

3. Coverage of the Study and the Stylised Facts

This section provides information on the industries selected for the estimation of productivity in India's manufacturing sector and on the relative importance of the selected industries in manufacturing. As a prelude to the estimation of productivity, we present estimates of growth of real gross output and real value added (using both SD and DD methods) in this section.

3.1 Selection of Industries

It is rather unambiguous that other things remaining the same, an increase in productivity can improve the price competitiveness of exports due to its cost-reduction effects. At the outset, therefore, it is useful to examine India's export performance to show the relative contribution of various industries to total exports. This can form an objective criterion for the selection of industries for productivity analysis ([Table 2](#)).

Table 2: Major Items of India's Exports as a Percentage of Total Exports
(Total Exports in million US \$)

Export Item/Year	1970-71	1980-81	1990-91	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
Primary Products	42.4	36.8	24.0	21.0	22.1	19.7	22.8	23.8	21.9	20.6
Agriculture & allied products	31.7	30.7	19.4	17.6	18.7	16.0	19.1	20.4	19.5	18.5
Ores & minerals	10.7	6.2	4.6	3.4	3.4	3.8	3.7	3.5	2.4	2.1
Manufactured Goods	50.3	55.8	72.9	76.1	75.6	76.8	73.9	73.5	76.7	78.7
Textile fabrics & Manufactures	9.5 (18.8)	13.9 (24.9)	21.0 (28.8)	23.3 (30.6)	21.3 (28.2)	24.0 (31.3)	22.6 (30.6)	23.5 (31.9)	24.7 (32.2)	25.4 (32.2)
Engineering goods	12.9 (25.6)	12.3 (22.1)	11.9 (16.3)	13.3 (17.4)	13.6 (18.0)	13.3 (17.4)	13.8 (18.7)	14.6 (19.9)	15.0 (19.6)	13.0 (16.5)
Chemicals & allied products	1.9 (3.8)	3.3 (6.0)	6.5 (8.9)	7.4 (9.8)	8.2 (10.8)	7.4 (9.7)	7.4 (10.0)	8.1 (11.0)	10.5 (13.7)	10.0 (12.7)
Leather & Manufactures	5.2 (10.4)	5.8 (10.4)	8.0 (11.0)	10.8 (14.3)	5.8 (7.7)	6.1 (8.0)	5.4 (7.4)	4.7 (6.4)	4.7 (6.1)	4.8 (6.1)
Memo-item:	29.4 (58.6)	35.4 (63.3)	47.3 (64.9)	54.8 (72.1)	48.9 (64.7)	50.8 (66.3)	49.2 (66.7)	50.9 (69.2)	54.9 (71.5)	53.2 (67.5)
TOTAL EXPORTS	2,031.0	8,486.0	18,143.0	18,537.0	22,238.0	26,331.0	31,797.0	33,106.0	35,006.0	33,659.0

Sources: Economic Survey, Ministry of Finance, Government of India, New Delhi (various issues)
Report on Currency and Finance, Reserve Bank of India, Mumbai (various issues)
Annual Report, Reserve Bank of India, Mumbai (various issues)

Note: (i) Figures in parentheses are expressed as percentage of exports of Manufactured Goods.
(ii) Engineering goods comprise of Machinery and Transport Equipment, Metal Manufactures including iron and steel, Electronic Goods, Computer Software and Project Goods.
(iii) Memo-item refers to the items listed below the Manufactured Goods.

In 1970-71, manufactured goods accounted for almost half of India's export earnings and during the 1990s the share of the manufacturing sector (inclusive of software and project goods) in total export earnings increased to more than three-fourths of the total exports. In the category of exports of manufactures, the performance of a few industries is noteworthy both in terms of their shares and the dominant influence they exert on the behaviour of the total exports. The shares of 'textile fabrics & manufactures' and 'chemical & allied products' have registered sharp increases in the last three decades. The share of 'engineering goods' has been more or less stagnant, whereas, the share of 'leather and manufactures' increased until early 1990s and witnessed a decline, thereafter. The share of memo items as a group recorded an increase in the total manufactured goods from 58.6 per cent in 1970-71 to 67.5 per cent in 1998-99 after reaching a peak of 72.1 per cent in 1992-93.

Five industries have been selected for the estimation of productivity in this study, on the basis of their contribution to India's export earnings ([Table 3](#)) and the availability/comparability of data needed for productivity analysis. The reason for choosing 1973-74 as the initial year of the study is that a major change in the classification of industries was introduced in this year. For the years 1973-74 to 1988-89, Annual Survey of Industries (ASI) followed the National Industrial Classification (NIC)-1970. Since 1989-90, the NIC-1987 has been in vogue.

We have aggregated industries at two-digit level of classification for textile, metal and machinery and transport equipment industries. No such aggregation was required for chemical and leather industries. Details of classification codes of the industries included in this study have been provided in [Annexure III](#). Apart from the industries mentioned in serial numbers 1 to 5 in [Table 3](#), we have estimated productivity for these selected industries as a group (selected industries) and also for the total manufacturing sector. The analysis includes only the registered components of the various industries/manufacturing sector.

Table 3: Industries Selected for Measurement of Productivity

Sr. No.	Industry (Abbreviation Used in the Study)
1.	Textiles and textile products (TEX)
2.	Metal and metal products (METAL)
3.	Machinery and transport equipment (MTE)
4.	Chemical and chemical products (CHEM)
5.	Leather and leather products (LEATH)
6 = 1 to 5	Selected industries (SMFG)
7	Manufacturing sector (MFG)

Note: (i) Abbreviations mentioned in the brackets have been used in the various tables and figures in this study. Industry groups mentioned against serial number 1 to 6 will be henceforth referred to, as textile, metal, machinery and transport equipment, chemical, leather and selected industries, respectively.

(ii) Engineering goods exports are inclusive of software and project exports as well. However, due to the non-availability of data in the required details, we could not

include software and project exports in the empirical investigation carried out in this study.

3.2 Data Sources and Data Details

Data sources used in this study are as follows: (1) *Summary Results for Factory Sector*, Annual Survey of Industries (ASI), Central Statistical Organisation, Government of India, New Delhi, (various issues); (2) *Technical Note to the Eighth Five Year Plan (1992-1997)*, Planning Commission, Government of India, New Delhi, 1995; (3) *Economic Survey*, Ministry of Finance, Government of India, New Delhi (various issues); (4) *Report on Currency and Finance*, Reserve Bank of India, Mumbai (various issues); (5) *Annual Report*, Reserve Bank of India, Mumbai (various issues); (6) *Reserve Bank of India Bulletin*, Reserve Bank of India, Mumbai (various issues); (7) *National Account Statistics*, Central Statistical Organisation, Government of India (various issues); and, (8) *Handbook of Statistics on Indian Economy*, 1999, Reserve Bank of India, Mumbai.

In this study we have used the data (from ASI) on the following variables: (i) number of employees; (ii) fixed capital (i.e., the depreciated book value of fixed assets owned by the factory on the closing day of the accounting year); (iii) depreciation; (iv) total emoluments; (v) fuels and materials consumed; (vi) total inputs; (vii) gross output; (viii) net value-added; and, (ix) gross capital formation. As the data used in this study pertain only to the factory sector, the analysis and conclusions emanating from this study are valid only for the factory sector.

Using the data on fixed capital at book value, gross capital formation, depreciation, Wholesale Price Index (WPI) for machine tools and investment deflator index series, we have computed two series on real capital stock, viz., K1 and K2. Details of these have been given in [Annexure IV](#). As mentioned in the previous section, we have attempted measurement of productivity using the DD method also. This required compilation of the price indices of inputs for each of these industries. We have used data source (2), wherein, the technological coefficient matrix for 1983-84, updated to 1991-92 prices, has been provided. The information on commodity sectors included in this input-output transactions matrix, which broadly corresponds to the industries selected by us, has been presented in [Annexure V](#). [Annexure VI](#) explains the procedure for compiling the input price indices. Industry-wise input price indices have been compiled and used for the measurement of productivity for the first time in this study and the relative (input-output) price indices have been reported in [Table A1](#).

3.3 Relative Positions of the Various Industries in India's Manufacturing Sector

It can be seen from [Table 4](#) that the selected industries in this study accounted for an average of 55.9 per cent of employees (L) in the organised manufacturing sector during the period 1973-1980. This figure registered a decline over the years and stood at 52.7 per cent during 1995-98. The average share of total emoluments (W) of these industries also decreased from 67.1 per cent (1973-80) to 57.0 per cent (1995-98). During this period, the decline in the average share of real capital (K) was of the order of about 3 percentage points. Average shares of inputs (IN), gross output (Y) and net value added (V), all at current prices, also witnessed decreases across the years. In brief, it can be said that the relative importance of these industries

in the organised manufacturing sector witnessed a decline over the years. However, these industries still covered about 50 per cent or more of the organised manufacturing sector in terms of labour employed, emoluments, capital stock, inputs used, gross output and net value added.

Although the textile industry provided the maximum employment, machinery and transport equipment industry had the highest share of the total emoluments in the recent years. Metal industry accounted for the highest amount of fixed capital. Textile industry accounted for as high as 18.6 per cent of the net value-added of the manufacturing sector during 1973-80. This came down sharply to 9.2 per cent during 1995-98. The variations in the share of net value-added for other selected industries were not as pronounced as in the case of textile industry.

Table 4: Average Shares of Employment, Emoluments, Real Capital Stock, Inputs, Gross Nominal Output and Nominal Net Value-added of Various Industries in India's Manufacturing Sector (As a percentage of Manufacturing Sector)

Average Shares in Manufacturing Sector						
Textiles and Textiles Products (TEX)						
Period	L	W	K	IN	Y	NV
1973-1980	23.9	22.9	10.2	16.7	16.9	18.6
1980-1985	20.8	18.9	8.8	13.0	13.1	14.0
1985-1990	19.1	15.8	8.3	11.2	11.2	11.4
1990-1995	17.8	14.5	8.0	11.7	11.5	11.2
1995-1998	18.2	12.5	9.4	11.8	11.2	9.2
Metal and Metal Products (METAL)						
Period	L	W	K	IN	Y	NV
1973-1980	10.1	13.8	19.3	13.0	13.1	12.8
1980-1985	10.3	13.4	17.3	14.5	14.2	12.9
1985-1990	10.4	12.5	15.3	14.5	14.1	12.3
1990-1995	10.0	11.8	17.4	14.6	14.0	11.4
1995-1998	9.8	12.0	16.1	13.2	13.2	12.9
Machinery and Transport Equipment (MTE)						
Period	L	W	K	IN	Y	NV
1973-1980	15.3	21.2	11.5	15.1	16.2	20.1
1980-1985	16.0	22.7	11.4	15.4	16.7	21.7
1985-1990	16.6	22.4	11.6	16.1	16.9	20.7
1990-1995	16.0	21.9	10.6	16.5	16.9	19.6
1995-1998	15.6	21.4	10.7	17.4	17.7	19.6
Chemicals and Chemical Products (CHEM)						
Period	L	W	K	IN	Y	NV
1973-1980	5.8	8.6	13.3	12.5	12.6	12.7
1980-1985	6.3	9.3	12.8	13.2	13.2	12.3
1985-1990	7.1	9.8	12.9	13.2	13.2	12.5
1990-1995	7.2	10.2	13.4	12.7	13.1	14.0
1995-1998	7.8	10.2	15.0	13.1	13.7	15.8

Leather and Leather Products (LEATH)

Period	L	W	K	IN	Y	NV
1973-1980	0.7	0.6	0.2	1.0	0.9	0.6
1980-1985	0.8	0.6	0.3	0.9	0.8	0.6
1985-1990	1.1	0.7	0.3	1.0	0.9	0.6
1990-1995	1.3	0.9	0.4	1.1	1.1	0.9
1995-1998	1.3	0.8	0.4	1.0	0.9	0.7

Selected Industries (SMFG)

Period	L	W	K	IN	Y	NV
1973-1980	55.9	67.1	54.5	58.2	59.7	64.7
1980-1985	54.3	65.0	50.6	57.0	58.0	61.4
1985-1990	54.2	61.1	48.3	56.0	56.3	57.5
1990-1995	52.3	59.3	49.8	56.6	56.6	57.2
1995-1998	52.7	57.0	51.5	56.5	56.7	58.1

Note: Period 1973-80 indicates financial years 1973-74 to 1979-80. Similar practice has been used for the other time-periods, as well. Average shares of L, W, IN, Y and NV have been calculated from the ASI data. Though the estimates of absolute K1 differ from K2, the share of K1 and K2 for individual industries in relation to total K1 and K2 for manufacturing sector are the same and have been denoted by 'K' in this table. For calculation of real capital stock series K1 and K2, see [Annexure IV](#).

It is interesting to note that though the organised sector of textile industry has shrunk compared to other industries in terms of share in all the parameters mentioned in [Table 4](#), the contribution of this industry as a whole to exports has registered a phenomenal increase over the time-span of the study ([Table 2](#)). Engineering goods industry – which includes metal and machinery and transport equipment industries contributed about 25 per cent of manufactured exports in 1970-71. The corresponding figure was at its lowest in 1990-91 (16.3 per cent) and even in 1998-99 its share is almost the same (16.5 per cent). As mentioned earlier, the data on exports of engineering goods also include the exports of computer software and project goods, which have grown rapidly in the recent years. This means that the contribution of metal and machinery and transport equipment to India's export earnings was even lower than 16.5 per cent in 1998-99. In other words, export performance of metal and machinery and transport equipment industries does not compare very well in relation to textile industry. One of the reasons could be that these industries were supposed to be import substituting industries rather than export-oriented industries. The relative importance of chemical industry in manufacturing sector has improved over the years. During the period of the study, this industry recorded an impressive increase in its contribution to manufactured exports. The significant contribution of leather industry to manufactured exports ([Table 2](#)) cannot be overlooked.

3.4 Capital Intensity and Per Capita Emoluments in Indian Industries

A comparative view of the various industries in terms of the capital intensities (K1L) and the per capita emoluments has been provided in [Table 5](#) and [Figures 1A](#) and [1B](#). Capital intensities have been relatively lower in textile, machinery and transport equipment and leather industries as compared with the metal and chemical industries. Capital intensities ([Figure 1A](#)) increased sharply

in textile and machinery and transport equipment industries during the latter half of the 1980s and this trend continued in the nineties as well.

In metal, chemical and leather industries, capital intensities did rise during 1980s, but the jump was pronounced in nineties. Selected industries and the total manufacturing sector also witnessed sharp increases in capital intensities since the mid-1980s. It is also worth noting that capital intensities for the selected industries as a group were consistently lower than the corresponding figures for the total manufacturing sector. This was true for all the sub-periods mentioned in [Table 5](#).

Table 5: Average Capital Intensity (K1L) and Per Capita Emoluments (E) in Indian Industries

(Rupees)							
Average Real Capital Stock (at 1981-82 constant prices) per Employee (K1L)							
Period	TEX	METAL	MTE	CHEM	LEATH	SMFG	MFG
1973-1980	27134	121120	47924	146940	17307	62118	63806
1980-1985	30696	122180	51206	146121	23486	67389	72447
1985-1990	42125	142141	67552	175934	25936	86321	96839
1990-1995	57928	222306	84539	240361	34931	121825	127925
1995-1998	87281	276322	116497	325038	49251	165475	168987
Average Annual Per Capita Emoluments (E)							
Period	TEX	METAL	MTE	CHEM	LEATH	SMFG	MFG
1973-1980	5407	7702	7840	8385	4973	6791	5644
1980-1985	9377	13611	14693	15163	8340	12419	10397
1985-1990	15268	22065	24931	25406	12302	20795	18473
1990-1995	24881	36515	41885	43816	19630	34752	30761
1995-1998	33388	59440	66924	63826	28697	52521	48536

Note: K1L is the capital intensity, i.e., stock of capital stock (at 1981-82 prices) per employee. Per capita emoluments (E) have been obtained as ratio of nominal emoluments (W) to the number of employees (L). These ratios have been expressed in terms of rupees per employee. See [Annexure IV](#) for the compilation of ‘K1’ series. In this table, we have not provided capital intensity based on the real capital stock K2, since the ranking of capital intensity based on K2 is exactly the same as that obtained by using K1.

A rise in per capita emoluments has taken place more evenly than capital intensities, across the sub-periods. It may be also be noted that unlike the capital intensities, per capita emoluments in selected industries (as a group) have been consistently higher as compared with the corresponding figures for the manufacturing sector. Textile and leather industries consistently recorded lower per capita emoluments than those witnessed for other selected industries and also for the total manufacturing sector. These industries also happen to be the traditional industries with the lowest capital intensities. Among the selected industries, chemical (leather) industry had the highest (lowest) per capita emoluments. It is interesting to note that chemical (leather) industry had the highest (lowest) capital intensity. The correlation coefficient between the capital intensity and per capita emoluments was about 0.52 for the industries selected in this study, indicating that there is a direct association between the capital intensity and the per capita emoluments.

3.5 Trend Growth Rates of Selected Variables in Indian Industries

Rates of growth in employment, real capital stock, capital intensities, total emoluments and per capita emoluments across the industries have been estimated as semi-logarithmic trends ([Table 6](#)).

**Table 6: Trend Growth Rates of Selected Variables in Indian Industries
(1973-74 to 1997-98)**

Industry Group	Trend Growth Rates (per cent per annum)						
	L	K1	K2	K1L	K2L	W	E
Textiles and textile Products (TEX)	-	5.6	7.0	5.5	6.8	9.9	9.8
Metal and metal products (METAL)	1.6	5.7	7.1	4.0	5.4	12.3	10.5
Machinery and transport equipment (MTE)	1.9	6.2	7.6	4.3	5.6	13.3	11.2
Chemical and chemical products (CHEM)	3.3	7.0	8.4	3.6	4.9	14.4	10.8
Leather and leather products (LEATH)	5.4	10.7	12.1	5.0	6.3	14.9	9.0
Selected Industries (SMFG)	1.4	6.1	7.5	4.7	6.0	12.3	10.8
Manufacturing Sector (MFG)	1.8	6.6	8.0	4.8	6.1	13.2	11.3

Note: See the list of abbreviations.

The trend rate of growth of employment for the total manufacturing sector was about 1.8 per cent per annum, whereas, it was 1.4 per cent per annum for the selected industries. Textile industry pulled down the rate of employment of the selected industries, as it did not witness any growth in employment during the period under investigation. As against this, leather and chemical industries recorded the highest growth in employment.

The rates of growth of capital stock 'K1' were lower than that of 'K2' by about 1.4 per cent per annum for all industries. We consider the former series of capital stock to be more appropriate as compared with the latter because the gross domestic capital formation (GDCF) deflator index is more comprehensive in comparison with the WPI for machine and machine tools. We have used the latter index also to compile the real capital stock series (K2) in order to compare our findings on productivity with the findings of other studies. The rate of growth of real capital stock turned out to be highest for leather and chemical industries and lowest for textile and metal industries. Machinery and transport equipment industry witnessed the trend growth of real capital stock similar to those obtained for the selected industries and for the entire manufacturing sector. The rates of growth in real capital stock for all the industries included in this study outpaced the rate of growth in employment in respective industries, thereby, resulting in rising capital-labour ratios (rising trends in capital intensities) in all industries. Textiles and leather industries recorded highest growth in capital intensity over the period of the study. However, in the case of the former, employment witnessed a declining trend, whereas, the latter industry recorded the highest growth in employment.

The rate of growth in total emoluments across industries varied between 9.9 per cent per annum (textiles industry) and 14.9 per cent per annum (leather industry). However, the rate of growth of per capita emoluments (i.e., the difference between the rates of growth of total

emoluments and the number of employees) varied between 9.0 to 11.3 per cent per annum. Growth in per capita emoluments in leather and textile industries turned out to be lowest (9.0 and 9.8 per cent per annum). The trend inflation rate (as measured by the Consumer Price Index, CPI, for industrial workers) during this period was 8.6 per cent per annum. This implies that the rate of growth of real per capita emoluments in the industries investigated ranged between 0.4 per cent per annum and 2.7 per cent per annum.

3.6 Relative Price Movements, Real Output and Real Value-added in Indian Industries

We have deflated gross output at current prices (Y) by the WPI for the respective industries in order to obtain the estimates of the real gross output (O), needed for estimating total productivity growth (TPG). The estimates of real value-added, required for computing total factor productivity growth (TFPG), have been obtained both by single (VSD) and double deflation methods (VDD). The movements in the ratio of input prices to output prices (henceforth, relative prices) explain the differences between the estimates of VSD and VDD. We, therefore, provide a synoptic view of the movements in relative prices for the various industry groups in [Figure 2](#), before providing the estimates of real output and real value added. [Figure 2](#) is based on the data provided in [Table A1](#).

During the 1970s there was no discernible trend in the relative prices for the various industry groups. The period thereafter, witnessed divergent trends in relative prices across industry groups. During the 1980s, relative prices moved more or less in tandem with each other in textiles, machinery and transport equipment industries and in the manufacturing sector as a whole. In chemical industry the relative prices witnessed a steady increase and peaked in 1990-91. Thereafter, relative prices continued to decrease and this trend got reversed only after the mid-nineties. For leather industry, we observe fluctuations in relative price index over the years. In the case of metal industry, relative prices were more or less stable until 1987-88. Thereafter, relative prices declined in this industry due to the fact that the output prices increased at a faster rate than the input prices.

After 1990-91, the decline in relative price in this industry was reversed. In view of the fluctuations in relative prices of various industries, it is logical to expect differences in estimates of productivity obtained by single and double deflation methods.

Table 7: Trend Growth Rates of Real Output, Real Inputs and Real Value-added in Indian Industries, 1973-74 to 1997-98

Industry Group	Trend Growth Rates in (per cent per annum)				
	O	N1	VSD	N2	VDD
Textiles & textile Products (TEX)	6.4	1.7	4.7	3.0	7.7
Metal & metal products (METAL)	6.8	1.2	5.6	-1.9	3.7
Machinery & transport equipment (MTE)	8.3	1.2	7.1	1.7	8.8
Chemical & chemical products (CHEM)	9.1	-0.1	9.2	4.5	13.7
Leather & leather products (LEATH)	8.2	-0.9	9.1	3.6	12.7

Selected Manufacturing (SMFG)	7.7	0.9	6.8	2.3	9.1
Manufacturing Sector (MFG)	7.8	0.6	7.2	1.8	9.0

Note: N1 and N2 measure real inputs. The former is obtained by deflating the value of inputs by the output price, as is the case in the SD method. The latter is obtained by deflating value of inputs by input price, which is done in the DD method.

It can be seen from [Table 7](#) that the trend rates of growth of O were higher than the trend rates of growth of VSD, barring the leather and chemical industries. Growth rate of N1 is the difference between the trend rates of growth of 'O' and 'VSD' (where, real input, N1 is defined as the value of nominal inputs deflated by output price index). The trend growth rates of N2, *i.e.*, the nominal value of inputs deflated by input price index, for different industries have also been reported in [Table 7](#). Trend rates of growth in real value-added by SD method (VSD) are lower, barring the metal industry, as compared with the respective rates obtained by the double deflation method (VDD). This implies that relative price index for industries, except the metal industry, witnessed a rising trend. This has implications for the measurement of total factor productivity growth (TFPG). It has already been explained that in a situation where relative price index records an increasing trend, TFPG measured by SD method will be lower than the TFPG measured by the DD method.

Textile and metal industries pulled down the rates of growth of O and VSD for the selected industries. These two industries, besides machinery and transport equipment industry, pulled down growth rate of VDD for selected industries. As against this, chemical and leather industries were the best performers in terms of both production and value addition.