in Developing Countries'*, Oxford Economic Papers* 22(1): 73-85.

Asso, P.F., G.A. Kahn and R. Leeson (2010) 'The Taylor Rule and the Practice of Central Banking', *Federal Reserve Bank of Kansas Working Papers* RWP 10-05. Kansas City: The Federal Reserve Bank of Kansas City.

Atkeson, A. and L.E. Ohanian (2001) 'Are Phillips Curves Useful for Forecasting Inflation?'*, Federal Reserve Bank of Minneapolis Quarterly Review* 25(1): 2-11.

Azad, R. and A. Das (2015) 'Has Globalisation Flattened the Phillips Curve?'*, Economic and Political Weekly* 50(2): 42-48.

Azad, R. and A. Das (2013) 'Inflation Targeting in Developing Countries Barking Up the Wrong Tree'*, Economic and Political Weekly* 48(41): 39-45.

Balakrishnan, P. (2014) 'The Great Reversal: A Macro Story', *Economic and Political Weekly* 49(21): 29-34.

Balakrishnan, P. (1994) 'How Best to Model Inflation in India'*, Journal of Policy Modeling* 16(6): 677-683.

Balakrishnan, P. (1991) *Pricing and Inflation in India: Pulapre Balakrishnan.* New York and Delhi: Oxford University Press.

Ball, L. and S.G. Cecchetti (1988) 'Imperfect Information and Staggered Price Setting', *The American Economic Review*, 78(5): 999-1018

Ball, L. and N.G. Mankiw (2002) 'The NAIRU in Theory and Practice'*, The Journal of Economic Perspectives* 16(4): 115-136.

Basu, S. and J.G. Fernald (2009) 'What do we Know (and Not Know) about Potential Output?'*, Federal Reserve Bank of St.Louis Review* 91(4): 187-214.

Bernanke, B. (2007) 'Inflation Expectations and Inflation Forecasting'. Speech delivered at Monetary Economics Workshop of the National Bureau of Economic Research Summer Institute, Cambridge, Massachusetts (July 10). Accessed 18 September, 2015. < http://www.federalreserve.gov/newsevents/speech/bernanke20070710a.htm>

BS Reporter (2013) "WPI-CPI Divergence A Challenge to Assess Inflation Accurately" *The Business Standard.* Accessed 3 September, 2015 <http://www.business-standard.com/article/finance/wpi-cpi-divergence-a-challenge-for-rbi-to-assess-inflation-accurately-113083100001_1.html>.

Callen, T., D. Chang and D. Chang (1999) Modeling and Forecasting Inflation in India. *IMF Working Paper* WP/99/199. Washington, D.C. : The International Monetary Fund.

Canavese, A.J. (1982) 'The Structuralist Explanation in the Theory of Inflation'*, World Development* 10(7): 523-529.

Clarida, R., J. Galí and M. Gertler (1999) 'The Science of Monetary Policy: A New Keynesian Perspective'*, Journal of Economic Literature* 37(4): 1661-1707.

Congdon, T. (2008) 'Two Concepts of the Output Gap'*, World Economics* 9(1): 147-175.

Cristadoro, R. and G. Veronese (2011) 'Monetary Policy in India: Is Something Amiss?'*, Indian Growth and Development Review* 4(2): 166-192.

Debabrata Patra, M. and P. Ray (2010) 'Inflation Expectations and Monetary Policy in India: An Empirical Exploration', *IMF Working Paper* WP 10/84. Washington, D.C. : The International Monetary Fund.

Dickens, E. (2013) 'The Political Economy of U.S. Monetary Policy: How the Federal Reserve Gained Control and Uses It', *International Journal of Political Economy*, 42(3): 24-43.

Fitzgerald, V. (2004) *Monetary Models and Inflation Targeting in Emerging Market Economies.* Vol. Nr. 189. Oxford: Department of Economics, University of Oxford.

Forder, J. (2010) *The L-Shaped Aggregate Supply Curve and the Future of Macroeconomics.* Vol. No. 486. Oxford: Department of Economics, University of Oxford.

Friedman, M. 1968, 'The Role of Monetary Policy', *The American Economic Review*, 58(1): 1-17

Frisch, H. (1983) *Theories of Inflation: Helmut Frisch.* Cambridge: Cambridge University Press.

Gabor, D. 2011, *Central banking and financialization: a Romanian account of how Eastern Europe became subprime.* Basingstoke: Palmgrave Macmillan.

Ghatak, S. (1995) *Monetary Economics in Developing Countries.* (2nd edn) Basingstoke and New York: McMillan.

Gibbs, D. (1995) 'Potential Output: Concepts and Measurement'*, Labour Market Bulletin* 1: 72-115.

Goodfriend, M. and R.G. King (1997) 'The New Neoclassical Synthesis and the Role of Monetary Policy'*, NBER Macroeconomics Annual* 12: 231-283.

Gordon, R.J. (2011) 'The History of the Phillips Curve: Consensus and Bifurcation'*, Economica* 78(309): 10-50.

Hagger, A.J. (1977) *Inflation: Theory and Policy,* London: The MacMillan Press,

Hagger, A.J. (1964) *The Theory of Inflation: A Review*, London: Melbourne University.

Hodrick, R. J., and E. C. Prescott (1997) 'Postwar U.S. business cycles: An empirical investigatio', *Journal of Money, Credit, and Banking* 29: 1–16.

Humphrey, T.M. (1998) 'Historical Origins of the Cost-Push Fallacy', *Federal Reserve Bank of Richmond Economic Quarterly*, 84(3): 53-74.

Jahan, S. and A.S. Mahmud (2013) 'What is the Output Gap?', *Finance & Development* 50(3): 38.

Kapur, M. (2013) 'Revisiting the Phillips Curve for India and Inflation Forecasting', *Journal of Asian Economics* 25: 17-27.

Kapur, M. and R. Mohan (2014) 'India's Recent Macroeconomic Performance: An Assessment and Way Forward', *IMF Working Papers* 14(68). Washington, D.C.: The International Monetary Fund.

Kazmin, A. and G. Shivakumar (2011) 'Oil Price Rise Fuels India's Inflation Woe', *FT.com.* Accessed on 4 August, 2015 <http://www.ft.com/cms/s/0/eb3c344c-8090-11e0-adca-00144feabdc0.html>.

Khundrakpam, J.K. and S. Pattanaik (2010) 'Fiscal Stimulus and Potential Inflationary Risks: An Empirical Assessment of Fiscal Deficit and Inflation Relationship in India', *Journal of Economic Integration* 25(4): 703-721.

Kumar, M.M. and P. D.C.Vashist (2012) 'An Empirical Study Of Phillips Curve In India', *International Journal of Economics and Research* 3(4): 10-25.

Mazumder, S. (2011) 'The Stability of the Phillips Curve in India: Does the Lucas Critique Apply?', *Journal of Asian Economics* 22(6): 528-539.

McLeay, M., A. Radia and R. Thomas (2014) 'Money Creation in the Modern Economy', *Bank of England Quarterly Bulletin* 54(1): 1-14.

Ministry of Commerce and Industry, Government of India (2015) 'Index Numbers For Wholesale Price in India'. (press release, 14 October). <http://www.eaindustry.nic.in/cmonthly.pdftp://mospi.nic.in/Mospi_New/upload/manual_cpi_2010.pdf>

Ministry of Finance, Government of India and RBI (2015) 'Agreement on Monetary Policy Framework'. (press release, 28 February) http://finmin.nic.in/reports/MPFAgreement28022015.pdf

Ministry of Statistics and Programme Implementation, Government of India (2010) 'Manual on Consumer Price Index 2010'. (press release, 24 December). <http://mospi.nic.in/Mospi_New/upload/manual_cpi_2010.pdf>

Mishkin, F.S. (2007) 'Estimating Potential Output'. Speech delivered at the Conference on Price Measurement for Monetary Policy, Federal Reserve Bank of Dallas, Dallas, Texas (May 24). Accessed on September 7, 2015. <http://www.federalreserve.gov/newsevents/speech/mishkin20070524a.htm>

Mishra, P. and D. Roy (2012) 'Explaining Inflation in India: The Role of Food Prices', in S. Shah, B. Bosworth and A. Panagriya (eds) *India Policy Forum 2011-12,* Vol. 8. pp. 139.

Mitra, A.K. and Abhilasha (2012) 'Determinants of Liquidity and the Relationship between Money and Liquidity: A Primer'*, Reserve Bank of India Working Paper Series* 18. Mumbai: The Reserve Bank of India.

Mohanty, D. (2010) 'Monetary Policy Framework in India: Experience with Multiple-Indicators Approach'. Speech delivered at the Conference of the Orissa Economic Association, Baripada, Orissa (21 February). Accessed on 3 October, 2015. <https://www.rbi.org.in/scripts/BS_SpeechesView.aspx?Id=481>.

Mohanty, D. and J. John (2015) 'Determinants of Inflation in India'*, Journal of Asian Economics* 36: 86-96.

Nagaraj, R. (2013) 'India's Dream Run, 2003-08: Understanding the Boom and its Aftermath'*, Economic and Political Weekly* 48(20): 39-51.

Nam, R. and Kumar, M. (2015) 'India Sets Inflation Target in Monetary Policy Overhaul' *Reuters News.* Accessed on 3 September, 2015. <http://in.reuters.com/article/2015/03/02/india-rbi-idINKBN0LY0B320150302>

Nelson, E. and A.J. Schwartz (2008) 'The Impact of Milton Friedman on Modern Monetary Economics: Setting the Record Straight on Paul Krugman's "Who was Milton Friedman?"'*, Journal of Monetary Economics* 55(4): 835-856.

Nicholas, H. (1988) *Inflation in Sri Lanka 1971-87: A Preliminary Study.* Colombo, Sri Lanka: University of Colombo.

Paul, B.P. (2009) 'In Search of the Phillips Curve for India'*, Journal of Asian Economics* 20(4): 479-488.

Prasad, E. and I. Sorkin (2009) 'Assessing the G-20 Economic Stimulus Plans: A Deeper Look', Brooking Institution Article. Accessed on 12 August, 2015. <http://www.brookings.edu/research/articles/2009/03/g20-stimulus-prasad>

Press Trust of India (2015) 'Chidambaram Blames High Inflation for UPA's Defeat in Elections' *The Hindu Business Line*. Accessed on 8 October, 2015. http://www.thehindu.com/news/national/chidambaram-blames-high-inflation-for-upas-defeat-in-elections/article6971755.ece

Rakshit, M. (2007) 'Inflation in a developing economy theory and policy', *Money & Finance*, *3*(2): 89-138.

Rakshit, M. (2011) 'Inflation and Relative Prices in India 2006-10: Some Analytical and Policy Issues'*, Economic and Political Weekly* 46(16): 41-54.

Ranjan, R., R. Jain and S.C. Dhal (2007) 'India's Potential Economic Growth: Measurement Issues and Policy Implications'*, Economic and Political Weekly* 42(17): 1563-1572.

Reserve Bank of India (2015) 'RBI Monetary Policy Report - September 2015'. Mumbai. Accessed on 18 October, 2015. <https://rbi.org.in/Scripts/PublicationsView.aspx?id=16691>

Reserve Bank of India (2012a) 'RBI Annual Report 2011-12'. Mumbai. Accessed on 24 October, 2015. <https://www.rbi.org.in/scripts/AnnualReportPublications.aspx?year=2012>

Reserve Bank of India (2012b) 'RBI Third-Quarter Macroeconomic and Monetary Developments Third Quarter Review 2011-12'. Mumbai. Accessed on 7 September, 2015. <https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/M2D210112FL.pdf>

Rochon, L. (2004) 'Wicksell After the Taylor Rule: A Post-Keynesian Critique of the Taylor Rule'*, Laurentian University, mimeografiado* .

Saad-Filho, A. (2000) 'Inflation Theory: A Critical Literature Review and a New Research Agenda', in Zarembka, P. (ed) *Value, Capitalist Dynamics and Money*, pp. 335-362. Bingley, U.K.: Emerald Group Publishing.

Sahu, J.P. (2013) 'Inflation Dynamics in India: A Hybrid New Keynesian Phillips Curve Approach'*, Economics Bulletin* 33(4): 2634-2647.

Sargent, T.J. and N. Wallace (1984) 'Some Unpleasant Monetarist Arithmetic', *Federal Reserve Bank of Minneapolis Quarterly Review* 5(3): 1-17.

Sasmal, J. (2015) 'Food Price Inflation in India: The Growing Economy with Sluggish Agriculture'*, Journal of Economics, Finance and Administrative Science* 20(38): 30-40.

Sims, C.A. (2009) *Inflation Expectations, Uncertainty and Monetary Policy*. Vol. No. 275. Basel: Bank for International Settlements, Monetary and Economic Department.

Sincavage, J.R., C. Haub and O.P. Sharma (2010) 'Labor Costs in India's Organized Manufacturing Sector'*, Monthly Labor Review* 133(5): 3-22.

Singh, B.K., A. Kanakaraj and T.O. Sridevi (2011) 'Revisiting the Empirical Existence of the Phillips Curve for India', *Journal of Asian Economics* 22(3): 247-258.

Singh, P. and M.K. Pandey (2010) 'Financial Innovation and Stability of Money Demand Function in Post-Reform Period in India', *Economics Bulletin* 30(4): 2895-2905.

Sonna, T., H. Joshi, A. Sebastin and U. Sharma (2014) 'Analytics of Food Inflation in India', *RBI Working Paper Series* WPS (DEPR): 10/2014(6174). Mumbai: The Reserve Bank of India.

Srinivasan, N., V. Mahambare and M. Ramachandran (2006) 'Modelling Inflation in India: A Critique of the Structuralist Approach', *Journal of Quantitative Economics, New Series* 4(2): 45-58.

Srinivasan, T.N. (2008) 'Price Indices and Inflation Rates', *Economic and Political Weekly* 43(26/27): 217-223.

Subbarao, D. (2013) 'Statistics in RBI's Policy-Making: Conceptual and Empirical Issues'. Speech delivered at RBI's 7th Statistics Day Conference, Mumbai (August 30, 2013).

Subbarao, D. (2011) 'The Challenge of Food Inflation'. Speech delivered at 25th Annual Conference of the Indian Society of Agriculturual Marketing at Hyderabad, India (November 22)< https://www.rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=12760>

Svensson, L.E.O. (2010) 'Inflation Targeting', *NBER Working Paper Series* 16654. Cambridge, Massachusetts: The National Bureau of Economic Research

Taylor, J.B. (2000) 'Teaching Modern Macroeconomics at the Principles Level', *The American Economic Review* 90(2): 90-94.

Taylor, J.B. (1993) 'Discretion Versus Policy Rules in Practice', *Carnegie-Rochester Conference Series on Public Policy* 39(1): 195-214.

Vernengo, M. (2007) 'Money and Inflation', in P. Arestis and M. Sawyer (eds) *A Handbook of Alternative Monetary Economics,* pp. 471-489. Cheltenham, U.K. and Northampton, Massachusetts: Edward Elgar Publishing.

S. Williamson (2012) 'HP Filters and Potential Output' Stephen Williamson: New Monetarist Economics. Accessed 16th October, 2015 <http://newmonetarism.blogspot.nl/2012/07/hp-filters-and-potential-output.html>.

Woodford, M. (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton and Oxford: Princeton University Press

Woodford, M. (2008) 'How Important is Money in the Conduct of Monetary Policy?', *Journal of Money, Credit and Banking* 40(8): 1561-1598.

Wray, L.R. (2001) 'Money and Inflation', in R.P.F. Holt and S. Pressman (eds) *A New Guide to Post Keynesian Economics,* pp. 79-91. London and New York: Routledge.

Appendices

Appendix A: Augmented Dicky-Fuller Test for Unit Root

(Null Hypothesis is Unit Root is present)

	Test Statistic	5% Critical Value	p-value	Outcome: 5% Significance
WPI Inflation (%)	-1.0640	-1.6780	0.1464	Do not Reject
CPI Inflation (%)	-1.2620	-1.6780	0.1065	Do not Reject
GDP/GVA Deflator (%)	-2.4960	-1.6750	0.0079	Reject
M3 Growth (%)	-0.8110	-1.6820	0.2110	Do not Reject
M0 Growth (%)	-2.9400	-1.6820	0.0027	Reject
GDP Growth (%)	-1.6940	-1.6800	0.0487	Reject
d.WPI Inflation (%)	-3.8930	-1.6790	0.0002	Reject
d. CPI Inflation (%)	-2.9000	-1.6790	0.0029	Reject
d. M3 Growth (%)	-4.2290	-1.6830	0.0001	Reject
WPI Manufacturing (%)	-1.8090	-1.6780	0.0384	Reject
WPI Food (%)	-1.4870	-1.6780	0.0719	Reject*
Crude Oil	-1.8220	-1.6780	0.0374	Reject
Rupee	0.2730	-1.6800	0.6069	Do not Reject
d.Rupee	-2.6480	-1.6810	0.0056	Reject
Agricultural Growth (%)	-2.7830	-1.6800	0.0040	Reject
Excess Money Growth (%)	-3.4140	-1.6820	0.0007	Reject
Industrial Inputs (%)	-1.8930	-1.6990	0.0342	Reject
Output Gap (λ=1600)	-3.6000	-1.6800	0.0004	Reject
Output Gap (λ=100)	-4.4250	-1.6800	0.0000	Reject
Non-agricultrual growth (%)	-1.3570	-1.6800	0.0908	Reject*
All tests carried out at 4 lags as data is quarterly and including drift term				
*Rejected at 10% significance level				

Appendix B

The Durbin-Watson test is a post-estimation test that checks for auto-correlation of error terms. The null hypothesis is that there is no auto correlation. A value of 2 for the Durbin-Watson test indicates very little possibility of autocorrelation. dL and dU specify the lower and upper limits of the d-value for positive autocorrelation. If the d-value is less than dL, the null hypothesis is rejected, and if it is greater than dU, it is accepted. The band between dL and dU is referred to as the zone of indecision. dL and dU values change depending on the number of regressors and the number of observations in the estimating equation. The following table is from Savin and White (1977).

Durbin Watson Table of Significance (1% Level) for Positive Autocorrelation			
No. of regressors	**No. Of observations**	**dL**	**dU**
2	50	1.285	1.445
3	50	1.245	1.491
4	50	1.206	1.537
5	50	1.164	1.587
2	55	1.32	1.466
3	55	1.284	1.505
4	55	1.246	1.548
5	55	1.209	1.592
2	23	0.938	1.29
3	23	0.858	1.407
4	23	0.777	1.535
5	23	0.699	1.674