5.1 Introduction

In our analysis of process of interactions between industry and agriculture in India in the last chapter we observed that variables relating to the agricultural sector, i.e., output and price level, were found to be insufficient on their own to explain the performance of the industrial sector satisfactorily. This indicates that other sectors/factors have also been important in exerting their influence on performance of the industrial sector over the years. Following from there, here we examine some of these possible variables, along with agricultural sector variables, and explore their impact on the level and growth of the industrial output in India. In Section 4.2 the performance of the industrial sector was reviewed in detail and here we pick up the thread of discussion and proceed further.

This chapter is organized as follows: Section 5.2 presents a review of the literature on industrial output growth in the Indian context. Various hypotheses emerging from different studies are examined in this backdrop. The empirical analysis relating to the factors responsible for industrial output level and its growth are dealt with in Section 5.3 in the light of different hypotheses. Section 5.4 provides some concluding observations.
5.2 The Literature on Industrial Growth:

We have seen in Section 4.2 that industrial growth in India has been characterized by significant fluctuations in the post-independence period. These fluctuations, especially the deceleration phase from the mid-sixties to late seventies, evoked considerable debate regarding the factors influencing the process of industrial growth. Different economists have offered different explanations with regard to variables affecting industrial performance. The main thrusts of the various explanations offered may be summarized here under:

i) **Performance of agricultural sector:** Most studies broadly say that the unsatisfactory performance of the agricultural sector, as we discussed in Section 4.3 earlier, can have a serious impact on industrial growth via the demand-supply linkages between the two sectors [Chakravarty, 1974; Raj, 1976; Mitra, 1977; Vaidyanathan, 1977; Rangarajan, 1982; Ahluwalia, 1985; Rao, 1993;]

ii) **Agricultural price** ($P_{agr}$): From our analysis of agricultural sector in Section 2.4 we found that the current price of the farm output is not significantly influenced by current agricultural output. Consequently, the agricultural price ($P_{agr}$) is likely to influence the industrial output level in an independent manner. However, its net impact is likely to depend on the interplay of various forces\(^1\). Krishnaji (1992) also argued that "*other things remaining the same, rising cereal prices depress the demand for the manufactures*" (p 105)\(^2\). In

\(^1\)For instance a higher level of $P_{agr}$, on the one hand, increases the income of the surplus producing farmers but, on the other hand, it leads to contraction of incomes of the agricultural landless labourers and small and marginal farmers as well as of industrial workers.

\(^2\)Bose (1993) also of the opinion that impact of higher farm prices will be negative on industrial output.
Taylor’s view (1984) if Engel effects are strong then a rise in the food prices will choke-off the demand for non-agricultural (or industrial) sector\(^3\). Storm (1993), in his analysis, finds that with rising crop prices, agricultural income and demand rises, adding to consumer price inflation. Nominal wages in industry, generally indexed to cost of living index of workers, also tend to rise correspondingly\(^4\);

iii) **Level of public investment** \((I_{gov})\): Public investment, on the one hand, has impact in terms of expanding demand for industry and at the same time, it eases the infrastructural bottleneck, on the supply side. This is because in India, as also in many other developing economies, the financing of infrastructural projects is crucially dependent on the public investment, which is usually assumed to be autonomous [Patnaik and Rao, 1977; Srinivasan and Narayana, 1977; Rangarajan, 1982; Lahiri et al., 1984; Ahluwalia, 1985];

iv) **Public consumption** \((C_{gov})\): Public consumption expands demand for industrial products directly. The public consumption in India has been growing at steady pace over the years, unlike public investment which has been subject to significant fluctuations in the period under consideration (Graph 5.1) [Lahiri et al., 1984; Sanyal et al., 1990; Maiti and Rao, 1995];

v) **Private investment** \((I_{priv})\): Another important component of the demand generated by the industrial sector is the private investment component. One of the prime determinants of private investment may be public investment itself. There are many forms of linkages between public and private investment. In a demand constrained industrial sector, public expenditure (investment as well as consumption) is expected to stimulate private investment both directly by stimulating aggregate demand and indirectly through relaxing infrastructural bottlenecks on the supply side. In this context, it is also important to keep in mind the debate relating to crowding out of public investment.  

\(^3\) p 43-44.  
\(^4\) p 197.
GRAPH 5.1: Public Consumption and Investment Expenditure
(at constant prices)
investment is often argued to be a cause of 'crowding out' private investment through financial and physical channels. The physical channel is supposed to work through the lowering of investible resource availability for the private sector if public sector picks up a larger proportion of these resources. The financial crowding out works through raising the cost of borrowing funds for investment purposes for the private sector when the public sector comes to the financial markets in a big way for meeting its resource requirements. Both the arguments implicitly assume that there is fixed amount of available investible resources and the two sectors are competing for the same pool of resources. This is usually not the case for a growing economy 5.

Ahluwalia (1985) found, on the basis of empirical analysis, the following four factors responsible for industrial slow-down since the mid-sixties: a) slow growth in agricultural incomes which meant slower expansion in demand for industrial products; b) slowdown in public investment and the resulting infrastructural bottlenecks; c) poor management of the infrastructure industries; and d) restrictive industrial and foreign trade policies.

Rangarajan's (1982) study, for the period 1960-1982, of agriculture-industry interactions also observed that agricultural growth significantly affects industrial output growth. He showed that 1 percent increase in agricultural output by itself generated a rate of growth of 0.5 percent in industry.

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5 In the opinion of Post-Keynesians, through appropriate use of monetary policies, the monetary authorities can regulate the cost of borrowing in the desired direction.
Lahiri et al (1984) estimated an econometric model in which special stress was given to government policies and international trade in the determination of the output and the price level. Their study found following important determinants of output: a) real government expenditure; b) real exports; c) real income of the primary sector; and d) the availability of credit. This work provided empirical support for the hypothesis emphasized by Raj (1976) and Chakravarty (1979) about real income of the agricultural/primary sector being an important source of demand for the industrial sector. The model formulation emphasized the role of demand factors. The authors believed that the supply bottlenecks were not significant in this context.

Mukhopadhyay (1992) estimated a demand-supply model for the industrial sector and also concluded that the industrial deceleration was mainly due to the demand constraint.

Rao (1993) attempted an analysis of the determinants of industrial sector output in the 'dual economy' setting for the 1950-1990 period. Her empirical results show that demand side variables, public expenditure and income accruing to the farm sector, provided a reasonably satisfactory explanation.

Balakrishnan's (1995) analysis using the time-series methodology indicates that three variables, namely, agricultural output, public sector investment, and domestic terms of trade together explained quite well the short run variation in the industrial output.
In our analysis of these studies, we find that one or more of the following factors, public investment, infrastructural facilities, agricultural output, policy of import substitution, and the domestic terms of trade turn out to be significant in explaining the industrial performance. However, on the whole, demand-side factors were found to be more critical than the supply-side variables.

In order to analyze empirically the role of various factors the industrial output \( Q_{\text{ind}} \) could be written as a function of these variables, i.e.,

\[
Q_{\text{ind}} = \alpha \left[ Q_{\text{agr}}, \frac{P_{\text{agr}}}{P_{\text{ind}}}, C_{\text{gov}}, I_{\text{gov}}, I_{\text{pot}}, X \right]
\]

where \( X \) stands for other variables.

5.3 The Empirical Evidence

In this chapter also, as earlier, we use the tests of stationarity before going for the cointegration analysis to carry out the empirical exercise for our purpose of finding out the probable variables affecting the industrial output level.

A) Cointegration and error correction mechanism

The variables, \( Q_{\text{agr}}, P_{\text{agr}}, \frac{P_{\text{agr}}}{P_{\text{ind}}}, C_{\text{gov}}, I_{\text{gov}}, \) and \( I_{\text{pot}}, \) are all found to be integrated of order one. We check for the above mentioned variables whether they have any long run relationship with the industrial output. To do this we carried out the Engle

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\[\text{For a detailed survey of these issues see Krishna (1995) and Mookherjee (1996).}\]

\[\text{For data and stationarity and cointegration issues see Appendix A.}\]
Granger (EG) cointegration two step procedure.

The analysis indicates that level of real public investment, on its own, does not significantly influence the level of industrial output. However, it is found to be statistically significant when we take real total investment as the explanatory variable. In other words, in the empirical analysis we find level of real aggregate investment (public plus private) to be affecting significantly the level of industrial output.

A.1) Public and Private Investment

In this context, it becomes important to investigate whether there exists any relationship between the public and private investment. In other words, does public investment stimulate private investment or compete with it? Empirical results clearly show that there exists a long run relationship between public and private (corporate as well as household) investment in India. The result on the testing of possible crowding-out of private investment does seem to indicate that the public investment does stimulate private corporate as well as household sector investment in the Indian economy. The results from the direction of causality indicate quite clearly that public investment Granger-causes private corporate investment as well as household sector investment.

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8 Which includes household and private corporate investment.

9 All the result are based on the figures for the current prices as the decomposition for these categories at constant prices is available only from the eighties.
The following cointegrating relation was estimated:

\[ \log(I_{pvt}) = \alpha_1 + \beta_1 \log(I_{ps}) + \epsilon_1 \]

where Ipvt = Ipcs or Ihh.

The results are as follows\(^{10}\):

(i) public and private corporate investment\(^{11}\):

\[
\log(I_{pcs}) = -1.703 + 1.0869 \log(I_{ps})
\]

(t-values): (-3.91) (21.5)

\[ R^2 = 0.9152, \text{ Adj-R}^2 = 0.9132, \text{ DW} = 1.47, \text{ ADF} = -5.378 (-3.4747) \]

(ii) public and household investment\(^{12}\):

\[
\log(I_{hh}) = 0.844 + 0.911 \log(I_{ps(-1)})
\]

(t-values): (3.46) (35.9)

\[ R^2 = 0.967, \text{ Adj-R}^2 = 0.966, \text{ DW} = 0.672, \text{ ADF} = -3.2574 (3.139) \]

NOTE: Figures in parenthesis are the critical values.

where

- Ips = Gross Capital Formation in the public sector at current prices.
- Ihh = Gross Capital Formation in the household sector at current prices.
- Ipcs = Gross Capital Formation in the private corporate sector at current prices.

The first result shows a strong long run elasticity of private corporate investment with respect to public investment. This implies that public investment's stimulatory impact on corporate investment is almost one to one in the long run. The evidence on

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\(^{10}\) All the investment component variables, Ipvt, Ips, Ihh were found to be integrated of same order which is a necessary condition to do a meaningful cointegration analysis.

\(^{11}\) The least square error is found to be stationary from this regression which is statistically significant at 1 percent level.

\(^{12}\) The least square error is found to be stationary from this regression which is statistically significant at 10 percent level.
direction of causality also confirms that public investment Granger-causes private corporate investment (result in Endnote 5.1).

The second result shows a very strong (+ 0.91) long run elasticity of household investment with respect to public investment. This implies that public investment’s stimulatory impact on household investment is somewhat weaker relative to its impact on private corporate investment in the long run. The evidence on direction of causality here also confirms the importance of the public investment in encouraging household sector investment (Result in Endnote 5.1).

These results highlight the complementary nature of public and private investment in the long run in the context of the economy of India.

Analysis of the short run dynamics using the error correction mechanism (ECM) further enhances the validity of these results which also show a significant impact of the public investment on the private corporate and household sector investment. The ECM results are

(i.a) Public and Private Corporate Sector Investment

\[
\Delta \text{Log}(Ipcs) = 1.354 \Delta \text{Log}(Ips) - 0.751 e_{t-1} \\
(\text{t-values}): (2.82) (-5.12)
\]

(i.b) Public and household Sector Investment

\[
\Delta \text{Log}(Ihh) = 0.393 \Delta \text{Log}(Ips(-1)) - 0.349 e_{t-1} \\
(\text{t-values}): (2.3) (-3.31)
\]
We observe that the short run elasticity coefficient of private corporate investment with respect to public sector investment to be 1.35 (well above unity) which shows strong positive impact of public investment on the private corporate investment. The speed of adjustment of $I_{pcs}$ is also found to be swift with three-quarter of the adjustment [(coefficient stands at (+) 0.76] taking place in the current period itself.

However, the impact on the household sector of the public investment is not so strong though it is positive and the elasticity coefficient of household investment with respect to public investment is found to be 0.39. Also, the speed of adjustment is relatively slow with only about one-third adjustment taking place in the current period.

A.2) *The Other Variables:*

The other variables besides real investment which were observed to be significant in stimulating industrial output are *agricultural output* (or real farm income) and the *real government consumption expenditure*. The *agricultural price* was found to be statistically significant only at 15 percent level and therefore has been dropped from the subsequent analysis of industrial sector. The countervailing forces seem to neutralize largely the impact of *agricultural price level* on *industrial output*. The final cointegration regression that we arrive at is summarized as:
Log(Q_{ind}) = -1.61 + 0.466 \ log(Q_{agr}) + 0.442 \ log(C_{gov}) + 0.28 \ log(I_r) \\
(t-values): \ (-2.9) \ (5.4) \ (10.2) \ (5.8) \\
R^2 = 0.997, \ \text{adj-} R^2 = 0.996, \ DW = 1.2, \ ADF = -4.9797 \ (-4.3492)^{13}

Note: Figures in parenthesis is the 5 percent critical value.
All the variables were found to be significant at 1 percent level.

As can be seen from the above equation, all the three variables are found to be statistically significant. The coefficient of Log(Q_{agr}) = 0.47, represents the long-run elasticity of Q_{ind} with respect to Q_{agr}. This indicates positive long-run impact of the agricultural output on industrial output given C_{gov} and I_r. More quantitatively, 1 percent growth in Q_{agr} is estimated to stimulate about 0.47 percent growth in industry in the long run.

The elasticity coefficient of Q_{ind} with respect to real public consumption, C_{gov}, for long-run stands at 0.44 and, as expected, is positive and significant indicating strong demand impact of the public consumption over the long run. It is found to be very close to the coefficient of Q_{agr} and also more robust.

The long-run elasticity coefficient of Q_{ind} with respect to real investment spending (I_r) stands at 0.28 with expected positive sign. It is also found to be significant at 1 percent indicating strong effect of real aggregate investment in the economy over the long run. However, its elasticity coefficient is found to be much smaller than Q_{agr} and

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C\textsubscript{gov} which means the long run stimulating impact of the investment expenditure to be rather limited relative to the other two variables.

As we know that cointegration among the variables implies existence of error correction model (ECM)\textsuperscript{14}, we set up an ECM for analyzing the short run dynamics of change in the industrial output. The following ECM was set-up:

\[ \Delta \text{Log}(Q_{\text{ind}}) = \delta_1 \Delta \text{Log}(Q_{\text{agr}}) + \delta_2 \Delta \text{Log}(C_{\text{gov}}) + \delta_3 \text{Log}(l_t)_{\text{trend}} + \delta_4 (e_{t-1}) \]

The results:

\[ \Delta \text{Log}(Q_{\text{ind}}) = 0.33^* \Delta \text{Log}(Q_{\text{agr}}) + 0.62^* \Delta \text{Log}(C_{\text{gov}}) + 0.05 R_{t} - 0.33^o (e_{t-1}) \]

(t-ratios): (4.1) (7.7) (1.04) (-2.2)

* indicates significance at 1 percent level, \(^o\) indicates significance at 5 percent level.

Note: The Log(\(l_t\)) series is found to be trend-stationary variable, hence it was used in the ECM after detrending it. \(R_t\) is the relevant detrended variable.

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.

In above equation describing the short-run dynamics, the coefficient of \(\Delta \text{Log}(Q_{\text{agr}})\) equal to (+) 0.33, represents the short-run elasticity of industrial output with respect to agricultural output. This indicates positive short-run impact of the agricultural output on industrial output. In the short run, impact of changes in agricultural output is found to be moderate indicating that the full impact of agricultural output on the

\textsuperscript{14}See the Appendix A for a detailed discussion.
industrial output takes some time to fully develop.

The coefficient of $\Delta \log(C_{gov})$, the short run elasticity coefficient of industrial output with respect to government consumption, is found to be highly significant and equal to 0.62 indicating a strong short run demand impact of government consumption spending on industrial sector output growth. The short-run elasticity coefficient of government consumption is found to be higher relative to the short-run coefficient for agricultural output indicating former's strong influence on the performance of the industrial sector than latter's. Real public consumption expenditure's impact on the industrial output is found to be stronger in the short run, however, part of the effect in the long run tends to get evened out. This indicates that part of the immediate impact of government consumption gets somewhat weakened in the long run. In contrast, the agricultural output has much stronger impact over the long run than in the short run on the industrial sector output.

Real investment spending¹⁵ is not found to be statistically significant in the short run dynamics. This could, possibly, be because investment takes time to have its impact on the industrial output and therefore is observed to be significant only in the long run.

¹⁵ Which is observed to trend-stationary variable, hence detrended for the ECM analysis.
The error correction term was also found to be significant indicating the importance of the adjustment when the dependent variable deviates from its long-run relationship with the other variables. Its coefficient at (+) 0.33 tells us the speed at which the adjustment takes place in the presence of disturbance from the long-run relationship among the variables. This coefficient indicates that only about a third of the adjustment takes place in the current period in the wake of a deviation of the dependent variable from the other variables from their long-run equilibrium in the last period.

The above analysis suggest that the government policy's influence is more important from final consumption side relative to the influences exerted through its investment decisions. This is a somewhat unexpected finding. However, public investment together with private investment (i.e. aggregate investment) does seem to have significant influence on the level of industrial output in the long run. Agricultural output is also found to be important in its influence on industrial sector performance and the impact is found to be relatively stronger in the long run than in the short run.

In contrast, agricultural price is not found to play any significant role in the empirical analysis. This could be happening due to the interplay of countervailing forces associated with change in the level of farm prices as discussed above (see Section

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16 This could be due to the larger fluctuations of public investment relative to public final consumption. Also, public investment in infrastructure sectors is likely to create more conducive environment which is likely to have stimulatory impact on private investment and correspondingly on the industrial output.
5.2) The terms of trade ($\frac{P_{agr}}{P_{ind}}$) variable also was not found to be having any significant impact on the industrial output level.

B) The multivariate causality test

The results from the Wald Coefficient test indicate that agricultural output, real consumption expenditure of the government, and real investment spending do significantly influence the industrial output. The analysis was carried out using the stationary transformation of the variables (results in the Endnote 5.1).

In the multivariate analysis, we also checked out whether the other variables add anything to the explanation of the agricultural output. We found that variables other than the industrial output ($Q_{ind}$) do not significantly influence the agricultural output (detailed result in the Endnote 5.1). This strengthens the finding of the last chapter in which we found that industrial output is significant in explaining agricultural output.

5.4 The Concluding Observations

The analysis carried out in this chapter suggests that the industrial output is, in fact, endogenous but not in any simple way as often postulated in macro models based on relative exogenity of agricultural sector. This finding is in congruence with the

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This also raises doubt about the argument of Bose(1993), Storm(1993), Taylor(1984) of negative influence of a higher agricultural price on industrial output.
findings of a few other studies which also have arrived at similar conclusions\(^\text{18}\). In the last chapter while analyzing the process of interactions between industry and agriculture, we observed that the industrial output appeared to be relatively exogenous and not influenced markedly by agricultural sector variables. However, following from the findings of this chapter based on more elaborate analysis we find that both agricultural output as well as industrial output emerge as endogenous variables and mutuality of the output of the two sectors is an important finding in this context. They depend on each other, but in the process are also influenced by other macro variables.

The other important findings is that real government consumption spending is found to be quite strong in its influence on industrial output in the long run as well as in the short run. In the long run, however, part of the impact gets neutralized though it still remains stronger relative to the farm sector. The agricultural output's impact is observed to be much stronger in the long run than in the short run which means that the full impact of agricultural output on industrial output takes time to materialize.

Other important deduction of the analysis is that the role of government is found to be much more important from the consumption side rather than from the investment side in the long as well as in the short run. *Real Public investment* is found to be an important determinant along with *real private investment* but only in the long run\(^\text{19}\).

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\(^{19}\)However, we do observe evidence of public investment having long run relationship with private corporate and household investment and significantly influencing these as well.
Real investment in the short run, however, is not observed to be a significant explanatory variable.

Out of these variables real public consumption expenditure is clearly a demand-side variable whereas the agricultural output could influence the industrial sector output from the demand as well as supply side. The same could be argued for the real investment variable as it stimulates demand for industrial products and at the same time has facilitating impact on the industrial output. This is especially the case for public investment as it has stimulatory influence on the private sector investment.

From the analysis carried out so far we find that government's final consumption expenditure emerges as the exogenous variable for the industrial output. Part of the investment demand component, i.e., the public investment, could also be considered as exogenous in its influence on industrial output through its impact on the private sector investment. On the other hand, industrial output was observed to be an important variable for explaining agricultural output as well as agricultural price determination as we saw in the Section 4.4 of the last chapter. The agricultural price was observed to be determined by lagged farm output as well as lagged nominal industrial income (which is a function of industrial price and output).

So, we find that the empirical results raise serious doubts about the exogenity of either agricultural or industrial output in the process of interactions between the two sectors.
in the Indian context. We find that the mutuality of the output levels is what describes this interaction better. The theoretical literature needs to incorporate these empirical findings for more meaningful analyses.

In this context, it becomes important to look at the inflationary process in greater detail as it has significant influence on the output dynamics in the Indian economy. This is the subject matter of the next chapter.
The result from multivariate causality:

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

I) The estimated regression for the $Q_{\text{ind}}$:

$$\Delta \log(Q_{\text{ind}}) = 0.0395 + 0.197 \Delta \log(Q_{\text{agr}}) + 0.155 \Delta \log(Q_{\text{agr}}(-1)) - 0.09* \Delta \log(P_{\text{agr}}(-1)) + 0.127^{\circ} \Delta \log(C_{\text{gov}}(-1)) + 0.109 \Delta \log(I_{r})$$

$R^2 = 0.532$, $\text{adj-R}^2 = 0.471$, $\text{DW} = 1.66$

* indicates significance at 5 percent level, $^{\circ}$ indicates significance at 10 percent level.

Note: figures in the parenthesis are the t-ratios

Testing for the significance for causality of the variables $Q_{\text{agr}}$, $P_{\text{agr}}$, $I_{r}$ and $C_{\text{gov}}$ with $Q_{\text{ind}}$ involves checking whether $Q_{\text{agr}}$ (current and lagged) and others individually are helpful in explaining of current $Q_{\text{ind}}$ or not. 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>$Q_{\text{agr}}$ [c(2)=c(3)=0]</td>
<td>7.213</td>
<td>0.0022</td>
</tr>
<tr>
<td>$P_{\text{agr}}$ [c(4)=0]</td>
<td>4.003</td>
<td>0.0526</td>
</tr>
<tr>
<td>$C_{\text{gov}}$ [c(5)=0]</td>
<td>3.026</td>
<td>0.0900</td>
</tr>
<tr>
<td>$I_{r}$ [c(6)=0]</td>
<td>16.50</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

NOTE: The above analysis was using the stationary transformation of the variables, i.e. all the variables in the log-difference form.

$c(i)$, $i=2,3,4,5,6$; refers to the respective coefficient of the variable to be tested.
II) The estimated regression for the $Q_{agr}$:

\[
\Delta \log(Q_{agr}) = -0.032 + 0.89 \Delta \log(Q_{ind}) + 0.408 \Delta \log(P_{agr}(-1)) - 0.277 \Delta \log(C_{gov}) + 0.227 \Delta \log(C_{gov}(-1)) - 0.279 \Delta \log(C_{gov}(-2)) + 0.0525 \Delta \log(I) - 0.22 \Delta \log(I(-1)) + 0.134 \Delta \log(I(-2))
\]

$R^2 = 0.368, \text{ adj-}R^2 = 0.220, \text{ DW} = 2.7$

<table>
<thead>
<tr>
<th>Variables</th>
<th>F-statistic</th>
<th>prob.-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{ind}$ [c(2)=0]</td>
<td>5.524</td>
<td>0.0247</td>
</tr>
<tr>
<td>$P_{agr}$ [c(3)=0]</td>
<td>7.956</td>
<td>0.0079</td>
</tr>
<tr>
<td>$C_{gov}$ [c(4)=c(5)=c(6)=0]</td>
<td>0.907</td>
<td>0.4477</td>
</tr>
<tr>
<td>$I$ [c(7)=c(8)=c(9)=0]</td>
<td>1.637</td>
<td>0.1989</td>
</tr>
</tbody>
</table>

NOTE: The above analysis was using the stationary transformation of the variables, i.e. all the variables in the log-difference form.

where c(i), i=2,3,4,5,6,7,8,9; refers to the respective coefficient of the variable to be tested.
### Pairwise Granger Causality Tests

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>lags</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ips does not Granger Cause Ipcs</td>
<td>44</td>
<td>1</td>
<td>4.79535</td>
<td>0.03428</td>
</tr>
<tr>
<td>Ipcs does not Granger Cause Ips</td>
<td></td>
<td></td>
<td>0.33776</td>
<td>0.56431</td>
</tr>
<tr>
<td>Ips does not Granger Cause Ipcs</td>
<td>43</td>
<td>2</td>
<td>3.54088</td>
<td>0.03889</td>
</tr>
<tr>
<td>Ipcs does not Granger Cause Ips</td>
<td></td>
<td></td>
<td>0.39019</td>
<td>0.67961</td>
</tr>
<tr>
<td>Ips does not Granger Cause Ihh</td>
<td>42</td>
<td>3</td>
<td>2.56479</td>
<td>0.07027</td>
</tr>
<tr>
<td>Ihh does not Granger Cause Ips</td>
<td></td>
<td></td>
<td>2.14511</td>
<td>0.11211</td>
</tr>
</tbody>
</table>

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

Ips, Ipcs, Ihh refer to Gross Capital formation at current prices of public sector, private corporate sector and household sector respectively.