THE GROWTH BEHAVIOUR OF MANUFACTURING INDUSTRIES IN INDIA : A CROSS - SECTION ANALYSIS

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1. Introduction

The growth rate of the manufacturing sector in India slowed down from the mid-sixties, the trend rate of growth of value-added declining from about 7.6 per cent annum during the period 1959-60 to 1965-66 to 5.5 per cent per annum during 1966-67 to 1978-79, according to one recent estimate[1/]. While causes of this deceleration have been the subject of an extended debate, the answers have remained somewhat ambiguous. This is partly because the discussion has been conducted at a rather aggregative and general level and partly because competing explanatory hypotheses have rarely been subjected to any rigorous tests.

One major exception is the work of Ahluwalia, cited above. Ahluwalia did undertake a careful statistical exercise based on a disaggregated statistical picture of the growth performance of some twenty different industries. However, Ahluwalia's main purpose was to test some of the existing hypotheses at the aggregative level and relatively little use was made of the excellent data which she assembled for the potentially useful exercise of re-examining the problem in a disaggregated frame of reference[2/].

The purpose of the present exercise is precisely to address the problem at this disaggregated level. In other words, the determinants of growth in Indian manufacturing industry are sought to be identified by drawing on the very substantial variations between different industries in their growth performance. The average annual rates of growth for twenty manufacturing industries at the 2-digit level of disaggregation of the Annual Survey of Industries for the period 1960 to 1977 are shown in Table 1.

TABLE 1

Compound Annual Growth of Gross Value-Added: 1960-62 to 1975-77

Below Average Growth			Above Average Growth		
Sr.No.	Sector	Growth rate	Sr.No.	Sector	Growth rate
04	Non-ferrous Metals	-2.7	11	Motor Vehicles Repair	7.4
09	Railway Equipment	-0.4	10	Motor Vehicles	8.3
18	Food Products, etc.	0.6	17	Pulp & Paper	8.7
20	Sugar	1.9	01	Chemicals	8.9
15	Structural Clay Products	2.3	06	Non-electrical Machinery	9.8
16	Textiles	2.8	07	Electrical Machinery	11.2
19	Tobacco Products	3.0	05	Electric Light & Power	14.0
13	Rubber Products	4.0			
14	Petroleum	4.3			
02	Cement	4.4			
12	Metal Products	4.8			
08	Shipbuilding	5.3			
03	Steel	5.8			

Source: Computed from Annual Survey of Industries.

The average compound growth for the period 1960-62 to 1975-77 works out to 6.5 per cent. Seven industries, mostly manufacturing, engineering and chemical products, grew at higher than average rates, going up to 14.0 per cent in the case of electrical light and power. The thirteen industries growing at rates below the average included almost all the agro-based industries and at first sight it is tempting to draw an input-based distinction between the slow growing agro-based industries and the faster growing chemical and engineering industries as facing different constraints to growth. It can be argued that the former are constrained by the slow growth of agriculture, i.e., the supply of inputs, which has not constrained the latter.

In the study cited earlier, Ahluwalia drew attention to this distinction. She pointed out that agro-based industries, presumably constrained by the normally tardy pace of raw material supplies from agriculture, grew at a slow but stable trend rate which did not decline after the mid-sixties. On the other hand, it was the faster growing basic and capital goods industries which faced a distinct decline in grwth since the mid-sixties, possibly as a consequence of the sharp decline in public investment around that period. It is possible to read into this an implied dichotomy between a supply-constrained agro-based subsector and a demand-constrained producer goods subsector within manufacturing industry, with distinct patterns of growth.

While the distinction between different subgroups of manufacturing industries is obviously necessary and useful, the specific formulation just presented is not really tenable. For one thing, it will be immediately evident from Table 1 that, apart from agro-based industries, the set of slow growing industries also included a whole range of metal-based and engineering industries; cement, petroleum and structural clay products. Indeed, the two industries which actually experienced negative growth during this period were non-ferrous metals and railway equipment. Furthermore, as we shall argue later, the market size is a single unifying explanation that applies as much to agro-based industries as to others, though it has operated differently for different subgroups of industries. However, before returning to this question of the demand constraint towards the end of the paper, we shall first examine alternative hypotheses which could account for the variations in growth performance between different industries.

2. Innovation, Productivity and Growth

We begin with a Schumpeterian proposition. It will be recalled that for Schumpeter the prime mover behind the long-term dynamics of capitalist growth was innovation.[4] We are not concerned here with his theory of innovation itself, the role of the innovator, his motivations, the role of finance, etc. We are concerned with the effects. As a new invention or a new way of doing things more efficiently is introduced, it sets off a wave of innovation starting with the industry of its original application and then spreading to technologically related industries where the same innovation is applicable. One major innovation may also be followed by subsidiary innovations.

Following every innovation and the associated changes in efficiencies and costs of the innovating enterprise, competitors are forced to either follow suit or get squeezed out of business. Whole systems of production and cost structures are revolutionised.

As the new systems are put in place, this calls forth a burst of capital accumulation and economic activity until the changes are absorbed and the system settles down to a higher level of activity until a new wave of innovation begins. Every wave of innovation sets off a fresh wave of growth and overlapping waves of innovations are reflected in overlapping business cycles of greater or lesser amplitude. The causality always runs from innovative activity to economic growth.

If indeed the growth and decline of Indian industries are to be understood in terms of this Schumpeterian dynamic, then it would follow that inter-industry variations in output growth should closely follow the inter-industry differences in the strength of innovative activity.

Our problem now is to translate this hypothesis into an empirically verifiable proposition. Clearly in those industries where innovation is active or technical progress is the most rapid, productivity will also be rising very rapidly. We should then be able to compare rates of output growth and productivity growth between different industries to see whether the two are closely related.

The difficulty that arises here is about the choice of an appropriate concept of productivity since new innovations could be raising the efficiency of labour or the means of production or both. Ideally we should be able to capture improvements in the efficiency of both labour and the stock of capital goods. The latter however is rendered virtually impossible by the well-known problems of valuation. Fortunately, in the Indian context technical improvements are still largely of the labour-saving kind and changes in labour productivity would appear to be a reasonable index of the pace of innovative acitivity.

Accordingly, rates of output growth and labour productivity growth (PROG) have been compared in Table 2 for our twenty industries arranged in ascending order of growth and grouped together as very slow growers, slow growers, medium growers and fast growers. The cut-off levels approximate to mean growth minus one standard deviation (3.0 per cent), mean growth (6.5 per cent) and mean growth plus one standard deviation (10.0 per cent). Comparing the average for each subgroup, we notice that productivity growth rates do seem to increase from negative rates to a rate of 1.1 per cent and then 3.4 per cent as we move from low to high growth industries. The pattern is distorted for the fastest growing category by the peculiar case of power and light. Labour productivity in this sector has actually been declining even though it is indeed the fastest growing industry. A similar odd case is the exceptionally rapid growth of productivity in shipbuilding, compared to its growth rate, and the remarkably poor performance of sugar. Such unusual cases notwithstanding, we do see a clear positive relationship between productivity growth and output growth, as revealed in regression equation no. 1

$$g = 4.4402 + 0.901021 \text{ PROG} \quad (1)$$
$$(5.55805) \quad (3.16003) \qquad R^2 = 0.35682 \quad N = 20$$

It has a statistically significant positive coefficient for PROG and an explained variation coefficient of over 35 per cent. When the regression was run after eliminating the three extreme observations for light and power, shipbuilding and sugar, the statistical fit improved remarkably with nearly 75 per cent of the variation in growth rate now being explained by variation in productivity growth, as shown in equation 2.

$$g = 3.21947 + 1.42345 \quad (2)$$
$$(5.92042) \quad (5.6422) \qquad R^2 = 0.74627 \quad N = 17$$

TABLE 2

Sr. No.	Sector	g	PROG
04	Non-ferrous Metals	-2.7	-2.8
09	Railway Equipment	-0.4	0.5
18	Food Products, etc.	0.6	-2.9
20	Sugar	1.9	-5.7
15	Structural Clay Products	2.3	-0.1
16	Textiles	2.8	2.4
19	Tobacco	3.0	-1.2
Average: group g 3.0		1.1	-1.4
13	Rubber	4.0	0.0
14	Petroleum	4.3	0.3
02	Cement	4.4	0.2
12	Metal Products	4.8	1.3
08	Shipbuilding	5.3	3.8
03	Steel	5.8	0.8
Average: group 3.0 g 6.5		4.8	1.1
11	Motor Vehicles Repair	7.4	2.9
10	Motor Vehicles	8.3	2.2
17	Pulp & Paper	8.7	4.9
01	Chemicals	8.9	2.7
06	Non-electrical Machinery	9.8	4.5
Average: group 6.5 g 10		8.6	3.4
07	Electrical Machinery	11.2	4.3
05	Electric Light & Power	14.0	-0.8
Average: group g 10		12.6	2.5

Source: As for Table 1.

This statistical relationship is consistent with our hypothesis that industry growth rates are determined by the rate of innovation in different industries. However, a new problem of interpretation arises here since the same statistical relationship is also consistent with a reversal of Schumpeter's hypothesis,i.e., that the rate of technical progress is highest in industries which are growing most rapidly since fast industries open up the necessary economic space for deployment of new techniques with greater economies of large-scale production. Cause and effect are now reversed.

Particularly in the Indian context, this latter hypothesis must be considered at least as tenable since industries in India do not display international best practice technologies. For every national best practice technology in use in any industry, it would be possible to find superior techniques in use elsewhere in the world. There is, in other words, always a certain technological slack and Indian industries do not generally operate in the zone of frontline technology where the Schumpeterian process of new waves of innovation initiating new spurts of growth is likely to be most in evidence.

Thus the statistical evidence establishes a strong relationship between productivity growth and output growth but we are still left with a problem of identifying causality i.e., which causes which. If indeed one facilitates the other and there are feedback effects in both directions, regardless of where the growth process starts, then it would be incorrect to sharply identify one variable as cause and the other as effect. However, while recognising this qualification, a problem of identifying the <u>prime</u> mover between the two variables still remains and clearly this cannot be resolved by the observed statistical relationship between the two variables.

One way of resolving the puzzle is to look for alternative satisfactory explanations of output growth. For reasons spelt out above, the proposition that rates of productivity growth determine the rates of output growth does not appear to be convincing in the Indian context. If however it were possible to establish an alternative explanation for the observed inter-industry variations in growth rates, then the observed statistical relationship between output growth and productivity growth could be reinterpreted as indicating that it is output growth which leads productivity growth instead of a casual relationship the other way round.

3. Rates of Return, Concentration and Growth

The standard neo-classical theory of price formation and resource allocation of the Marshall-Walras traditions does not explicitly address itself to the problem of explaining the growth of industries, still less the variation in growth rates between industries. However, by incorporating the Fisherian extension of this paradigm in capital theory we arrive at equalisation of the rate of return on capital or the rate of profit as the key principle for the allocation of resources between industries and over time. By this principle competitive conditions should ensure equalised rates of return and equal rates of return and equal rates of growth between different industries in a long-run equalibrium. Any deviation from this Von Neumann-like steady state pattern of growth would have to be explained by exogenous disturbances.

According to this view, differences in rates of return or growth between industries could be viewed as transitional variations which would disappear once the system had completely adjusted to one or another exogenous disturbance to which it is currently responding. Of course, even by this view, an actual steady state is unlikely to be reached since new disturbances appear before the system has completely adjusted to old disturbances.[5/] Such overlapping disturbances notwithstanding, the underlying principle of allocating investments according to rates of return would imply that output growth would generally be higher where the rates of return are higher. In other words, for a given cross-section of industries we should expect to see a strong positive association between inter-industry variations in rates of growth and rates of return.

The traditional theory of industrial behaviour has now been largely replaced by what we may describe as 'entry barrier' theory following the seminal work of Bain.[6/] One of the central propositions of this theory is that industrial markets are typically characterised by oligopolistic structures with severe barriers to entry and that the performance of industries are largely to be explained by their structure and conduct. While the main focus of this literature has been addressed to performance in terms of pricing and profitability, 'entry barrier' theory also offers an interesting alternative to the traditional theory in explaining inter-industry variations in output growth. Briefly, it can be argued that oligopolistic industries, by raising high barriers to entry, are able to restrict fresh investment by new entrants while maintaining high profit margins. On the other hand, existing firms in the industry may also restrict output and investment, in accordance with explicit or tacit market sharing agreements, and diversify their investible surplus into more competitive branches of production.

In other words, 'entry barrier' theory would hold that maintaning market shares and profit margins, rather than maximising the rate of return in a particular industry, are the guiding objectives of oligopolistic enterprises and that, in general, capital would accumulate more rapidly in the more competitive industries. The first proposition implies that we may treat profit margin or the share of profit in value-added as an index of the degree of monopoly while the second suggests that this index should be inversely related to output growth in a comparison across industries. This contrasts with the traditional theory which would suggest that growth rate variations across industries are positively associated with variations in the rate of return.

We now turn to the data on India manufacturing industries to see how far their growth behaviour is explained by either of the theories outlined above. The data on industry and group growth rates (g), the Index of Return on Productive Capital (IRPC) and wage share (WASH) have been shown in Table 3. The construction of the IRPC as a measure of the rate of return has been discussed in the appendix. We need only mention here that it has been computed with the average rate of return on productive capital being set at 100. The wage share has been employed instead of the profit share in view of the accounting procedures usually employed to conceal profits for tax purposes. Empirically the wage share in value-added is unambiguous and much easier to capture and analytically it makes no difference except that the new theory should now be interpreted to imply a positive association between wage share and growth rate.

As before, the industries have been arranged in ascending order of growth rates and grouped together into stagnant or very slow growing industries with g   3.0, slow growing industries with 3.0   g   6.5, medium growth industries with 6.5   g   10. and high growth industries with g   10. The cut-off points g = 6.5, 3.0, 10.0 are approximately equal to the mean growth rate and one standard deviation below and above the mean. Comparing first the group averages of

TABLE 3

Sr.No.	Sector	g	IRPC	WASH
04	Non-ferrous Metals	-2.7	44	19.3
09	Railway Equipment	-0.4	100	63.0
18	Food Products, etc.	0.6	182	23.0
20	Sugar	1.9	50	32.0
15	Structural Clay Products	2.3	91	45.3
16	Textiles	2.8	106	54.7
19	Tobacco	3.0	232	26.0
Average: group g 3.0		1.1	115	37.6
13	Rubber	4.0	94	26.6
14	Petroleum	4.3	209	9.8
02	Cement	4.4	106	26.5
12	Metal Products	4.8	121	33.6
08	Shipbuilding	5.3	29	54.6
03	Steel	5.8	32	41.4
Average: group 3.0 g 6.5		4.8	98	32.1
11	Motor Vehicles Repair	7.4	100	63.8
10	Motor Vehicles	8.3	132	27.6
17	Pulp & Paper	8.7	76	27.5
01	Chemicals	8.9	73	18.7
06	Non-electrical Machinery	9.8	91	34.5
Average: group 6.5 g 10		8.6	95	34.4
07	Electrical Machinery	11.2	103	29.0
05	Electric Light & Power	14.0	21	22.0
Average: group g 10		12.6	62	25.5

Source: As for Table 1.

g and IRPC, there appears to be an inverse relationship between growth rate and the rate of return. As we move down the line from industries with high rates of return to those with low rates of return, the growth rate increases instead of declining as traditional theory would suggest. This inverse relationship did show up as a negative coefficient when IRPC was regressed on growth rate, as shown in equation 3. However, the coefficient is not statistically significant (figures in parentheses denote T-values) and the coefficient of explained variation is also very low.

$$g = \underset{(3.60067)}{6.86909} - \underset{(-0.98769)}{0.01656}\ IRPC \qquad R^2 = 0.05141 \quad N = 20 \tag{3}$$

Replacing IRPC by an index of return on fixed capital (IRFC) or eliminating a couple of extreme observations did not improve the results.[7] In other words, so far as Indian manufacturing industry is concerned the rate of return turns out to be a very poor explanatory variable and the proposition that variations between industry growth rates are largely explained by variations between their rates of return cannot be maintained.

We turn now to the alternative proposition derived from 'entry barrier' theory about growth behaviour under conditions of oligopoly. As we have seen earlier, this hypothesis would imply that as we move from low to high wage share (or high to low profit share) industries, the industry growth rates should rise. However, it will be evident from data presented in Table 2 that this is not the case. If anything, a comparison of group averages suggests a reverse relationship. The picture is made obscure by the exceptionally low share of wages in the petroleum industry, presumably because of its capital-intensive character. It did show up in the negative sign of the coefficient when WASH was regressed on the growth rate as shown here in equation 4.

$$g = 6.60448 - 0.04078 \text{ WASH} \qquad (4)$$
$$(2.81077) \quad (-0.6425) \qquad R^2 = 0.02242$$
$$N = 20$$

However, the coefficient is again not statistically significant. The coefficient of explained variation is also very low and these results did not improve significantly even after eliminating the petroleum observation from the analysis.

In other words, inter-industry variations in wage share or profit share appear to have little to do with inter-industry differences in growth rates so far as manufacturing industry in India is concerned. Concentration of markets is indeed an important phenomenon in the Indian context, yet 'entry behaviour' theory does not appear to be any more helpful than traditional neo-classical theory in explaining the variations in growth rates between industries. It should be mentioned however that the relationship between market structure and growth in a particular industry may be more complex than suggested in the hypothesis tested here. For example, in an earlier exercise, using a sample of firms controlled by Indian conglomerate groups, Siddharthan found that firms operating in concentrated oligopolistic markets grew much faster than those operating in less concentrated markets while firms operating in the most concentrated monopolistic markets had the lowest growth rates and highest rates of profit.[8/]

4. Growth and Capacity Utilisation

We have now seen that inter-industry variations in output growth in Indian manufacturing industry cannot be explained on the basis of either traditional neo-classical theory or the alternative 'barriers to entry' theory in any straightforward way. We also saw in Section 2 that an attempt to interpret this variation in terms of a Schumpeterian hypothesis left us with a puzzle of causality. Does productivity growth determine output growth or is it the other way round? Having exhausted the alternative explanations, we can now return to our original proposition that inter-industry differences in output growth are largely to be explained by the size of the market, i.e., the state of demand.

The changing state of demand over time, especially over the business cycle, is usually represented by the utilisation ratio or the ratio of actual output to capacity output. A number of alternative methods have been employed to estimate economic capacity, as distinct from capacity in a purely technical sense.[9] However, the standard procedure still employed is to treat past peak output as capacity output. In the present exercise we have followed this procedure, choosing workers employed as a better proxy for physical output than the deflated value of output at current prices. Using this basic definition, utilisation rates were calculated for each year in each industry and averaged over the reference period. This was then indexed with reference to the average utilisation for all industries to establish the relative state of demand in any one industry in relation to the others.

The index of capacity utilisation (CAPU) so estimated has been presented in Table 4 alongside industry growth rates. If our hypothesis is correct, we would expect to see a rising index of capacity utilisation as we move down the line from low growth industries to high growth industries, as is indeed the case. This is confirmed by regression equation 5 where growth is run to be a positive function of

TABLE 4

Sr.No.	Sector	g	CAPU
04	Non-ferrous Metals	-2.7	100.7
09	Railway Equipment	-0.4	86.9
18	Food Products, etc.	0.6	100.7
20	Sugar	1.9	104.6
15	Structural Clay Products	2.3	101.7
16	Textiles	2.8	96.7
19	Tobacco	3.0	85.9
Average: group g 3.0		1.1	96.5
13	Rubber	4.0	99.7
14	Petroleum	4.3	95.8
02	Cement	4.4	99.7
12	Metal Products	4.8	101.7
08	Shipbuilding	5.3	83.9
03	Steel	5.8	102.6
Average: group 3.0 g 6.5		4.8	97.2
11	Motor Vehicles Repair	7.4	103.7
10	Motor Vehicles	8.3	103.7
17	Pulp & Paper	8.7	102.7
01	Chemicals	8.9	104.6
06	Non-electrical Machinery	9.8	102.7
Average: group 6.5 g 10		8.6	103.5
07	Electrical Machinery	11.2	104.6
05	Electric Light & Power	14.0	117.5
Average: group g 10		12.6	111.1

Source: As for Table 1.

capacity utilisation and the coefficient is statistically significant.

$$g = -24.7783 + 0.299235\ CAPU \qquad (5)$$
$$\qquad (-2.38017) \qquad (2.76792) \qquad R^2 = 0.29856$$
$$N = 20$$

On the basis of the foregoing analysis we can now state the following conclusions:

a. The hypothesis that inter-industry variations in growth rates are related to conditions of demand is maintained. Alternative hypotheses that these variations are related to either the relative rate of return or the degree of monopoly in an industry are rejected.

b. The observed relationship between output growth and productivity growth can now be explained as follows. It is the rate of output growth which determines productivity growth, output growth in turn being dependent on the state of demand.

c. It is not only the growth of fast growing industries which is demand-constrained but also the growth of the slow growing industries. It will be noticed that the utilisation index for the group of slowest growing industries (g 3.0) is indeed the lowest. As such it is not very meaningful to distinguish between a slow growing, supply-constrained subsector of agro-based industries and a faster growing, demand-constrained subsector of non-agro-based industries.

5. Concluding Remarks

Our cross-section analysis of inter-industry differences in growth rates has led us to conclude that the state of demand is the critical explanatory variable underlying Indian industrial growth. What insights can we now offer towards explaining the so-called problem of deceleration of India's industrial growth since the mid-sixties in the light of our analysis?

Starting with the slowest growing group of industries, we note that apart from agro-based industries this group includes industries like non-ferrous metals, railway equipment and structural clay products. The special problems which account for the stagnation or slow growth of demand for these products will have to be investigated separately for each of the cases, e.g., the sudden decline in public investment on railroads since the mid-sixties. But a more interesting general feature we must note is that the agro-based industries also happen to be consumer goods industries. Indeed, where an agro-based industry was not a consumer goods industry, its growth performance was better, as for instance in the case of rubber products and especially pulp and paper products.

In other words, since demand is the critical growth determinant, it is not the input base of industries but their end use which needs to be looked at in order to understand why an industry has grown rapidly or slowly. From this point of view it will be immediately evident that the demand for consumer goods has grown slowly while the demand for producer goods (basic or capital goods) has grown much faster. There are exceptions to this observation and more would appear with greater disaggregation, e.g., if textiles were disaggregated further into cotton and jute. However, this is the general pattern.

Using this basic distinction and comparing the period before and after the mid-sixties, we can now say that, yearly fluctuations apart, the demand for consumer goods has grown throughout the post-independence period at a slow but steady pace without any deceleration after the mid-sixties. Instability was introduced in the system by the demand for producer goods - led principally by public sector investment. In the first period, while the Mahalanobis strategy of rapid industrialisation based on massive State investment in heavy industries was under implementation, the demand for producer goods grew very sharply, pulling the average industry growth rate well above the stable but slow growth of consumption demand. However, when this massive investment programme faltered after the mid-sixties, there was in consequence a sharp decline in the growth of demand for producer goods which pulled down the average rate of growth of manufacturing industries, bringing it closer to the low but stable rate of growth of consumption demand.

It should be emphasised finally that these concluding remarks are purely suggestive. This paper has addressed primarily the problem of explaining variations in growth rates <u>across</u> industries and not over time. The insights it offers towards the understanding of a dynamic process must be seen for what they are and not as a substitute for the required disaggregated time-series analysis of that dynamic process as it has operated over time.

Notes

1. Isher J. Ahluwalia, Industrial Stagnation in India Since the Mid Sixties, (mimeo). India International Centre Seminar, September 20, 1983.

2. A second exercise which did attempt to analyse the disaggregated growth pattern was that by N.S. Siddharthan, Industrial Structure and Industrial Growth in India, (mimeo). Institute of Economic Growth. The paper throws up a number of useful insights but it is not specifically addressed to examining the industrial stagnation problem.

3. The sources and preparation of data, concepts and choice of variables have been discussed in the Appendix.

4. J.A. Schumpeter, Business Cycles. McGraw Hill, 1939.

5. For an interpretation along these lines, G.J. Stigler, Capital and Rates of Return in Manufacturing Industries. National Bureau of Economic Research, 1963.

6. J.S. Bain, Barriers to New Competition. Harvard University Press, 1963.

7. However we should refer here to the multiple regression exercise reported in the Appendix. The whole set of alternative explanatory variables were regressed on growth rate first with all obsefvations and then after dropping some extreme observations to check the sensitivity of the estimates to these extreme values. While the coefficient of explained variation moved up from about 71 per cent to over 93 per cent, the IRPC coefficient became significant at the 5 per cent level with a positive sign.

8. N.S. Siddharthan, Conglomerates and Multinationals in India. Allied Publishers, New Delhi, 1981.

9. For a discussion of alternative procedures and some applications in developing countries, see R.M. Bautista et. al. Capital Utilisation in Manufacturing. Oxford University Press, 1981.

Appendix: The Sources and Use of Data

1. Source

The data for this study have been drawn from the Annual Survey of Industries covering the period 1960 to 1977. Prior to 1971 the ASI used its own classification of industries but since that year it has adopted the National Industrial Classification, somewhat different from the United Nations Standard Industrial Classification, which has 173 industry groups at the three-digit level.

2. Coverage

Following the Central Statistical Organisation Bulletin on Wages and Productivity in Selected Industries, the 173 groups were arranged in descending order of value-added and the top three-digit groups accounting for 75 per cent of total value-added were taken. Some further 3-digit groups were added for a proper match between the new NIC classification and the old ASI classification at the 2-digit level. This yielded a total of 20 industry groups at the 2-digit level covering about 87 per cent of value-added, 83 per cent of employment and 93 per cent of fixed capital in the registered factory sector. The registered factory sector consists of all factories registered under the Indian Factories Act, 1948, employing 10 or more employees with power or 20 or more workers without power. Within this, data for the Census sector including all large enterprises are collected on a complete enumeration basis. For the rest, data are collected on a sample survey basis. The two sets of estimates are then pooled to yield estimates for the factory sector. The accounting year varies from firm to firm such that the reference period cannot be strictly interpreted as calendar year or financial year. However, for our purpose the reference year has been treated as a calendar year.

3. The Variables

3.1 Growth of Gross Value-added (GVAG)

Gross Value-added is the difference between total output and total value of input at current prices. Total output includes the ex-factory value of all products and by-products manufactured during the year, goods sold in the same condition as purchased, capital assets produced for use within the factory plus the net balance, i.e., change over the year, in the stock of semi-finished goods. Total input consists of all manufacturing costs of the factory on account of fuels and other materials consumed as defined above, including cost of industrial and non-industrial services purchased.

The estimates of gross value-added for each industry were deflated using the wholesale price index, with 1960 = 100, for the relevant product group to convert current price estimates to constant price estimates. The compound annual growth rate of gross value-added at constant prices was then computed for each industy for the period 1960 to 1977.

3.2 Productivity (PROD) and Productivity Growth (PROG)

As explained in the main text, the productivity variable used in this study is labour productivity. This is defined as gross value-added divided by the number of employees in a given reference year. Employees include all 'workers' as defined in the 1948 Factory Act plus all supervisory or managerial staff, proprietors, partners, and unpaid family members engaged in the enterprise but excludes persons engaged in retail sales or delivery. The number of employees is the estimated number per average working day. The gross value-added per worker at constant prices was calculated for each industry for all years over the period 1960 to 1977. Productivity growth (PROG) is defined as the compound annual growth rate of the variable PROD over the reference period.

3.3 Wage Share (WASH)

The wage share is defined as the ratio of wages paid to workers to value-added. The wages paid to workers include all compensation to workers for work done during the year. This includes basic wages as well as dearness allowance, overtime payments, shift allowance, leave pay, bonus, etc. The wage share was calculated for each year and the average share over the reference period has been treated as the wage share of the industry.

3.4 Index of Return on Productive Capital (IRPC)

The average rate of return to an industry over the reference period is calculated as the ratio between the increase in the annual flow of surplus in an industry and the increase in the value of productive capital over the reference period.

The annual flow of surplus is the net value-added plus depreciation less wages during the year. Productive capital is the total capital invested in the business at current prices. It includes the depreciated book value of fixed assets at the factory and head office, i.e., fixed capital plus the value of working capital such as stocks of material, stores, fuels, finished and semi-finished goods at the end of the accounting year.

change in the value of productive capital over the reference period measures the net capital investment over the period or net addition to capital stock. Increase in the annual surplus flow over the period measures the extra surplus flow resulting from the investment over the base period. The ratio between the two measures is the rate of return to investment in the industry. The index of rate of return for each industry is calculated with average rate of return for all industries equal to 100.

An analogous index was also calculated for the rate of return on fixed capital (IRFC) and statistical analysis was conducted using both IRPC and IPFC to see if the results were sensitive to a change from one to the other. There was no significant difference in the results and the analysis using IRPC have been used since the productive or total invested capital appears more appropriate conceptually than just fixed capital for calculating the rate of return.

3.5 Index of Capacity Utilisation (CAPU)

Different methods of calculating capacity, and hence the utilisation ratio Actual Output to Capacity Output, are employed for different purposes. The standard or most common procedure is to adopt the past peak output, or the current trend output based on peak trend interpolation, as a measure of capacity output. This has been found inappropriate for studies of capacity utilisation itself, i.e., why capacity utilisation in an industry is what it is and not higher or lower. This is because output at any time is subject to a multiplicity of constraints, both physical and economic, such that even with no change in, say, the size of a plant, capacity may in fact change from one period to another. Furthermore, output that may be technically feasible may not be economically feasible because the extra cost of producing the extra output may be too high, e.g., when introducing an extra night shift with special wage rates.* However, where the purpose is to use the utilisation ratio as an index of the state of demand over, say, the business cycle and other time-series analysis, the past peak method seems to be quite reasonable.

Accordingly, this method has been employed in the present study. However the ASI does not give data on actual volume of output but only current value of output, which has then to be deflated to get the output movement in real terms. Fortunately ASI also gives separately the actual number of workers employed in an industry apart from employees as a whole (see paragraph 3.2 above). Since the number of workers employed varies in close association with output volume, the ratio of workers employed in a year to previous peak employment of workers has been taken as a proxy for capacity utilisation in a given year. The average of the utilisation ratio, so estimated, for a given industry over the reference period has then been indexed with average utilisation for all industries equal to 100 to arrive at the capacity utilisation index for each industry CAPU.

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* For a discussion of these issues and some applications in developing economics, see Romeo M. Bautista et. al., Capital Utilisation in Manufacturing Industries. Oxford University Press, 1981

4. Sensitivity Analysis

One of the most serious difficulties of cross-section statistical analysis at the 2-digit level of disaggregation is that we are working really with a small sample of only 20 observations. This renders the estimated statistics highly sensitive to the extreme values of just a few observations. To check exactly how sensitive the results are to such extreme observations, a multiple regression exercise was conducted, regressing the whole set of independent variables discussed in the main text above on the dependent variable GVAG, first retaining all observations and then after dropping six extreme observations. These were Iron and Steel (03), Non-ferrous Metals (04), Electric light and power (05), Shipbuilding (08), Petroleum (14) and Sugar (20).

The results of this sensitivity exercise are evident from a comparison between the equation with all observations (A1) and that without six observations (A2).

onstant	Coefficient of PROD	PROG	WASH	IRPC	CAPU	R^2
						(A1)
-22.7361	-0.00002	+1.02028	-0.04600	-0.00015	+0.28689	0.713518
(-1.91706)	(-0.172017)	(4.39356)	(0.81351)	(-0.01144)	(2.88644)	N = 20
						(A2)
21.2362	0.00024	+1.35584	-0.03064	+0.32229	+0.20809	0.931752
-2.04306)	(0.93732)	(6.61374)	(-0.70274)	(2.15044)	(2.61866)	N = 14

It will be noticed that the coefficient of explained variation improves very significantly from around 71 per cent with all observations to 93 per cent when the extreme observations are dropped.

The multiple regression equations also enable us to check the analysis based on simple regression in the main text. It is confirmed that productivity growth (PROG) and capacity utilisation (CAPU) are both positively related to GVAG with statistically significant coefficients while productivity (PROD) and wage share (WASH) are not. Interestingly, the coefficient of IRPC which is negative but not statistically significant with all observations, becomes positive and statistically significant when the extreme values are dropped. The correlation matrices for all variables corresponding to all 20 observations and 14 observations are presented in panels A and B of Table A.1. respectively.

TABLE A – 1

PANEL: A

Number of observations: 20

					Correlation matrix	
	GVAG	PROD	PROG	WASH	IRPC	CAPU
	(1)	(2)	(3)	(4)	(5)	(6)
GVAG	1.00000	0.815510E-01	0.597341	-0.149731	-0.226738	0.546404
PROD	0.815510E-01	1.00000	0.342391E-01	-0.520220	0.345339	0.403946E
PROG	0.597341	0.342391E-01	1.00000	0.283571	-0.953061E-01	-0.578209E
WASH	-0.149731	-0.520220	0.283571	1.00000	-0.266322	-0.361201
IRPC	-0.226738	0.345399	-0.953061E-01	-0.266322	1.00000	-0.371411
CAPU	0.546404	0.403946E-02	-0.578209E-01	-0.361201	-0.371411	1.00000

PANEL: B

Number of observations: 14

					Correlation matrix	
	GVAG	PROD	PROG	WASH	IRPC	CAPU
	(1)	(2)	(3)	(4)	(5)	(6)
GVAG	1.00000	0.591918	0.832745	-0.325607	-0.401228	0.670582
PROD	0.591918	1.00000	0.423435	-0.574571	-0.460464	0.478811
PROG	0.832745	0.423435	1.00000	0.103066	-0.644345	0.486904
WASH	-0.325607	-0.574571	0.103066	1.00000	-0.234488	-0.288371
IRPC	-0.401228	-0.460464	-0.644345	-0.234488	1.00000	-0.537831
CAPU	0.675082	0.478811	0.486904	-0.288371	-0.537831	1.00000