CHAPTER 6

The Interaction of Real and Monetary Sectors in India: Inflationary Process and Monetary Transmission Mechanism

6.1 Introduction

In the earlier chapters we observed that price level tends to influence the output dynamics (agricultural price directly and industrial price indirectly, see Section 4.4, Chapter 4). This makes it necessary for us to examine the price formation process as a complement to output dynamics for a more adequate analysis of the problem. In this chapter, we attempt to understand empirically the principal determinants of the domestic price formation process in the Indian context. In particular, we examine the extent to which it is a monetary phenomenon, taking into account the monetary transmission mechanism. The alternative view is that it is influenced by the real sector variables. Broadly speaking, the former relates to the monetary and the latter to the structuralist view of the inflationary process.

This chapter is organized as follows: Section 6.2 identifies the issues raised in this debate so far. Section 6.3 takes an overview of the inflationary process and looks at the empirical literature in the Indian context. Our empirical analysis of the competing hypothesis is carried out in Section 6.4. The analysis of monetary transmission mechanism is also carried out in this section. This became imperative as we find that the price formation process, especially industrial, gets significantly influenced by the money stock variables. Section 6.5 interprets the empirical findings and concludes the discussion.
6.2 The inflationary process debate

The inflationary process has been a controversial topic in the literature, both theoretically as well as empirically. The precise nature of the relationships of price level with other macroeconomic variables have, despite years of research, remained an area of controversy. It is not surprising that there is no consensus among economists as to which variables decisively influence the price formation process. The channels through which price formation takes place continue to be a matter of debate.

In the subsequent sections of this chapter we would examine these and related issues in the context of the Indian economy, while this section identifies some relevant issues raised in the theoretical literature. For convenience of discussion we shall characterize the debate on the inflationary process by the following propositions:

i) **The Monetarist School** usually assumes a stable function of money stock to nominal income. In this tradition 'fiscal deficit' is argued to be the root cause of the inflationary process in so far as it affects money supply;

ii) **The Structuralist School**, in contrast, argues that the crucial source of the price rise are the structural rigidities usually in the farm sector of a developing economy. Excess demand is supposed to drive up the price level triggering the inflationary process; and

iii) **The Conflicting Claims Models** give an account of the inflationary processes by which clashing claims of different social classes cannot be reconciled and inflation is argued to be a result or symptom of these conflicting claims. This is often complemented by structuralist models.
We take these schools one by one:

i) The proponents of the monetarist school argue that by reducing the rate of growth of base money (H or $M_0$), which in most cases requires cutting down the 'fiscal deficit' of the government, the rate of inflation can be brought down. This assumed role of fiscal deficit as the kingpin of the inflationary process is of recent origin. In the macroeconomic stabilization package of the multilateral financial institutions like the I.M.F. this is generally an implicit precondition for ensuring the stabilization process in the borrowing countries.

The theoretical reasoning underlying the argument is based on the procedure of financial programming which is derived from the influential work of Polak (1957). It is based exclusively on the double entry accounts system of external trade and banking sector.

Financial programming starts from an identity:\(^1\): money supply as the liability of the financial sector must be matched by assets held by that sector. Thus, increase in money supply ($\Delta M^p$) = increase in the liabilities of the financial sector to the public = increase in the assets of the financial sector = increase in the international reserves ($\Delta R$) + increase in credit to private sector ($\Delta B$) + increase in credit to the public (government) sector ($\Delta G$) normally from the central bank (monetary authority), i.e.,

$$\Delta M^p = \Delta R + \Delta B + \Delta G \quad (6.1)$$

\(^1\)based on Bhaduri (1993), p 13-52.
where

\[ \Delta R = (E - Z) + F \]  \hspace{1cm} (6.2) 

\[ E = \text{Exports}; \quad Z = \text{Imports}; \quad F = \text{Net Capital Inflows}. \]

Finally, use is made of the celebrated 'exchange identity' which, with some modifications, can be interpreted as the 'quantity theory of money', i.e., the demand for money \((M^d)\) times the velocity of circulation = price level \((P)\) times output level \((Q)\).

Thus,

\[ M^d = k \cdot P \cdot Q \quad \text{where} \quad k = (1/v), \text{reciprocal of velocity of money}. \]

Rewriting this in first order approximation (neglecting second order terms as small).

\[ \Delta M^d = P \cdot Q \cdot \Delta k + k \cdot P \cdot \Delta Q + k \cdot Q \cdot \Delta P \]  \hspace{1cm} (6.3) 

Since increased supply of money must equal its demand, so,

\[ \Delta M^d = \Delta M^s \]

Substituting (6.2) in (6.1) and then equating it to (6.3) gives us

\[ (E - Z) + F + \Delta B + \Delta G = P \cdot Q \cdot \Delta k + k \cdot P \cdot \Delta Q + k \cdot Q \cdot \Delta P \]  \hspace{1cm} (6.4) 

So far this has been an identity relation and no assumption have been imposed and the analysis is definitonal in nature.

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\(^2\) \(F\) must include not only foreign concessional inflows but also various net factor incomes.
Special assumptions are made to modify (6.4) for the purpose of financial programming. The special assumptions are as follows:

1. The crucial postulate of the QTM that velocity of circulation of money is roughly constant, which implies \( \Delta k = 0 \);

2. The assumption that level of output \( (Q) \) and its increase \( (\Delta Q) \) can be exogenously fixed from the supply side, i.e., in terms of supply considerations.

This would make \( \Delta Q = \Delta \bar{Q} \), as exogenously given.

Thus, the term \( k.P.\Delta Q \) becomes a constant on the right hand side of the identity (6.4) but only on the strength of assumption of (2) above. Given \( \Delta k = 0 \) and \( k.P.\Delta Q = C_1 \), identity (6.4) becomes equation (6.5) below:

\[
(E-Z) + F + \Delta B + \Delta G = C_1 + k.Q.\Delta P
\] (6.5)

Dividing throughout by \( P.Q \) (or the nominal value of output). Note \( Q = Q(-1) \), the output of previous period.

\[
\frac{[E-Z] + F}{P.Q} + \frac{[\Delta B + \Delta G]}{P.Q.} = C_2 + k.(\Delta P/P)
\] (6.6)

where \( C_2 = (k.\Delta Q/Q) \)

From (6.5) and (6.6) it can be argued that a stricter financial discipline interpreted as a lower increase in credit advanced by the financial sector to the government(\( \Delta G \)) and/or the private sector(\( \Delta B \)) would tend to reduce the left side of (6.5) or (6.6). To
balance the equation, either the rate of inflation \((\Delta P/P)\) must slow down correspondingly and/or the trade balance must improve. However, it can be noted that even under these rather restrictive assumptions made, the case for financial discipline in terms of (6.5) and (6.6) is not unambiguous from a purely logical point of view. Since there is only one equation in three unknown variables, it is still conceivable that lower public and private sector borrowing as a proportion of GDP, i.e., lower 

\[
[(\Delta B+\Delta G)/P.Q]\n\]

term in (6.6) may be associated with higher (lower) inflation but a larger (smaller) trade surplus, \((E-Z)/P.Q\) to balance the equation. Nevertheless, this is the skeleton model on which the policy advice of the multilateral financial institutions is usually based.

Usually the government borrows from the central bank to finance its *fiscal deficit* \((FD)\). Therefore, if the government reduces its FD then, according to the monetarists, the rate of inflation could be contained and/or external deficit could be controlled. This is the essential logic identifying 'fiscal deficit' as the main causal variable for the inflationary process.

ii) In contrast, the structuralists' models identify structural bottlenecks in the agricultural sector, especially in the wage good segment, as the source of inflation in the developing economies. Sectoral imbalances (caused by the rapid growth of the industrial sector) lead to an excess demand for wage goods and consequently result in rise in agricultural prices. The increase in raw-material prices and the indexation
of industrial money wages to price results in the transmission of rise in agricultural prices to industrial prices as enterprises simply pass on the rising costs to the consumers. Therefore, structuralists argue that the ultimate cause of inflationary process can be traced to the agricultural sector. In their view, there could be no autonomous development within the industrial and/or monetary sectors that would lead to continuous increase in prices (Sen and Vaidya, 1995, p 29).

iii) The process of price rise is fuelled by conflicting claims among various classes according to the different variants of the conflicting claims based models. Basically, these models assert that the rise in price level is generally due to rising costs and in this process the workers and capitalists try to keep their shares through real wage targets and profit margin targets (see for instance Bhaduri, 1986; Sanyal, 1996).

An increase in the level of prices induces an increase in the money wage rate because the workers try to protect their real wage rate. Conversely, an increase in money wage rate leads to an increase in the price level, because the capitalists attempt to protect their profit margin per unit of output sold.

Sanyal (1996, p 621-2) in the context of developing economies affirms that different groups in the process of influencing their income shares need not necessarily exert their influence through setting prices directly. This they could do through some proxy item, namely the ability to hold stocks. Besides, he argues that changes in the mark-up
fixed by producers when they set prices, or in the amount of stocks held are both
governed *inter alia* by access to credit. Thus, the actual amount of stockholding is
related not only to the rate of interest but also to the conditions in the credit market.
This links tangentially conflicting claims with a monetary, as distinct from monetarist,
view of inflation.

6.3 Overview of the inflationary process in India

India has been a low inflation country from the international perspective. A large part
of the credit for this is generally given to her conservative fiscal and monetary
policies. There has been some dilution of fiscal conservatism in the eighties, but the
fiscal deficit have not spilled over into large money creation by international
standards. There has been various shocks (principally droughts, oil-crises of the
seventies and the nineties and terms of trade changes) that have led to moderate
inflation by international standards, but these have subsided relatively quickly. In
other words, shocks have made rate of inflation more volatile without significantly
affecting its low long run trend (Graph 6.1). On the basis of this, it is argued by Little
and Joshi (1994, p 254) that inflationary expectations have never been able to take
hold3.

In the empirical literature, Indian inflationary process has been studied quite
extensively. Most studies following the structuralist tradition tend to treat the price

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3They attribute this to the situation of low coverage of indexation in the economy.
GRAPH 6.1: The Wholesale Price Index and its Annual Rate of Change
dynamics of the agricultural and industrial sector to be qualitatively different. Correspondingly, these studies decompose the inflationary process into the two sectoral prices of agriculture and industry. The weighted average of the two price levels gives the wholesale price index of all commodities (WPI). There has been other studies, in the monetarist tradition, at the aggregate levels as well which do not take into consideration the sectoral differentiation in the price formation process.

In Section 4.3 of Chapter 4 earlier, we surveyed the sectoral prices in the process of interaction of industry and agriculture in India. Here, we will bring in other probable variables in the analysis and examine their influence on the price levels in the two sectors keeping in view the above underlying debate⁴. Due to the bidirectional nature of causal evidence of the output dynamics and price formation process, presented in the discussion of Section 4.4 earlier we examine empirically these issues in greater detail in the following section.

6.4 Evaluating the Competing Hypotheses - The Empirical Evidence on India:

6.4.1 The Inflationary Process

We decompose the inflationary processes into the two sectoral price formation processes: agricultural and industrial. We explore whether the prices are mainly determined by the developments in the real sector or the monetary sector variables

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⁴The empirical analysis of Moosa (1997), for instance, is supportive of money being neutral and having one-to-one correspondence with the industrial price level in India. Sen and Vaidya (1995), on the other hand, found evidence of income-claims of different classes influencing the industrial price formation process.
also influence these. First, we examine the agricultural price formation process.

\[ \text{a) Agricultural Price Level} \]

In chapter 4, we looked at the agricultural price formation in the process of interaction between industry and agriculture. Now, we introduce the monetary sector variables and examine if they exert any significant influence on it. We had found that agricultural price level is significantly influenced by lagged agricultural output and lagged industrial nominal income. We tried other (monetary) variables, like rate of interest, money stock, etc., but we did not find any evidence of these having significant influence on the farm price level\(^5\). This implies that our earlier results of agricultural price level stand even in the presence of monetary sector variables.

The result in Section 4.4 was as follows:

\[
\text{Log}(P_{agr}) = 6.6 - 0.923 \text{Log}(Q_{agr}(-1)) + 0.764 \text{Log}(Y_{ind}(-1))
\]

\[ R^2 = 0.990, \text{adj.-} R^2 = 0.989, \text{DW} = 1.01, \text{ADF} = -4.256 (-3.935)^6 \]

Next, we move to the analysis of the industrial price formation process.

\(^5\)\(M_3: \text{Log}(P_{agr}) = 6.75 - 0.933 \text{Log}(Q_{agr}(-1)) + 0.672 \text{Log}(Y_{agr}(-1)) + 0.084' \text{Log}(M3) \)

\[(t\text{-ratios}): (2.96) (3.5) (4.5) (0.65)\]

\[ \text{Rois: Log}(P_{agr}) = 6.53 - 0.88 \text{Log}(Q_{agr}(-1)) + 0.71 \text{Log}(Y_{agr}(-1)) + 0.02.77' \text{Rois} \]

\[(t\text{-ratios}): (2.9) (3.4) (9.9) (1.3)\]

\(^6\)*indicates that the variable is not significant.

b) Industrial Price Level

Adding monetary variables to the equation explaining the industrial price level \((P_{ind})\) we find the following long run relationship: in addition to agricultural price \((P_{agr})\) and industrial output level \((Q_{ind})\), \(P_{ind}\) depends on rate of interest \((R_{olls})\) and broad money stock \((M_3)\). The observed cointegrating relation is as follows:

\[
\log(P_{ind}) = -1.2 + 0.128 \log(P_{agr}) + 0.54 \log(M_3) + 2.8 R_{olls} - 0.32 \log(Q_{ind})
\]

\((t\text{-values}): (-3.5) (2.5) (19.1) (-3.1) (-6.5)\)

\(R^2 = 0.9987, \quad \text{adj-} R^2 = 0.9985, \quad \text{DW} = 1.35, \quad \text{ADF} = -5.003 \quad (-4.496)\)

*significant at 5 percent level, \(\circ\) significant at 1 percent level.

NOTE: Critical value for test of cointegration in parenthesis\(^7\).

The result shows that long run elasticity of industrial price level \((P_{ind})\) with respect to agricultural price level \((P_{agr})\) and broad money \((M_3)\) is found to be \((+0.13)\) and \((+0.54)\) respectively. The long run coefficient of \(P_{ind}\) with respect to the rate of interest \((R_{olls})\) stands at \((+2.8)\) which shows that for each percentage point change in rate of interest, the industrial price level is pushed up by about 2.8 percent. The long run elasticity of industrial price with respect to industrial output \((Q_{ind})\) is observed to be \((-0.32)\) indicating higher industrial output eases off the upward pressure on the industrial prices. This might possibly be through underlying improved labour productivity and/or

\(^7\)At 5 percent level, source: MacKinnon(1991).
better capacity utilization$^8$.

Next, we carry out the analysis of short run dynamics of inflationary process for the industrial sector using the following error correction mechanism$^9$:

$$
\Delta \log(P_{\text{ind}}) = 0.21 \Delta \log(P_{\text{agr}}) + 0.38 \Delta \log(M_3) + 1.71 r_{\text{trend}} - 0.013 \Delta \log(Q_{\text{ind}})
$$

\begin{align*}
\text{(t-values):} & \quad (2.96) \quad (5.1) \quad (2.2) \quad (-0.1) \\
- 0.61 e_{t-1} & \quad (-2.6)
\end{align*}

$^*$indicates significance at 5 percent level, $^\circ$indicates significance at 1 percent level.

NOTE: As mentioned earlier coefficient of determination, $R^2$ etc., would not be valid in this regression model as it does not contain an intercept term.

From the ECM result, it can be observed that in the short run all the variables, except the change in industrial output, are found to be significant in contributing to industrial inflationary process. The short run elasticities of industrial price with respect to agricultural price and broad money are observed to be ($+$) 0.21 and ($+$) 0.38 respectively. This indicates that the broad money's influence on the industrial price level is relatively stronger than agricultural price level. Though the result is similar to the long run result, the gap is narrower in the short run between the two. Also, the impact of broad money is smaller in the short run and it increase as time passes. In

\begin{align*}
\text{Log}(P_{\text{ind}}) &= -0.097 + 0.158 \log(P_{\text{agr}}) + 0.465 \log(M_3) + 3.2 \text{ RoIs} - 0.27 \log(\text{LPROD}) \\
\text{(t-values):} & \quad (-14.5) \quad (2.0) \quad (15.6) \quad (3.7) \quad (-7.5) \\
R^2 &= 0.9985, \quad \text{adj-} R^2 = 0.9983, \quad DW = 1.82, \quad \text{ADF} = -4.5869 (-4.5669 at 10 percent)
\end{align*}

$^8$This is corroborated by our analysis using labour productivity (LPROD) instead of $Q_{\text{ind}}$ in the above cointegrating coefficient. The result:

\begin{align*}
\text{Log}(P_{\text{ind}}) &= -0.097 + 0.158 \log(P_{\text{agr}}) + 0.465 \log(M_3) + 3.2 \text{ RoIs} - 0.27 \log(\text{LPROD}) \\
\text{(t-values):} & \quad (-14.5) \quad (2.0) \quad (15.6) \quad (3.7) \quad (-7.5) \\
R^2 &= 0.9985, \quad \text{adj-} R^2 = 0.9983, \quad DW = 1.82, \quad \text{ADF} = -4.5869 (-4.5669 at 10 percent)
\end{align*}

$^9$For a detailed discussion see Appendix A and B.
contrast, the agricultural price's influence is relatively stronger in the short run but it
tends to ease with time. The short run coefficient of industrial price level with respect
to rate of interest is found to be 1.7. This indicates that short run changes in the rate
of interest from its trend positively influences the industrial inflation rate, mainly
through its cost-push impact. However, the short run industrial output elasticity of
industrial price, as stated above, is found to be statistically insignificant. This reflects
that the immediate impact of industrial output's is not significant. The coefficient of
error correction term (e_{t-1}) which stands at (-) 0.61 shows that about 60 percent of
adjustment of disturbance of industrial price from the above variables is corrected in
the present period itself.

Now, we have the results of price formation process of both the sectors. Using these
we can attempt to explain the overall wholesale price index (WPI) for all
commodities. The results in levels as well as log-levels give us reasonably good
outcome. These are as follows:

c.1) in level form

\[(WPI) = 0.601 + 0.12^* (P_{agr}) + 0.72^* (P_{ind})\]

\[(t-values): (-1.2) (2.6) (15.6)\]

\[R^2 = 0.999, R^2 = 0.998\]
c.2) in log-level form

\[
\log(\text{WPI}) = -0.30 + 0.36^{\circ} \log(\text{P}_{\text{agr}}) + 0.668^{\circ} \log(\text{P}_{\text{ind}})
\]

(t-values): (-1.2) (2.6) (15.6)

\[R^2 = 0.9984, R^2 = 0.9983.\]

*indicates significant at 5 percent level. **indicates significant at 1 percent level.

In the above analysis, we found the monetary variables (especially the broad money and rate of interest) significantly influences the behaviour of inflationary process in India, especially through their influence on industrial prices, in addition to the level of output in the economy.

In the following analysis we would examine whether this measure of broad money \( (M_3) \), found to be significant statistically, could be effectively controlled by the monetary authorities. We also look at the implications of the earlier analysis of output dynamics and of the inflationary process for the monetary transmission mechanism in the Indian context.

6.4.2 The Monetary Transmission Mechanism

Firstly, we examine the possibility of any systematic relationship between the fiscal deficit \( (FD)^{\circ} \) and deficit financing\(^{11} \) \( (DFin) \) component of the fiscal deficit. Graph 6.2

\(^{10}\)Fiscal deficit is defined as difference between total expenditure and total revenue (which includes revenue receipts and non-debt creating capital receipts) of the government.

\(^{11}\)Defined as the first difference of reserve money (government). See Appendix A for more details.
GRAPH 6.2: Deficit Financing as a proportion of Fiscal Deficit
shows that deficit (or money) financing as a component of fiscal deficit has been fluctuating widely over the years. The Graph shows that money creation usually finances less than half of the fiscal deficit. The bivariate cointegration result also tends to raise serious doubts about a systematic relationship between the two. The result is as follows:

Sample 1965-1995\(^{12}\)

\[
\text{Log}(\text{DFin}) = -1.475 + 0.982 \text{ Log}(\text{FD})
\]

(t-ratios): (-0.25) (7.68)

\[R^2 = 0.686, \ R^2 = 0.675, \ D W = 1.41, \ ADF = -3.329 (-3.591)^{13}\]

NOTE: the critical value for test of cointegration test is the parenthesis.

It does not show any systematic relationship between the FD and DFin in this period. Our analysis of long run relationship of high-powered money (H) with narrow and broad money (\(M_1\) and \(M_3\)) also does not indicate any systematic relationship between the two\(^{14}\). We ran the following regression:

\[
\text{Log}(M_1) = \alpha_0 + \alpha_1 \text{ Log}(H) + \varepsilon
\]

The results are reported below:

\(^{12}\)Figures for FD are possible to compute only for this period in a consistent manner.


\(^{14}\)For a detailed survey of these issues see Palley (1994).
i) Reserve money and narrow money

\[ \log(M_1) = 0.8892 + 0.9337 \log(H) \]

\[ R^2 = 0.9963, \text{ adj}-R^2 = 0.9962, \text{ DW} = 0.319, \text{ ADF} = -1.9805 (-3.4747) \]

ii) Reserve money and broad money

\[ \log(M_3) = 0.4377 + 1.1442 \log(H) \]

\[ R^2 = 0.9973, \text{ adj}-R^2 = 0.9972, \text{ DW} = 0.271, \text{ ADF} = -1.4018 (-3.4747) \]

NOTE: Critical values for cointegration test are given in parenthesis\(^\text{15}\).

The ADF test for the presence of any long run relationship among variables does not show any evidence of cointegration (or long run relationship) between \(M_1\) and \(H\), or \(M_3\) and \(H\). This suggests that over this period the money multipliers (narrow as well as broad) have not been stable. GRAPH 6.3 also substantiates this observation.

The possible explanations for the unstable money multipliers could be many, important ones being the widening and deepening of the financial sector made possible by rapid growth, especially via the recent liberalization of the financial institutions, bank as well as non-bank. On the one hand, these institutions have been important catalysts in the process of channelizing the financial resources from surplus to deficit sectors of the economy, and on the other, they have tended to disturb the close link between reserve money (H) and money stock (M). Since 1969, the bank

\(^{15}\text{At 5 percent level of significance, source: MacKinnon (1991).}\)
nationalization process has been an important step in accelerating this transformation. In addition to these, there have been contributions from changing reserve ratios (CRR and SLR)\(^{16}\) and interest rate policy and other related policy measures in corroding the close association between the two, as is assumed by the monetarists. Thus, it can be argued that in the context of monetary transmission debate the money multiplier approach is of limited applicability in India\(^{17}\).

In the analysis of inflationary process above, we saw that broad money (M3) significantly influences the industrial price level (P\(_{\text{ind}}\)) along with other variables, both in the long run as well as in the short run. But what is more problematic is the question as to what are the determinants of broad money? The instability of the income velocity of money (narrow as well as broad) further highlights the importance of including other variable in the analysis (see Graph 6.4). We incorporate rate of interest in the analysis besides the nominal income level. The final cointegrating regression uses the following variables: level of economic activity in the goods producing sector (proxied by the agricultural plus industrial sector output), the price level (using WPI), and rate of interest (proxied by 12-months deposit rate) to explain the broad money stock. We found these variables to be having a systematic long run relationship with the broad money. The result of cointegrating regression is as follows:

\(^{16}\)Cash Reserve Ratio and Statutory Liquidity Ratio.

\(^{17}\)Sen and Vaidya (1997) also arrive at the same conclusions of no long term relation between the H and M\(_1\) or M\(_4\).
GRAPH 6.4: Income Velocity of Money - Narrow and Broad
Log(M₃) = -10.997 + 1.457 Log(Q) + 1.377 Log(P) - 7.954 (RoIs)
(t-values): (-6.15) (7.6) (14.1) (-3.5)

R² = 0.997, adj-R² = 0.996, DW = 1.37, ADF = -4.847 (-4.3494)

'indicates significance at 1 percent level.

NOTE: Critical values for cointegration test are given in parenthesis

The long run elasticity coefficients of broad money with respect to output and the price level stands at (+)1.46 and (+)1.38 respectively, well above unity (statistically). This shows that the credit distributed by the organized sector banking institutions (M₃) in the economy expands at a faster pace in response to expansion in the output and/or price level for each percentage change, possibly due to expanding levels of monetization of the economy. The long run elasticity coefficient of broad money with respect to rate of interest is observed to be (-) 7.9 which shows that for each percentage point increase in the rate of interest, the banking sector credit stock in the economy falls by almost 8 per cent in the economy. This seems to reflect the cost of borrowed funds aspect of the organized banking sector.

Next, we examine the short run behaviour of these variables with regards to their influence on the growth of broad money stock using the error correction mechanism, existence of which is ensured by the above stated cointegration relationship. The

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19 This process is also sometimes referred to as monetary widening process.
20 See Appendix A and B for details.
ECM result is as follows:

\[ \Delta \text{Log}(M_3) = -0.824 \Delta \text{Log}(Q) + 0.998 \Delta \text{Log}(P) - 3.399 \text{r}_{\text{trend}} - 0.464 \epsilon_{t-1} \]

(t-values): (-3.9) (7.0) (-1.8) (-3.9)

*indicates significance at 1 percent level, *indicates significance at 10 percent level, *indicates significance at 5 percent level.

We find that the short run elasticity of broad money \( (M_3) \) with respect to level of output \((Q)\) and the price level \((P)\) stands at (+)0.82 and (+)0.99 respectively, both very close to unity. This shows that even in the short run price and output influence the broad money on almost one-to-one basis.\(^{21}\) The rate of interest (the detrended 'r' series, \( r_{\text{trend}} \)) is also found to be significant and has the expected negative sign with coefficient (-)3.4. That is, for each percentage point deviation in the rate of interest from its trend, broad money changes by about 3.4 per cent in the opposite direction.

The error correction term \( (\epsilon_{t-1}) \) is also statistically significant with a coefficient of (-) 0.46. This means that about 46 per cent of the adjustment takes place in the current period whenever broad money deviates from its long run equilibrium relationship with the level of economic activity, price level, and the rate of interest.

**Multivariate Causality tests:**

First we checked out the direction of causality (using Wald coefficient elimination

\(^{21}\) Tested statistically as well.

\(^{22}\) We found it to be trend-stationary and therefore it needed detrending to make it stationary.
test, see Appendix B for details) for the agricultural and industrial price relationships. It can be observed that the agricultural output along with industrial income (with their lags) significantly affect the farm price level\textsuperscript{23}. In the regression of industrial price relation we observe that the rate of interest, agricultural price, industrial output and broad money all significantly influence it. This tends to confirms the above cointegrating regression relationships for the two price levels indicating long run systematic relationship between these variables (the detailed result in Endnote 6.1).

Next, we carry out the test of causality on money stock variable. The result clearly indicates that the price-level, the output level, and the interest rate significantly influence the broad money ($M_3$). The detailed results are reported in the Endnote 6.1.

6.5 Interpretation and Conclusions

In our empirical results of the inflationary process, we found that the inflation outcome is dependent not just on broad money stock but also on agricultural output level (lagged), industrial output level (current as well as lagged), and the rate of interest. However, the results did not show any clear evidence of reserve money (or deficit financing) having any significant systematic influence on the inflationary process in India. It could, therefore, be legitimate to argue that the monetarist proposition of one-to-one correspondence between reserve money and the price level is ruled out. The results also put serious doubts on the implicit monetarist assumption

\textsuperscript{23}See Endnote 4.1 and Section 4.5 of Chapter 4 for details.
of one-to-one correspondence between fiscal deficit and money financing of the fiscal deficit. These results on the price formation process seem to be closer to the conflicting claims models as the variables influencing price level are mainly cost-push and profit-push, especially for the industrial price-formation process. However, some impact of demand (proxied by industrial sector income) and supply (proxied by agricultural output) variables is not ruled out, especially for the agricultural price formation process. But the more extreme structuralist proposition of food (or agricultural) output as the sole determinant (or initiator) of the inflationary process is not found to be a sufficient explanation. The fact that lagged rather than current level of output is found to be significant suggesting the importance of stockholding of farm commodities in the Indian context.

The strong impact of broad money on industrial price level reflects, probably, the importance of credit availability to the industrialists in their pricing decisions, as pointed out by Sanyal (1996) in his version of the conflicting claims model of price formation process in the developing country context. However, perhaps the important point to note is that price level gets affected by broad money stock (M₃ here) which is observed to be endogenous in nature rather than by the reserve money which is usually in the direct control of the monetary authorities. This implies that the cutting down of the fiscal deficit (or more precisely the money financing of the fiscal deficit) is unlikely to have any significant impact on the inflationary process in the Indian context.

24 It is the most important component of the reserve money.
These findings seem to corroborate the conclusions of Blanchard and Fischer (1989) that, "...the data rarely show a positive association between budget deficit and the inflation rate" (p 513). In the Indian context, the results seems to substantiate, partly, the observations of Chakravarty Committee Report. To quote from the Report, "...The Indian experience in regard to price behaviour shows that inflationary pressures are generated by a simultaneous operation of several forces. For example, in the case of agricultural commodities, administered prices and supply-demand factors have a dominant impact on price behaviour while prices of industrial products are eventually influenced by cost-push factors..." (RBI, 1985, p 150).

The empirical results about broad money stock clearly show that the money multiplier process by which reserve money is supposed to determine (broad) money stock is found to be inadequate as an explanation. In contrast, reasonably good results are obtained in which broad money stock, reflecting overall liquidity position in the economy, is found to be significantly influenced by the level of economic activity, the price level, and the rate of interest. This seems to substantiate the argument that broad money stock responds endogenously to the requirements of expanding levels of income and the rate of interest, without any simple causal link with the fiscal deficit.
The result from multivariate causality tests:

A dynamic specification of the equation was estimated with three set of lags, thought reasonable, of the variables. The model, as in the estimated equation, was progressively reduced to the most parsimonious representation possible. The estimated equations are as follows:

i) the price level

a) agricultural price level

Discussion under Section 4.5 of Chapter 4 remains unchanged.

b) the industrial price level

\[ \Delta \log(P_{in}) = -0.007 + 0.156 \Delta \log(P_{ag}) - 0.288 \Delta \log(Q_{ind}) + 0.509 \Delta \log(M_3(-1)) + 1.605 r_{trend} \]

\[ R^2 = 0.713, \quad \text{adj-}R^2 = 0.684, \quad DW = 1.71 \]

Note: figures in the parenthesis are the t-ratios

The results from Wald coefficient test

<table>
<thead>
<tr>
<th>Variables</th>
<th>F-statistic</th>
<th>prob.-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>agricultural price</td>
<td>7.521</td>
<td>0.009</td>
</tr>
<tr>
<td>$P_{ag}[c(2)=0]$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>broad money</td>
<td>42.700</td>
<td>0.000</td>
</tr>
<tr>
<td>$M_3[c(3)=0]$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interest rate</td>
<td>5.754</td>
<td>0.021</td>
</tr>
<tr>
<td>$r[c(4)=0]$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial output</td>
<td>4.511</td>
<td>0.040</td>
</tr>
<tr>
<td>$Q_{ind}[c(5)=0]$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: All the variables in the log-difference form.

c(i), i=2,3,4,5; refers to the respective coefficient of the variable to be tested.
ii) the broad money stock

\[ \Delta \log(M_3) = 0.0595 + 0.23 \Delta \log(Q) + 0.36 \Delta \log(Q(-1)) + 0.483 \Delta \log(Q(-2)) + 0.224 \Delta \log(P(-1)) + 0.333 \Delta \log(P(-2)) - 2.893 (r_{trend}) \]

\[ R^2 = 0.403, \quad \text{adj-}R^2 = 0.301, \quad DW = 1.22 \]

Note: figures in the parenthesis are the t-ratios.

Testing for the significance for causality of the variables \(M_3\) with \(P\), \(Q\) and \(r\) involves checking whether \(Q\) (current and lagged) and other variables with their lags are individually helpful in explaining of current \(M_3\). We used the Wald test of coefficient restriction (using F-test) to check for the significance level of the variables.

The results from Wald coefficient test

<table>
<thead>
<tr>
<th>Variables</th>
<th>F-statistic</th>
<th>prob.-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>output (Q[c(2)=c(3)=c(4)=0])</td>
<td>3.86</td>
<td>0.017</td>
</tr>
<tr>
<td>price (P [c(5)=c(6)=0])</td>
<td>9.01</td>
<td>0.0007</td>
</tr>
<tr>
<td>interest rate (r [c(7)=0])</td>
<td>8.83</td>
<td>0.005</td>
</tr>
</tbody>
</table>

NOTE: All the variables in the log-difference form.

\(c(i), i=2,3,4,5,6,7\), refers to the respective coefficient of the variable to be tested.
The Flow Diagram: Real and Monetary Sector Interactions in INDIA

- $Q_{agr}$
- $Q_{ind}$
- $C^{*}_{gov}$
- $I^{*}_{gov}$
- $I_{pvt}$
- $I_{r}$
- $M_3$
- $P$
- $P_{agr}$
- $P_{ind}$
- $RoIs^{*}$
- $Y_{ind}$

* exogenous variables
others all endogenous