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# Propagation Mechanisms in Inflation: Governance as key

June 2012

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## Abstract

Resurgence in Indian inflation since 2007 was associated with sharp food and oil price inflation. Propagation mechanisms that allow these relative prices to affect aggregate prices include governance failures, the effect of food prices on wages, exchange rates on costs and the response to cost shocks in firm price-setting. The paper analyzes these mechanisms. Supply shocks took the form of upward shifts of an aggregate supply elastic in the sense costs did not rise with output. First round effects have to be allowed since of asymmetric price adjustment. Estimations show it was multiple supply shocks rather than persistent second round price effects that caused inflation. Output remained below potential. In such a structure, the best policies are those that reduce average production costs. Policy induced demand tightening to anchor inflationary expectations and prevent a wage-price spiral that could shift up costs imposed a large output sacrifice. Policy contraction generally exceeded the fall in output. A large negative demand impulse over 2010-12 constrained growth more than inflation. The analysis provides a new understanding of how supply constraints affect the economy.

*Keywords*: inflation, propagation, aggregate supply, relative price shocks, governance

*JEL codes*: E31, E52, E62, O23

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## Introduction

After an initial jump, the post-reform period saw inflation fall to unprecedented lows. The resurgence of inflation since 2007 was associated with sharp food and oil price inflation. Food and oil prices are relative prices, but propagation mechanisms allow these to affect aggregate prices. Governance failures broadly defined as dysfunctional systems that create poor incentives, or narrowly defined as inappropriate government policies are responsible for many of these propagation mechanisms[1]. Firm price-setting, the response to cost shocks, and the relationship between wages, prices and the exchange rate are important dimensions of the inflationary process. In an open economy border prices impact domestic prices. Policies are inappropriate also to the extent they are not based upon these relationships.

This paper analyzes these understudied issues, including the contribution of demand and supply shocks to inflation, the policy response, and the growth inflation tradeoff. Recent high and persistent consumer price inflation may have been due to multiple supply shocks, so inflation may come down as the commodity cycle turns. Estimations of aggregate supply show average price increase to be 10 percent and decrease only 5 percent—so 5 percent inflation is required to accommodate relative price increase. This is an example of a propagation mechanism. Half of Indian firms reset their prices in any period, and a little more than half are forward looking in their price setting. Cost shocks have a larger impact on price compared to demand proxied by changes in money supply. Price inertia reduces the size of monetary tightening required. A sharp rise in interest and exchange rate is a negative for highly leveraged firms.

Some relative prices, such as food prices and the exchange rate, have a greater impact on aggregate prices—requiring a prompt policy response, using a mixture of supply-side, tax, trade and the exchange rate policies. Multiple supply shocks are estimated to have caused inflation, but since they did not become persistent, second round price effects did not set in. So output remained below potential. Since prices rise more easily than they fall, a first round price increase following a supply shock has to be allowed. Supply shocks took the form of upward shifts of elastic aggregate supply—they did not reduce a fixed capacity. Average costs rose, not marginal

[1]International agencies define governance broadly as accountability, stability, effectiveness, rule of law and regulation. The World Bank has focused on these issues.

costs that rise with output. Poor governance contributed to chronic cost creep at all levels of output.

With such a structure, policy induced demand tightening can anchor inflationary expectations and prevent a wage-price spiral that shifts up costs, but at a large output sacrifice. This growth sacrifice was large during past supply-shocks. Policy contraction generally exceeded the fall in output. Monetary and fiscal policy tend to expand and to contract together. There was a large negative demand impulse over 2010-12, but the impact constrained growth more than inflation. Credit grew at less than GDP ever since the global financial crisis

The best policies are those that reduce average production costs. If propagation mechanisms can be reformed, so demand can support an elastic aggregate supply, growth sacrifice as well as inflation can fall. The analysis provides a new understanding of how supply constraints affect the economy.

**Size and persistence**

Indian consumer price index (CPI) and wholesale price index (WPI) based inflation (Figure 1a) show sustained divergence over 2008-10.The CPI was high and persistent, while WPI and its components such as fuel and manufactured products were more volatile (Figure 1b). The divergence can be explained by the larger share of food (48.5 percent) in the CPI and fuel (15 percent) in the WPI. Just as food prices rose fuel prices crashed in July 2008. That, the slowdown following the monetary tightening of the summer, and the global financial crisis (GFC) that set in from the autumn, explain the negative WPI inflation in early 2009. But continuing high food prices and a quick recovery in oil prices led to the sharp resurgence of WPI inflation in early 2010 although demand, as reflected in credit uptake[2], remained low. Figure 1b, which shows the momentum or 3-month moving average of inflation in WPI components, suggests WPI manufacturing follows fluctuations in food and fuel. Figure 1c which graphs WPI non-food

[2]Indian policy also used effective counter-cyclical prudential regulations to damp bubbles in real estate, even as excess international liquidity creation was driving up asset and commodity prices.

manufacturing, the RBI's measure of core or demand driven inflation, with CPI food inflation, also shows the persistence of the latter pulling up the former.

Panel of Figure 1(a) to 1(d) here

The large exchange rate depreciation in 2008-09 (Figure 1d) may have contributed to the momentum in food prices, since the border prices of food affect the minimum support price, and food articles are now traded goods (Goyal, 2010). There was also more pass-through of international oil price changes to domestic prices, since many categories of the latter are now market determined. Only diesel, kerosene and gas prices continue to be administered. When the rupee depreciation and dollar crude prices rise happens together, as in 2008-09 and 2011, WPI manufacturing rises. Deeper analysis has brought out the causality between these components of inflation (Box 1).

Commodity price driven inflation is not normally persistent. But food inflation remained at above double digits for a longer period than it ever had in the past. This may have been a coincidence since international food prices peaked in 2007 and agricultural growth in the poor rainfall years of 2008-09 and 2009-10 was only 0.1 and 1 percent respectively. But it may also indicate structural inadequacies in the agricultural supply response required as dietary patterns changed with rising per capita incomes (Gokarn 2011). Restrictions on movement and marketing of agricultural goods were an example of poor governance vitiating price signals and the supply response.

Food inflation did soften following the good harvest of 2010-11, although it remained high in protein items and was volatile in vegetables. But time series tests [3]also do not show persistence, so it is possible Indian inflation can come down to the early 2000 levels. There is normally a commodity cycle: many years of soft prices follow sustained high prices as supply expands. There are signs of this happening in oil prices, so higher demand from China and India is not altering the commodity cycle.

[3]Bicchal et al. (2013) in a careful study of different measures of core inflation find persistence based measures to be among the worst performers as measures of core. The trend HP filter, heavily influenced by end points of the data, is one of the best.

**Propagation mechanisms: Food prices, wages, exchange rates and aggregate prices**

Mainstream economists are unwilling to accept that a relative price change can affect aggregate prices. So the initial rise in high food price inflation in India in 2007 was dismissed as a passing relative price adjustment even when it had persisted for two-three years. To argue relative prices cannot affect inflation assumes perfectly clearing markets and flexible prices and wages. Then a fall in one price balances a rise in another with no effect on the aggregate price level.

But there are a number of propagation mechanisms that allow relative prices to affect the aggregate price level. First, relative price shocks can raise the price level if price increases exceed price decreases. Aggregate price depends on the distribution of relative price changes—the level rises when the distribution is skewed to the right. Tripathi and Goyal (2011) provide evidence that price increase exceeds decrease in India and show distribution based measures of supply shocks perform better than traditional measures, such as prices of energy and food. Real world markets do not work in textbook frictionless fashion. Administered prices also prevent fall in prices—this is part of governance failure.

Second, some relative prices, among them food prices and the exchange rate, have more of an impact on aggregate prices. Food prices are critical for Indian inflation, given the large share of food in the typical consumption basket. Sustained high food inflation has a second round impact on wages and therefore the general level of prices[4]. Since both prices and wages rise more easily than they fall, a rise in a key price can raise wages and therefore other prices, becoming inflation (Box 1).

**Box 1: Causality between consumer and wholesale prices**

Consumer prices are a weighted average of the prices of domestic and of imported consumption goods, and producer prices feed into final consumer prices, so wholesale price inflation (WPII) should cause consumer price inflation (CPII). But if average wages respond to food prices, costs rise. If producer prices are set as a mark-up on wage costs, the mark-up depends on demand

[4]GOI (2012, ch. 4, pp 78) studies wage adjustment in textiles. While wages generally adjust with a lag, there was sharp over-correction in the peak food inflation years of 2007 and 2008.

pressures, and wages depend on consumer prices, then domestic price inflation is a function of consumer prices through this aggregate supply (AS) link. So causality should run from CPII, for which food is the dominant component, to WPII. There is stronger evidence that CPII and food price inflation Granger causes wholesale price inflation (in the sense that past values of the first explain the second) when controls are used for other macroeconomic variables affecting the indices. That exchange rate depreciation Granger causes CPI food inflation also supports the identity. There is evidence of longer-term convergence between domestic and international prices in the major foodgrains.

Moreover, there should exist a long-term equilibrium relationship between consumer and wholesale price inflation and the exchange rate, and also through the AS function. The two long run (cointegrating) relationships are found to hold. They are:

$$WPI_{t-1} - 1.127CPI_{t-1} - 1.045IIP_{t-1} - 1.003OIL_{t-1} - 0.838ER_{t-1}$$

$$CPI_{t-1} - 1.501WPI_{t-1} - 0.029ER_{t-1}$$

The first, which is the AS, implies that WPI rises with CPI, IIP, oil prices and the exchange rate. The second, which is the identity, implies that CPI is the sum of WPI and exchange rate. In estimating the adjustment to equilibrium for the CPI equation only the second CPI identity was significant, while for WPI the cointegrating equation derived from AS equation was significant. So adjustment equations are written for only the CPI and WPI variables in matrix form below, with t-values in brackets.

$$\begin{bmatrix} \Delta CPI_t \\ \Delta WPI_t \\ \Delta IIP_t \\ \Delta OIL_t \\ \Delta ER_t \end{bmatrix} = \begin{bmatrix} -0.044(3.354) & -0.004(-0.686) \\ 0.015(-1.019) & -0.39(3.395) \\ \vdots & \vdots \end{bmatrix} \begin{bmatrix} CPI_{t-1} - 1.501WPI_{t-1} - 0.029ER_{t-1} \\ (NA) \quad (-6.549) \quad (-2.362) \\ -1.13CPI_{t-1} + WPI_{t-1} - 1.045IIP_{t-1} - 1.003OIL_{t-1} - 0.838ER_{t-1} \\ (-6.815) \quad (NA) \quad (-2.823) \quad (-7.029) \quad (-4.963) \end{bmatrix} +$$

$$\begin{bmatrix} -0.220(-2.118) \\ 0.211(2.589) \\ \vdots \end{bmatrix} + \begin{bmatrix} 0.379 & 0.349 & 0.022 & 0.002 & 0.014 \\ (3.79) & (-4.15) & (2.268) & (0.372) & (0.712) \\ 0.319 & 0.069 & 0.023 & 0.031 & 0.014 \\ (6.074) & (4.790) & (1.759) & (2.793) & (1.587) \\ \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix} \begin{bmatrix} \Delta CPI_{t-1} \\ \Delta WPI_{t-1} \\ \Delta IIP_{t-1} \\ \Delta OIL_{t-1} \\ \Delta ER_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \end{bmatrix}$$

Differential shocks on the two series, together with, slow long and short-run convergence explain their recent sustained divergence. While OIL is not significant in the short run for CPI adjustment (ΔCPI), for ΔWPI, OIL, ER (exchange rate) and IIP (index of industrial production) came out to be strongly significant. Food price inflation is also cointegrated with manufacturing inflation.

Output is found to be below capacity. There is no evidence of a structural break in the time series on inflation, and there is no substantial change in the relationships in sub-periods. Reform seems to have barely touched the deeper structural factors affecting the Indian inflationary process. In Goyal's (2008) estimates of NKE aggregate demand and supply curves for India also, lagged CPI inflation affects WPI inflation. Expected future CPI values significantly affect CPI inflation, but WPI inflation is backward looking.

Source: Goyal and Tripathi (2011)

…

Third, CPII pulled up the WPII partly through a new propagation mechanism. It demonstrated poor governance since the second round effect of policies was not understood. India's large rural population had kept unskilled wages at subsistence. But the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) employment insurance schemes raised subsistence wages above productivity. States competed with each other in raising minimum wages since the Centre was footing the bill[5]. For the first time, minimum wages were actually implemented. This is a good thing. But the demand for all types of agricultural produce rose, and productivity did not rise in step. MGNREGA's record in creating assets is poor as is that in infrastructure improvements. Persistent inflation, even with growth below potential can be explained if a trend rise in wages exceeds that in agricultural productivity (Goyal 2010). Supply chain inefficiencies meant the high prices consumers were paying were not reaching farmers and motivating a supply response.

[5]Regressing State wage and average State wage inflation in recent years on macroeconomic variables gave positive and highly significant values for WPI (food) inflation and exchange rate depreciation.

The exchange rate affects inflation since international food inflation now influences domestic. Moreover, India imports many intermediate goods, including oil, so currency depreciation adds to general costs and prices. Since imported costs enter the price level, a higher real wage requires a more appreciated real exchange rate. Rising real wages require a more appreciated real exchange rate. But if a policy of nominal depreciation is followed to encourage exports (for example, if inflows are inadequate to finance a current account deficit), a painful and prolonged rise in nominal wages and prices, can occur. A rise in one pushes up the other to form the fourth propagation mechanism (Goyal, 2010). Since the exchange rate affects the political economy of food prices and wages, its contribution to inflation is broader than just from goods or commodity price pass through.

Sri Lanka and Bangladesh avoided much exchange rate depreciation during the global crisis. They were the only South Asian countries whose CPI inflation dropped to low single digits by 2009. A strategic nominal depreciation can also abort the pass through of a temporary rise in foreign prices—such as an oil price shock. In India, after depreciation immediately following the crisis in 2008 inflows were allowed to determine the exchange rate. They resumed soon and were about equal to the current account deficit (CAD), so intervention in FX markets was negligible. The depreciation reversed. But at strategic periods when inflation showed signs of softening, there were outflows, due to global issues, such as the Euro debt crisis—and therefore unrelated to the domestic cycle. Periodic depreciation prevented the softening of inflation. Expectations of high inflation firmed up. The nation's exchange rate policy was unable to smooth shocks in another failure in terms of the second definition of governance. Another set of propagation mechanisms includes many policies that give short-term benefits but raise hidden or indirect costs thus creating cost-push inflation. This set comes under the first definition of poor governance, and is analyzed later in more detail.

To understand cost-push inflation, the price setting process and the way firms pass on costs should be studied. The next section presents some results from such an exercise.

**Price setting behaviour**

Indian monetary policy has largely focused on the relationship between money supply and prices with the economy assumed to be near full capacity. But under cost shocks firms' price setting is important for inflation. There is a large literature on estimation of aggregate supply following the modern New Keynesian (NKE) approach, but little work in the Indian context. The estimations reported in this section were done at three levels of aggregation. Aggregate data for the AS, disaggregated price indices to derive the estimate of skewness as a measure of supply shocks, and disaggregated industry level data for price setting at this level. Key results were similar.

When a firm experiences a shock to its desired relative price, it resets price only when the change is large enough to cover costs of the process of change. That is, firms respond to large shocks and not to small shocks. These asymmetric relative price changes can be a measure of aggregate supply shocks. Tripathi and Goyal (2011) find distribution based measures of supply shocks are significant in estimations of aggregate supply.

Average price increase over time is greater than average price decrease. While price increase is around 10 percent, price decrease is less than 5 percent. Changes in the price level are positively related to skewness of relative price changes. Therefore an aggregate inflation of about 5 percent is required to accommodate relative price changes. The estimated Indian Phillips curve shows half of Indian firms reset their prices in any period, and a little more than half are forward looking in their price setting (Box 2).

In a disaggregated study of the effects of oil shocks on firm pricing Tripathi (2012) found the coefficients on money supply growth while positive were generally much smaller than on cost variables. There was evidence of forward looking behavior.

**…..**

**Box 2: Price setting behaviour deduced from an estimated AS**

A hybrid Philips curve (Gali 2008) includes backward (the lagged inflation term) and forward ($\pi_{t+1}$) looking behavior. Apart from these terms, current inflation is a function of current marginal cost. The coefficients are functions of three model parameters: $\theta$, which measures the degree of price stickiness; $\omega$, measures the degree of backwardness in price settings and the discount factor $\beta$.

$$\pi_t = \alpha_f E_t\{\pi_{t+1}\} + \gamma mc_t + \alpha_b \pi_{t-1} + e_t$$

Where:

$$\phi - \theta + \omega[1 - \theta(1 - \beta)]$$

$$\alpha_f = \beta\theta\phi^{-1}$$

$$\alpha_b = \omega\phi^{-1}$$

$$\gamma = (1 - \omega)(1 - \theta)(1 - \beta\theta)\phi^{-1}$$

The estimated version of the hybrid Philips curve is:

$$\pi_t = 0.69E_t\{\pi_{t+1}\} + 0.27mc_t + 0.28\pi_{t-1} + e_t$$

The parameter θ is estimated to be about 0.516, that is, about half of Indian firms reset their prices in any period. The parameter ω is estimated to be about 0.34, that is, 34 percent of the prices setting industries are backward looking. The parameter β came out to be 0.96.

The PC was also estimated with the variable AsymX, a measure of supply shocks derived from asymmetric price adjustment. In the NKE approach, when a price is varied, it is set as function of the expected future marginal cost. A proportionate relationship is assumed between the output gap and marginal cost. A cost shock, then, is anything that disturbs this relationship. Such deviations can occur due to mark-up shocks as costs of intermediate inputs rise:

The coefficient of AsymX is small but is significant. Including the asymmetry measure leads the coefficient on marginal cost to fall substantially. The slope or marginal cost coefficient in the previous regression was higher because it was capturing part of the shift in the curve due to supply shocks.

Source: Tripathi and Goyal (2011)

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Using time series methods, it is possible to estimate the relative impact of demand and supply shocks on inflation, and test whether long-run aggregate supply is elastic or inelastic. One or the other restriction has to be imposed to estimate the shocks from price and output time series.

**Demand and supply shocks**

If the restriction of elastic long-run supply (or supply does not affect output in the long run) is imposed, then supply shocks should account for the major part of measured inflation and demand shocks should have a sustained impact on output levels.

If the restriction of in elastic long-run aggregate supply (or demand does not affect output in the long run) is imposed, then supply shocks should have little sustained impact on measured inflation, and only supply shocks should affect long run output levels. These predictions serve as tests on Indian longer-run aggregate supply.

On successively imposing these identifications in a two-equation structural model, a high elasticity of long run supply could not be ruled out, because supply shocks had a large impact on inflation and demand shocks had a large and persistent effect on output levels.

The long-run restriction allows inflation to be decomposed into that due to short-run structural demand and supply shocks. Figure 2reports these for the years 2010 and 2011 (Goyal and Arora 2012).The inflation figure is the annualized month on month rise in WPI. The output series used were the index of industrial production (IIP). The Figure shows the dominance of supply shocks in causing inflation, while demand shocks were largely negative[6]. The large positive supply shocks over the end of 2010 to early 2011 can be explained by the low agricultural growth, and the new plateau oil prices reached after the Arab spring (see Figure 1d). The sharp exchange rate depreciation following the escalating Euro debt crisis was probably responsible for the peak in supply shocks towards the end of 2011.

[6]This was the period the IMF (2011) classified the Indian economy as overheating with large excess demand. But growth fell steeply in the second half of 2011 as monetary tightening continued.

Figure 2 here

There were multiple supply shocks, but they were not sustained, suggesting that a wage price spiral, or second round pass-through had not set in. A good measure of potential output, under frequent supply shocks, conditions, is when such pass-through occurs so supply shocks are sustained at above 5 per cent. Since prices rise more than they fall, first round cost shocks must be passed through, so positive manufacturing or core inflation alone does not imply output is above potential. And falling growth in a slowdown does not imply potential growth has fallen[7].

The identification procedure does not impose any short run restrictions; elastic long-run supply is consistent with short-run supply bottlenecks that raise inflation. These could either be due to a steep short run AS or to an upward shift of an elastic AS. Recent episodes suggest that short run supply is also not inelastic.

The sharp monetary tightening raising short rates above 9 percent in the summer of 2008 precipitated a collapse in industrial output even before the September fall of Lehman. The tightening came after a period of high growth. The economy was feared to be overheating and inflation, following the international spike in fuel and food, was high. A demand shock, with a near vertical supply curve should affect inflation more than output. But the reverse happened. The wholesale price index (WPI) did not fall until November when Indian fuel prices fell, but the consumer price index remained high. The rapid recovery also indicated a reduction in demand rather than more intractable destruction of capacity. Although the IIP began to slow from April 2011, the repo rate was raised from 6.75 in May to a peak 8.5 in October of that year. Manufacturing fell from 7.2 in Q1 of 2011-12 to - 0.3 in the last quarter of 2011-12. But WPI inflation at the end of 2011 was at 9 percent. The rise in policy rates affected output again, not inflation. If prices and wages are sticky, it will be output that adjusts first after a monetary shock. Labour availability contributes to a flat supply curve—the NSSO 66$^{th}$ round showed double digit unemployment among the skilled in 2009-10. Short-term training institutes adapting skills to requirements have mushroomed. Higher growth during catch-up periods implies that

[7]Time series filter (such as the HP filter) based estimates of potential output are regarded as incorrect since such filters tend to be heavily influenced by the end point.

unemployable labour becomes employable. Structural unemployment reduces in a reversal of the process whereby cyclical unemployment becomes structural as the unemployed lose skills after a long out of work period. Then a demand stimulus alone cannot reduce unemployment. In a growing economy remedial training becomes available to upskill available labour.

Table 1 here

There is other evidence. The low coefficients on the output gap and the IIP suggest a flat AS—a rise in industrial output does not have much impact on prices (Box 1).The demand variable is insignificant in short-run adjustment indicating elastic AS. Including supply shocks reduced the coefficient of marginal cost (Box 2) again showing the Indian aggregate supply curve to be flat, but subject to shifts. These results suggest that the aggregate Indian supply curve, when estimated including a proper measure of supply shocks, is flat. There is, however, an important role for supply shocks, which take the form of shifts of the supply curve. A similar structure of AS is theoretically derived for an open EM with a dualistic labour market in Goyal (2011a).

The estimated supply shocks are therefore due to shifts of the supply curve. The interest elasticity of aggregate demand is rising as retail and housing loans rise. But the still large informal sector reduces it. Poor governance is a factor that shifts up the supply curve at all levels of output, not just at the margin.

**Governance failures, chronic cost shocks**

While commodity price shocks, and the propagation mechanisms they trigger, are a major source of the multiple supply shocks identified in the previous section, governance failures also impart an upward bias to prices, forming a fifth set of propagation mechanisms. Poor public service delivery raises costs. Large consumption subsidies and tax breaks reduce government spending on essential infrastructure, creating bottlenecks that raise costs. Potential expansion in capacity is lost. Taxes in themselves create distortions—direct taxes reduce effort, and indirect taxes raise prices and costs. Wastage and ineffective expenditure adds to these costs. Large government borrowing raises financing costs for private investment.

Many populist policies give short-term benefits but raise hidden or indirect costs. This holds even for policies that prevent prices from rising. Examples are price caps that freeze key prices and user charges. These distort relative prices and therefore the allocation of resources. Both producers and consumers get wrong signals. Distortions in fertilizer and diesel prices have destroyed the environment and created serious health costs. Subsidized diesel has created a black market in adulterating petrol. Free electricity and over-irrigation has harmed the water table, and soil fertility—again raising costs of production.

If user charges are not raised when costs of production are going up, the quality of the service normally is reduced. Then partly explains the poor quality of many public services, which creates indirect costs.

Moreover, since administered prices become a political decision, it is difficult to change them. Thus despite steep cost escalation passenger fares have not been raised in Indian railways since 2003. Freight rates have been raised, since this is an indirect charge the voter does not perceive. So the voter pays less for train travel but more for every good she consumes as transport costs rise. Indirect costs are even higher—Indian rail lost freight to subsidized environmentally polluting diesel trucks with much higher social costs.

While some administered prices are frozen others, where there are active lobbies, are raised too much. The minimum support price (MSP) given to farmers tends to impart an upward bias to food prices. The distance from international prices is used to force a rise in domestic prices. One reason for low inflation over 2003-07 was low global food prices—so Indian MSPs were not raised. In 2007 as the gap between domestic and international foodgrain prices rose sharply, farmers' lobbying secured steep rises over the next few years.

Farmers benefit from stable prices—a sharp price rise induces oversupply in the next season, and reduces farm income. Raising producer prices steeply yet attempting to protect the consumer through the public distribution system, is a source of corruption, apart from the distortions in movement of foodgrains and monopoly marketing channels created to ease government

procurement. All of these disrupt supply chains and raise costs. Crime is encouraged as low-price foodgrains meant for the poor are diverted to where prices are higher.

World commodity prices rise and fall sharply. In India since they are administered they do not rise as sharply, but they also never fall—so over time the cumulative rise can be more. Figure 3 shows Indian fuel prices are less volatile than international, but unlike for the latter, trend upwards. Inflation was higher[8] over time. Such a system of price setting can convert a temporary supply shock into a persistent shock. In recent periods both domestic prices also fluctuated as exchange rate fluctuations raised non-administered components (Figure 1d).

Figure 3 here

This structure of AS-AD has implications for the tradeoff between growth and inflation and the output sacrifice.

**Growth and inflation tradeoffs and the output sacrifice**

The standard Phillips curve suggests that higher wages induce more effort, raising output and inflation—so higher output can be attained at the cost of higher inflation. There is a potential short-run tradeoff between output and inflation. But if behavior is forward-looking, the inflation becomes anticipated. Since expected real wages fall there is no output increase but inflation rises. There is no long-run tradeoff—a macroeconomic stimulus only raises inflation without affecting real output. If expectations affect current behavior, there is no short-run tradeoff either. One school has gone further in saying that the distortions inflation creates reduce growth. That logic suggests macroeconomic stimuli would only raise inflation, and the latter would lower growth. The inflation threshold where such negative effects kick in is estimated at about ten percent in EMs (Jha and Dang 2012). RBI (2011 Box 11.4, pp.32) put this threshold at about 5 percent for the Indian economy. The *Economic Survey* (GOI 2011) points out real exchange rate appreciation as wages rise may require a higher rate of inflation in EMs—so a higher growth requires higher inflation exceeding world inflation. It should be possible, however, to

[8]Over 1975-76 to 2011-12 average annual international crude inflation works out to 8.9 percent, while Indian FPLL WPI inflated at 9.5 pa per annum.

accommodate the factors making for higher inflation within the threshold of 5 percent, which still exceeds world inflation.

The NKE school models pricing power together with forward looking behavior (Box 2). If current or future demand is causing inflation, raising interest rates such that excess demand falls to zero for all time can lower inflation with no cost in terms of output. A short-run trade-off between inflation and output variability arises only if there are cost shocks. Since supply shocks have been frequent in India it is useful to analyze the tradeoff in that context.

If the AD-AS structure is as derived in the previous section with the AS elastic but subject to upward shocks, policies that shift AD alone without reducing costs or shifting the AS downwards involve a large output sacrifice (Figure 4), without much impact on inflation. But without policies that shift down the AS, a large output sacrifice may become necessary to moderate sticky inflation expectations and the rise in wages that itself shifts up the AS curve[9]. If policy is able to abort the propagation mechanisms pushing up the AS curve, output and employment sacrifice from supply shocks can be reduced even as inflation is kept within bounds.

Figures 4 and 5 here

The social impact of the sacrifice is high since a slowdown reduces employment and wages more in the informal sector. Figure 5, based on ASI data, shows that in the downturn following peak interest rates after the East Asian crisis, manufacturing real wages did not fall—these were indexed to inflation. But non-manufacturing real wages which may not have been so indexed fell[10]. India's large informal labour probably bore the brunt of the slowdown as lower employment reduced their pricing power.

But informal wages are also now being partially indexed through MGNREGA, so employment growth will fall but sticky real wages keep up cost pressures. In 2011 MGNREGA wages were

[9]Basu (2011) shows how policy makers' inflation forecasts tend to be underestimates since they attempt to anchor expectations. But more than just words are required for statements to be credible.
[10]ASI puts items like servicing watches in non-manufacturing. These wages seem to be more responsive to demand conditions. As Dr. Kanagasabapathy pointed out, their rise in the preceding high growth period exceeded trend, implying non-manufacturing wage growth exceeded trend growth in wages.

indexed to the CPI agricultural wages, and in 2012 exceeded State minimum wages in 21 States. They set a floor to wages in many informal sector activities, and reduce indexation lags.

*Policy induced demand shocks and output sacrifice*

The official understanding of monetary policy in India is that a huge monetary overhang built up due to financing of large fiscal deficits created excess demand that had to be sharply reduced during periods of high inflation. But every period of double-digit inflation in India was associated with a supply shock. It is possible to check for the size of contraction in demand and in factors affecting demand (relative to GDP) during these periods. Excessive contraction would be a failure of governance in the sense of inappropriate macroeconomic policies.

Place Table 2 here

Table 2 shows the "monetary" and "fiscal" shocks and sum of the two in the "policy" variable. These shocks identify the policy induced demand shock, and also show if monetary and fiscal policies acted in concert or at cross purposes. The bold figures show the monetary and fiscal response to periods of inflation above 8 percent, which were all periods of an adverse supply shock. The table gives the average annual rates over inflationary and non-inflationary years.

The monetary policy shock is calculated as the change in reserve money growth before 2002 and the change in the repo rate after 2002. The fiscal policy shock is the change in the sum of Central Government revenue and capital expenditure each as a percentage of GDP[11]. That is, period t gives the total of the two fiscal policy variables and the monetary policy variable each minus their respective values in period t-1. A negative value implies policy contraction exceeded that in GDP. Policy amplified supply shocks since the contractionary impulse exceeded the fall in output. It was negative in years when the GDP growth rate fell due to a supply shock. The only shock period in which policy was countercyclical was 2008-09 when the GFC constituted a large negative external demand shock. Monetary policy was also not procyclical over 1995-08, as it

[11] Changes in spending are a better measure of the fiscal impulse than the fiscal deficit. The latter should increase during an economic slowdown as revenues fall, to function as an automatic non-discretionary stabilizer. Krishnan and Vaidya (2012, this volume) explore the cyclical properties of government consumption.

generally was in other periods. Also monetary policy and fiscal expenditure tend to expand and to contract together.

The "credit" variable does a similar calculation for broad money M3, bank credit to the commercial sector and total bank credit, the sum divided by three. Credit also contracted in periods of policy tightening, and it grew at less than the GDP ever since the GFC. Finally the "demand" shock measures changes in domestic absorption relative to GDP. It is the sum of changes in private final consumption expenditure (PFCE), government expenditure (G), Gross Domestic Capital Formation (GDCF) each as a percentage of GDP.

In general Table 2 shows each shock, plus the policy response, imparted a considerable negative impulse to aggregate demand, even as the supply shock pushed up costs. Demand remained positive through the first oil shock years but fell steeply in 1975-76. It was consistently negative through the eighties, which were the years of largest fiscal deficits and RBI accommodation! Since the table measures final demand categories, perhaps large government transfers were siphoned away, perhaps abroad, without reaching beneficiaries and creating demand.

Policy shocks were no longer negative after the mid-nineties, and demand shocks remained positive. But they became highly negative in 2011-12, as policy contracted severely. Rates of inflation and the output sacrifice were lower under recent shocks, although policy reactions remained as severe, suggesting greater resilience and diversity with a larger share of the private sector. Policy needs to play a stabilizing role, with more nuanced and smaller forward-looking adjustments.

**Policy**

*Monetary-fiscal coordination*

Price adjustment is asymmetric, that is prices rise more easily than they fall. So tightening in response to cost shock will impact output more than prices. It follows policy may allow the price level effect of a temporary price shock without tightening. The first round pass through of a cost shock such as higher oil prices into manufacturing prices, for example, should not be regarded as core inflation.

But if key relative prices that trigger propagation mechanisms are involved, policy must react quickly. Typically monetary tightening has occurred as second round effects set in. The supply shock itself is extended because of delayed administrative pass-through. Instead early but mild tightening, to at least the neutral interest rate, together with supply-side measures, could anchor inflationary expectations without a sharp reduction in demand. Short term supply-side measures include fiscal moves such as reduction in excise and tariffs, freer movement of food, imports etc. A nominal exchange rate appreciation can abort pass through for a temporary oil price shock.

The idea that policy should tighten severely if inflation is above a threshold is flawed because strict inflation targeting is never optimal (Goyal 2011a), some weight must be given to output, and tightening moderated when growth slows.

*Size and speed of monetary tightening*

The size of required tightening may be low if the share of lagged and administered prices is large. Since the cumulative effect of past steps will continue to slow the economy, tightening cycles must not be prolonged. If, however, price setting is forward looking, but prices once set are sticky, a quick policy response to inflation can abort a price rise. The policy rate change itself can be moderate since firms will internalize future rise of rates on the changed policy path.

Estimated real and nominal price rigidities imply that a sharp policy response to a rise in expected future excess demand can prevent the 66 percent of forward looking firms from raising prices. Since the higher prices persist for about a year, policy that anchored inflation expectations would reduce inflation persistence. This is without any cost to output since inflation is reduced by reducing future, not current, output gaps.

However, 34 percent of firms continue to be backward looking, so there is some price inertia and lagged effects of policy rate changes. A reduced but continuing share of administered prices aggravates this. So policy response to supply shocks should be moderate—anchor inflationary expectations to prevent second round pass through yet allow lagged adjustment to play out.

High interest rates tax the most dynamic interest elastic component of the economy, such as investment which reduces capacity. When nominal interest rates are high firms prefer to earn higher returns on their surplus cash, rather than invest it. It is difficult to destroy the pricing power of cash rich firms through interest rate hikes. Since mark-ups tend to be counter-cyclical, prices are sticky downward. What gets destroyed is capacity utilization and expansion. Even if real interest rates are low, they normally coincide with supply shocks when costs rise for both firms and consumers. Sharp spikes in interest rates must be avoided also since they affect ability to repay of indebted firms, and reduce loan quality of banks.

Strategic capital controls and signaling can also affect exchange rates separately from interest rate policy. In Indian conditions the exchange rate may have a broader reach compared to the interest rate—it affects costs in the informal sector and headline as well as core inflation. Even so large spikes in the exchange rate must also be avoided, since they affect firms who have borrowed abroad, as well as exporters, adversely.

*Long-term structural and fiscal reforms*

A rise in productivity will allow higher wages to be consistent with a more depreciated and competitive real exchange rate required to reduce the CAD, thus closing one propagation mechanism. A rise in agricultural productivity, especially, would reduce pressures for rising wages and domestic second round inflation, thus reducing real exchange rate appreciation from higher domestic inflation differentials. China has similar population levels. A sharp rise in agricultural productivity preceded its industrial transition. Given past failures, a new approach that strengthens local institutions and creates new options for farmers is required. Multi-brand FDI in retail is one such option but will take long to fructify. Domestic changes to improve inter-state connectivity and competition in agricultural marketing could be faster, and would make FDI more effective when and if it did come in. Even if the Government needs to procure more it must do so in competitive markets without artificial divisions.

Since MGNREGA is a source of wage indexation and inflation propagation it must be focused on creating assets, through conditional allocations. Officials implement a clear target given to them. With asset creation as the objective, employment would be created as a by-product.

Agricultural production and distribution are now on the concurrent list. The Centre can legislate on the movement of goods and on creating a national market. It could push through a new bill, using new political alignments. But even without that, two or more States can pass a resolution on goods movement under Article 252 of the Constitution. States can be motivated by making key allocations conditional upon reforms of their existing Agricultural Produce Marketing Committee laws. Once a few States start showing positive results, others will follow. Experience with recent Finance Commissions and the Jawaharlal Nehru Urban Renewal Missions show that incentives work with States, if they are not subject to political renegotiation. They should be made more formula based.

A fiscal deficit (FD) implies a government's expenditure exceeds its revenues. Large FDs in India are thought to create excess demand that drives Indian inflation. But Table 2 shows large demand compression during inflationary episodes. Given high private savings, relatively low government debt, and growth prospects, current deficits are manageable, provided there is a credible fiscal consolidation path (Goyal, 2011b). Improvements in institutions and laws such as the FRBM Act did succeed in reducing deficits, especially in the States where they were complemented with incentives.

Many Western countries have much higher deficits and debt with worse growth prospects. If the composition of government spending changes towards building human capacity[12] including improvements in public service delivery, it can deliver inclusive growth, remove the fear of unsustainable deficits, and improve the supply response. Strengthening institutions and thickening democracy are imposing more continuous accountability. State elections are also rewarding better governance.

Better systems are required. Formula based pricing in the oil sector could reduce political pressures that lead to lags in adjustment to external price shocks, yet deliver some smoothing and burden sharing even as regulatory capacity and competition are encouraged. That fuel prices in

[12]Romar Correa pointed out the distinction between soft and hard government expenditure and its differential effectiveness. A poor composition of expenditure is also a failure of governance, but can be captured in a more standard macroeconomic variable.

India rise but rarely fall is one feature that turns a temporary supply shock into a persistent one. This could change.

If improvements in governance reduce cost pressures on inherently elastic supply, monetary policy can support demand. Monetary-fiscal coordination would improve reducing the cyclicality seen in Indian growth rates.

**Conclusion**

To the extent supply-side issues dominate inflation contractionary demand policies should be used with moderation, although they have a role in anchoring inflation expectations. Headline inflation can have persistent effects in India but needs to be reduced through short and long-term policies that impact the supply-side.

Key contributions of the analysis include the idea that aggregate supply is elastic but subject to frequent upward shocks. It provides a new way of understanding how supply constraints affect the economy. Output turns out to be demand determined but supply shocks and propagation mechanisms that make them persistent create inflation. Certain relative prices—including food prices and the exchange rate—play a critical role in the propagation process as does price setting behavior and failures of governance.

Standard macroeconomic analysis requires adaption to context. Else mistakes are made. In summer 2011 there was a crescendo in international pressure: India was said to be overheating, when it was clear that industry was already slowing (Table 1, 2011-12, Q2). A July 2011 Economist article, based on IMF research, put India among 'sizzling 7' countries, on highly contestable grounds[13],even as advanced countries were encouraged to try innovative policy mixes for unemployment much lower than that in EMs. Indian policy has always reacted strongly to high inflation; as interest rates were raised further, output crashed. Instead, as the sharp post GFC rise in oil prices was partly responsible for EM inflation, the IMF should have sought to plug regulatory gaps in advanced countries that allow 'innovative' excess liquidity to

[13]For example, it used 20 year trends which are incorrect for countries undergoing structural change. The variables included amounted to putting responsibility for external shocks on domestic policy.

raise commodity prices, and created an emerging market fund to compensate for excessive volatility in capital flows driven by external events.

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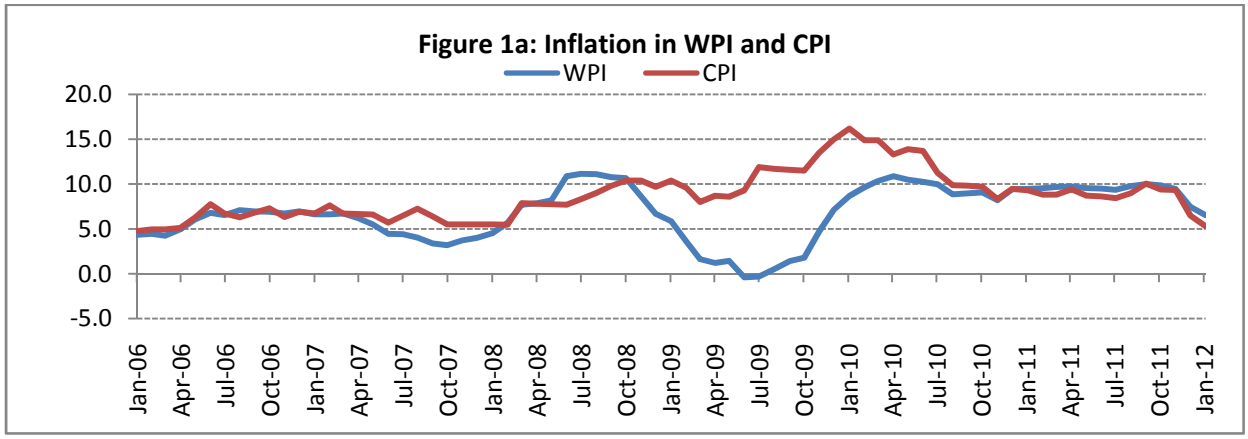


Source: Reserve Bank of India http://www.rbi.org.in and Office of the Economic Advisor http://eaindustry.nic.in.

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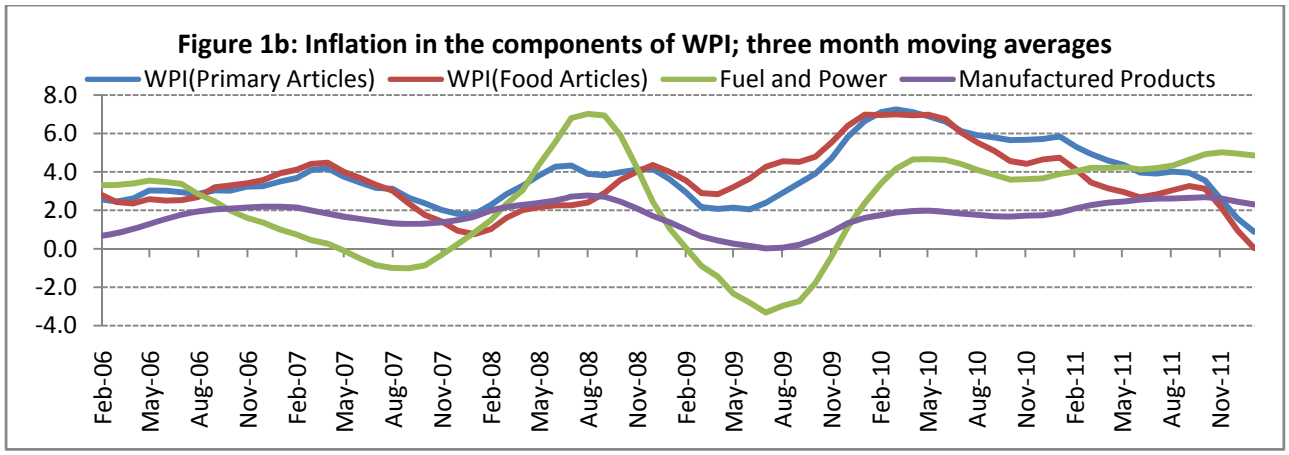


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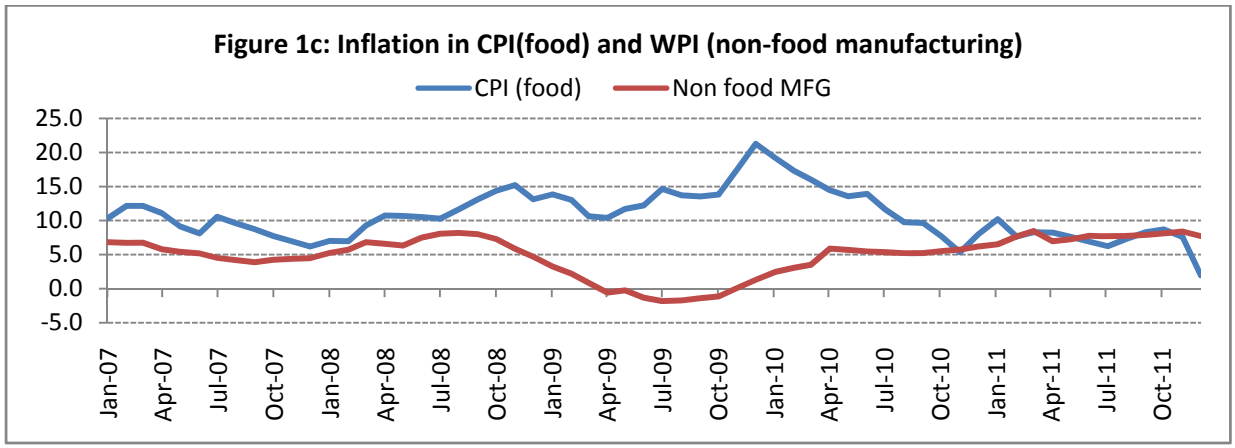


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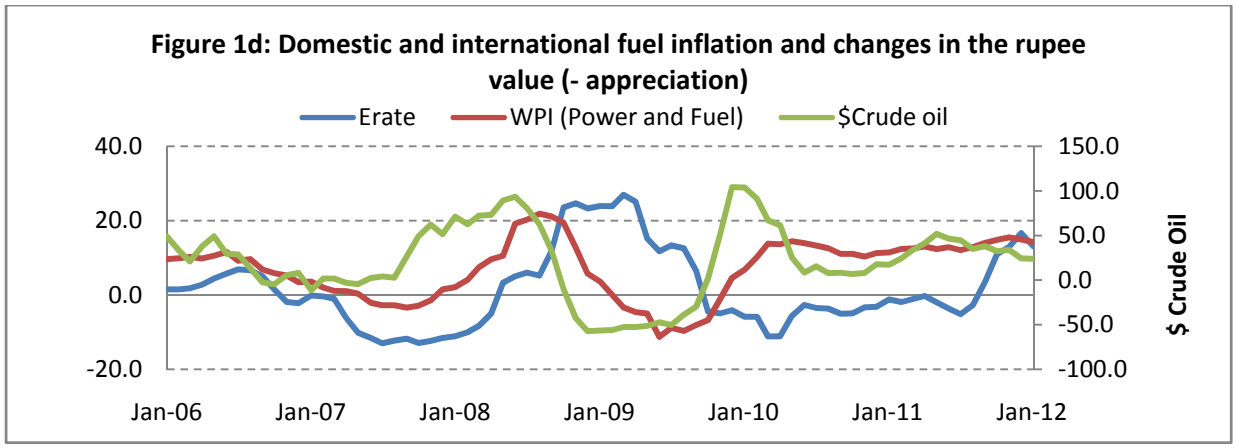


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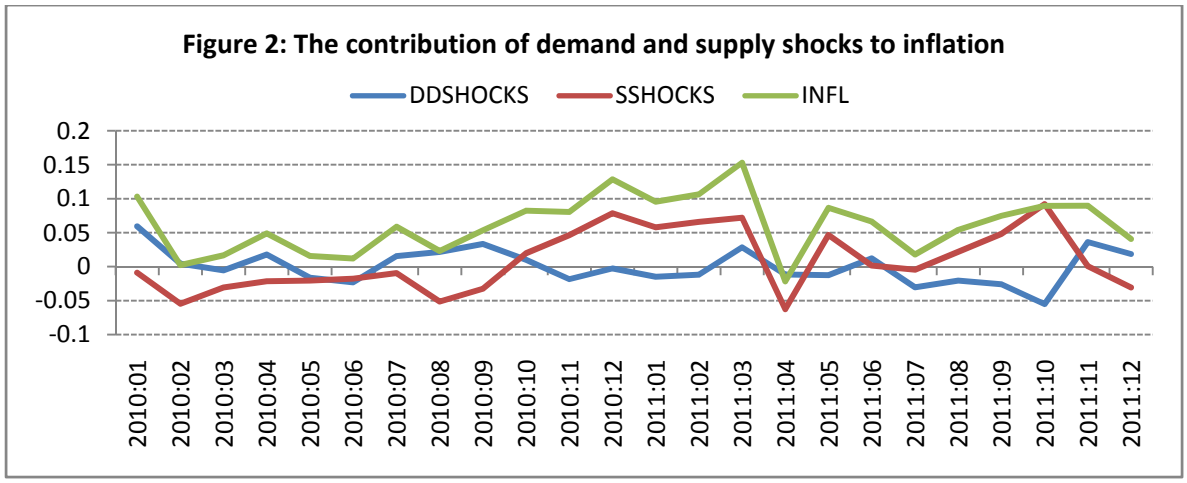


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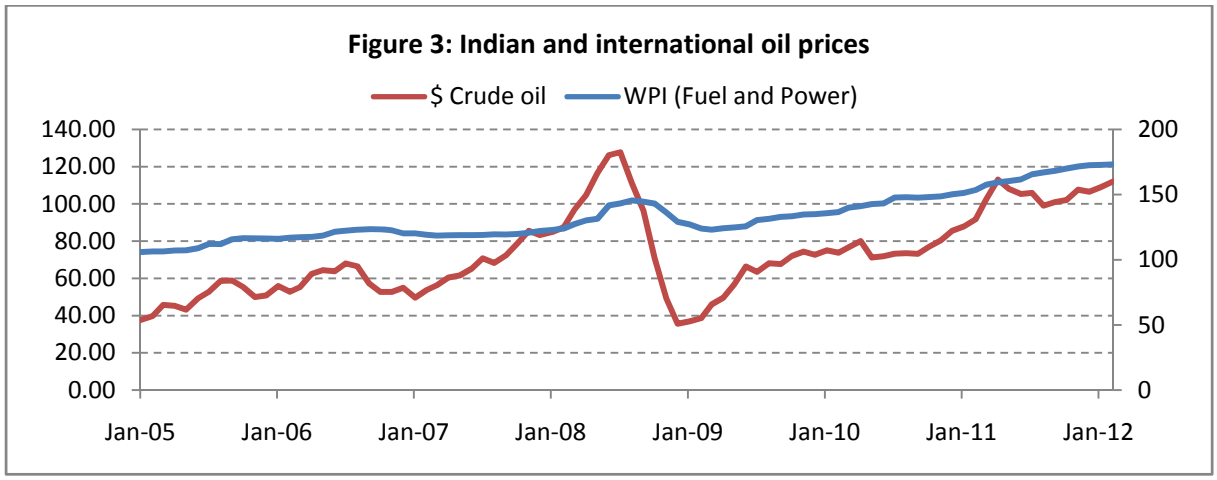


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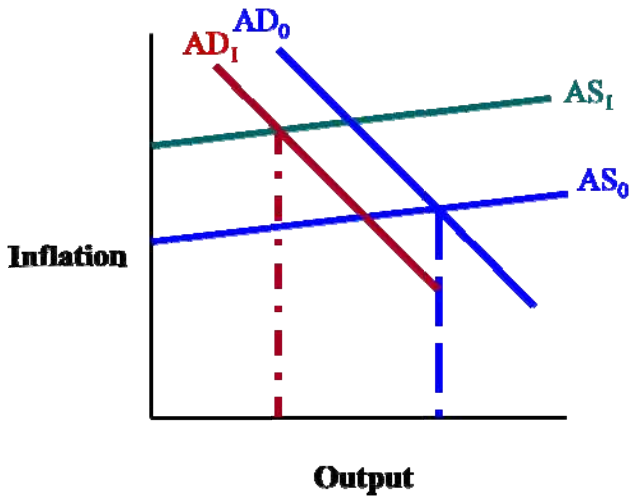
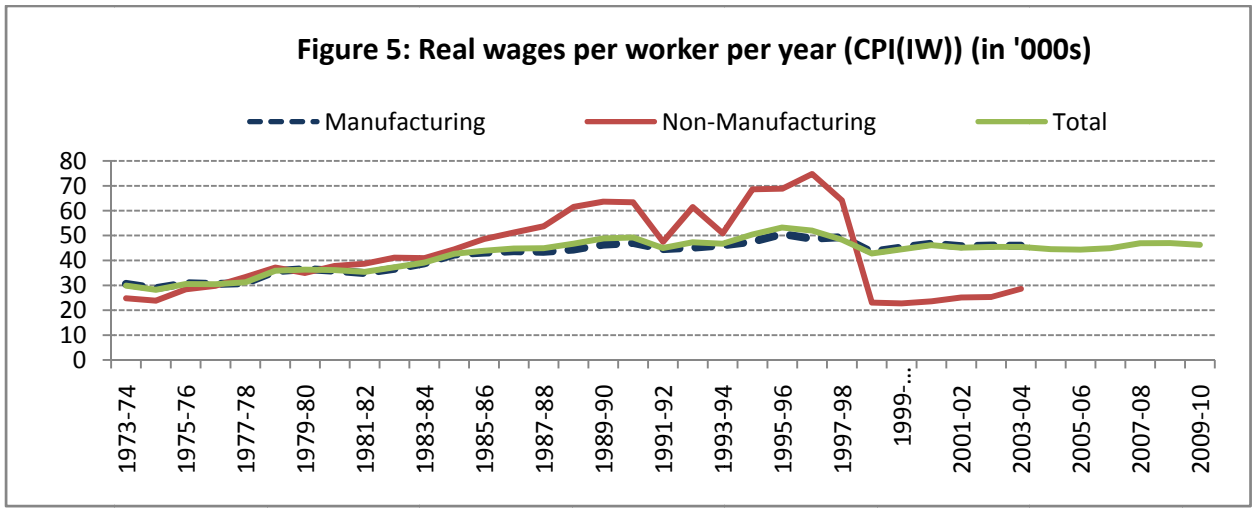



**Figure 4: Aggregate demand and supply**

Source: Goyal (2010)




Source: Annual Survey of Industries (ASI) and http://mospi.nic.in. Accessed in March 2012.

**Table 1: Growth, inflation, and policy rates**

| | 2008-09: Q1-Q4 | | | | 2009-10: Q1-Q4 | | | | 2010-11: Q1-Q4 | | | | 2011-12: Q1-Q4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **Growth (Y-o-Y) (%) (constant 2004-05 prices)** | | | | | | | | | | | | | | | | |
| GDP at factor cost | 7.9 | 7.7 | 5.8 | 5.9 | 6.3 | 8.6 | 7.3 | 9.4 | 8.5 | 7.6 | 8.2 | 9.2 | 8.0 | 6.7 | 6.1 | 5.3 |
| manufacturing | 7.0 | 6.6 | 2.6 | 1.3 | 2.0 | 6.1 | 11.4 | 15.2 | 9.1 | 6.1 | 7.8 | 7.3 | 7.3 | 2.9 | 0.6 | -0.3 |
| GFCF/GDP* | 33.0 | 34.8 | 31.5 | 32.7 | 30.4 | 31.9 | 30.9 | 34.5 | 32.2 | 34.0 | 32.3 | 31.4 | 33.9 | 33.4 | 30.3 | 30.9 |
| **Inflation (Y-o-Y) (%)** | | | | | | | | | | | | | | | | |
| WPI | 9.6 | 12.5 | 8.6 | 3.2 | 0.5 | -0.1 | 5.0 | 10.2 | 11.0 | 9.3 | 8.9 | 9.3 | 9.4 | 9.7 | 8.9 | 7.0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CPI- IW | 7.8 | 9.0 | 10.2 | 9.5 | 8.9 | 11.6 | 13.2 | 15.1 | 13.6 | 10.5 | 9.3 | 9.0 | 8.9 | 9.2 | 8.4 | 7.2 |
| **Policy rate** | | | | | | | | | | | | | | | | |
| Overnight (call) money | 6.8 | 9.5 | 7.8 | 4.2 | 3.2 | 3.2 | 3.2 | 3.3 | 4.2 | 5.4 | 6.6 | 6.8 | 7 | 7.8 | 8.6 | 8.9 |

Source: CSO press release and Reserve Bank of India
Note: * This row is a ratio not a growth rate

**Table 2: Monetary and Fiscal Policy and Outcomes in High Inflation and other Years (Average annual rates)**

| Years | Monetary Shock | Fiscal Shock | Policy Shock | Credit Shock | Demand Shock | Real GDP Growth | WPI Inflation |
|---|---|---|---|---|---|---|---|
| **1972-75** | **-0.4** | **-0.4** | **-0.8** | **-0.6** | **0.4** | **1.8** | **18.5** |
| 1975-79 | 0.7 | 1 | 1.8 | 0.8 | 0.3 | 5.8 | 1.6 |
| **1979-81** | **0.4** | **-0.6** | **-0.3** | **-1.3** | **-3.1** | **1** | **17.7** |
| 1981-90 | 0.3 | 0.4 | 0.7 | 0.1 | -0.6 | 5.6 | 8 |
| **1990-92** | **-0.4** | **-0.9** | **-1.3** | **-0.6** | **-1.3** | **4** | **11.4** |
| 1992-94 | 1.3 | 0.1 | 1.4 | 1.7 | 0.3 | 5.7 | 8.4 |
| **1994-95** | **0.6** | **-0.6** | **0.1** | **-0.9** | **1.8** | **6.4** | **12.6** |
| 1995-08 | 0.1 | -0.1 | 0 | 0.1 | 0.6 | 7 | 5.2 |
| **2008-09** | **0.5 (-1.1)** | **1.4** | **1.9 (0.3)** | **-0.7** | **-0.7** | **6.7** | **8.1** |
| 2009-10 | 0.0 | 0.2 | 0.2 | -1.2 | 1.3 | 8.4 | 3.8 |
| **2010-12** | **-1.8 (-0.5)** | **-0.5** | **-2.3 (-1)** | **-0.8** | **-2.4** | **7.7** | **9.4** |

Notes: From 2001 the rise in the repo rate rather than fall in reserve money is used as the measure of monetary tightening. The terms in brackets shows policy shocks using change in reserve money. Figure in bold indicate the years in which inflation was in double digits; WPI- Wholesale Price Index; GDP- Gross Domestic Product
Source: Reserve Bank of India http://www.rbi.org.in and CSO press releases