

Analysis of MSME Sector: Opportunity, Policy Gaps and Action

Pradip Kumar Biswas and Parthasarathi Banerjee



**CSIR - NATIONAL INSTITUTE OF SCIENCE
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Summary

Different manufacturing units have different levels of technology – some units have very low level technology, some others have medium level technology, yet a few others have high or even advanced level of technology. One may find distribution of firms across technology levels at any time point. Over a period of time Innovations occur, which lead to change in the level of technology of a manufacturing unit, while the same alter the distribution of firms across technology levels in an industry or a region. In other words, the pattern of changes in the technology level wise distribution of the units would indicate the nature and intensity of innovations taking place in the industry or region. This report analyses the nature and intensity of innovations that took place in the Indian registered manufacturing sector for the period from 1999-00 to 2009-10 based on primarily ASI data.

More than two decades of liberalization and globalization has made the Indian economy very much integrated with the global economy. Resultant competition along with the rapid change in the technology at the global level and unprecedented inflow of FDI in India would lead the country's manufacturing sector to make rapid advancement in technology. Further, the global turmoil in the second half of the 2000s must have forced the Indian manufacturing sector to innovate, particularly for cost cutting, in order to survive in the midst of severe competition and crisis.

The most important problem in the measurement of innovations addressed in the report is the understanding of the level of technology of a manufacturing unit – what are various levels of technology and what would be the criteria of assigning these levels to different manufacturing units. There is no unique way of identifying technology; rather technology has multiple facets showing different characteristic features or attributes of technology. Each attribute may be treated as a technology parameter. All the parameters are however not equally important in every context. From among many such technology parameters, twelve distinct parameters (some of which may be interrelated) are selected. The selected parameters are highly relevant for MSMEs and for which ASI unit level data are available for the period under investigation. These parameters are grouped into three major technology pillars, viz., input pillar, capital pillar and output pillar.

- (i) Input pillar parameters are use of white collar managerial and supervisory staff, contract labour, use of imported inputs and wage rates paid to workers;
- (ii) Capital pillar parameters are land and building assets, capital per unit labour, number of manufacturing units owned by a firm and share of productive non-land assets such as plant and machinery, tools and equipment, ICT capital etc. in total assets;

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- (iii) Output pillar parameters are output per labour, value added per labour, contract work, export orientation of production and sale of others' products.

Each parameter relates technology level either positively or negatively and either directly or indirectly. Further, each parameter represents a scale for technology levels and on a point of the scale lies the value of the particular dimension of technology of a manufacturing unit. Summation of such values of all the parameters constituting a pillar, for a manufacturing unit, denotes the unit's technology level for the particular pillar of technology indicators. Each pillar is indexed corresponding to seven levels of technology, namely, very low, low, lower medium, medium, higher medium, high and advanced technologies. Combining the values of all the three pillars, namely input pillar, capital pillar and output pillar, through simple averaging consolidated index of technology is formed. For the consolidated index also a scale is set to represent seven levels of technology.

Combined index based on all the twelve parameters of technology indicators reveals that there is neither very low technology unit nor advanced technology unit. Only 1.2% of the total manufacturing units have low level technology and these units conspicuously belong to micro size class. Around 0.3% of the units are of high technology level and these units belong to medium and large size classes. Most of the units however belong to lower medium, medium and higher medium technology groups. Between 1999 and 2009 there has not been any perceptible change in distribution across technology levels or across size classes. Input pillar estimates however do not display any indication of innovativeness, although in general micro or small enterprises are found to be less innovative as compared to medium or large enterprises. Similar to input pillar, capital pillar estimates also show no improvement in the technology levels of the enterprises irrespective of size classes. Output pillar indices however show some technological improvement as the proportion of lower technology units (technology levels being lower medium or below) marginally declined and that of higher level technology units (higher medium or above technology levels) increased a bit.

Combined index based on all the parameters shows that food products, wood and cork, printing, chemicals, basic metals, fabricated metals and furniture industries made some technological progress, pharmaceuticals, machinery and equipment, and motor vehicles also made minor improvement, with the increase in the proportion of higher technology units. Further, all these sectors generally have larger number of factory units with higher medium and high technology levels.

In terms of percentage share of higher medium and high technology units at present, the top states are Himachal, Goa, Delhi, Haryana, Maharashtra, Karnataka, and Gujarat with the share varying between 36% and 58%. In terms of the total number of factory units, Tamil Nadu is the largest state, followed by Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh, and Karnataka.

Geographical concentration of manufacturing activities in Tamil Nadu is quite significant – as much as a quarter of the MSMEs and a fifth of the large sized manufacturing units are located in a

particular district, Coimbatore. Agglomerative forces facilitate the operation of so many MSMEs and large units through cost cutting, because of infrastructure development, and inter-industry exchanges such as among basic metals, fabricated metals, and machinery and equipment industries.

Manufacturing activities in Maharashtra is located in the region around Mumbai – three districts, namely, Thane, Greater Mumbai and Pune shared more than 55% of the manufacturing units. The region acts as agglomeration of different types of industries where the large number of MSMEs can take advantage of market and intermediate inputs. Presence of so many large units would not only create industry friendly environment and infrastructure but also develop inter-linkages with the MSMEs for various kinds of business transactions.

Industries in Gujarat are well dispersed throughout the state, although Ahmedabad has a major chunk. However, maximum number of large units as well as advanced technology units is found in Bharuch. Dispersion across districts indicates some sort of specialization/clustering based on availability of local resources and relevant infrastructure.

In Andhra Pradesh, large presence of industries in and around Hyderabad is the result of the benefits received from the developed infrastructure of the state capital and the business friendly environment created by the state.

Regional concentration of industries in Karnataka is very high – state capital, Bangalore district alone share more than half of all the factory units of the state. Agglomeration of different types of industries in Bangalore created some infrastructure and market for final and intermediate goods. This has provided great opportunities to the MSMEs who took advantages of infrastructure, market and availability intermediate goods. A kind of dynamism has been created as a result of agglomeration economies, leading to cost cutting and further technological progress.

It is therefore highly imperative that the manufacturing sector as a whole needs to be more innovative and for which suitable innovation policies are required. The policies should encompass all the three pillars so that innovations would take place in capital pillar, input pillar and output pillar. It also requires that innovation should not be confined to select few industries; policies should aim at creating enabling environment for all the industry sectors to make innovations. High technology small scale units are rare; there should be many more such units. Technology up-gradation schemes for the MSMEs should be widened and the conditions should be made easier for the enterprises to get the benefits. Finally, too much regional concentration of industries, particularly higher technology industries and large sized industries, needs to be avoided; based on geographical distribution of natural resources and other man made inputs at local levels decentralized industrialization policies promoting MSMEs are required.

The state wise analysis does indicate possibilities of inter-linkages, and vertical cooperation based growth and technological progress of the MSMEs and large enterprises. There are also indications of progress of MSMEs without such cooperation, possibly benefitted from conglomeration of several industries. Policies must aim at nurturing inter-linkages or vertical cooperation among enterprises as a route to innovation and industrialization.

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Chapter : 1

Understanding technology levels of Indian manufacturing units

An important measure of innovation-capability and also the capacity to undertake innovation in the area of manufacturing is the status and the level of technology-commitment of the manufacturing enterprises. Innovation is the outcome of a complex process that goes much beyond the technology-commitment involving among others the organization, the marketing and the finance. Nevertheless, the extent to which capital has been sunk or committed to technology and also the degree to which an enterprise is linked-up with advanced manufactured items as its input or else, as its output together indicate the technology-commitment of an enterprise. Such commitments cannot be shaken off before the period of production of that technology has been exhausted. Therefore, a measure even if that is very primitive in nature, of such technology-commitment will indicate the manufacturing sector's capacity and the current capability to undertake such production as could be clubbed under the category of innovative manufactured produce.

There are, however, several lacunae in such an approach. First and foremost is the separation of and non-inclusion of the services. To recall, a fairly large degree of innovative action of an enterprise remain locked-in with the services component of that enterprise. Similarly, at the macro-level, innovative capacity and capability of Indian industry cannot exclude the component of services that is embedded within the enterprise. Nonetheless, general global direction of innovation as also of the industry is towards a specialization and a consequent separation of manufacturing and services both within and outside the boundaries of an enterprise.

Further, sunk-in investment in machineries or manpower or even on relations has a flip side too. Breaking out of such commitment to sunk-in investment in technology has cost associated. In other words, for those technologies that are not experiencing rapid changes or significant dynamism in innovative threats a commitment to technology of this type might prove competitively advantageous in the current technological period of production, and therefore such commitments to technology can be described as adding up to capacity and capability for innovation.

Technology-Commitment:

Level of technology-commitment of a manufacturing unit/enterprise can be understood in terms of its use of fixed capital, plant & machinery, land & building (indicating creditworthiness/solvency), volume of productive assets per worker, proportion of high skilled or even white collar or dedicated (non-contractual or not temporary) workers employed on long term basis as well as that of short term or temporary unskilled or contract workers. Intensity of the use of imported inputs in production as well as export orientation of production indicates level of technology as it

may require particular type of machinery to produce standard quality products. Similarly, those firms regularly involved in subcontracting, particularly contracting in to supply to others, are likely to require advanced technology with dedicated plant, machinery and skilled workforce, for maintaining quality. Further, high output or value added or even wage per worker may indicate use of high technology.

Use of higher or advanced level of technology can be made not only by the large units but also by the MSMEs (micro, small and medium enterprises). We would try to identify the categories of enterprises belonging to MSMEs and large enterprises that are potentially innovative and have technology commitment of higher value because they invested in the kind of advanced technology elaborated above. Such potentially innovative enterprises may be specific to sectors or regions and might have been promoted by different factors, such as vertical inter-linkages with large enterprises, agglomeration of different industries, clustering, state policies or local entrepreneurial talents. Some of these issues would be examined in the subsequent chapters.

Enterprises with higher technology commitments can be described as frontier organizations. Alongside such frontier enterprises, low technology micro, small and medium enterprises can also improve through spillover effects their respective technology levels. In a dynamic industry or in a region, the distribution pattern of enterprises across technology commitment levels changes over time towards another distribution with higher proportion of high technology enterprises. This change in the distribution may be used to measure the innovations made by an industry or a sector or by a region. In this chapter we will examine the factors that can be associated with high technology of a manufacturing unit and find out how many of such units/enterprises presently exist, first among large enterprises and then among MSMEs.

Data Source:

This analysis is based on two primary data sources, namely ASI and NSSO. Unit level data from both the sources are used for selected years. *Those manufacturing units are selected for which the values of total fixed assets, gross value added (GVA) and total employees, are greater than zero.* Thus, closed units and those units with negative GVA or having no fixed assets or with no persons employed, are excluded. In the case of NSSO the relevant units are enterprises belonging to informal sectors whereas in the case of ASI the relevant units are factories. An enterprise may have two or more factory units, although most of the enterprises have only one factory unit each and for them factory unit and enterprise are synonymous.² We would be using factory unit and enterprises more or less interchangeably. It is to be further noted that the present exercise would be based on the performing units, i.e., those factory units that are functioning with positive values of GVA, employment and fixed asset. ASI data are used mainly for two years, 1999-00 and 2009-

² Based on ASI data the number of factory units in the year 2009-10 is estimated to be 189275, out of which 102860 factory units are presently functioning with positive values of employment, fixed capital and gross value added. As much as 98.22% of the latter factory units belong to the single-unit enterprises, 1.17% of the enterprises belong to the double-units enterprises and the remaining 0.63% of the units belong to enterprises running 3 or more factory units.

10. For ASI 2009-10 survey, information on the sources of finance of the manufacturing units was collected but not provided in the database. Information on exports by individual units was collected for the year 2009-10 but not for the other year, 1999-00. Using these data bases we will measure high technology units among large enterprises as well as among MSMEs across sectors and regions.

Overall Industry Scenario

The period under review, from 1999-00 to 2009-10 is the fastest growing phase in the post-independence India. During the period 2000 to 2008 average annual growth rate of the manufacturing sector exceeded 7.5% and if we extend the period till 2010, the average growth rate reduces to below 6.5% because of the decline in growth rate after 2008. In fact the growth rate was negative in 2009-10 over the previous year. Nonetheless average 6.5% growth rate for a decade means a lot for a developing country, which provides enough opportunity to bring about major structural change and technological innovation.

Table 1.0: Year wise growth of the manufacturing sector during 1995-2010

Index number of seventeen major industry groups of manufacturing sector (Base: 1993-94 =100)		
Year	Manufacturing Index	Annual growth rate (%)
1994-95	109.1	
1995-96	124.5	14.12
1996-97	133.6	7.31
1997-98	142.5	6.66
1998-99	148.8	4.42
1999-00	159.4	7.12
2000-01	167.9	5.33
2001-02	172.7	2.86
2002-03	183.1	6.02
2003-04	196.6	7.37
2004-05	214.6	9.16
2005-06	234.2	9.13
2006-07	263.5	12.51
2007-08	287.2	8.99
2008-09	295.1	2.75
2009-10	293.4	-0.58

Source: RBI, *Handbook of Statistics on Indian Economy*, Tables 28 & 29, ([http://rbi.org.in/scripts/AnnualPublications.aspx?head=Handbook of Statistics on Indian Economy](http://rbi.org.in/scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20Economy), accessed on 02 March 2014)

Since the present exercise is primarily based on ASI data for 1999-00 and 2009-10, fluctuations in these two years would greatly affect our conclusion about the industry sector. Although the year 1999-00 is a moderate year at least for the manufacturing sector, the year 2009-10 is a bad year for the sector. Therefore, any comparison between 1999 and 2009 would likely to under report the true performance of the sector during the entire period. Nonetheless, ASI data also provide information about the factory units that have been poorly performing, sick or closed for the last three years or so. Thus, sickness or closure data on the manufacturing units provided in the ASI 2009-10 survey would actually reveal the extent of anomalies existed during the high growth phase, such as for the years, 2006-07, 2007-08, 2008-09.

As per ASI data the total number of registered manufacturing units increased at a modest rate of 1.96% per annum during 1999-2009, but the number of non-functional units including those having problems in operation, consisting of units closed within last 3 years, not-in-operation (less than 3 years), found non-existent for less than 3 years, non-response due to various reasons like owner not traceable, records are with court/income tax department, refusal to submit return, factory under prosecution, increased at a rate of 2.20% per annum. Consequently the proportion of units remained operational declined marginally from 70.37% to 69.15%. Further, many of the units are operating with zero or even negative value added (GVA) which are basically sick units, and there are many more with positive GVA but negative profit. As high as a quarter of the operating units are estimated to be sick (includes only those having zero or negative GVA) in 2009, which were much higher (32%) in 1999. Considering all the registered manufacturing units of the country, around 52% are affected, either closed or non-functional or sick in 1999, which reduced to 48% in 2009. Despite this decline over the decade, the anomalies in the manufacturing sector still remain at alarmingly high level.

The period under review, is preceded by a decade of fundamental policy changes, namely liberalization with greatly reducing restrictions on domestic entrepreneurial activities, and globalization with removing restrictions on trade in goods, capital inputs, technology and knowhow. The economy has been deeply integrated with global economy exposing the Indian manufacturers to global competition and the industries have received the full benefit of policy changes. One would expect the global exposure would bring dynamism in the Indian industry through helping the manufacturers to modernize technology. Those who were able to do so, would survive and grow and those who fail to do so would ultimately decline. An assessment of the technological changes of the Indian manufacturers during the period would be done in this report.

Technology commitment levels of the large enterprises - varieties of yardstick:

So far as technology is concerned, large enterprises often have a positive role in the overall innovative activity including technology development of industry not only through developing/upgrading own technology but also directly or indirectly promoting technology of the MSMEs. Large enterprises thus can act as an organizer of a sector or of a region and can even act sometimes

as innovation driver or technology pusher. We would thus first see the distribution/concentration of large manufacturing units across industries, their technology levels and their links with the MSMEs, and then in the subsequent part we would focus on the distribution of MSMEs across industries, their technology commitment levels, inter-relationship within the MSMEs and the relationships with the large units. There are an estimated 5772 large manufacturing units with investment in plant & machinery exceeding Rs 10 crore and positive GVA, presently operating in India (as per ASI 2009-10 data).³ As much as 43% of these large enterprises have total assets exceeds Rs 50 crore, 23% having assets more than Rs 100 crore, 4% exceeding Rs 500 crore. Even as many as 10% of these large units have more than one factory units. These units seem to be cash-rich or otherwise financially solvent and they are expected to use latest/advanced technology. This may be corroborated by the fact that on the average 76% of the large volume of fixed assets of the enterprises consist of 'productive capital' in the form of plant & machinery, tools & equipment, ICT (information and communication technology) capital etc and the remaining 24% is made of land and building which may be high valued collateral for the banks to grant them loans.

Concentration of these large units are found in the manufacturing sectors of food products, textiles, chemicals, pharmaceuticals, rubber & plastic, other non-metallic minerals, basic metals, machinery and equipment and motor vehicles (Figure 1.1). Majority of the extra large units (exceeding Rs 100 crore) are also found among these nine industry sectors.

Most of the large firms in the above mentioned nine industry sectors have more than 50% of their fixed assets in the form of productive capital (Figure 1.2). Only in sectors of food products, textiles, machinery and equipment and motor vehicles there are quite a few large units with productive assets below 50%. Nonetheless, mere possession of so much assets reflects their ability to mobilize resource and thus finance installation/use of advanced technology.

Another way of understanding the commitment to high level of technology is by way of measuring value added per labour or by measuring value of productive capital like plant & machinery, tools, equipment, etc, per unit labour. This would in turn reflect a labourer's skills and expertise, capability to handle large or sophisticated capital equipment, and thus enabling generation of large value added per year. In terms of both these indicators, capital per labour as well as value added per labour, most of the large enterprises/units in all the 2-digit industry sectors may be grouped as using high technology (Figure 1.3). It would be interesting to see whether in the above mentioned nine sectors with high share of the large units also have a sizeable section of their smaller enterprises, particularly MSMEs, using high technology and whether the large units help MSMEs in this regard.

Still another mode of measuring technology commitment is the use of import as inputs to

³ Although, as per ASI data there exist an estimated 6505 large factory units in India in the year 2009-10 with the value of plant & machinery exceeding Rs 10 crore. Out of these large factory units 5776 units have positive values of GVA and employment, and the discussion on large factory units would be based on these 5776 units.

manufacturing, and this may also indicate the presence of high level of production technology because only such advanced technology alone can use specialised imported inputs. Sometimes these inputs are also used to produce goods for export purposes where product quality has to be maintained at high levels. In general, export goods manufacturers require latest production technology and practices, including machinery and equipment. Around 51% of the large units are found to use imported inputs and the mean value of the imported inputs in total inputs is estimated to be 27% of the total input (Figure 1.4). It may further be seen that as many as 520 (9%) large units use more than 50% of their total inputs from import, with the mean ratio of imported input to total inputs exceeding 71%. It is likely that these large units have committed to specialized machine or advanced technology which alone can use imported inputs. Most of the nine manufacturing sectors with high share of large enterprises are also found to have higher number of the enterprises using imported inputs together with higher share of imported contents in total inputs.

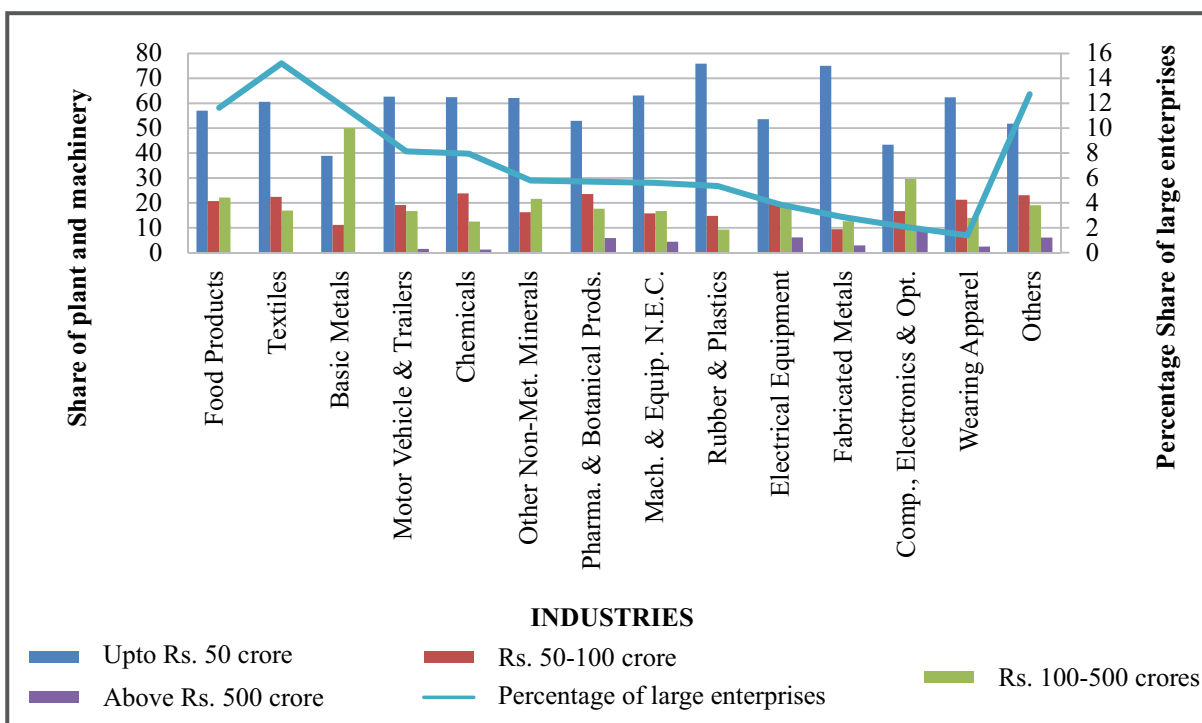
Similarly, exports also require specialized machinery and equipment, particularly for maintaining high product quality. Extent of export would thus indicate another measure of technology commitment. Enterprises who routinely export a major part of their output must be using advanced technology at par with global competition. Around 21% of the large enterprises are involved in exports and the mean value of the percentage ratio of direct exports to total output of these exporting units is around 40%, as displayed in Figure 1.5. Among the large firms around 7% are found to export more than 50% of their products and the actual average of the percentage ratio of exports to total production of these manufacturing units is estimated to be around 84%. Almost a quarter of the large manufacturing units exporting more than 50% of their products belong to the textiles sector. With the exception of 'Other non-metallic minerals' almost all the nine sectors mentioned above have relatively high share of exporting firms. Further, more than a hundred large manufacturing units export their entire output, mostly operating in food products, textiles, apparel, electrical machinery, machinery and motor vehicles industries.

A vital measure of commitment to technology is indicated by the nature of labour. From the perspective of labour it is them who have invested in the knowledge and skill, however, unless there is an enterprise that nurtures and grooms a novice for long term and on tasks involving high skill and knowledge this labour would fail to accumulate the capital of knowledge and skill. Presence of technologically committed enterprises is necessary for the generation and retention of such labour pool. Labour quality such as skills and tenure of engagement (permanent or temporary) to an extent reflect the production technology used. Another possible mode is degree of specialization, in particular the extent of non-shop-floor activities in an enterprise. The higher the proportion of white collar workers, the higher is the complexity of organisation as well as the potential sophistication of the level of technology. On the contrary, high turnover of workers, or high proportion of short duration or temporary workers, is often not appropriate for high technology which usually requires dedicated workers with specialized skills that are not readily available in the local labour pool or in the spot market. Thus employment of manufacturing

workers on a long term basis indicates potential use of higher level of technology. Contradicting cases however, may be found in the Indian manufacturing sector, as displayed in Figure 1.6. For example, in machinery & equipment sector more than 32% of the workers of the large factory units are white collar and another 18% are contractual workers (appointed through contractors) while the corresponding average shares for all the sectors together are a quarter each. Large enterprises in the machinery & equipment sector thus appear to use high technology. Similar pattern is found in motor vehicles, basic metals, computers & electronics industries. As opposed to these, chemicals seems to have dual (segmented) technology - one part, the advanced one, for high skilled white collar workers and the other part for the large section of contract workers. Textiles and food products industries use more experienced skill intensive workers and the technology is of the intermediate range.

Contracting in work from others is not a regular feature of the large factory units. Only in the case of rubber & plastic six factory units are found to contract in work worth more than 25% of their output. Similarly work done by others is also not a very common among large manufacturing units. However a large proportion of these units are found to be involved in selling goods in the same conditions as purchased from others (without any real value addition). This is nothing but trading and the large units also purchase goods from others, mostly MSMEs, and sell it to market. Around 44% of the large units are found to be engaged in such kind of trading although the volume of such trade varies (Figure 1.7). These large enterprises may be an important catalytic factor for technology development of the suppliers.

In brief, large factory units in general represent advanced technology but there is considerable variation between them within a sector as well as between sectors. Similarly, variations of technology among the MSMEs may be found within as well as across sectors, as will be discussed in the next section. We will also see later if the large enterprises directly or indirectly help the technological advancement of the MSMEs.

Figure 1.1: Distribution of large enterprises among different industries

- Note:
1. Large enterprises are those with investment in plant & machinery exceeding Rs 10 crore.
 2. Large enterprises are further grouped into different size classes based on total assets.
 3. Fixed assets include land, building, plant, machinery, equipment, tools, ICT capitals etc

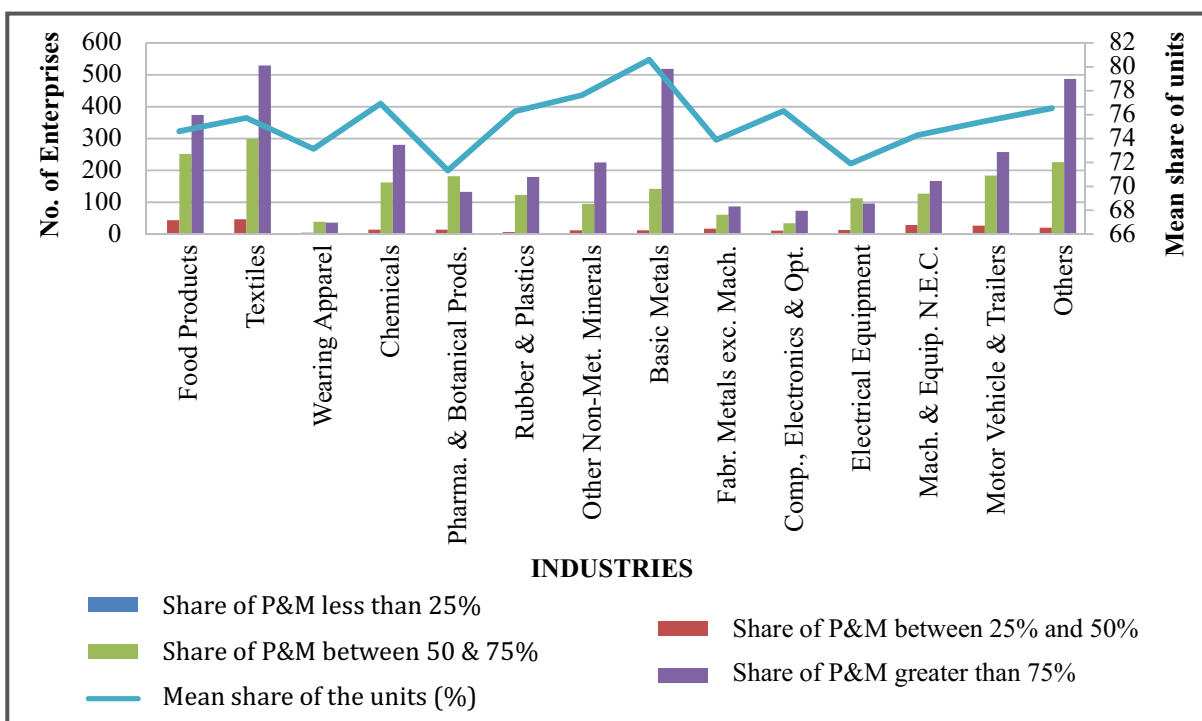
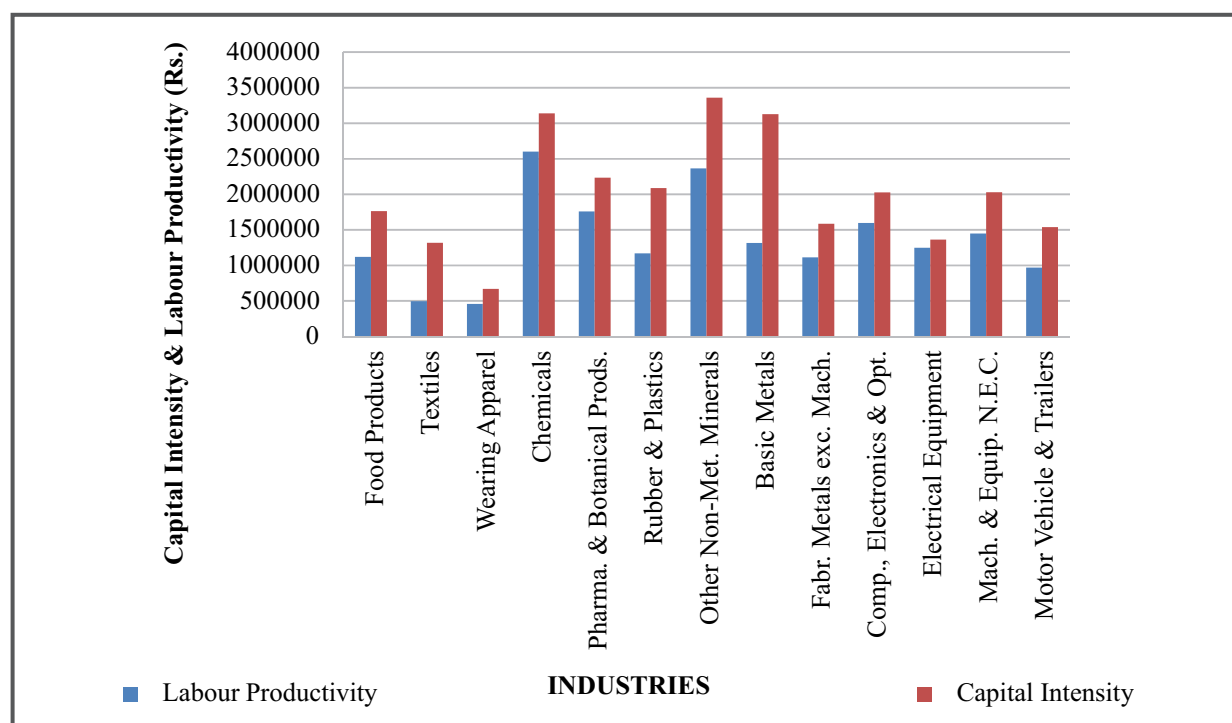
Figure 1.2: Share of assets other than land & building in total fixed assets among large enterprises

Figure 1.3: Capital intensity and labour productivity of large industries, 2009-10

Labour productivity - Value added per labour; Capital intensity – Capital per labour;

Note : Capital includes all the fixed assets excluding land & building.

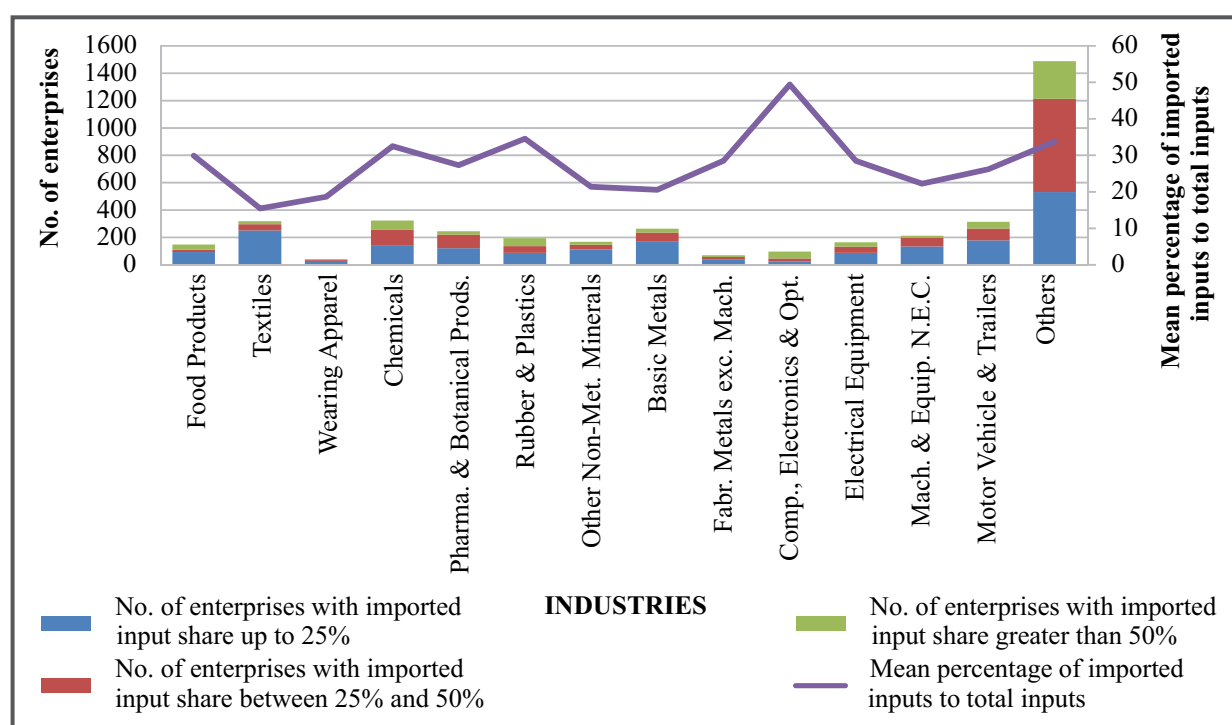
Figure 1.4: Use of imported inputs by large enterprises, 2009-10

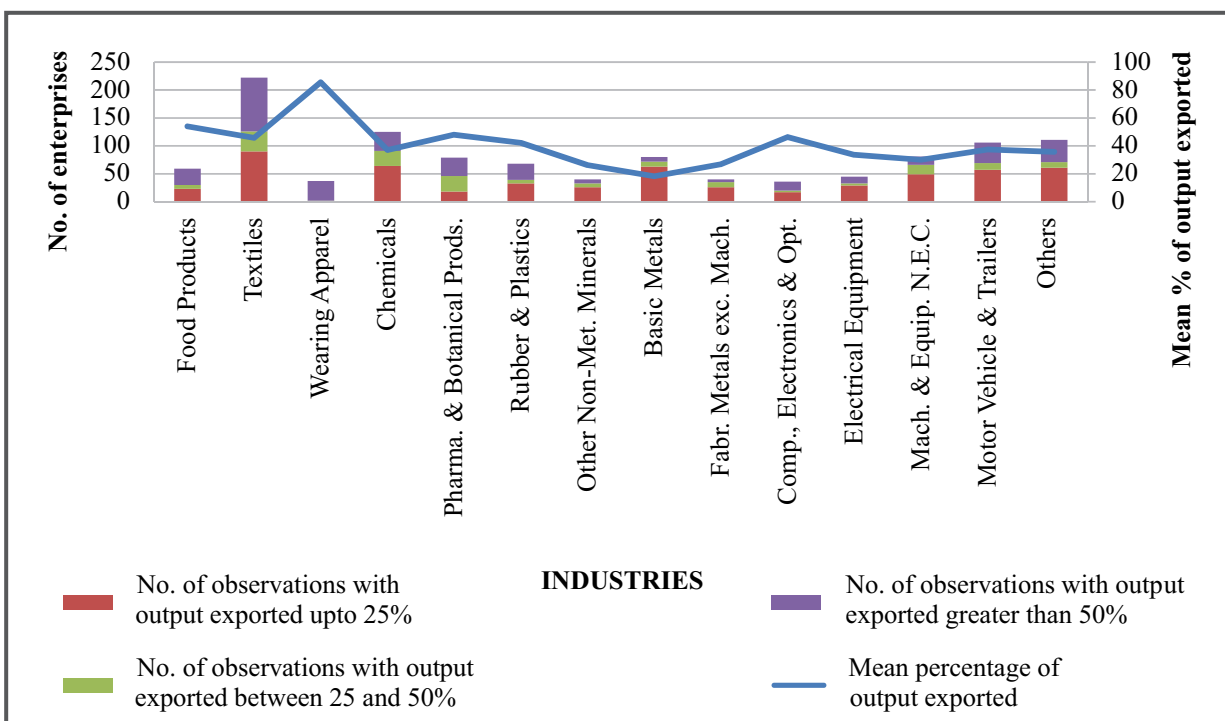
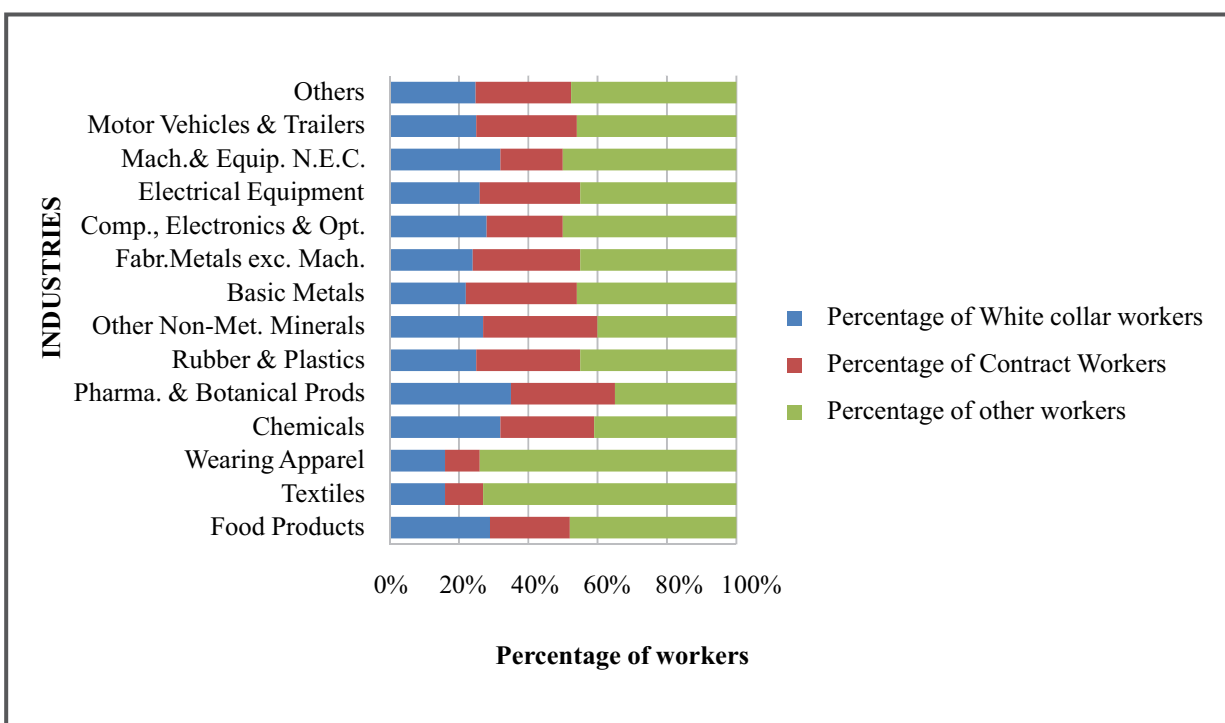
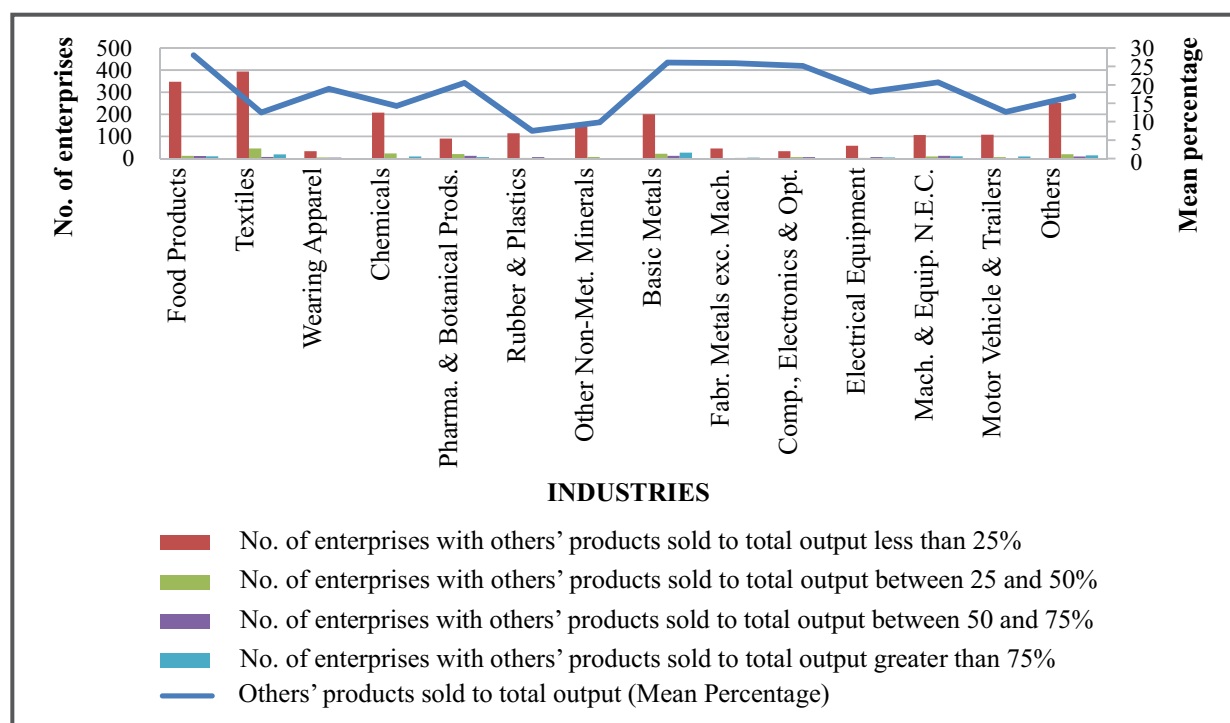
Figure 1.5: Exports by large firms, 2009-10**Figure 1.6 : Status of workers in large enterprises, 2009-10**

Figure 1.7: Sale of Others' products by large enterprises**Technological characteristics of MSMEs :**

It is already mentioned that capital intensity of production, an indicator of the level of technology, is generally very high in most of the large enterprises; but also there are a large number of MSMEs who use fairly high capital intensive production technology. It may be seen in Figure 1.8 that a majority of micro and small enterprises use low capital intensive technology, but there are a significant number of micro and small enterprises who use capital intensive technology like most of the medium and large enterprises. For example, there are more than 15 thousand micro units and close to 21 thousand small units whose productive fixed capital (ie, other than land & building) per employee is Rs 1-5 lakh and another 7 thousand small enterprises (21% of them) with productive fixed capital per labour in the range of Rs 5-25 lakh. In fact Rs 5-25 lakh is the modal class of capital intensity for the medium and large producers. If we assume a capital intensity of Rs 5 lakh or above per labour as high technology, then 14% of all the factory units under ASI belong to high technology group. Fixed assets like land and building do not enter into direct production the way machine does, but their possession indicates creditworthiness. Ten percent of the micro units possessing land & building worth more than Rs 25 lakh the maximum one can invest in plant and machinery indicating their solvency to finance investment on advanced technology (Figure 1.9).

High technology of the enterprises is reflected in the high level of output and value added per labour of a sizeable section of the micro and small enterprises. If we consider Rs 5 lakh value added per labour as a benchmark for indicating high technology, 8% of the micro and 29% of the

small units would be using such technology whereas 48% of the medium and 56% of the large units would be high technology firms, and an overall 19% of the factory units are said to be using high technology. Figure 1.10 displays the number of manufacturing units of different size-classes having value added per labour exceeding Rs 5 lakh. However, value added component in output appears to be lower among these micro and small enterprises as compared to medium and large enterprises. The benchmark for output per labour indicating high technology must be much higher than that of value added per labour. When we consider per labour output of Rs 25 lakh as representing high technology, 10% of micro units and 31% of small units would be high technology units whereas 43% of the medium and 54% of the large units would be high technology units. This indicates the competitiveness of the micro and small units who sell their product at lower prices as compared to their larger counterparts and operate with much lower profit margin. This phenomenon may be investigated further at sector or sub-sector level. However, at the aggregate level the divergence between the estimates based on these two criteria is not much - based on output per labour criterion around 21% of the units would be high technology units whereas according to value added criteria the relevant proportion is 19%.

Figure 1.8: Capital intensity of production among MSMEs

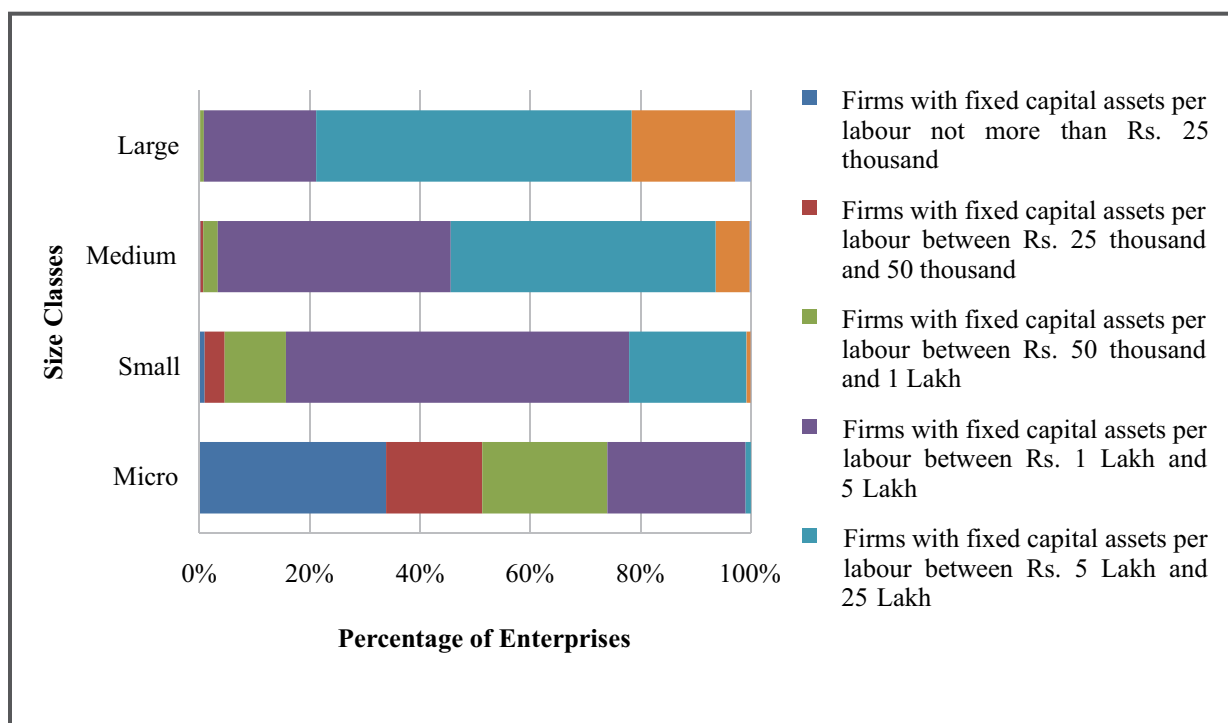


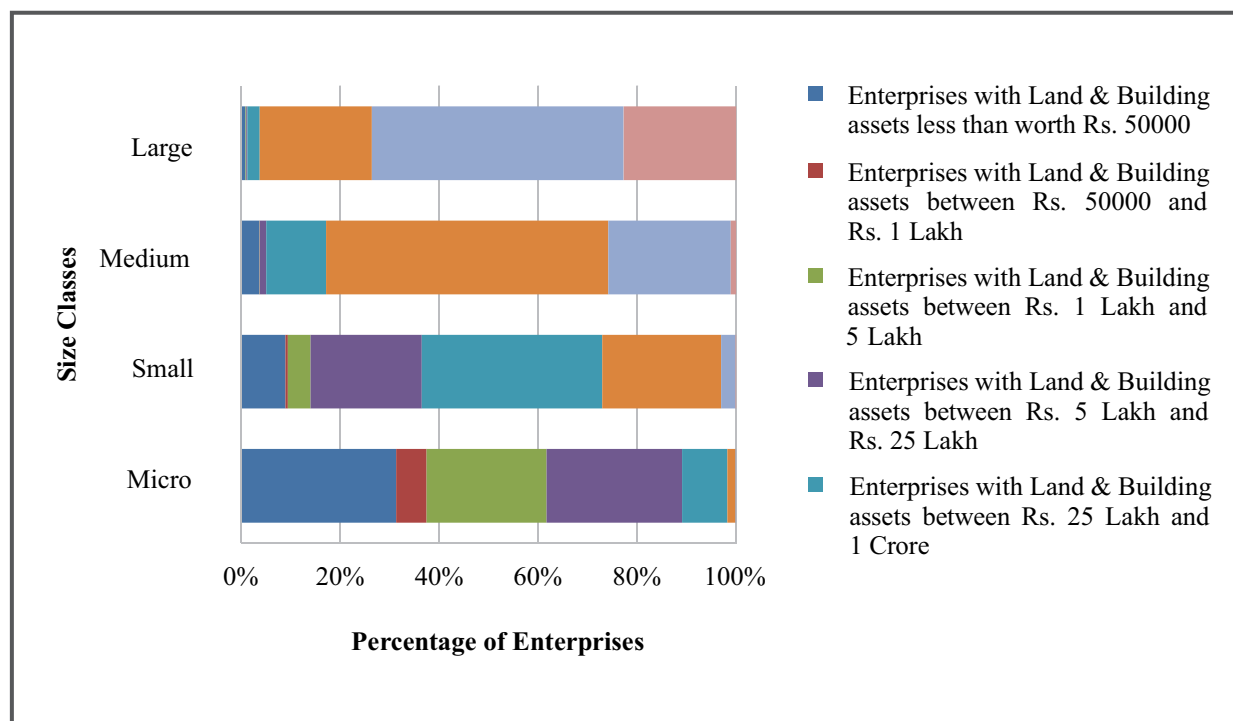
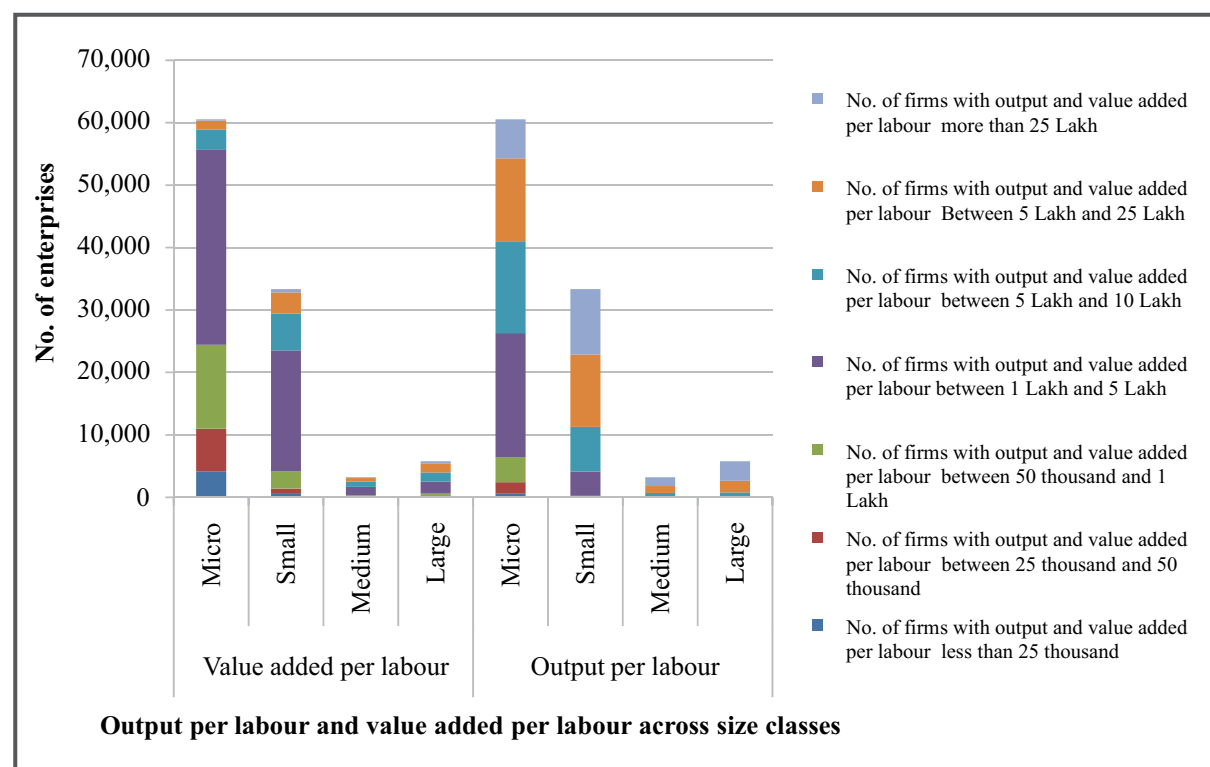
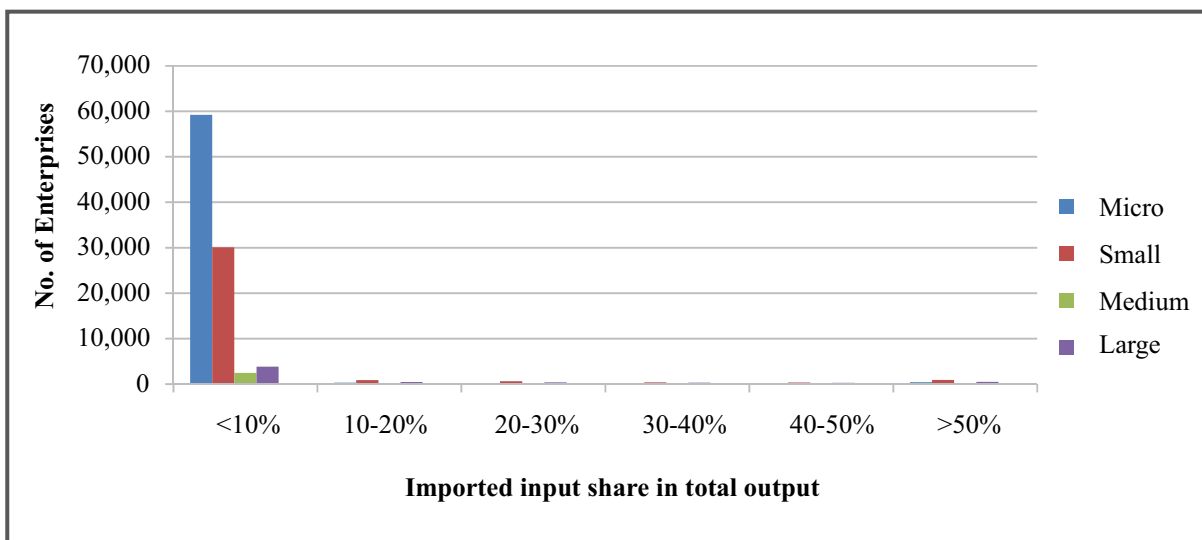
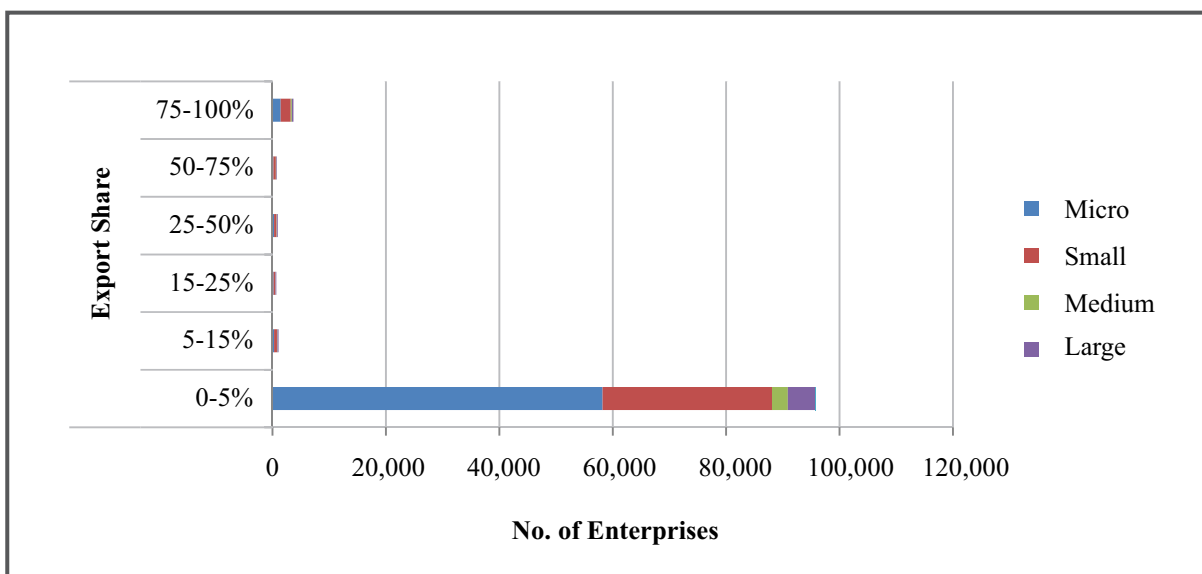
Figure 1.9 : MSMEs with land and building assets, 2009-10**Figure 1.10: Estimates of output and value added per labour by MSMEs, 2009-10**

Figure 1.11: Estimates of imported inputs for MSMEs, 2009-10

Utilisation of imported inputs would usually require specific technology involving specialized machinery & equipment as well as specialized skills. Obviously the most important purpose of using costly imported inputs is to produce high quality products. If only a small amount of imported inputs get used as critical input for production, the manufacturing process might not need investment in advanced technology, however, when imported input becomes major part of total inputs this manufacturing unit would need to invest in high level of technology, dedicated skilled workers and specialized machinery. Figure 1.11 displays the number of enterprises using a certain proportion of inputs imported. Close to 4% of all the factory units use more than 30% of inputs from the imported inputs and 3% of the units use more than 40% of the inputs imported. Among the MSMEs 1% of the micro units, 4% of the small units and 10% of the medium units use more than 40% of inputs imported. These units, numbering close to 4000, are expected to use high technology.

Similarly, involvement of manufacturing units in exports reflects their capability to compete globally. A precondition for competing in the global market is the quality control of product which can be maintained primarily through using advanced technology. It thus appears that the larger the global exposure of the output of an enterprise, the higher is the level of manufacturing technology in use. Close to four and a half thousand manufacturing units are found to export more than 50% of their produce (Figure 1.12). Around 2.6% of the micro units, 6.6% of small units, 8% of medium units and 6.8% of the large units export more than half of their output. These units are expected to use high technology. However, numerically majority of these high technology units belong to micro and small size classes. Do the domestic large exporting units help the smaller exporting units to export as well as develop technology?

Figure 1.12: Estimates of exports for MSMEs, 2009-10

There are a large number of manufacturing units that employ high proportion of white collar employees, including supervisory & managerial staff, other employees, unpaid family members, proprietors, etc – as much as 18.5% of the units are found to have more than 40% of their employees doing white collar jobs. The relevant proportion of units is more than 19% for micro size class and less than 16% for large size class. For the medium and small size classes it is 17.5%. More than 19000 manufacturing units are found to have high proportion of white collar employees (Figure 1.13). Excepting those smaller sized, primarily micro units, who use many family members that are counted under white collar employees, most of these 19000 units use sophisticated technology requiring high proportion of high skilled white collar employees. On the contrary, high proportion of short term workers, often employed through contractors, indicate fewer retained for long-term and thus dedicated workers that have accumulated the requisite knowledge, experience and skills for high technology manufacturing. Figure 1.14 shows that as much as 25400 units (a quarter of the total) have more than 20% of their workers employed through contractors mostly for short-term assignment. Their technology level is expected to be low.

Figure 1.13: Number of MSMEs with various percentages of non-worker employees, 2009-10

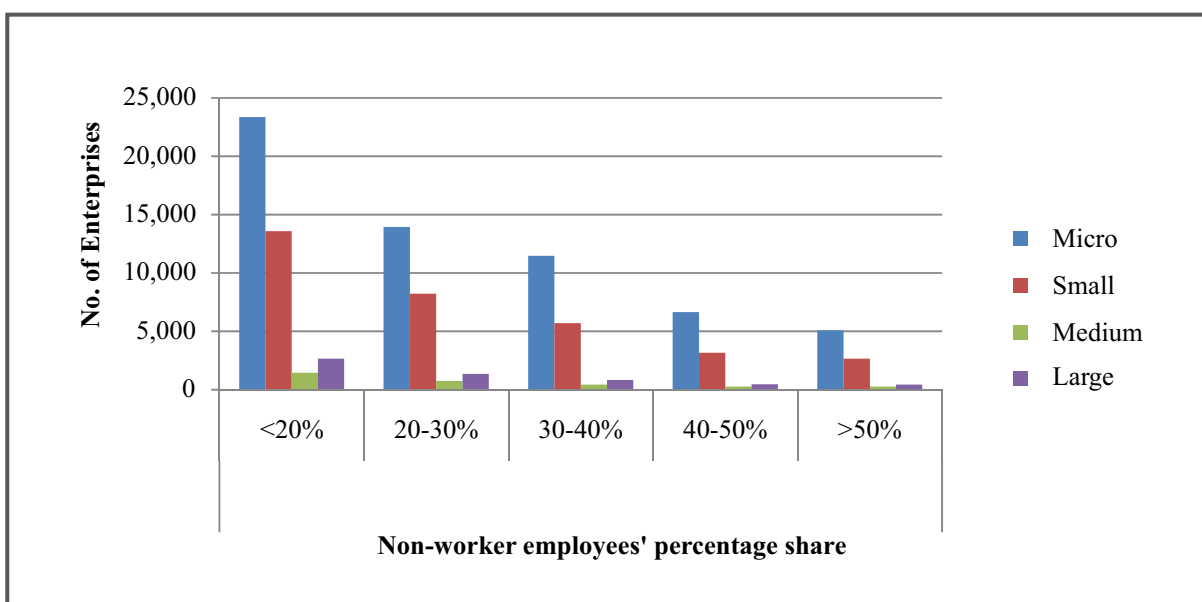


Figure 1.14: Number of MSMEs with various percentages of contract-workers, 2009-10

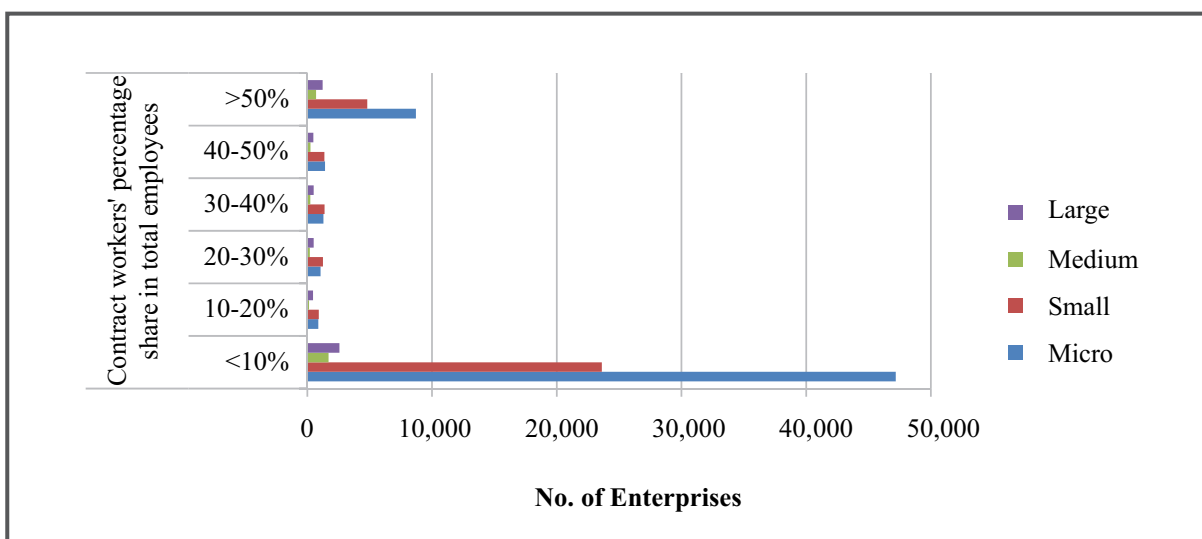
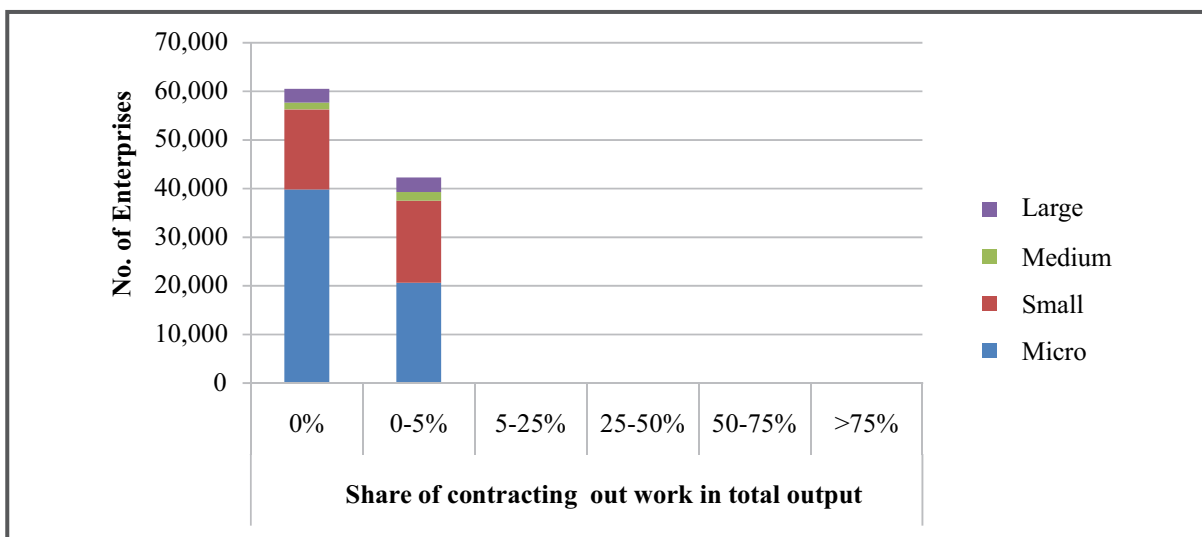


Figure 1.15: Number of MSMEs with various percentages of contracting out enterprises, 2009-10



Contracting out work to other manufacturing units may indicate specialization whereby contracting out firms do the core work and the peripheral works are done by others who are specialized in those works. It may also happen that many firms routinely get their large part of manufacturing work done through contractors and the former provide technology, design, advices, finance, etc to the latter to ensure product quality and timely delivery. However, in our sample the number of manufacturing units contracting out a major part of their work is very limited; although a large number of the manufacturing units are found to contract-in work from others (compare Figure 1.15 & Figure 1.16). Probably contracting out firms are either inter-state enterprises or units engaged in inter-state business transactions, or they could even be trading enterprises that are excluded from our sample of manufacturing units. Close to 18 thousand manufacturing units (more than 17% of total units) are found to contract-in three-fourths of their output. As expected, the proportion of such contracting-in units is higher for smaller size classes – 25% for micro units, 8% for small units, 4% for medium and 2% for large units. It is highly likely that a majority of these contracting-in manufacturing units, regularly involved in supplying large part of their produce to their counterpart contracting-out firms, need to install specialized high technology machinery and equipment for producing good quality products and for that, as mentioned above, contracting-out firms might have helped. NSSO (67th Round) data on informal sector enterprises have indeed revealed that a large proportion of the smaller manufacturing enterprises who receive work orders from large enterprises also receive several types of assistance, like product design, tools & equipments or finance, from the larger contracting-out enterprises who help the former in raising technology.

ASI data however, provide information about manufacturing units selling goods in the same condition as purchased from other manufacturing units. Perhaps this has been listed out as a separate group of enterprises because of taxation-based classification where inter-state business

transactions even of the manufactured good would appear under such trading group. From this perspective total number of enterprises can be grouped under two types of undertakers of intra-state and inter-state business transaction. There can of course be traders—buying goods manufactured by others and then selling it in the market without any real value addition. In fact such goods would belong to the standardised products, such as of spare parts, where un-branded produce from MSMEs are competing in free retail market with branded products. No further information on such buying and selling of others' goods is provided. This practice is very common among the manufacturing units. It may be seen in Figure 1.17 that one in every five units is found to be selling others' products, exceeding 75% of the value of total output. Therefore, this indicate that very large proportion of manufactured produce get transacted across state borders or even within the state but perhaps in the retail markets. The involvement in trading in others' products is however higher for the smaller sized enterprises who in addition to selling own product, also sell neighbours' products. There is a possibility that repeated transactions among these manufacturers would lead to development of some form of contractual relations as well as specialisation of production. Our data source, however, is limited and does not provide any further details on this issue. Development of a local thicket of dense quasi-contractual relations of helping market the produce might result in accretions to scale-economy, further specialisation and technology development and consequently, product innovation.

Figure 1.16: Number of MSMEs with various percentages of contracting in work, 2009-10

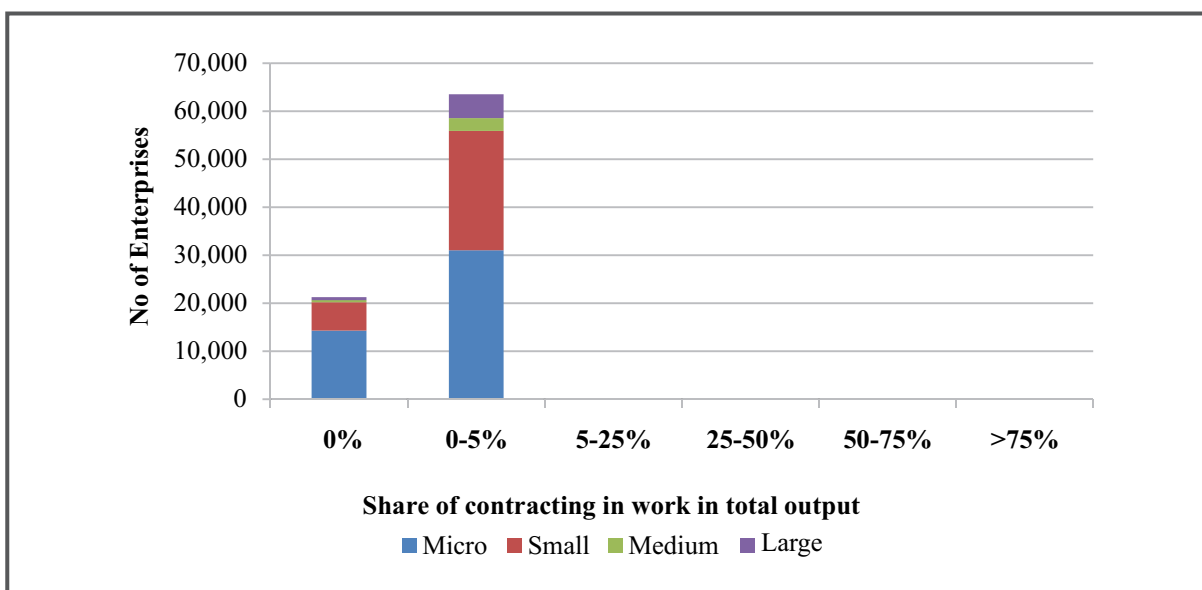
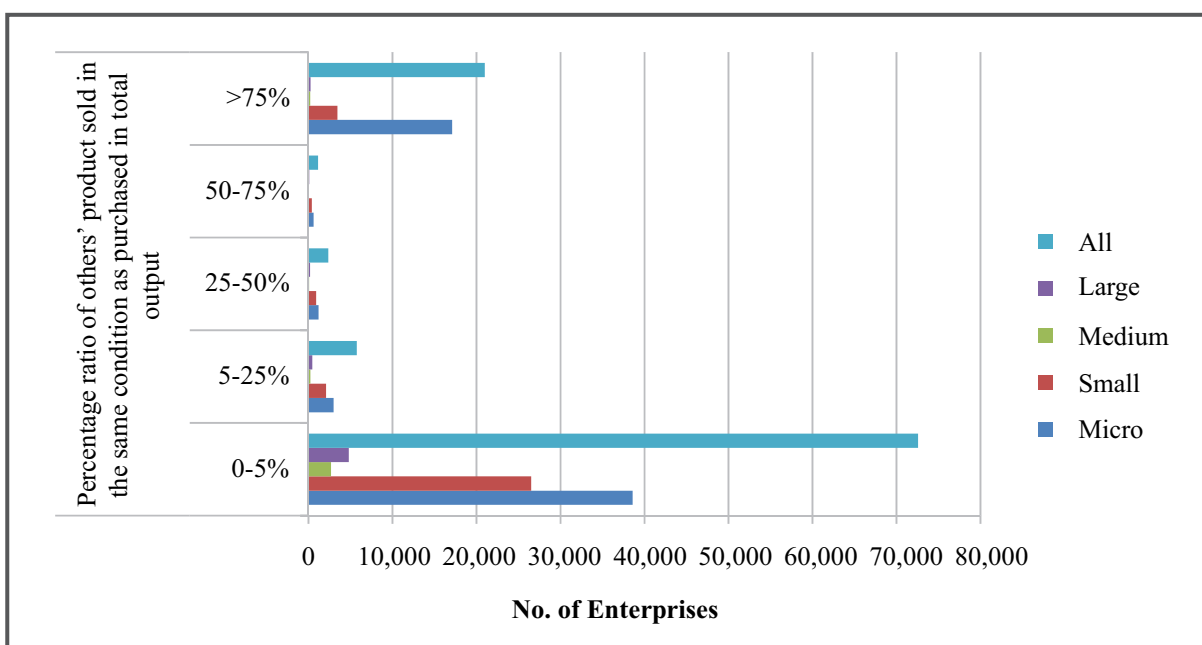


Figure 1.17: MSMEs selling others' product in the same condition as purchased, 2009-10



Above discussion suggests that there can be multiple parameters to gauge the level of technology of a manufacturing unit and there is a possibility that the same unit may appear as a high technology unit based on one parameter and in contrast, as a low technology unit based on another parameter. It is suggestive to combine multiple parameters so as to generate one or few composite indices which would describe the level of technology of the unit unambiguously. It would help us to identify and categorise units according to technology level for different size classes or industry groups (2-digit or more) or regions. For example, we can estimate the number of medium or high technology units that exist among micro units in one particular 2-digit industry group (or in a region). Further, changes in the level of technology in a particular group over a period of time would reflect innovation made by the group and an analysis of the disaggregated indices would reveal the types of innovations that have taken place. Once this is done, we may identify the factors responsible for such innovations by looking at other dimensions that may be internal or external to the firm, industry, cluster or region. Nature and magnitude of innovations have implications for industry dynamism.

It is worth noticing as may be seen from Table 1.1 that a sizeable number of MSMEs are present in those sectors where large enterprises are also concentrated, for instance in textiles, food products, chemicals, pharmaceuticals, other non-metallic mineral products, basic metals, fabricated metals, electrical machinery, machinery and equipment, and motor vehicles. Further, it is shown later that MSMEs in these sectors have made significant innovations together with large manufacturing units. It is thus very likely that MSMEs are, in some way or other, linked to large industries, or they are operating independently but all are taking advantage of the opportunities

created by the markets. This would be further probed in the following chapters through a study on the pattern of innovations and the likely factors influencing such innovations. The next chapter deals with the methods of construction of index that would be used to measure technology levels and innovations. Changes in the composition/distribution of manufacturing units across size-classes, sectors or regions would provide an account of innovations that took place over a period of time. This would also give an idea of the nature and type of innovations.

Table 1.1: Size distribution of MSMEs across manufacturing sectors

	nic2	Micro	Small	Medium	Large	Total	Percent
Food Products	10	10,024	5,079	292	672	16,067	15.62
Beverages	11	447	311	71	165	994	0.97
Tobacco Products	12	1,811	69	3	18	1,901	1.85
Textiles	13	2,934	2,737	394	878	6,943	6.75
Wearing Apparel	14	1,726	1,579	100	80	3,485	3.39
Leather & its Products	15	874	722	49	37	1,682	1.64
Wood & Plaiting, ex Furn	16	2,531	1,045	16	17	3,609	3.51
Paper	17	2,544	901	78	228	3,751	3.65
Print & Recorded Media	18	717	747	74	54	1,592	1.55
Coke & Refined Petr.	19	359	274	83	54	770	0.75
Chemical	20	3,714	2,007	233	459	6,413	6.23
Pharma. & Botanical Prods.	21	842	1,396	160	329	2,727	2.65
Rubber & Plastics	22	3,267	2,658	255	309	6,489	6.31
Other Non-Met. Minerals	23	11,125	2,389	179	334	14,027	13.64
Basic Metals	24	2,821	2,784	374	675	6,654	6.47
Fabr. Metals exc. Mach.	25	4,507	2,028	154	165	6,854	6.66
Comp., Electronic & Opt.	26	695	455	73	120	1,343	1.31
Electrical Equipment	27	2,420	1,374	135	223	4,152	4.04
Mach. & Equip. N.E.C.	28	4,189	2,248	177	324	6,938	6.75
Motor Vehicles & Trailers	29	834	1,318	195	470	2,817	2.74
Other Transport Equipment	30	793	500	51	98	1,442	1.4
Furniture	31	607	204	15	7	833	0.81
Other Manufacturing	32	687	478	51	50	1,266	1.23
Recycling	33	62	40	3	6	111	0.11
All	Total	60,530	33,343	3,215	5,772	102,860	100

Chapter : 2

Technology commitment levels and pattern of innovations

It is indicated in the previous chapter that there are multiple ways of measuring the technology commitment levels; such measurement is informed by and also determined by for example, what type of machinery is being used and hence what level of embodied knowledge is employed; what are the components with which the machine as well as the product is made of, what are the material inputs, and labour inputs or the skills engaged and what kind of energy source or motive force is required to operate the machineries, and what are the outcome of the use of the technology embodied machine/product in terms of output per labour or per unit of material inputs, what is the grade of product quality, and the export performance or market share of the products or types of contractual or quasi-contractual linkages of the enterprise.

For sake of simplicity in this chapter the relevant parameters for identifying technology level of manufacturing units have been grouped/clubbed into three broad groups; namely (1) those related to inputs, (2) those related to capital and (3) those related to output.

(A) Input related parameters as available from our dataset, are about the extent of the use of white collar managerial and supervisory staff, contract labour, use of imported inputs and wage-rates paid to workers; (B) similarly, the capital related parameters are about the extent of land and building assets, capital per unit labour, number of manufacturing units owned by a firm and share of productive non-land assets such as plant and machinery, tools and equipment, ICT capital etc in total assets; and (C) output related parameters are about output per labour, value added per labour, contract work, export orientation of production and sale of others' products.

Each parameter represents a scale for technology commitment levels and on one such point of this scale resides the value of the particular dimension of technology of the manufacturing unit/enterprise under consideration. It is being assumed that since all parameters reflect investment, which is homogeneous and therefore scalar additive, the summation of such values of all the parameters constituting a group, for a manufacturing unit, denotes the unit's technology commitment level for the particular group of technology indicators. Thus each group of technology parameters represents a pillar of technology and the pillar is indexed corresponding to seven levels of technology, namely, very low, low, lower medium, medium, higher medium, high and advanced technologies. Combining the values of all the three pillars, namely input pillar, capital pillar and output pillar, and through simple averaging a consolidated index of technology is formed⁴. For the consolidated index also the same seven point technology scale is used. These three pillars of technology together with the consolidated index help us to understand the status of the present level of commitment to technology and the degree of technological advancement that

⁴ Method of un-weighted or simple averaging of individual indicators of innovations is used by EC for constructing index of innovations.

has happened in Indian manufacturing over a decadal period.

1. Input Pillar: This index is created taking into account the share of contractual labour, share of employees involved in managerial work and supervision, share of imported input in a factory unit and the wages per employee. For each of these four parameters appropriate scale is set denoting technology levels. A detailed description of the scaling is given below:

- i. **Share of contractual workers:** It measures the percentage of total workers employed through contractor, and not directly by the factory. An index denoting technology level is assigned to a range of values. An enterprise with no contractual worker is assigned a value of 7; an enterprise with a share of contractual workers up to 15% is assigned a value of 6, in the range 15-30% is assigned a value of 5, 30-45% a value of 4, 45-60% a value of 3, 60-80% a value of 2 and more than 80% the value of 1. An enterprise with fewer contractual workers is expected to be technologically more advanced than an enterprise with larger number of contractual workers because in general an advanced technology would require machine/process specific skill/knowledge and hence retained longer-tenured and thus more dedicated skilled workers. Often advanced technology reduces demand for labour hands while however, knowledge-intensity increases and such knowledge/skill are unlikely to be available in a local spot market readily. Shorter job duration or frequent change in job does not allow a worker to accumulate enough work experience or skills. Further, with retained long-term worker an enterprise pays for and most often, higher wages including on social security. In other words, an enterprise commits in general higher investment on regular/permanent worker. Thus higher the level of technology of an enterprise, the higher would be the percentage share of permanent employees. Figure 2.1 displays the distribution of factory units for different proportions of contract workers.

Figure 2.1: Distribution of contract workers

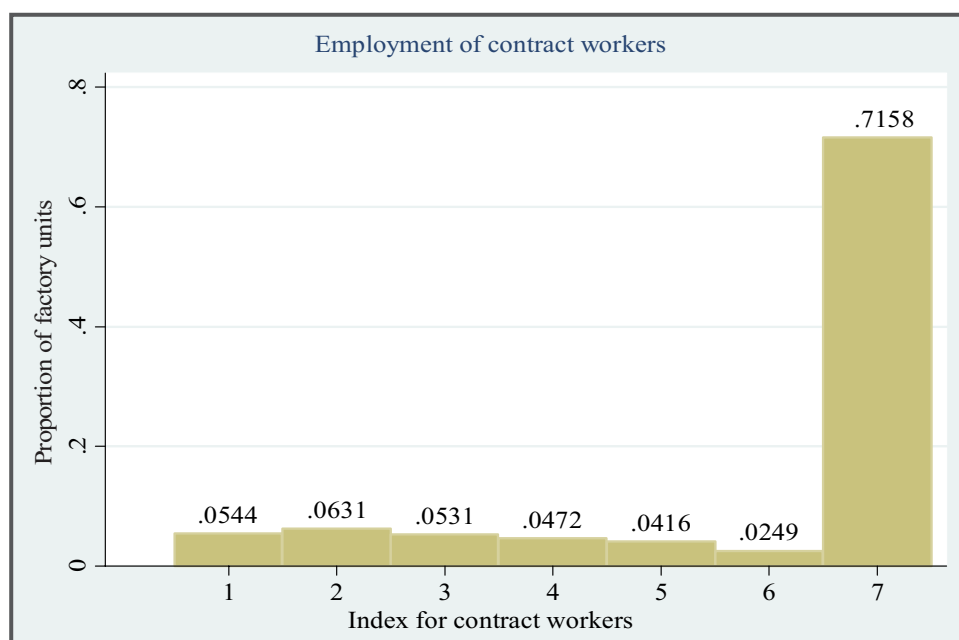
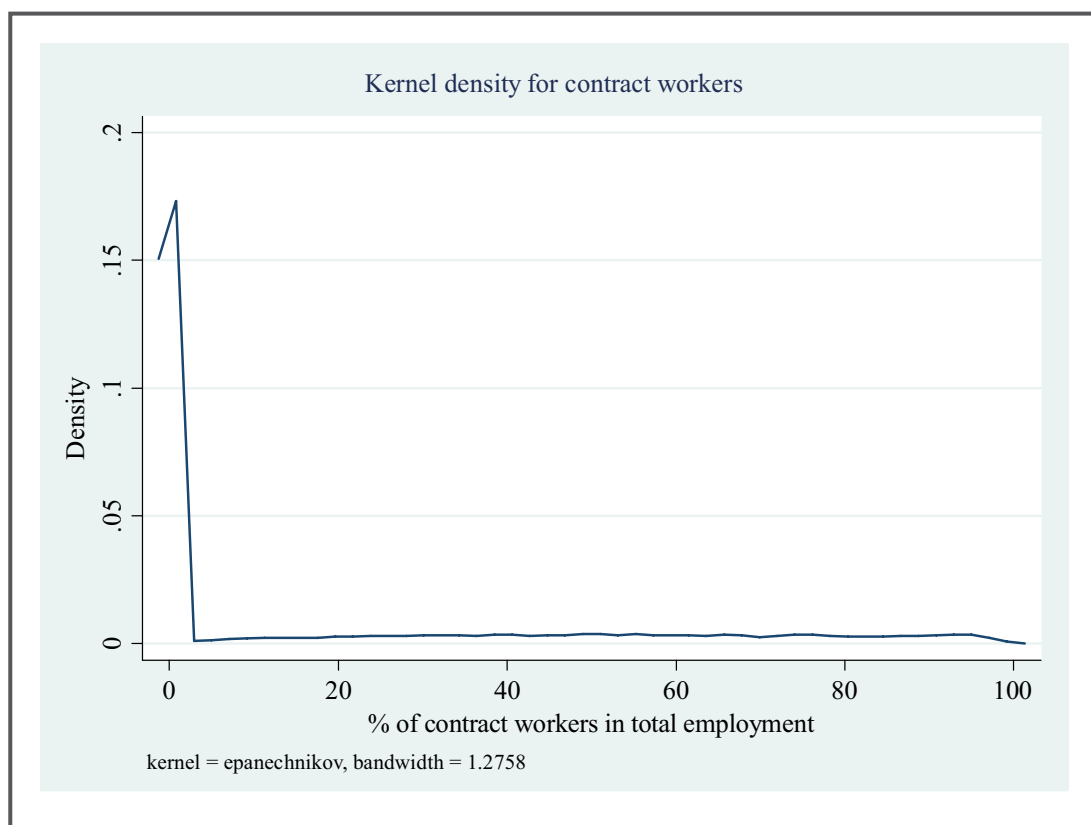


Figure 2.1a: Kernel density for the use of contract workers

- ii. **Share of employees involved in managerial work and supervision:** It measures the percentage of total employees involved in non-shop floor managerial and supervisory work or the white collar jobs of a factory unit. Different indices are assigned to different range of values in this case as well. Enterprises with a share of white collar employees up to 10% of employees are assigned an index value of 1, with a share of 10-20% a value 2, 20-30% a value 3, 30-40% a value 4, 40-50% a value 5, 50-60% a value 6 and more than 60% a value 7 is assigned. An enterprise using advanced technology is likely to emphasise on design, quality control and maintenance, and marketing and distribution, servicing including provisioning for spare parts of products, accounting and finance, and thus such an enterprise employs more designers, supervisory, managerial and marketing staff. Managerial and supervisory staff are important for coordination and smooth functioning of various departments of the manufacturing unit. Figure 2.2 displays the distribution of manufacturing units with different levels of managerial and supervisory staff and other white collar employees per manufacturing unit.

Figure 2.2: Distribution of manufacturing units across proportion of white collar employees

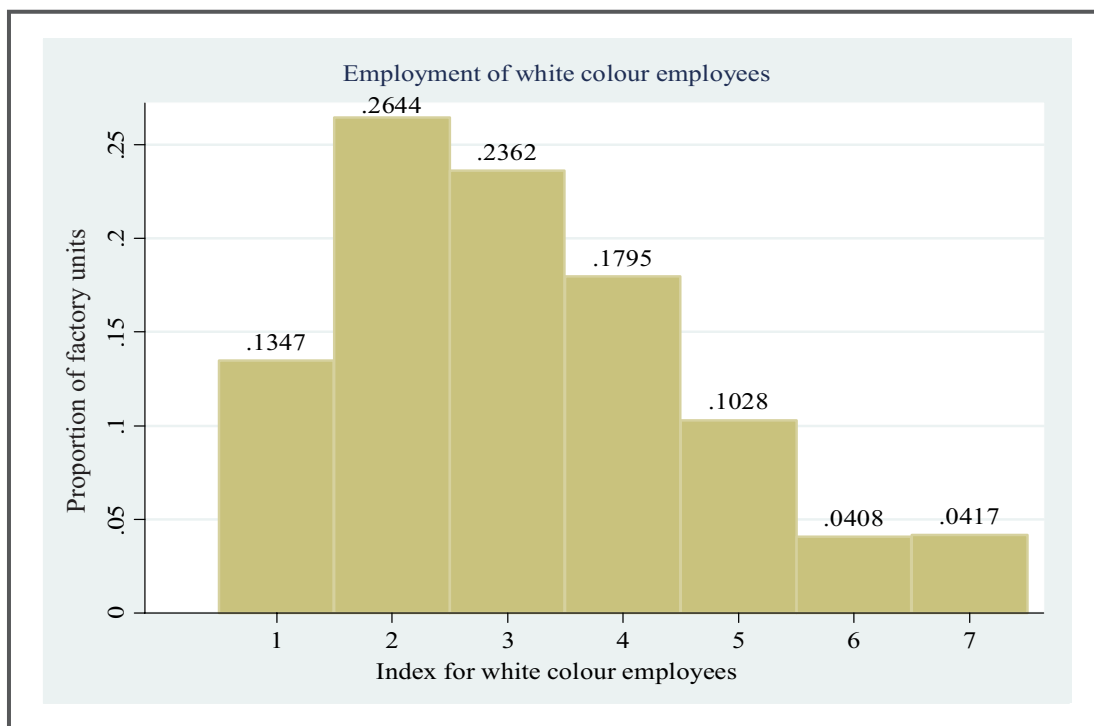
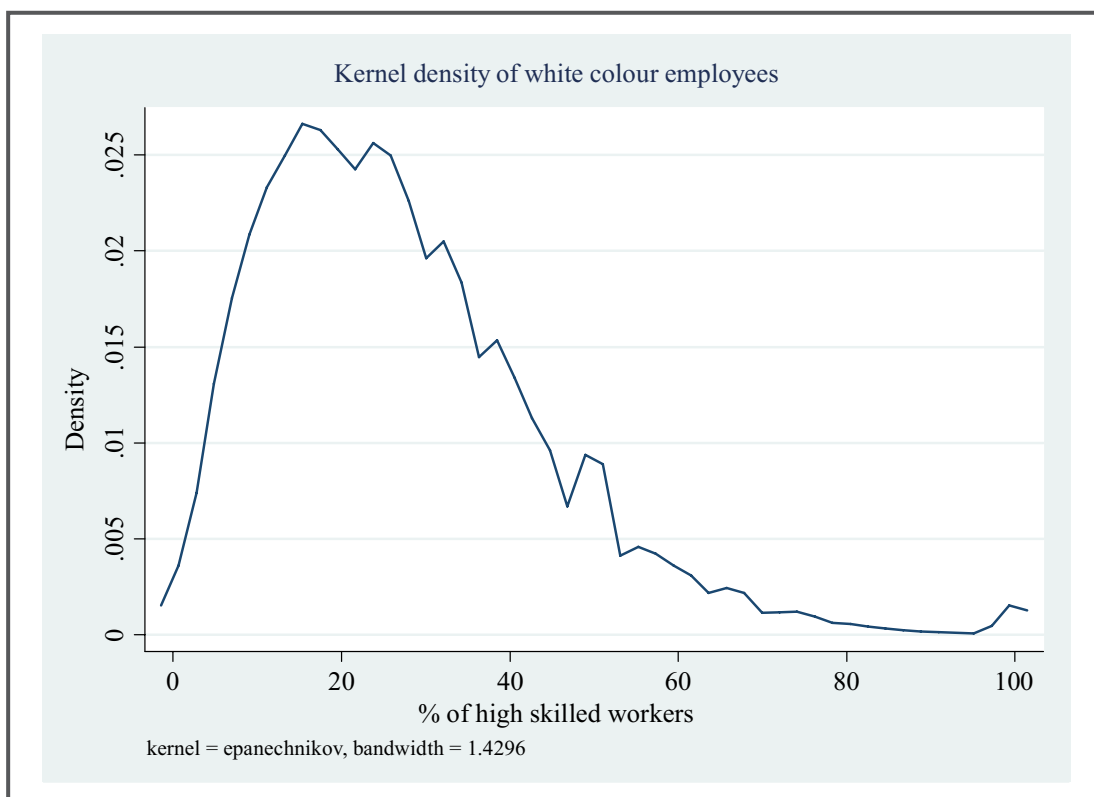


Figure 2.2a: Kernel density for the use of white collar employees



- iii. **Share of imported inputs:** It measures the proportion of imported inputs in total inputs used by a factory unit. An enterprise with a share of imported inputs up to 10% is assigned an index value 1, with a share of 10-20% a value 2, 20-30% a value 3, 30-40% a value 4, 40-50% a value 5, 50-60% a value 6 and more than 60% a value 7 is assigned. An enterprise with a higher share of imported input is more likely to produce specialized high quality product by using high technology. Distribution of manufacturing units for different proportions of imported inputs in total inputs is displayed in Figure 2.3.

Figure 2.3: Import intensity of inputs and distribution of manufacturing units

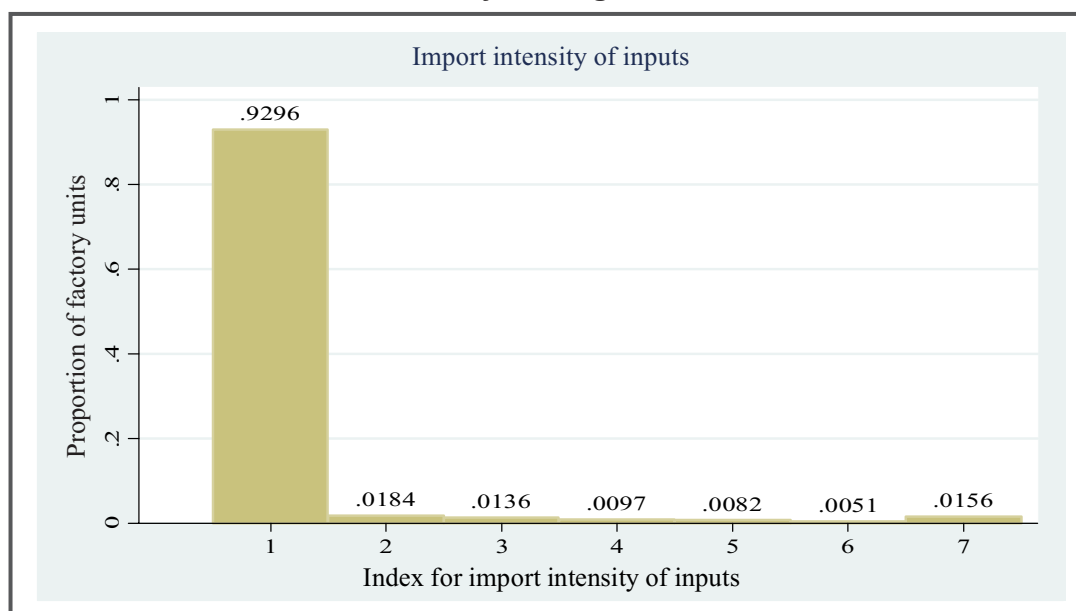
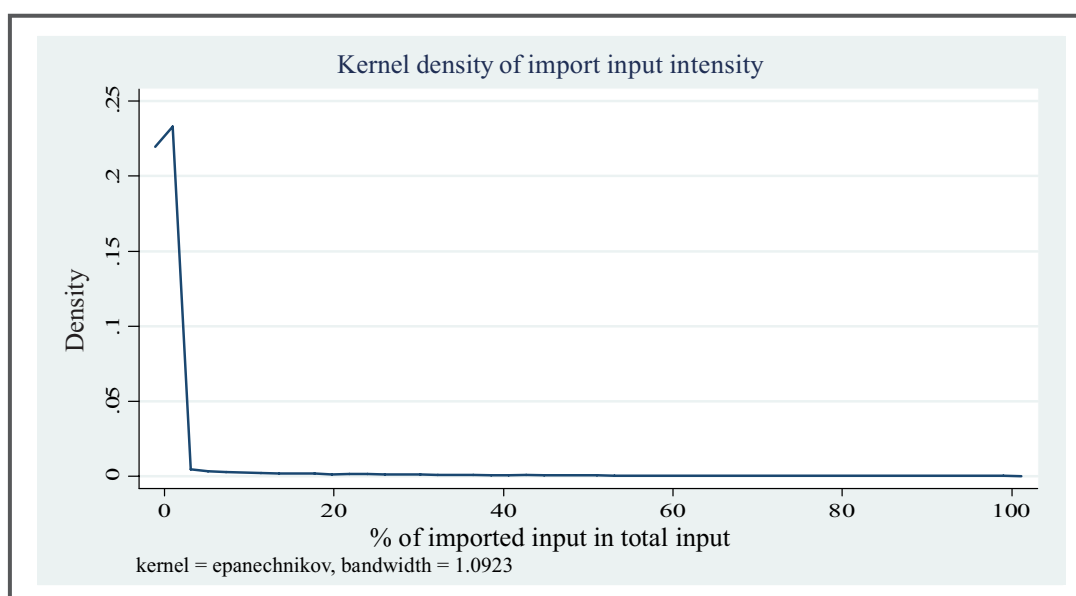


Figure 2.3a: Kernel density for import intensity of inputs



- iv. **Wage per employee:** This figure is obtained as the ratio of the total amount of wages paid in an enterprise and the total number of employees in the enterprise in a year. Indices of technology levels are assigned to enterprises corresponding to the different range of values of this parameter. An index 1 for values less than Rs 25000, 2 for values between Rs 25000 -50000, 3 for Rs 50000-100000, 4 for Rs 1- 2 lakh, 5 for Rs 2 -5 lakh, 6 for Rs 5 -10 lakh and 7 for values above Rs 10 lakh. A firm which is technologically advanced is likely to employ more skilled people and pay higher wages. Higher wage also reflects higher productivity. Figure 2.4 shows the distribution of factory units corresponding to these indices.

Figure 2.4: Distribution of manufacturing units for different wage indices

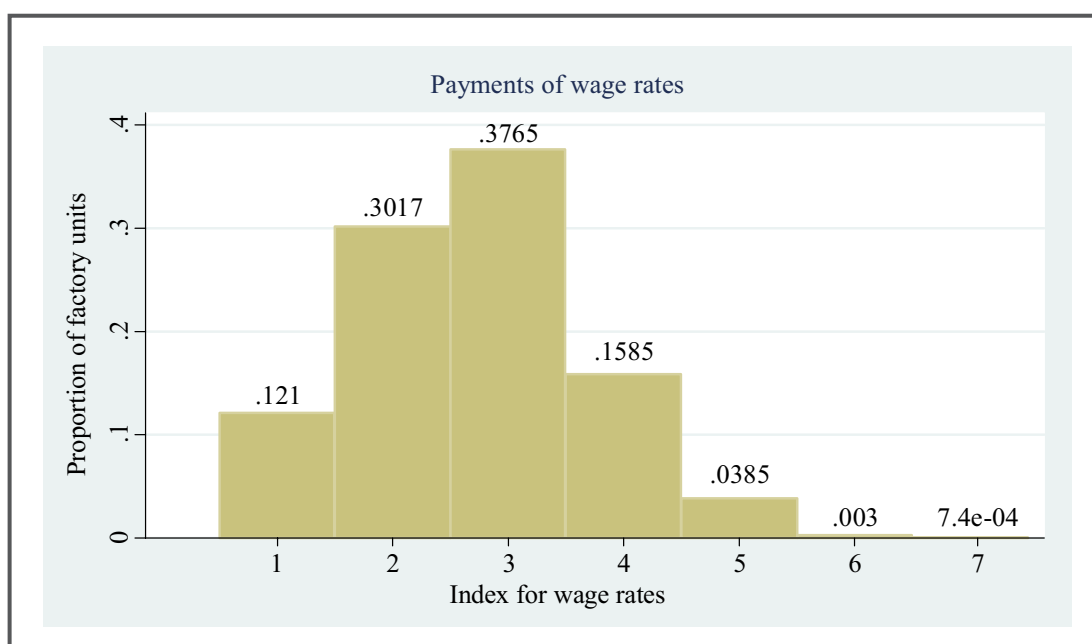
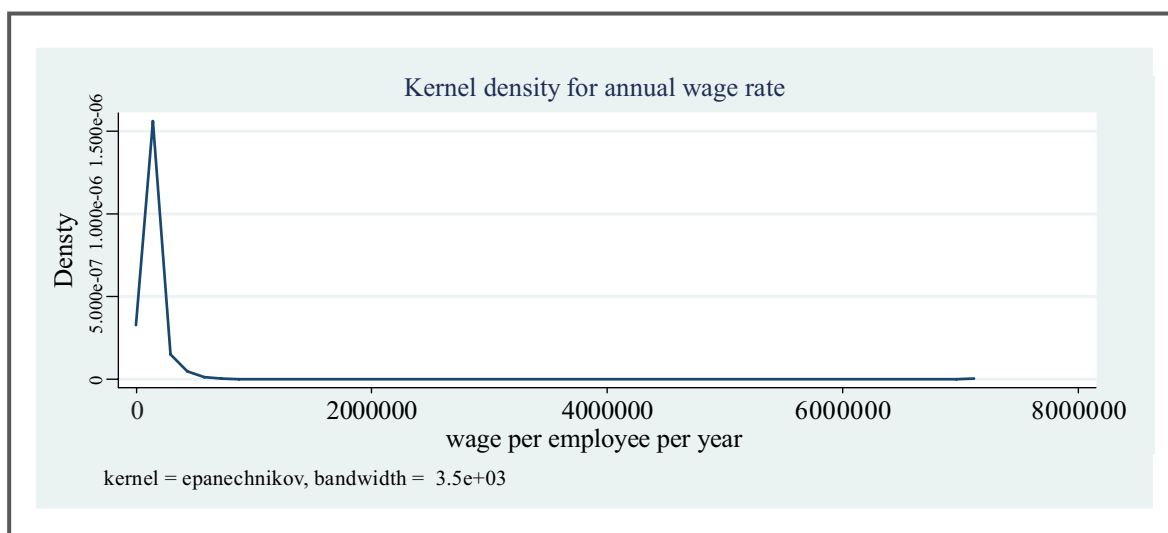
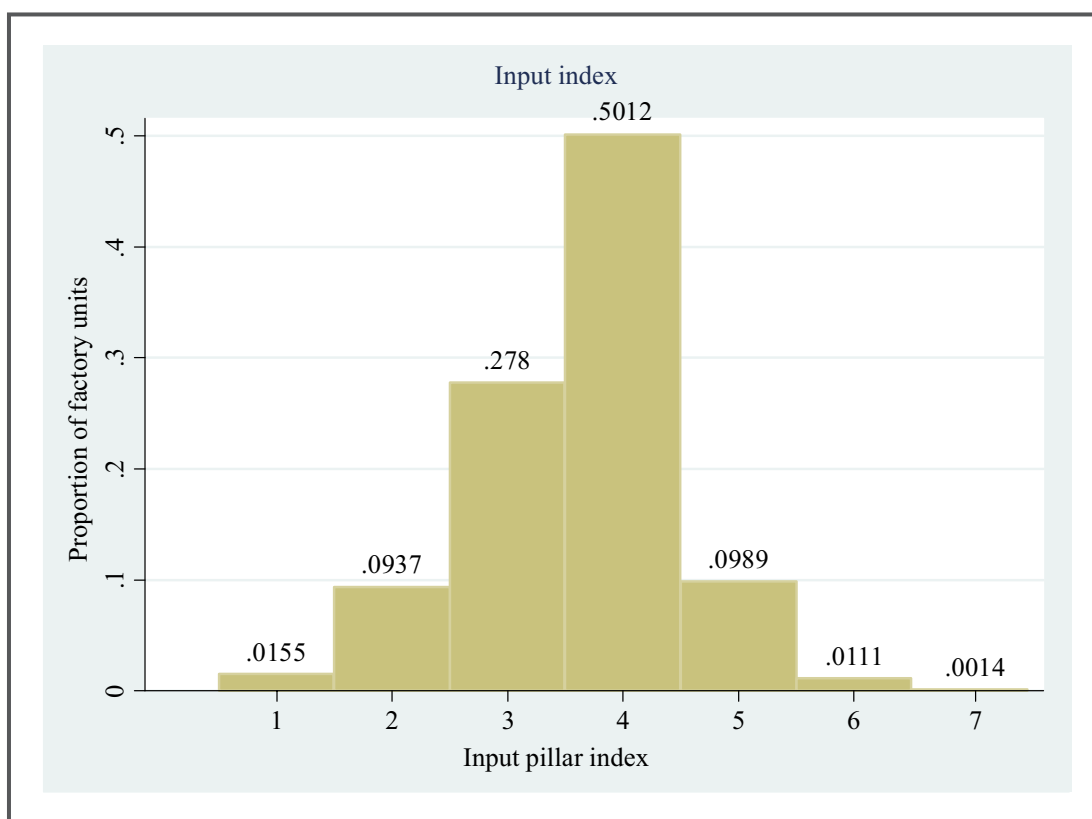


Figure 2.4a: Kernel density for annual wage rates



Input Pillar: It may be seen the four different parameters indicate technology in different ways and although all the parameters may not be equally important while denoting technology level of different size classes or industry sectors, we have combined them by taking their simple average. Combination of the four parameters, however more accurately captures the technology commitment level in so far as the use of inputs is taken into account. Thus, simple averaging the values of all the four indices for a manufacturing unit would provide the group index for the input-technology commitment pillar. For convenience, we set scales from 1 to 7 as follows: average value 1 is very low technology (level 1); average value more than 1 up to 2 is low technology (level 2), more than 2 up to 3 is lower medium technology (level 3), more than 3 up to 4 is medium technology (level 4), more than 4 up to 5 in higher medium technology (level 5), more than 5 up to 6 is high technology (level 6) and above 6 is advanced technology (level 7). Figure 2.5 displays the distribution of factory units across technology levels of the input pillar.

Figure 2.5: Distribution of factory units across total of input based indices

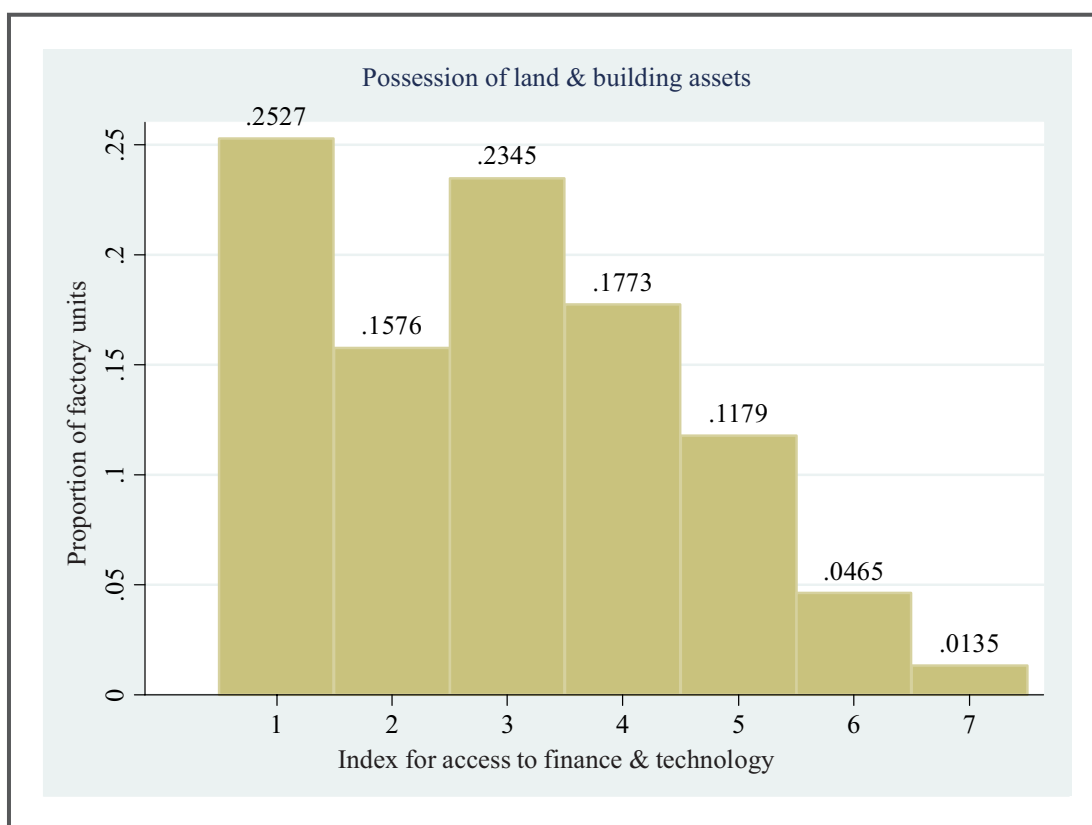


2. Capital Pillar: This index is created taking into consideration the values of land and building assets of a firm, share of plant & machinery, tools & equipment, ICT capital etc in total asset, number of factory units owned by the firm and capital per unit labour. For each of the four parameters relevant technology scale is assigned. A detailed description of the scaling is as under:

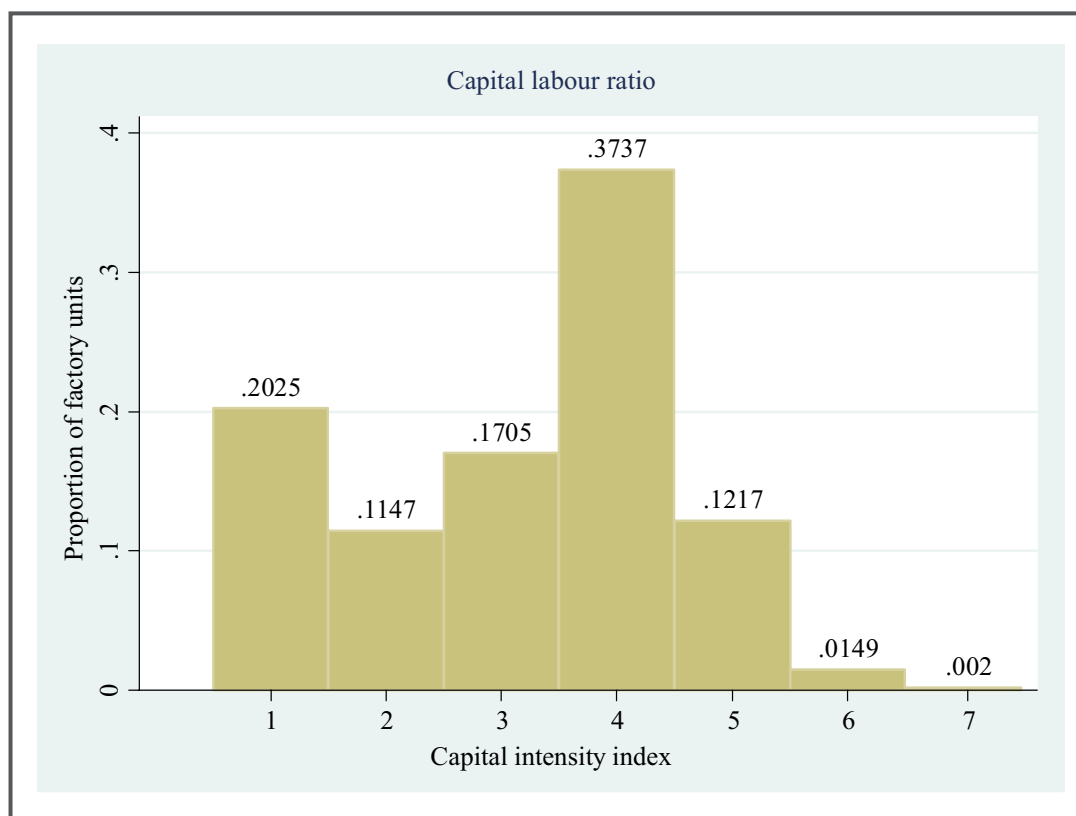
- i. **Land and Building assets of a firm:** Possession of high valued land and building assets shows creditworthiness or solvency of the enterprise capable of installing latest machinery

and equipment, and investing in R&D activities leading to modernization of technology. Thus larger the value of land and building, the larger is the probability of installing higher technology equipment. Corresponding to different ranges of values of land and building assets unique index numbers have been assigned to denote commitment to the technology level. An index value of 1 is assigned to land and building asset values less than Rs 1 lakh, 2 for values ranging between Rs 1–5 lakh, 3 for values ranging between Rs 5-25 lakh, 4 for values between Rs 25-100 lakh, 5 for values from Rs 1-5 crore, 6 for values between Rs 5-25 crore, and 7 for values exceeding Rs 25 crore. Figure 2.6 displays the distribution of manufacturing units for different indices of land and building.

Figure 2.6: Distribution of manufacturing units for different (index) values of land and building

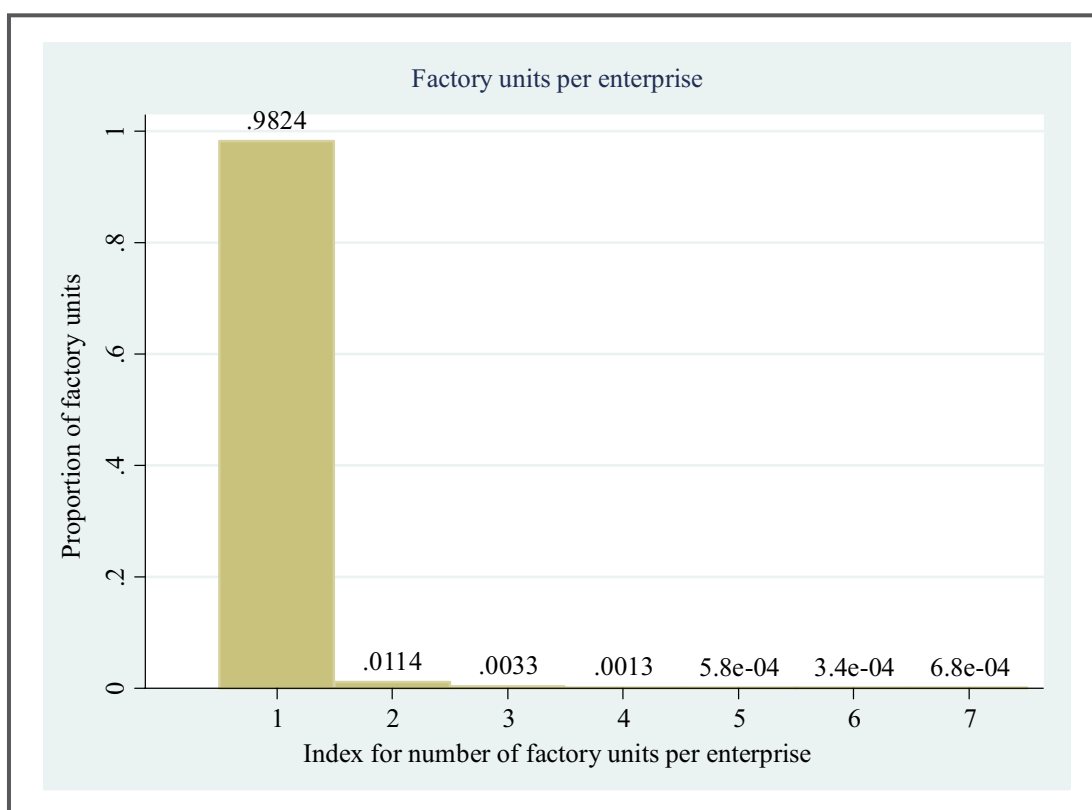


- ii. **Capital per labour:** Value of productive assets, consisting of plant and machinery, tools and equipment, etc, per unit of labour indicates capital intensity, and higher is the capital intensity the higher is the expected level of technology. Higher capital intensity is generally assumed to be associated with higher labour productivity. Index values are assigned corresponding to different ranges of the productive assets per labour. Index value of 1 is assigned for capital labour ratio upto Rs 25000, 2 for Rs 25-50 thousand, 3 for Rs 50-100 thousand, 4 for values ranging between Rs 1-5 lakh, 5 for values between Rs 5-25 lakh, 6 for values between Rs 25-100 lakh and 7 for values greater than Rs 1 crore. Here capital includes all the fixed assets other than land and building. Figure 2.7 displays the distribution of factory units corresponding to indices of capital intensity.

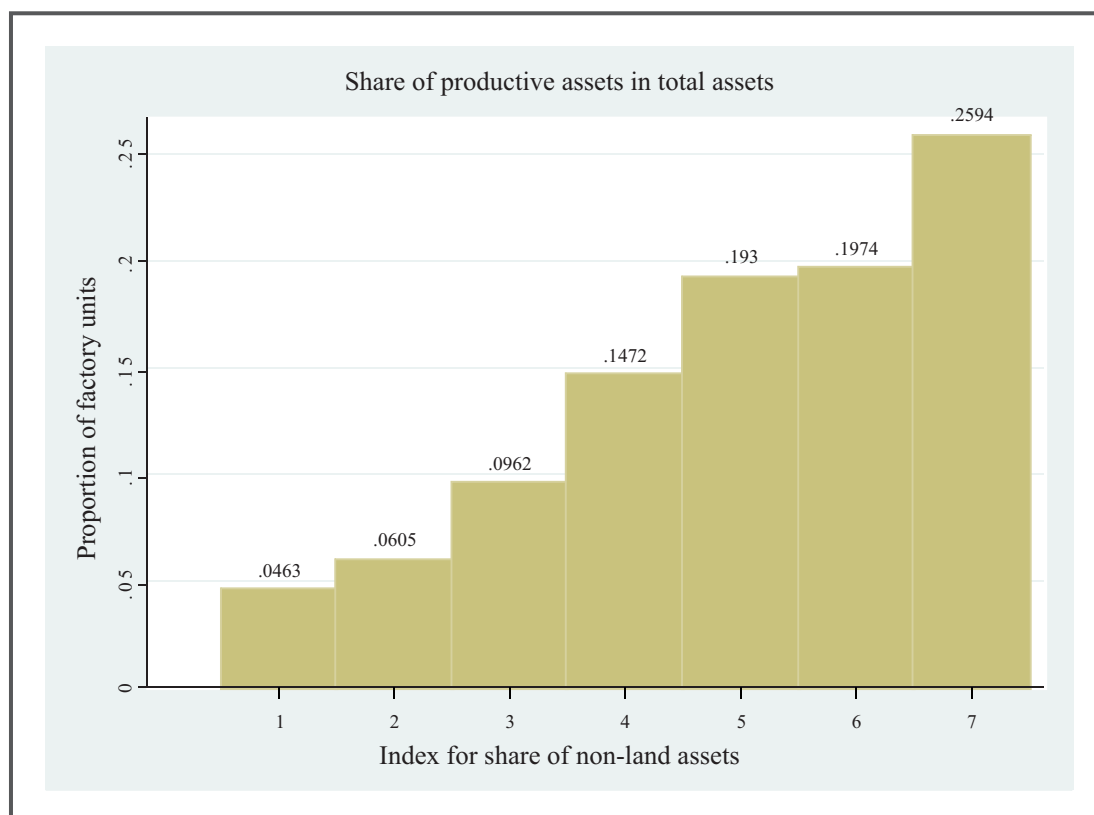
Figure 2.7: Distribution of manufacturing units based on capital intensity indices

- iii. **Number of factory units:** An enterprise with more than one operating factory units is usually large in size, and cater to several markets and therefore, in Schumpeterian sense of the technology which includes organizational and managerial knowledge, such an enterprise is likely to be committed to advanced technology. This might be also due to the fact that such an enterprise use economy of scale with upgraded technologies and is likely to manufacture better quality and larger quantity or large varieties of products catering to larger markets facing increased competition. Index values corresponding to number of factory units have been created as follows: Index 1 is assigned if number of factory units is 1, index 2, 3, 4, 5, 6 are assigned to firms having 2, 3, 4, 5 and 6 factory units respectively and index 7 is assigned to firms with factory units equal to or greater than 7. Figure 2.8 displays the distribution of factory units corresponding to indices of the number of factory units per enterprise.

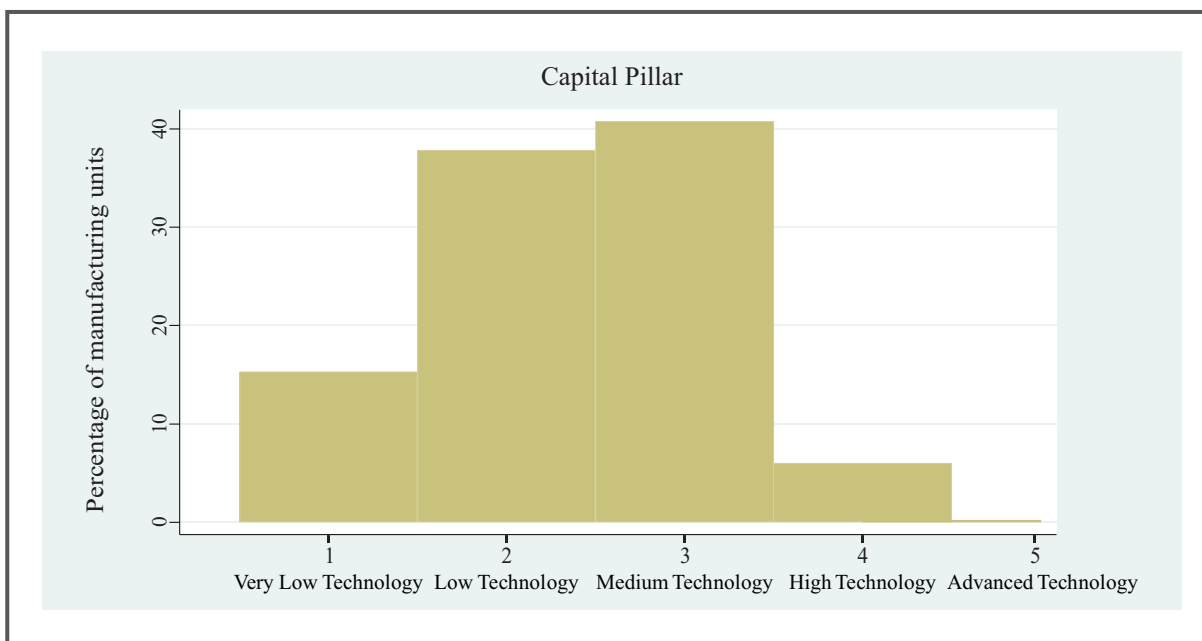
Figure 2.8: Distribution of factory units corresponding to indices of the number of factory units per enterprise



- iv **Share of non-land assets in total assets:** The percentage share of non land assets in total assets also proves to be useful in assessing the technological level of a manufacturing unit. Compared to asset category of land and building whose value does not increase owing to labour or technology, other assets like plant and machinery, tool and equipment, ICT capital, and other instruments whose value can be enhanced with intensified labour and technology, the latter group of asset is industrially productive and the technology is embodied in these assets rather than in land and building. Thus a firm with a higher share of non land assets is assumed to be better off technologically than its counterpart. Different index values were assigned to the share of non land assets in total assets. An index value of 1 is assigned for the factory unit/enterprise with a share of non land assets in total assets less than 15%, 2 for the shares between 15-30%, 3 for the shares between 30-45% and 4 for with the shares between 45-60%, 5 for the shares between 60-75%, 6 for the shares between 75-90% and 7 for the shares greater than 75%. Figure 2.9 displays the distribution of factory units for different proportions of productive assets.

Figure 2.9: Distribution of factory units for different proportions of productive assets

Capital Pillar: Combining all the four indices into a single index, generates the group index relevant for the capital pillar. Here as in the input pillar, each of the four different parameters indicates technology level in a different way and all the parameters may not be equally important while denoting technology level of manufacturing units belonging to different size classes or industry sectors. But their combination captures the technology level of a manufacturing unit from multiple perspectives of technology commitment as appreciated through use of capital, such as the amount of productive assets like plant and machinery, tools and equipment used by a labour, possession of necessary mortgage-able assets like land and building to buy costly machinery, share of productive assets in total assets, etc. Simply averaging the values of all the four indices for a manufacturing unit would provide the group index necessary for the capital pillar. Similar to input pillar index, we set scales from 1 to 7 for the capital pillar index as follows: average value 1 is very low technology (level 1); average value more than 1 up to 2 is low technology (level 2), more than 2 up to 3 is lower medium technology (level 3), more than 3 up to 4 is medium technology (level 4), more than 4 up to 5 in higher medium technology (level 5), more than 5 up to 6 is high technology (level 6) and above 6 is advanced technology (level 7). Figure 2.10 displays the distribution of factory units across technology levels of the capital pillar.

Figure 2.10: Distribution of factory units across total of capital based indices

3. Output Pillar: The level of technology used by a factory may be guessed indirectly through the outcome of the technology. Such outcome may be output per labour, value added per labour, ratio of the value of goods sold at the same condition as purchased to total output, proportion of output exported, proportion of output produced under contract. Depending on the availability of information in the ASI database, following parameters are selected for the construction of the output pillar:

- i. **Value added per labour:** Higher value added per labour reflects higher level of technology commitment, such as investments made on modern machinery with latest technology or capital intensive technology. Index values corresponding to different ranges of VAD/labour are assigned to reflect technology levels as under: For the value added per labour less than Rs 25000 an index of 1 is assigned, for the range Rs 25-50 thousand index of 2 is assigned, for Rs 50-100 thousand index of 3 is assigned, for values ranging between Rs1-5 lakh index of 4 is assigned, for values in the range of Rs 5-25 lakh index of 5 is assigned, for values ranging between Rs 25-100 lakh index 6 is assigned, and an index of 7 for values greater than Rs 1 crore. Figure 2.11 shows the distribution of manufacturing units according to the value added per labour index.

Figure 2.11: Distribution of manufacturing units according the value added per labour index



- ii. **Output per labour:** Although this indicator is similar to value added per labour, there is a major difference for the smaller sized producers who operate with less margin but higher turnover. High competition especially from the large producers often compels them to sell their products at lower price and with lower margin of profit. But they survive with larger volume of production relative to their size. In this situation output per labour may be high despite their low value added per labour. Index values corresponding to different ranges of output per labour are assigned in order to reflect technology levels. For the output value per labour less than Rs 25000 an index of 1 is assigned, for the range Rs 25-50 thousand index of 2 is assigned, for Rs 50-100 thousand index of 3 is assigned, for values ranging between Rs1-5 lakh index of 4 is assigned, for values in the range of Rs 5-25 lakh index of 5 is assigned, for values ranging between Rs 25-100 lakh index 6 is assigned, and an index of 7 for values greater than Rs 1 crore. Figure 2.12 shows the distribution of manufacturing units according the output per labour index.

Figure 2.12: Distribution of manufacturing units according the output per labour index



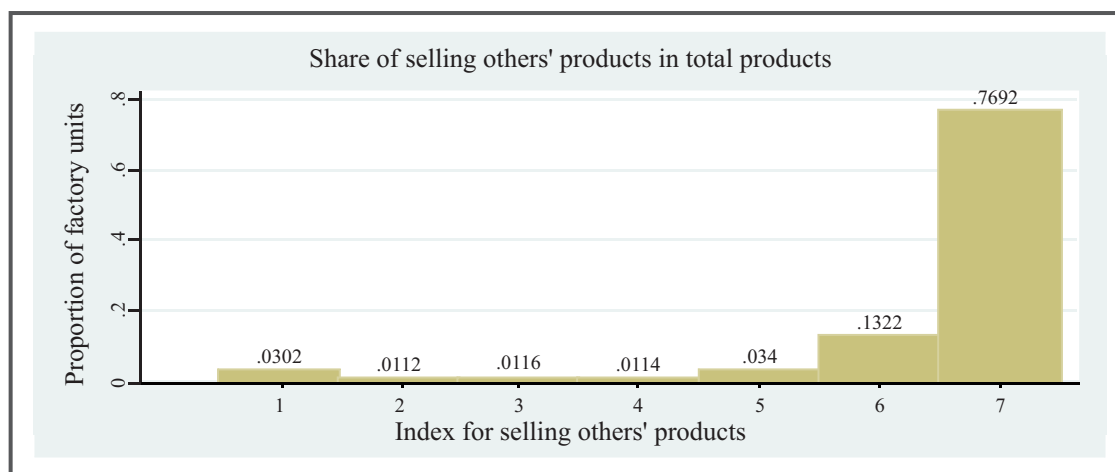
- iii. **Contracting in work/work for others:** An enterprise contracting in work from other enterprise probably uses a better technology than its counterpart contracting-out enterprise or from those who are not contracting-in similarly. Possibly an enterprise that regularly generates a good amount of revenue from contracting in manufacturing related activities may have set up specialized and dedicated plant and machinery to meet the quality standard of the buyer enterprise. Higher the percentage share of the revenue generated through contracting in of manufacturing activities to the total revenue, the higher would be the probability of having dedicated and specialized plant & machinery, skilled workforce, advanced process technology and other set up and so the technology level would be high. Different index values were allotted to the different ranges of these percentage shares of revenue. An index of 1 is assigned if the share is upto 5%, 2 is assigned if the share lies between 5 to 15%, 3 between 15-25%, 4 between 25-40%, 5 between 40-60%, 6 between 60-80% and 7 for values exceeding 80%. Distribution of the manufacturing units based on these indices is shown in Figure 2.13

Figure: 2.13: Distribution of manufacturing units according proportion of work contracted in



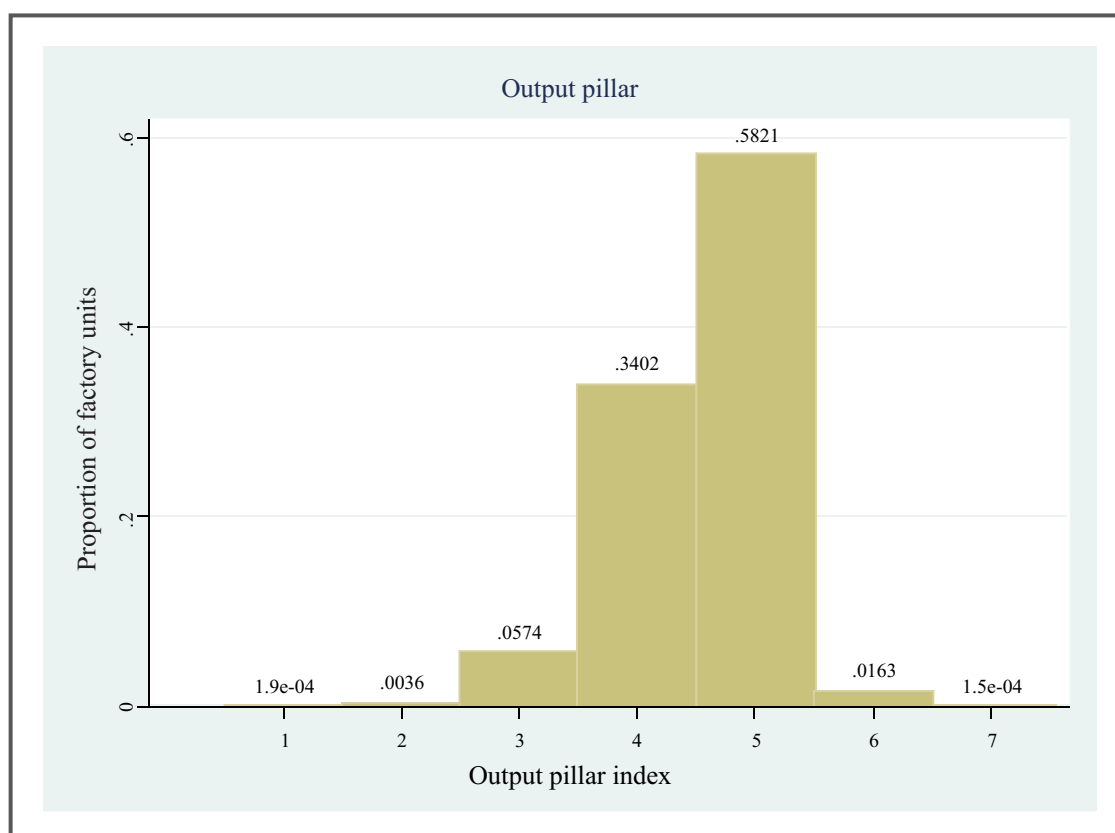
- iv. **Value of goods sold in the same condition as purchased:** This category of product includes the goods that an enterprise buys from a third party vendor and markets the same together with selling own products. (It also includes some raw materials sold on the same condition as purchased. All sales of a factory can be classified according as to whether the sale is (i) of the product of the factory, (ii) of goods incidental to manufacturing, and (iii) other items not connected with manufacturing. The present parameter will relate sum of the goods of (ii) and (iii) above, which are sold in the same condition as purchased, i.e., without any transformation. It further includes the value of sales of goods normally consumed by the factory when sold as purchased as well as the sale value of goods brought expressly for resale). The reselling is probably done in order to overcome diseconomies of smaller scale transactions of own goods and the enterprise is not in a position to raise own production. An enterprise which holds less share of such goods in total output is probably technology efficient; this is because an enterprise if technologically self-sufficient and advanced would seldom involve in marketing goods manufactured by other. Various index values are allotted to the different ranges of percentage share of this category of goods in total output. An index value of 7 if the share is 0%, 6 if share is up to 10%, 5 for 10-25%, 4 for 25-35% , 3 for 35-50%, 2 for 50-75% and 1 for shares exceeding 75%. Distribution of factory units based on these indices is shown in Figure 2.14.

Figure 2.14: Distribution of manufacturing units according to share of others' products in total sales

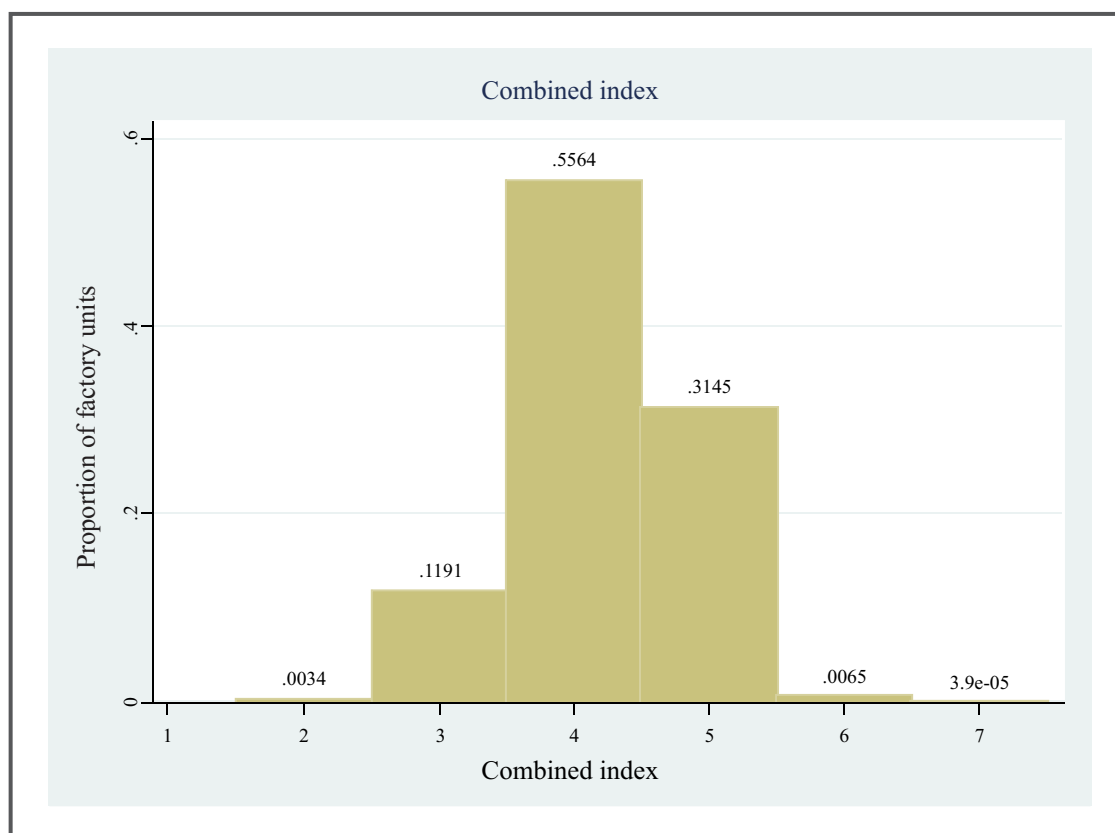


Output Pillar: Combining all the four indices into a single index generates the group index relevant for the output pillar. Here, as in the previous two cases, four different parameters indicate technology level in different ways from each other and further all the parameters may not be equally important while denoting technology level of manufacturing units belonging to different size classes or industry sectors. But they together capture the technology level of a manufacturing unit from a variety of perspectives of output, such as the amount of output per labour, amount of value added per labour, proportion of contracting in work in relation to total output, or proportion of others' products sold to total own production. Taking average of the values of all the four indices for a manufacturing unit would provide the group index necessary for the output pillar. Similar to the previous two cases, we set scales from 1 to 7 for the output pillar index as follows: average value 1 is very low technology (level 1); average value more than 1 up to 2 is low technology (level 2), more than 2 up to 3 is lower medium technology (level 3), more than 3 up to 4 is medium technology (level 4), more than 4 up to 5 in higher medium technology (level 5), more than 5 up to 6 is high technology (level 6) and above 6 is advanced technology (level 7).

Figure 2.15 displays the distribution of factory units across technology levels of the output pillar.



Combined Index: After obtaining the indices for input pillar, capital pillar and output pillar for each factory unit a combined index is generated by taking simple average of the index values of the three pillars of technology. The criteria of indexing technology levels is the same as used for the individual pillars: average value 1 is very low technology (level 1); average value more than 1 up to 2 is low technology (level 2), more than 2 up to 3 is lower medium technology (level 3), more than 3 up to 4 is medium technology (level 4), more than 4 up to 5 in higher medium technology (level 5), more than 5 up to 6 is high technology (level 6) and above 6 is advanced technology (level 7). Figure 2.16 displays the distribution of factory units across technology levels of the output pillar.

Figure 2.16: Distribution of factory units according to combined index

As already mentioned, all the technology parameters are not equally important to every size class of enterprises - some are more relevant for the medium and large and some are more important for micro and small enterprises. Even, some of these parameters do not directly refer to commitment to technology, but imply the same indirectly. For a few of the parameters, the relationship between the value of the parameter and the commitment to technology level is inverse or negative, for example, the percentage of contract workers in total employees or the share of others' products in total sales. Moreover, scales are not uniform for all the individual parameters in referring to technology level, which is done in keeping with the relative importance of the parameter and the range of the value of the parameter with which a particular technology level can be associated. Table 2.1 below displays the relationship between the value of the parameter and technology level, whether direct or indirect and whether positive or negative.

Table 2.1: Parameters, relations with technology and index values

	Relation to technology			
	Direct (D)/ Indirect (ID)	+/- (ve)	Strength of relation	Importance for size groups
Share of contractual worker	ID	-ve	Moderate	SML
Share of white collar employees	D	+ve	Strong	ML
Share of imported input	D	+ve	Strong	A
Wages per employee	ID	+ve	Strong	More for SML
Land & building asset	ID	+ve	Weak	MiS
Capital per labour	D	+ve	Strong	A
Number of factory units	ID	+ve	Weak	ML
Share of non-land assets	D	+ve	Strong	SMEL
Value added per labour	D	+ve	Strong	ML
Output per labour	D	+ve	Strong	A
Contract- in work	ID	+ve	Weakly	MiS
Selling others' product	ID	-ve	Weakly	MiS

Note: M - Micro, S - Small, Mi - Medium, L - large, A - All.

Based on these benchmarking of technology levels for each of the three technology pillars as well as the combined one we would measure technology levels of manufacturing units of different sizes and regions. Further changes in the distribution (or number) of manufacturing units among different technology groups for each of the technology pillars, including each parameter, over a period of time would indicate nature of innovation. Since the pillars are neither independent nor collinear, changes in the technology distribution based on these pillars may highlight whether the innovation is on the input side or capital side or output/organizational side. Nonetheless, combined index would show overall changes in technology across size classes, industry sectors and regions.

Table 2.2: Comparison of technological classification of industries based on present criteria with OECD classification

2-digit manufacturing sector	Our Classification	OECD classification
Food products	Low	Low
Beverages	Medium	Low
Tobacco	Low	Low
Textiles	Medium	Low
Wear. Apparel	Medium	
Wood & cork	Low	Low
Paper	Medium	Low
Printing & reprod.	High	Low
Coke, ref. petroleum, nuclear fuel	High	Medium
Chemicals	Medium	Medium
Pharma., medi, botanicals	High	High
Rubber & plastics	Medium	Medium
Other non-metal. Minerals	Low	Medium
Basic metals	Medium	Medium
Fabr. metal Pdt	Medium	Medium
Mach. & equip	Medium	Medium
Computers, electronics & optical	High	High
Electrical mach. & eqp	Medium	Medium
Motor Vehicles	High	Medium
Other Transp eqp	Medium	Medium
Furniture	Low	
Other manuf.	Medium	
Recycling	Medium	Low
i. Low technology if Very low + Low + Lower medium technology units >30% and/ or Higher medium + High + Advanced technology units <25% ii. Medium technology if Medium + Higher medium + High + Advanced technology units > 70%, of which Higher medium + High + Advanced technology units share between 25 to 50% iii. High technology if Medium + Higher medium + High + Advanced technology units > 70%, of which Higher medium + High + Advanced technology units > 50%		

A comparison of the classification of manufacturing industries (2-digit groups) according to technological level based on our criteria with that of OECD is made in table 2.2. It may be seen in the table that as compared to OECD, our methodology would slightly over estimate the technological level of the industries. This is possibly due to the fact that our criteria is primarily based on the technology levels of the majority of manufacturing units and further what is medium at the global level may be high at our level. Based on the criterion developed in this chapter, Chapter 3 and Chapter 4 would measure distribution of manufacturing units across technology levels, across states and across size classes. Temporal changes in the distribution across technology groups indicating innovations, has also been estimated across states and size classes.

Chapter : 3

Estimates of the distribution of manufacturing units across technology levels: Pattern of innovations across size classes and sectors

Based on the method described in the previous chapter we would first estimate the number of manufacturing units (that have positive GVA, positive employment and positive fixed assets) corresponding to different technology levels for each of the size classes and then see the changes in the distribution between 1999-00 and 2009-10 reflecting innovations. Three technology pillars would help us understand the nature of innovations - whether labour and other input augmenting or capital augmenting or management augmenting. Next section covers sector-wise analysis of the distribution of manufacturing units across technology levels and the nature of innovations and technological changes over the period.

Size class wise estimates

Estimates of the changes in the distribution of manufacturing units across technology levels for different size classes

Combined index based on all the twelve parameters of technology indicators reveals that there has been a little change in the distribution of manufacturing units/enterprises across technology levels during the decade of 2000s. Only one percentage of enterprises moved from each of lower medium and medium technology groups to upper medium technology group. Even the very limited number of 1011 high and advanced technology manufacturing units (0.98% of the total) in 1999-00, declined over the decade to 671 (0.65%). It may be mentioned that in 2009 there were only 4 advanced technology units, which were 12 a decade back, belonged to medium size class. Majority of the high technology units (61%) however belonged to large size class in both the years. Among the MSMEs, the share of micro and small size classes declined whereas the share of medium size class increased over the decade. Little more than 31% of the enterprises now belong to upper medium technology group and, excepting micro size class, all the other size classes raised their absolute number as well as percentage share of enterprises belonging to this technology group. The small size class has the major share (53%) of the medium technology units which is followed by micro size class with 29% share. Although the proportion of medium technology enterprises declined marginally from 56.4 to 55.6% over the period, but among different size classes the change in the share is significant. For instance, the share of micro size class declined substantially from 78% to 68% whereas all other size classes raised their shares with the major gainer being small size class.

The distribution of enterprises across technology levels is highly concentrated around the centre which changed a little-lower medium, medium and upper medium technology groups together share 99% of the enterprises of which lower medium shares 13% (12% for 1999) and upper medium shares 30% (31% for 1999).

Size class-wise distribution of enterprises of different technology levels reveals that despite substantial decline in the number of micro enterprises (by almost 8%), the percentage distribution of enterprises across technology groups remained almost unchanged for the micro size class. For the small size class 98% of the enterprises belong to the medium and upper medium technology groups however between these two groups the share of the latter declined and that of the former increased by about 4% points. As opposed to micro size class, small size class witnessed increase in the number of enterprises. Probably some enterprises of the micro size class moved up the scale to join the small size class, particularly with greater proportion in the medium technology group than in the higher medium technology group. Medium and large size classes also raised their shares in the total number of enterprises, but a majority of the new entrants joined with medium technology and some with upper medium technology. In general, micro enterprises have major concentration in medium technology group followed by lower medium technology group, whereas small and medium enterprises have major concentration in upper medium technology group followed by medium technology group. Large enterprises have concentration in upper medium technology group followed by high technology group. On the whole, combined technology index does not display any significant structural change of the manufacturing sector in terms of the movement of the enterprises either along the size ladder or along the technological hierarchy during the period under review. However, we would see if there is any specific type of technological change that may be captured through individual technology pillars or their parameters.

Estimates of the changes in the distribution of manufacturing units across technology levels for different size-classes based on Input Pillar

As compared to combined index, input based composite technology index has more wider dispersion of enterprises across technology groups and more tilted towards lower technology groups, such as lower medium and low technology groups. The distribution pattern is highly stable and remained almost unchanged over the period excepting minor decline in the share of the upper middle, high and advanced technology enterprises and some movement of lower middle technology enterprises to low technology and medium technology groups. Thus the input pillar data do not suggest any improvement of the technology of the enterprises as a whole.

As regards size classes, micro size class shows some decline in the percentage distribution of enterprises in the lower technology groups such as, very low, low and lower medium technology groups. It seems that a part of the decline in the total number of micro enterprises is caused by the decline of these low technology enterprises. Some of these micro enterprises must have moved to small size class. As opposed to micro size class, in the small size class the proportion of enterprises increased in the lower technology groups (particularly in low and lower medium technology groups where new entrants joined) and decreased in the higher technology groups (such as higher medium, high and advanced technology groups) from where some enterprises probably moved away to medium size class. Same dynamics as in small size class is also observed in medium and large size classes – the proportion of enterprises increased in the low and

lower medium technology groups and decreased in the higher medium, high and advanced technology groups. In fact the increase in the number of enterprises in the lower technology groups is more than the decline in the number in the high technology groups. Further, unlike combined index, input pillar index does not indicate any size class bias towards particular technology group(s).

Although input pillar index shows no visible change in the technology of the enterprises, its individual constituent parameters may hint at changes of particular feature of technology. Use of contract workers shows a negative aspect of technological change—intensity of the use of contract workers considerably increased and, as expected it increased at higher rates among higher size classes. The other parameter, employment of white collar employees, indicates that the proportion of enterprises employing high proportion of white collar employees has increased by a significant extent. It is worth noting that this increase is primarily confined to micro sized class and to a small extent in small size class, whereas in the medium and large size classes the number of such enterprises did not rise, rather declined a bit. Import intensity of inputs parameter indicates that the number (and proportion) of units using higher import intensity inputs declined in the medium and large size class, whereas in the marginal and small size class, the proportion remained unchanged at extremely low levels. Wage parameter based technology index data show that as much 91% of the micro enterprises and 71% of the small enterprises continued to remain at lower technology levels (lower medium technology level or below) however there has been a minor increase in the proportion of enterprises belonging to higher technological levels indicating emergence of some innovative enterprises. For the medium and large size classes the proportion of the lower technology enterprises increased and that of medium and high technology enterprises declined. In terms of absolute number, only a handful of higher technology enterprises are added to existing ones over the period. At present 12.5% of the medium enterprises and 22% of the large enterprises can be said to belong to high technology groups while for the micro and small enterprises the relevant proportions are 1.5% and 5% respectively.

Estimates of the changes in the distribution of manufacturing units across technology levels for different size classes based on Capital Pillar

Capital based technology index however shows a little optimistic picture than the input based technology pillar; the proportion of lower technology enterprises declined from 57% to 51% as a result of the increase in the proportion of medium technology enterprises. Among the higher technology groups, higher medium technology group gained a bit. A little more than 6% of the units now belong to higher technology groups. However, among the micro enterprises there is no change in technology, around 20% belong to medium technology group and the rest are in the lower technology groups. Small size enterprises too did not experience any improvement in technology, mostly belong to medium technology group (with 85% share) and only around 2.5% have higher medium technology. For the medium size class almost all the enterprises belong to the medium and upper medium technology groups. However new enterprises of joined the medium size class substantially raised its share of upper medium technology groups. Among the

large size enterprises, excepting 21% of them belonging to medium technology group, all are in the higher technology groups, mostly in upper medium group. There has been several new entrants in the large size class but the proportion of new entrants is higher in the medium technology group than the upper medium technology group.

Capital based index involves four different parameters, namely, value of land and building, capital labour ratio, number of factories per enterprise, and share of non-land assets. One may however debate about the relative importance of these parameters in assigning technology level to an enterprise/producing unit. We would therefore see the technological characteristics separately based on each parameter. Proportion of enterprises with higher value of land and building assets increased moderately over the period and this took place uniformly across all size classes of enterprises. As regards capital intensity, the proportion of enterprises with middle level capital labour ratio increased moderately. The increment however took place in the case of small and medium size classes. For the large size class however, more enterprises joined with high capital labour ratio. Distribution of enterprises with lower proportion of non-land assets in total assets declined and that of higher proportion increased excepting the largest group (with 75% of more share of non-land assets) where it declined a bit. This pattern of change is particularly observed for micro size class, the largest one. It is interesting to note that in general the smaller size classes also have lower share of productive assets in total assets. In other words, the proportion of enterprises with high share of productive assets in total assets increases as the size class increases.

Estimates of the changes in the distribution of manufacturing units across technology levels for different size classes based on Output Pillar

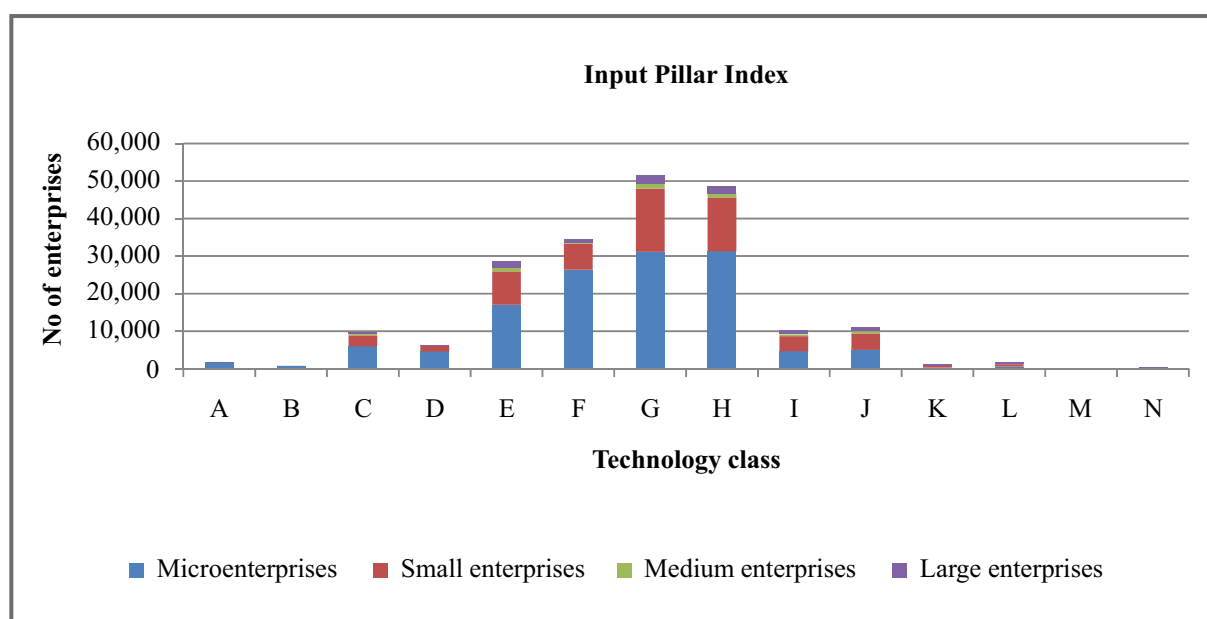
As compared to previous two pillars, output based technology pillar presents a slightly better picture with a large proportion of the manufacturing units belong to higher technology groups (consisting of upper medium, high and advanced technology groups). Further, there has been perceptible increase in the proportion of enterprises in the upper medium technology group. It is worth noting that the technological improvement, i.e., increase in the proportion of enterprises in the higher technology groups, is found among all the size classes.

Parameter-wise estimates show that for the technology index based on value added per labour the distribution of enterprises in the higher technology groups increased by 5.5% points to reach close to a fifth of the total enterprises. The increase in the number as well as proportion of enterprises in the higher technology groups however took place in all the size classes, although the larger size classes have larger proportion of their enterprises belonging to higher technology groups. Technology index based on output per labour also shows slight increase in the proportion of enterprises in the higher technology groups and, as expected, the increase is higher for the micro and small size classes as compared to medium and large size classes. Further as compared to value added per labour based technology index, output per labour based technology index has higher proportion of the micro and small enterprises in the higher technology groups. This is

probably due to higher output per worker as compared to value added per worker of several enterprises belonging to the smaller size classes who try to survive with high turnover and lower margin per unit of output. Proportion of enterprises with significant earnings through contracting in declined over the years, particularly for the MSMEs. As regards proportion of revenue generated through sales of others' products, there is no change in the distribution of enterprises.

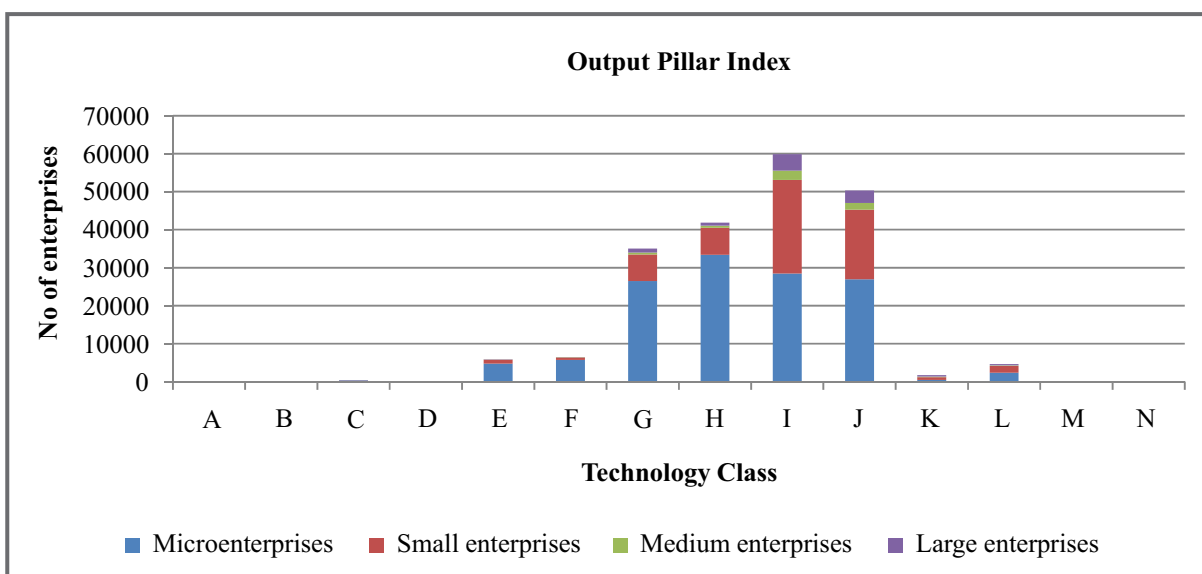
These observations lead to the following questions: Did the larger sized producers help the smaller ones to grow in size? Did the large producers help the smaller ones to improve their technology? Was the technology development of the large producers facilitated directly or indirectly by the small and marginal producers? Or, did they develop technology independent of each other? In order to find answer to these questions we would first identify the sectors where the technological changes take place.

Figure 3.1a: Estimates of the number of enterprises across size classes and technology levels based on input pillar



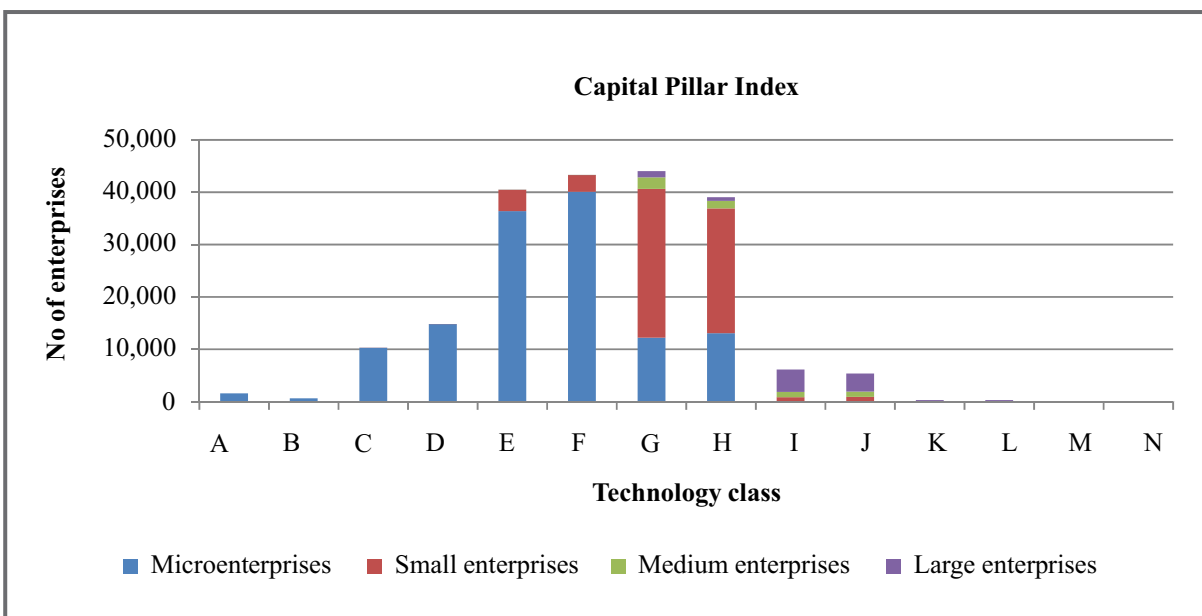
Note: A=Very low_2009-10, B=Very low_1999-2000, C=Low_2009-10, D=Low_1999-2000, E=Lower Medium_2009-10, F=Lower Medium_1999-2000, G=Medium_2009-10, H=Medium_1999-2000, I=Higher Medium_2009-10, J=Higher Medium_1999-2000, K=High_2009-10, L=High_1999-2000, M=Advanced_2009-10, N=Advanced_1999-2000

Figure 3.1b: Estimates of the number of enterprises across size classes and technology levels based on output pillar



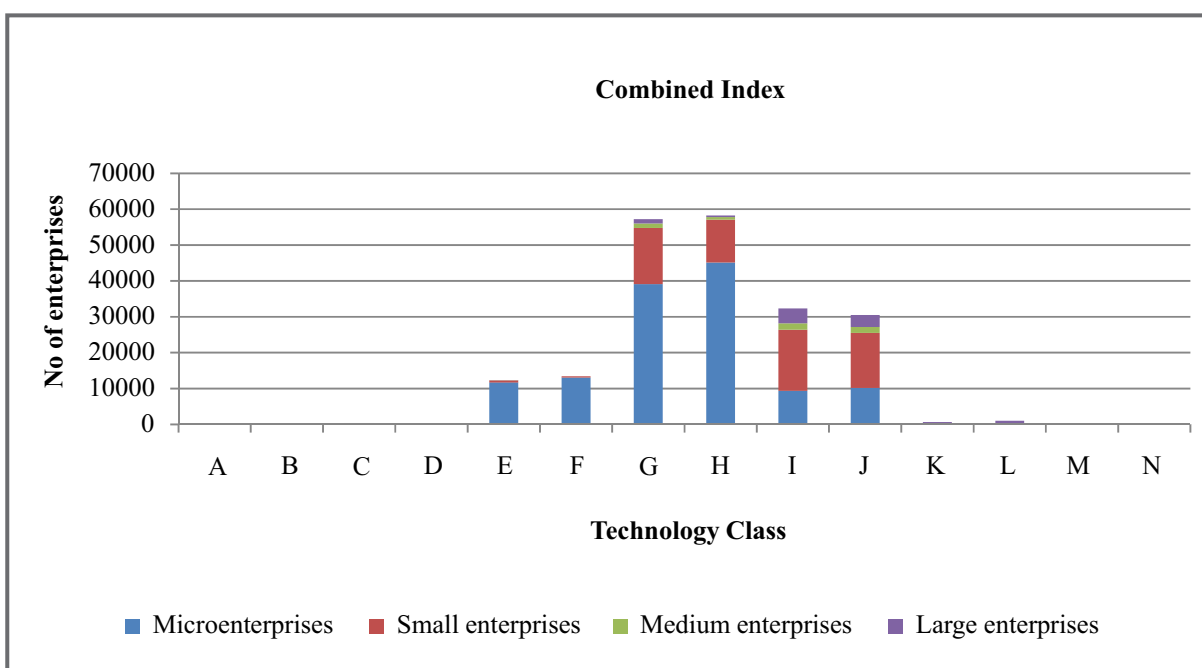
Note: Same as in Figure 3.1a.

Figure 3.1c: Estimates of the number of enterprises across size classes and technology levels based on capital pillar



Note: Same as in Figure 3.1a.

Figure 3.1d: Estimates of the number of enterprises across size classes and technology levels based on combined index



Note: Same as in Figure 3.1a.

Manufacturing sector wise estimates of higher technology units

Combined index based on all the parameters shows that almost all the 2-digit manufacturing sectors have very low proportion of the enterprises that belong to high or advanced technology groups. Coke and petroleum sector has 6% of the enterprises belong to high and advanced technology groups whereas among chemicals, pharmaceuticals, motor vehicles and computers and electronics have 1.5 to 3% of their manufacturing units using high or advanced technology. Rest of the 2-digit manufacturing sectors have less than one percent of the units using high or advanced technology. There are however large number of units in the higher medium technology groups in most of the sectors: out of 21 sectors as many as 15 sectors have more than 30% of the enterprises using higher medium and further, printing, pharmaceuticals, computers and motor vehicles have close to 50% or above of the enterprises use higher medium technology. Among the manufacturing sectors with fairly high proportion of higher medium or high technology enterprises, food products, wood and cork, printing, chemicals, basic metals, fabricated metals and furniture witnessed significant addition of enterprises to the higher medium and high technology groups indicating significant innovations made at sectoral level, during 1999-00 to 2009-10. These technologically dynamic sectors have also been able to raise the number of performing units over the period when the manufacturing sector as a whole witnessed marginal decline in the total number of performing units.

As opposed to these dynamic sectors, beverage, tobacco, wearing apparel and paper witnessed substantial decline in the proportion of higher medium and high technology enterprises and rubber, computers and electrical witnessed moderate decline in the proportion of enterprises with higher medium and high technology enterprises. More interestingly, textiles being one of the most important manufacturing sectors witnessed a drastic fall in the total number of factory units but retained the proportion of higher medium and high technology units of the surviving factory units. Wearing apparel and paper industries on the other hand witnessed significant fall in the proportion of higher medium and high technology manufacturing units despite a sizeable increase in the total number of performing units in the sector over the period. Wood products industry, generally a low technology industry, witnessed substantial rise in the number of enterprises and also the proportion of higher medium technology units increased significantly in this industry. Both the chemicals and pharmaceuticals industries moderately raised the number of enterprises as well as the proportion of higher medium and high technology enterprises.

Figure 3.2: Percentages of factory units across sectors & technology levels based on Input Pillar, 1999 & 2009

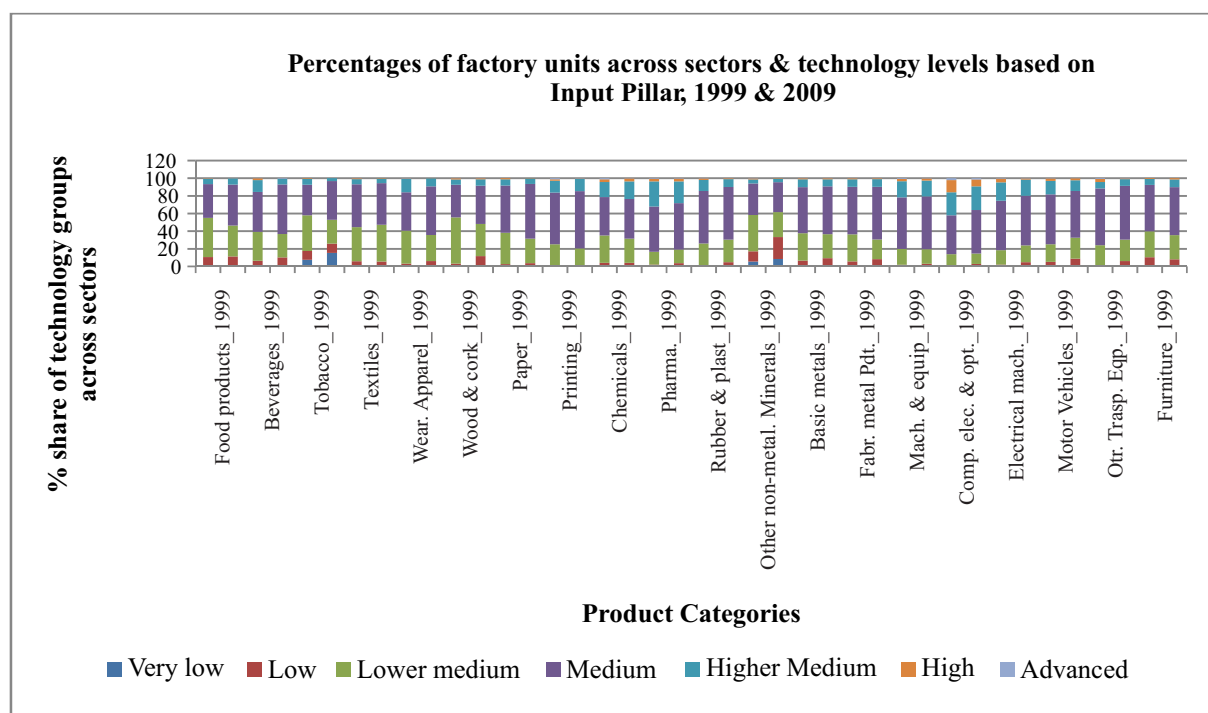
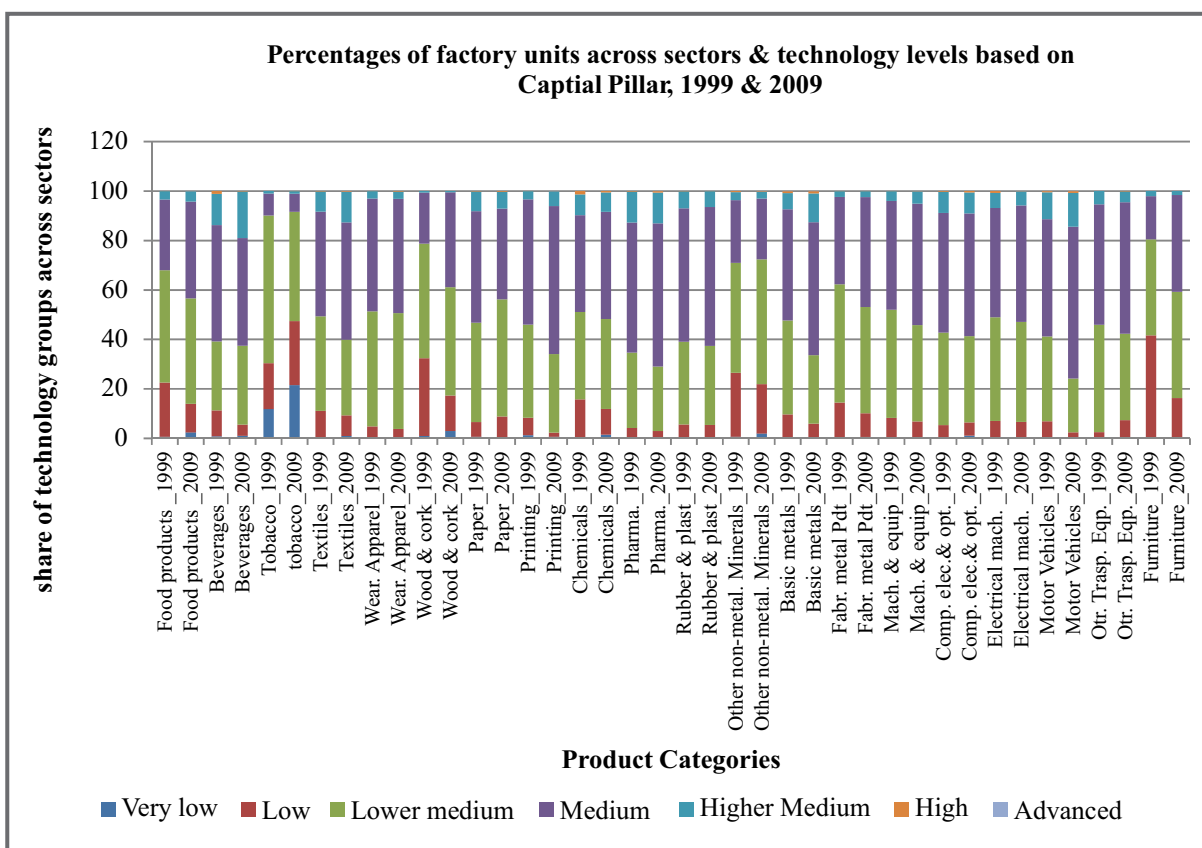


Figure 3.3: Percentages of factory units across sectors & technology levels based on Capital Pillar, 1999 & 2009

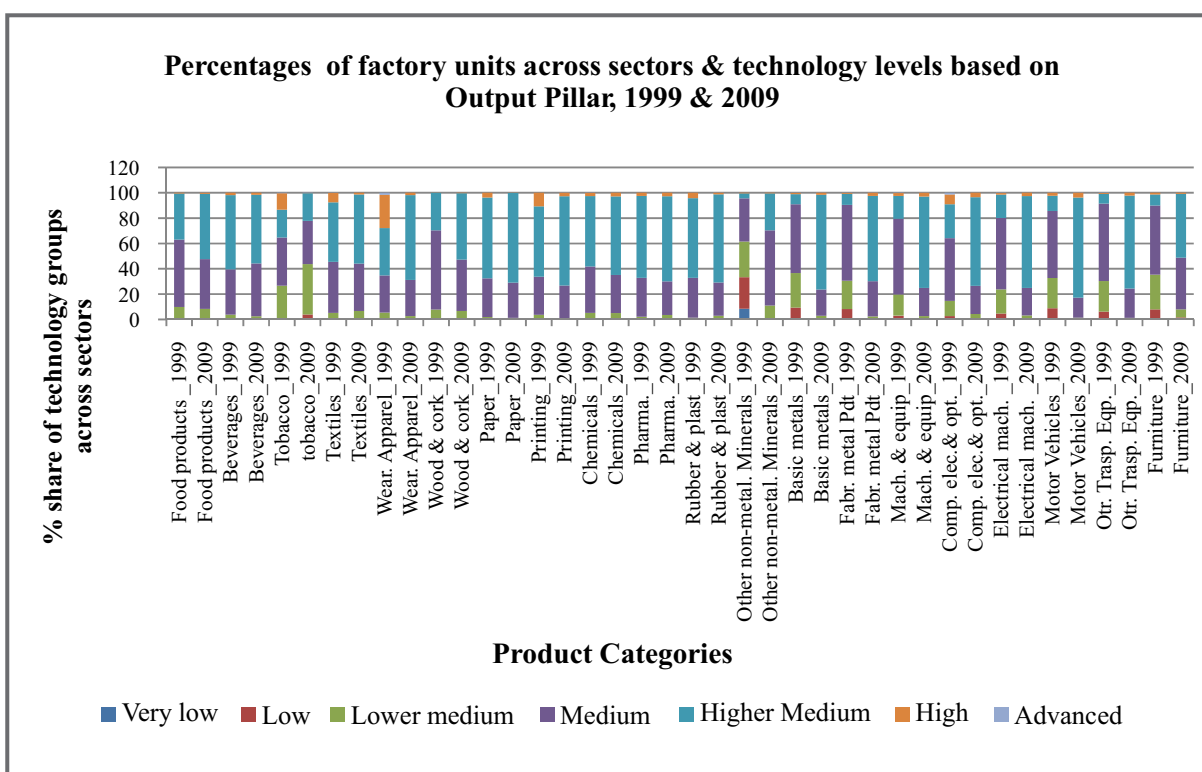


Estimates of the number of manufacturing units with different levels of technology based on input pillar reveal that larger number of manufacturing units with higher medium and high technology are found in chemicals, food products, pharmaceuticals, machinery & equipment, electrical machinery, other non-metallic minerals products, rubber & plastic, basic metals, and fabricated metals. The larger proportions of the higher medium and advanced technology units in total units are however found in computer and electronics, pharmaceuticals, motor vehicles, chemicals, machinery & equipment, printing and electrical equipment. Among these sectors with relatively higher share of higher medium and high technology groups in total number of enterprises only chemical industry witnessed some increase in the share of these technology groups and for the other industries the share declined. This indicates little evidence of technological advancement in terms of greater use of high skilled long tenured employees together with the use of high quality imported inputs.

Capital based technology index however suggests that more than a half of the manufacturing sectors witnessed some increase in the proportion of enterprises belonging to the higher medium and high technology groups during 1999-2009. Largest proportion of higher medium and high technology units are found in motor vehicles and beverages which are followed by textiles, basic

metals, motor vehicles and pharmaceuticals. They are also the ones with larger number of medium technology enterprises. Advanced technology units are however rare. Above observation suggests that some of the manufacturing sectors have made investment and added to fixed capital including plant and machinery.

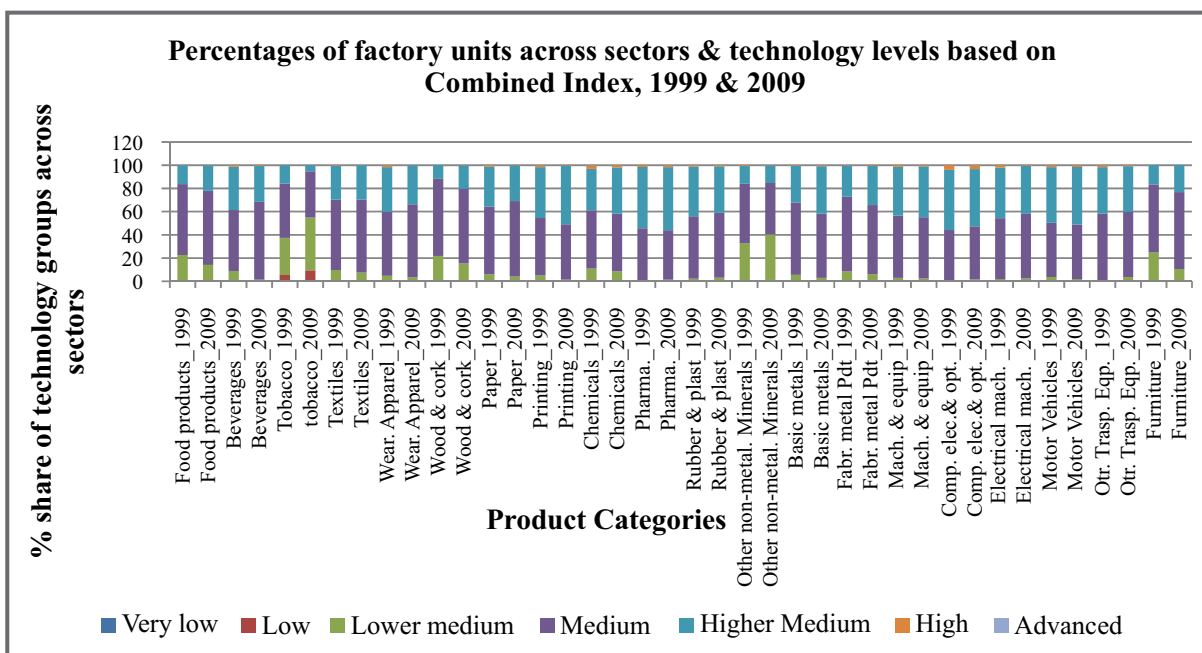
Figure 3.4: Percentages of enterprises across sectors and technology levels based on output pillar



Output based index shows food products, machinery and equipment, chemicals, rubbers & plastic, other non-metallic mineral products, fabricated metals, textiles and basic metals have relatively larger number of higher medium and high technology enterprises. However, in terms of the proportion of higher medium and high technology units in total units, all the above mentioned sectors excepting other non-metallic minerals, are predominant. Further, excepting beverage and tobacco, all the 2 digit manufacturing sectors under review have experienced increase in the proportion of enterprises belonging to higher medium and high technology groups. Output pillar of technology therefore suggests improvement of technology resulted in productivity growth.

For some of these highly important industry sectors further detailed investigation are made to see which size classes of the manufacturing units made sizeable changes in technology, what are the leading factors of these changes and what role played by the larger size classes.

Figure 3.5: Percentages of factory units across sectors & technology levels based on Combined Index, 1999 & 2009



Size class wise estimates of manufacturing units with different technology levels for selected sectors

- i. **Food products industry:** This industry seems to have reorganized itself through some advancement in technology and changes in organization in the face of competition. The industry has moderately raised the total number of performing enterprises/units. But the changes took place in the form of movement of enterprises/ manufacturing units towards higher size classes and higher levels of technology as revealed by the Combined Index data. A large section of micro enterprises have raised their scale of operation and moved up to small size class or higher. Many of the very low technology and low technology micro enterprises have improved themselves to become medium or high technology enterprises. Even some small size enterprises moved to medium or large size classes and at the same time improved technology levels. Further, the number of higher medium and high technology large enterprises is also increased. Notwithstanding this improvement in Food products industry, the number or share of medium and large sized units is quite low in this industry. The question is whether these medium and large firms facilitated the improvement of the micro or small firms.

Figure 3.6a: Number of factory units across technology levels and size classes in Food industries 1999 & 2009

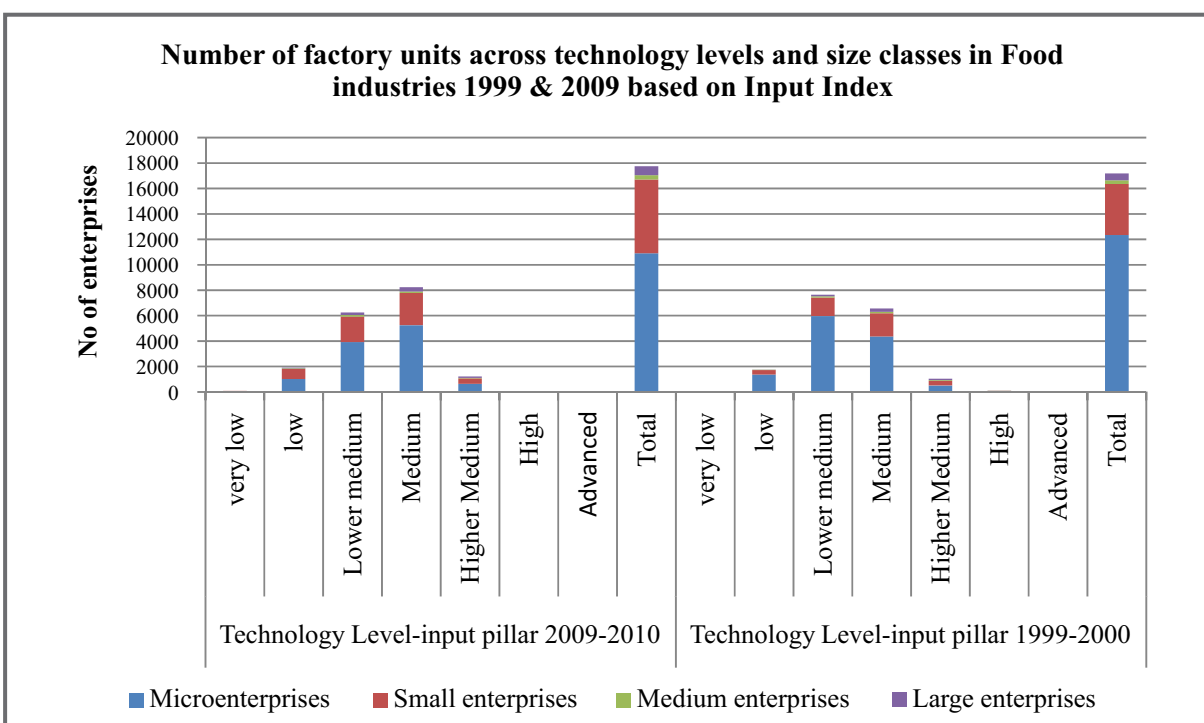


Figure 3.6b: Number of factory units across technology levels and size classes in Food industries based on capital index, 1999 & 2009

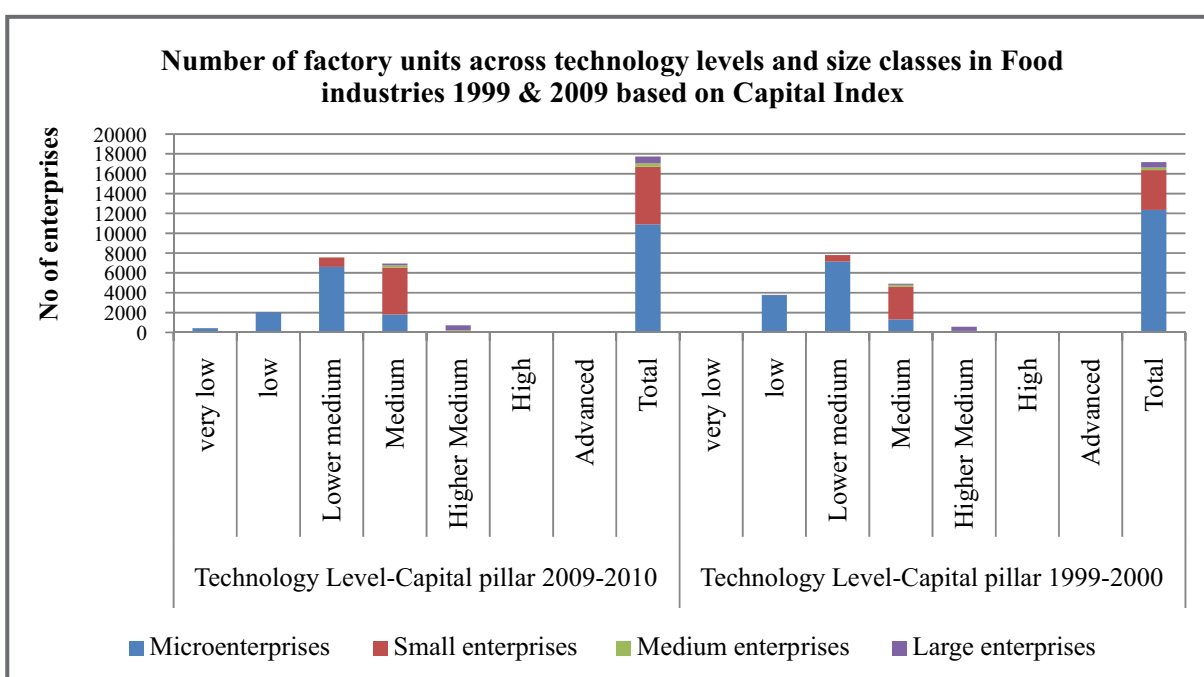


Figure 3.6c: Number of factory units across technology levels and size classes in Food industries based on output index, 1999 & 2009

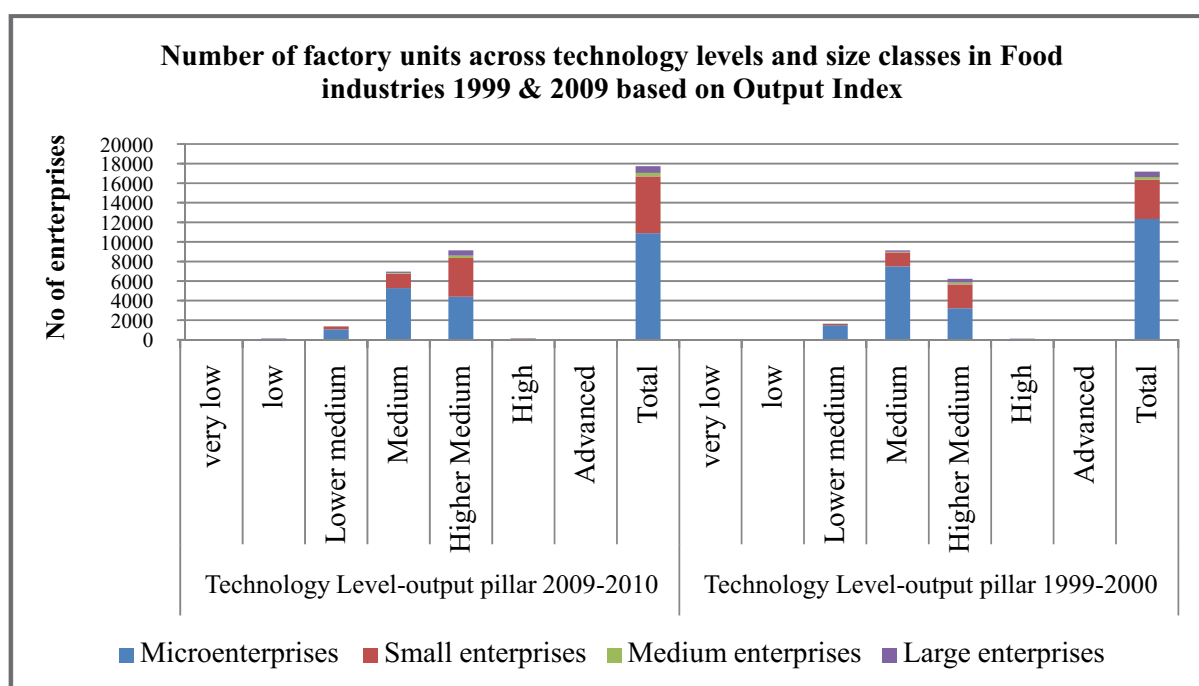
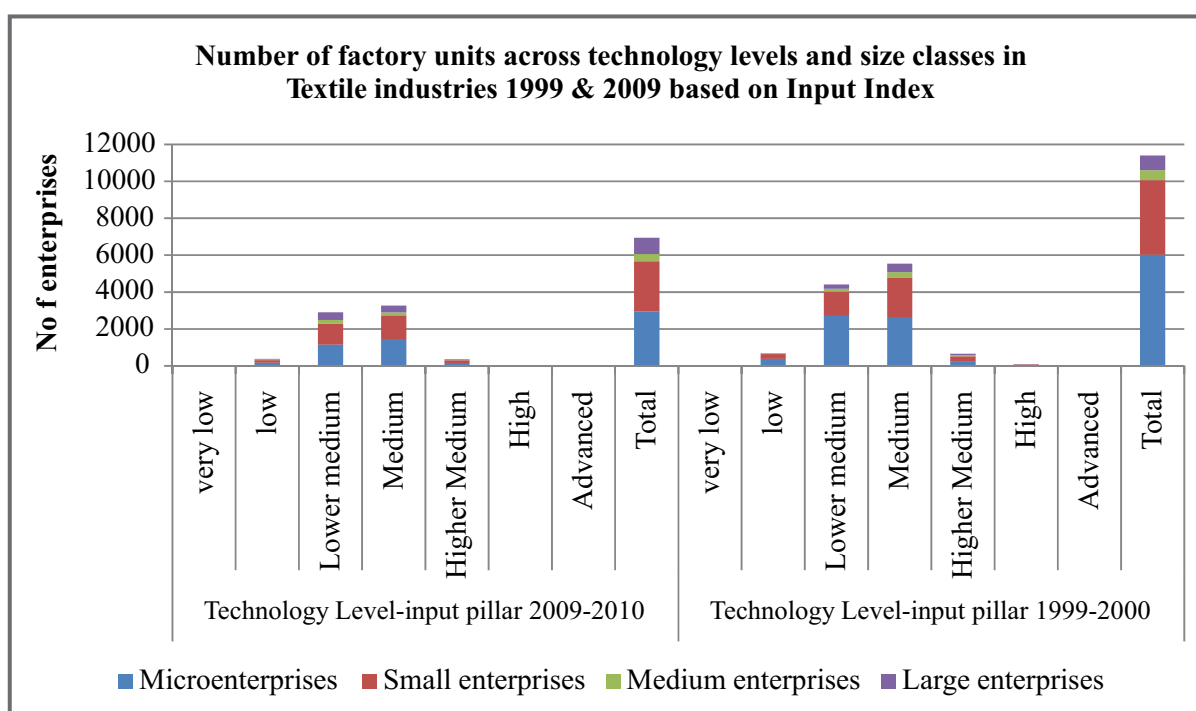


Figure 3.6d: Number of factory units across technology levels and size classes in Food industries based on combined index 1999 & 2009



Input pillar data however indicate that only for the micro size class there is improvement of the technology - the share of low and lower medium technology groups declined and that of medium and upper medium increased. On the contrary, in the case of small, medium and large size classes the share of the low and lower medium technology groups increased and that of the higher medium and high technology groups declined. This suggests deterioration of the input pillar related technology used by the small, medium and large enterprises which took place in the form of higher share of contract labour, lower share of white collar labour, lower share of imported input or lower wage rate.

Capital Pillar also suggests some improvement in technology of the micro size class - total number as well as proportion of low technology units declined and those of the medium technology units increased. For the other size classes the percentage distribution of enterprises across technology groups remained almost same but the number of units in the technology groups increased.

Output Pillar however shows improvement in technology across all the size classes – each size class reduced the share of enterprises belonging to lower technology groups and raised the share of enterprises belonging to higher technology groups. This improvement is more systematic for the micro and small size classes. All this indicates some improvement of labour productivity and increase in the contracting works.

Above observations however do not provide any direct evidence of how or whether larger enterprises help smaller ones to grow or develop technology. Involvement of the larger enterprises in contracting out work, exporting and selling others' products, as discussed earlier, may provide some clue in this regards. Moreover, dynamism of growth and technological changes created by the larger enterprises might have helped the smaller ones. A detailed discussion of various kinds of relationships among different size classes of enterprises is however needed for a better understanding of the issue.

- ii. **Textiles Industry:** In contrast to food products industry, textiles industry witnessed a major decline in the number of performing enterprises during the period. Combined Index data show that excepting the large size class, all the other size classes experienced decline in the number of performing enterprises - micro declined by 51%, small by 32% and medium by a quarter and large enterprises increased by 9%. This decline however took place irrespective of technology level, although high and advanced technology units declined by higher percentage as compared to lower medium or medium technology units. Apparently several higher technology units moved to lower technology levels for all size classes including the large one. Thus, despite each size class had fairly high proportion of textiles units in higher medium technology group initially, the share declined in the face of global competition. We have just described above that food products industry with much lower proportion of medium and higher medium technology units, has been able to raise not only the proportion

of these higher technology units but also the total number of performing units. Probably higher technology textiles firms became more exposed to global competition at home and abroad, particularly from Chinese firms.

Figure 3.7a: Number of factory units across technology levels and size classes in Textiles industries based on input index, 1999 & 2009

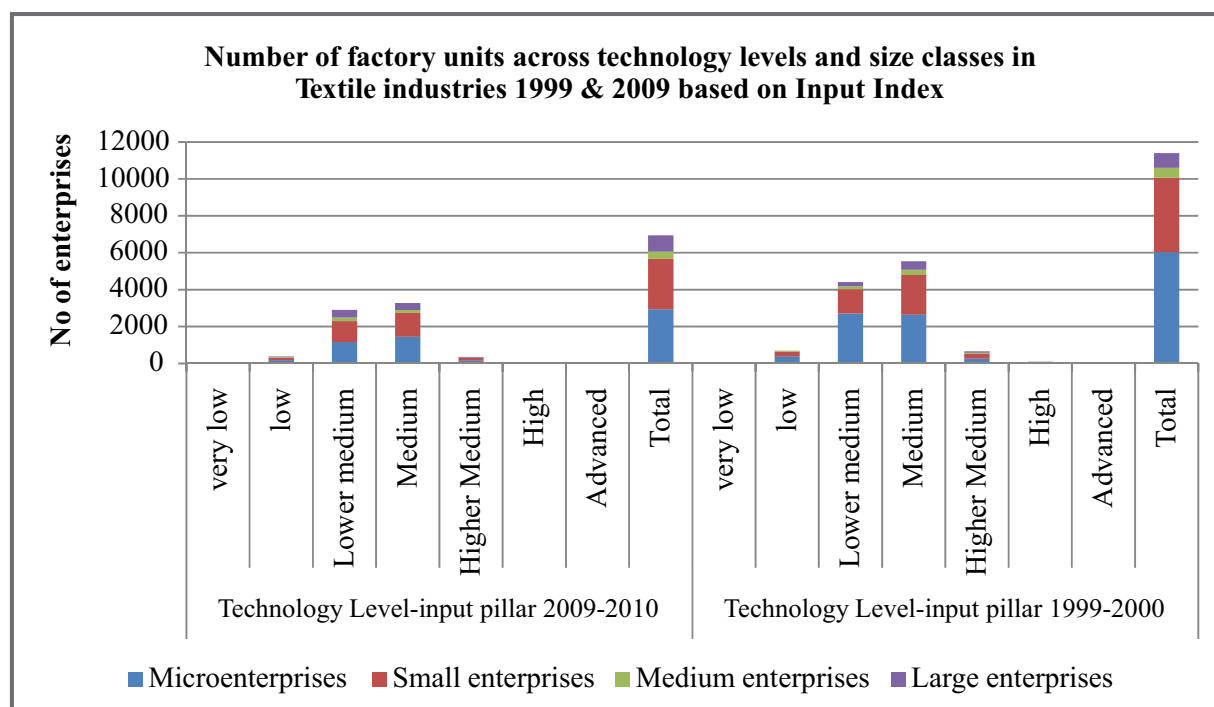


Figure 3.7b: Number of factory units across technology levels and size classes in Textiles industries based on capital index, 1999 & 2009

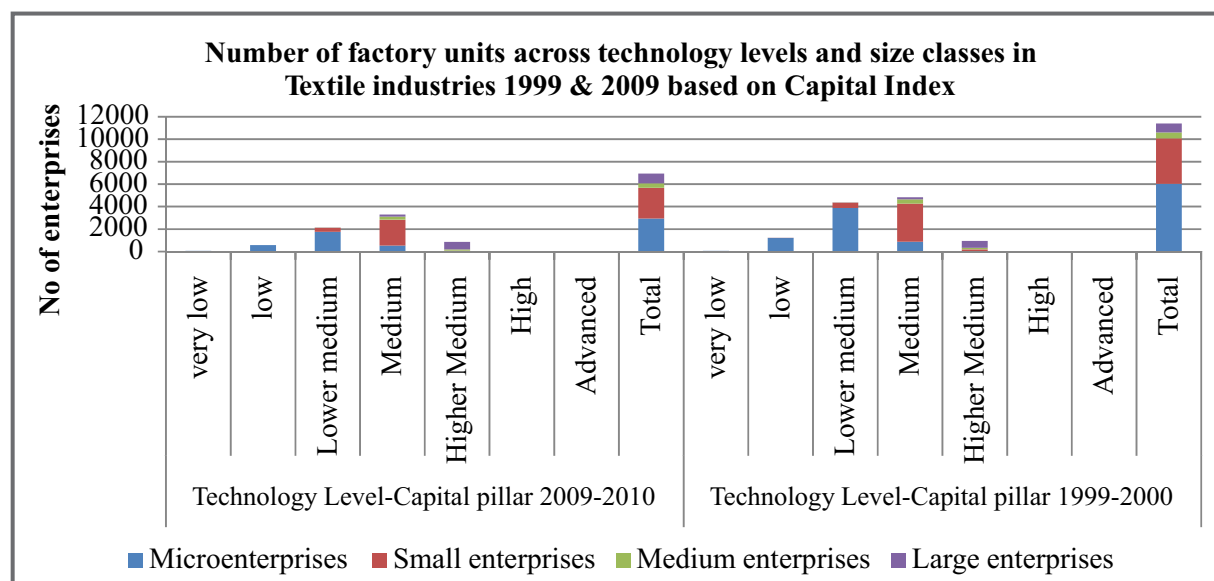


Figure 3.7c: Number of factory units across technology levels and size classes in Textiles industries based on output index, 1999 & 2009

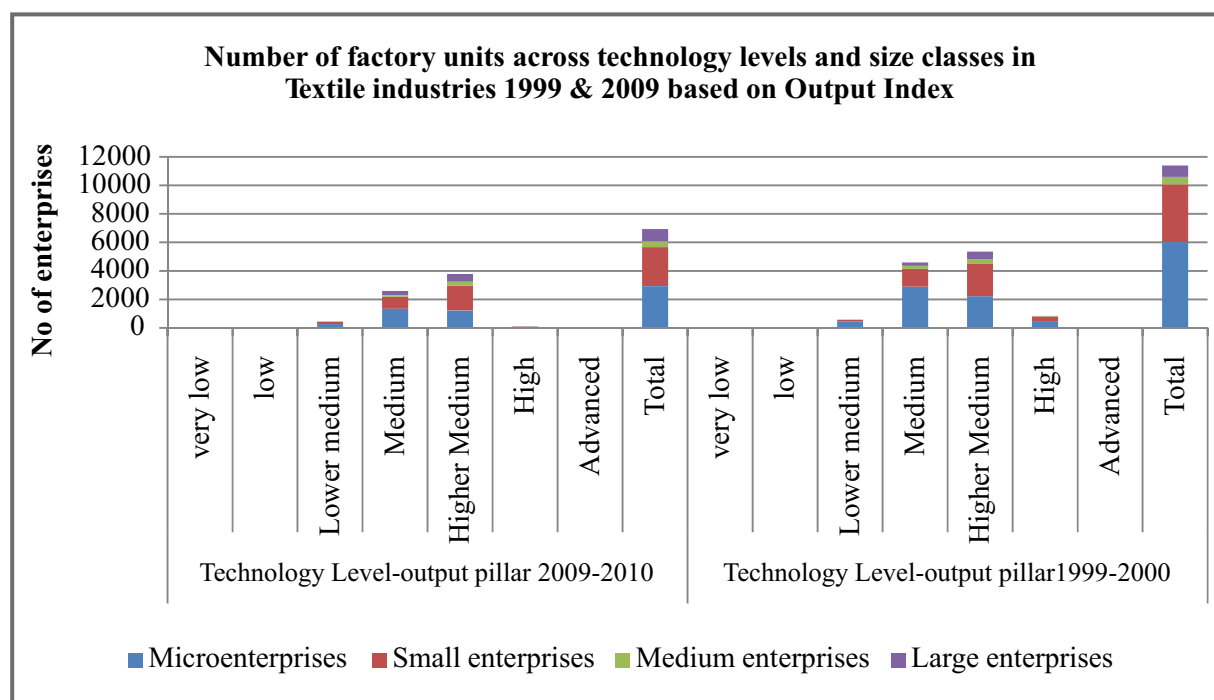
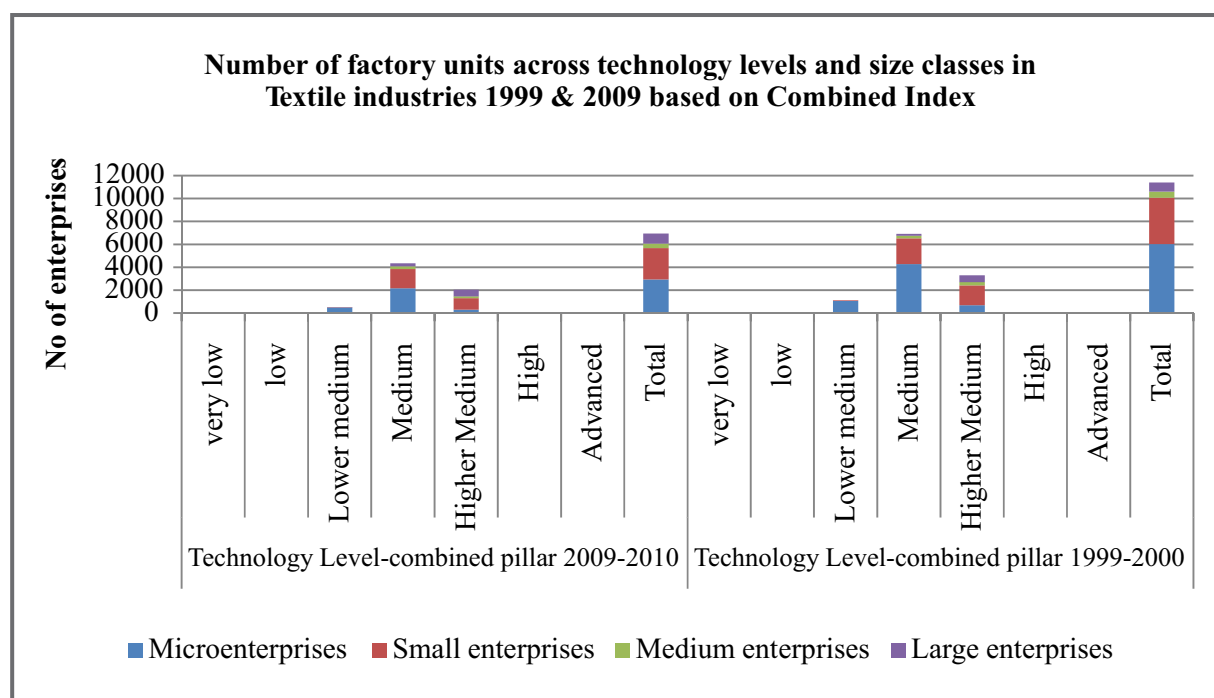


Figure 3.7d: Number of factory units across technology levels and size classes in Textiles industries based on combined index, 1999 & 2009



As opposed to combined index, Input Pillar estimates suggest very high proportion of the factory units belonged to low, lower medium and medium technology groups in all the size classes and the proportions increased further over the years. As regards Capital Pillar, a majority of the micro enterprises belong to lower medium technology group, majority of the small and medium enterprises belong to medium technology group and majority of the large enterprises belong to higher medium technology group. There has not been much change in the distribution over the period. In terms of Output Pillar, higher medium and high technology units have the major share of the enterprises - 85% for micro, 88% for small, 93% for medium and 98% for the large size classes. However, in all the size classes excepting micro size class, higher medium technology units are numerically predominant. There were a sizeable number of the MSMEs that belonged to high technology group in the 1999 but their numbers declined later on. All this corroborates the fact that manufacturing units with higher technology are more exposed to global competition, particularly from East Asian countries and the recent global slow down added to miseries of the textiles manufacturers in general and more particularly high technology manufacturers irrespective of whether catering to domestic market or foreign market. It appears that large units could offer little to the smaller one for their development.

iii. Chemical Industry: Despite no change in the number of performing manufacturing units at the all industry level, chemical industry has been able to raise the number of performing units. Such increment however took place in the higher medium technology group. On the other hand, enterprises in the low and lower medium technology groups as well as in the high and advanced technology groups declined. Probably some low and lower medium technology enterprises upgraded technology and moved to medium technology group. Decline in the high and advanced technology enterprises shows their inability to withstand global competition at the high end market. Size class wise break up data show that micro size class is the main innovator because most of the enterprises moved along the technology ladder belong to this class whereas high and advanced technology units of the large size class declined.

Input pillar data however show that for the micro and small size classes, enterprises predominantly concentrated in lower medium, medium and higher medium technology groups, and for the medium size class the distribution is dispersed to both the ends and for large size class it is skewed towards higher end. Although, small, medium and large size classes witnessed increase in the proportion of low and lower medium technology units and the decline in the proportion of higher medium, high and advanced technology units. Just the opposite trend is found for the micro size class.

Figure 3.8a: Number of factory units across technology levels and size classes in Chemicals industries based on input index, 1999 & 2009

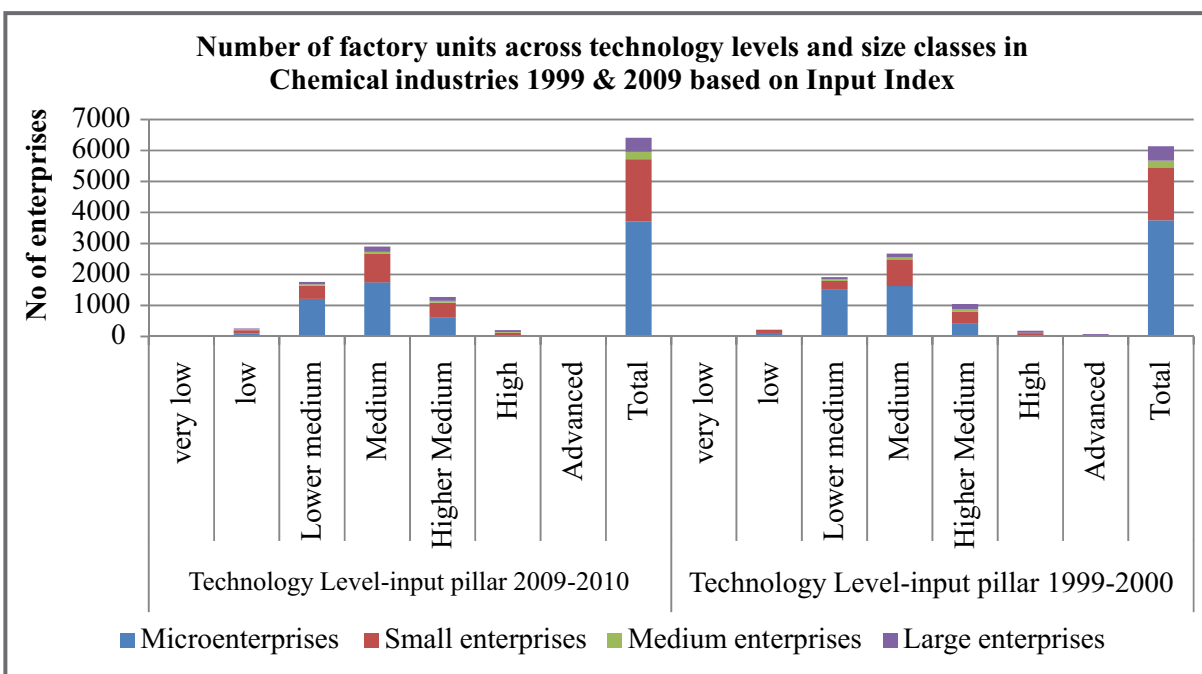


Figure 3.8b: Number of factory units across technology levels and size classes in Chemicals industries based on capital index, 1999 & 2009

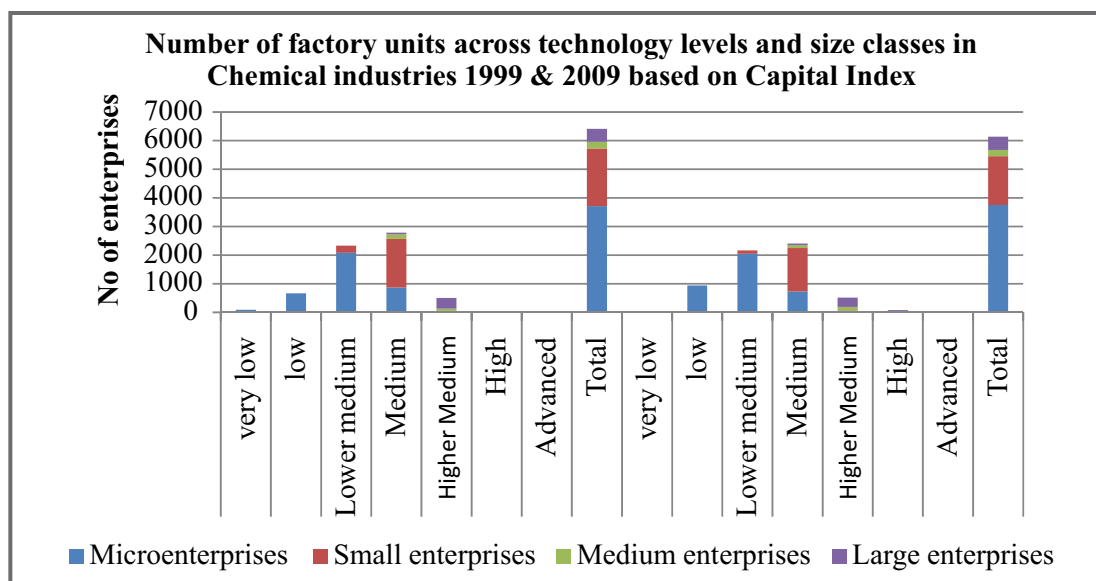


Figure 3.8c: Number of factory units across technology levels and size classes in Chemicals industries based on output index, 1999 & 2009

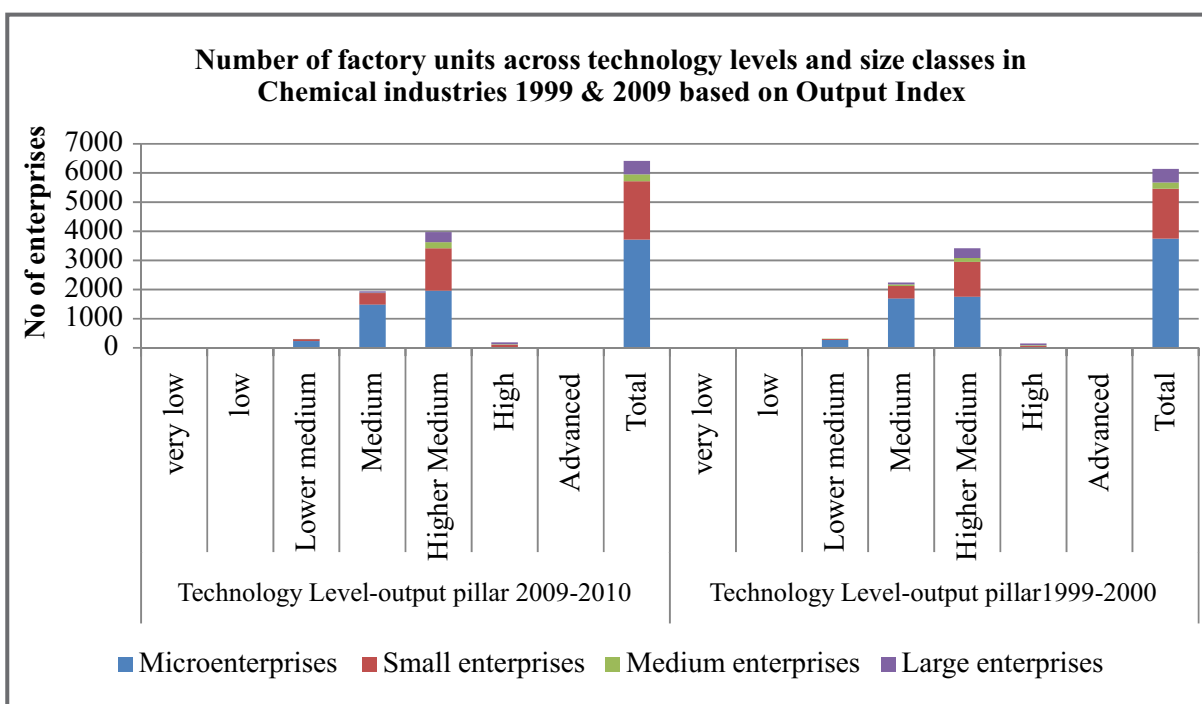
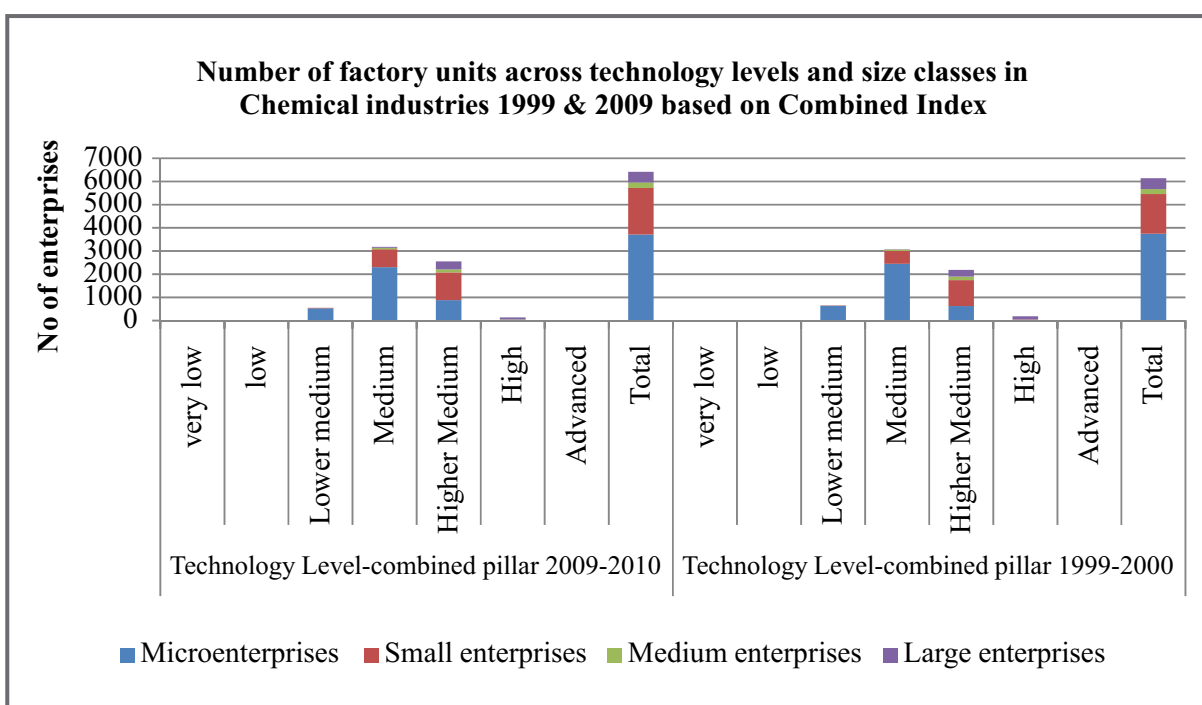


Figure 3.8d: Number of factory units across technology levels and size classes in Chemical industries based on combined index, 1999 & 2009



Capital pillar data show that almost all the manufacturing enterprises are distributed among very low, low, lower medium and medium technology groups, although predominated by lower medium technology group. Similarly small size class does not have very low or low technology units - most of the units belong to the medium technology group where there is some increase in the number of enterprises. Medium size class has medium and higher medium technology enterprises only with the predominance of the former whereas large size class has enterprises with medium, higher medium and high technology enterprises with the predominance of higher medium technology.

Output Pillar estimates suggest there has been some improvement in technology – all the size classes were able to raise the proportion of enterprises belonging to higher medium or above technology groups. In general enterprises are concentrated primarily in the higher medium technology group for all the size classes.

In brief, chemical industry experienced significant innovations for which the primary contribution came from the micro enterprises and small enterprises. It is however not clear what role played by the large enterprises in the development of micro and small enterprises.

- iv. ***Other non-metallic minerals industry:*** Two-digit industry sector manufacturing of other non-metallic minerals products has witnessed highly impressive growth of performing factory units during 1999-2009. The new performing units are added to all the technology groups excepting the high and advance technology groups.

Size class-wise estimates however show that only the large size-class did poorly whereas micro, small and medium classes registered impressive growth of performing units. Several lower medium, medium and higher medium technology units are added to the micro size class, medium and higher medium technology units are added to small and medium size classes. Thus MSMEs performed well as regards innovations or technological advancement where many manufacturing units have come up with higher levels of technologies.

Input Pillar data also suggests that excepting the micro size class, all other size classes witnessed some decline in the number of enterprises belonging to the higher technology groups leading to decline in their share of higher technology enterprises. Capital Pillar however shows that the large units exhaustively belong to medium, higher medium and high technology groups and that there has been no perceptible change in the distribution over the period. Small and medium size classes however made most of the innovations leading to substantial rise in the number of medium and higher medium technology units. Output Pillar shows higher presence as well as growth of performing micro and small sized enterprises in the high medium technology group.

Figure 3.9a: Number of factory units across technology levels and size classes in other non-metallic minerals Industries based on input pillar, 1999 & 2009

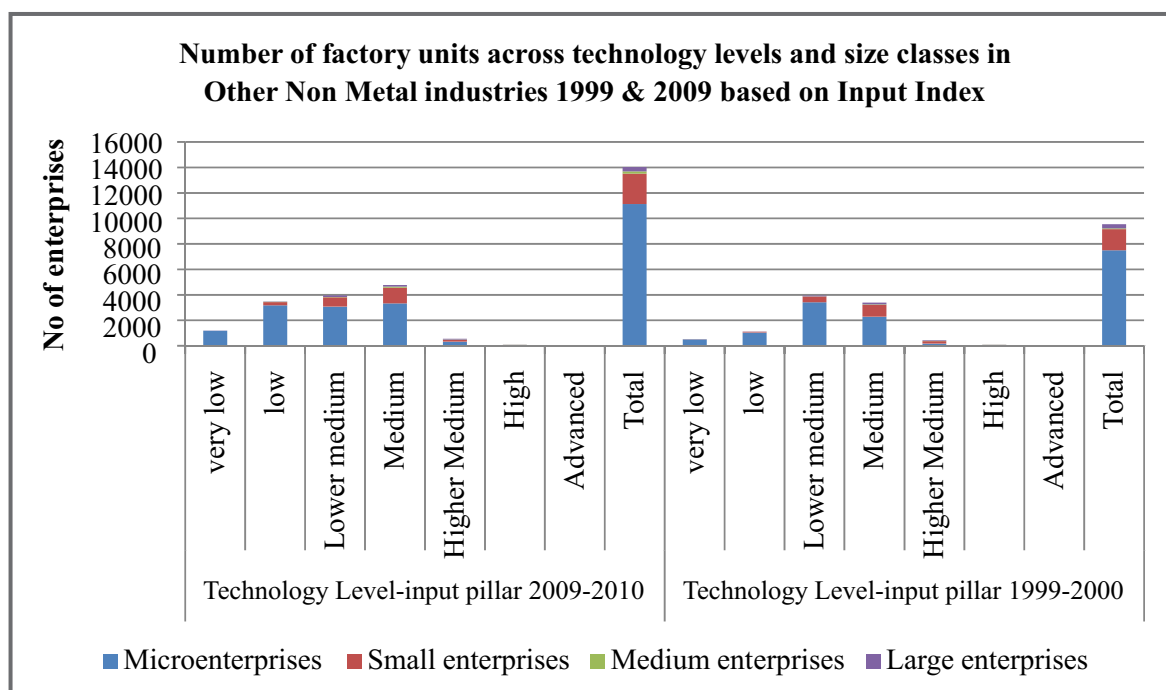


Figure 3.9b: Number of factory units across technology levels and size classes in other non-metallic minerals Industries based on capital pillar, 1999 & 2009

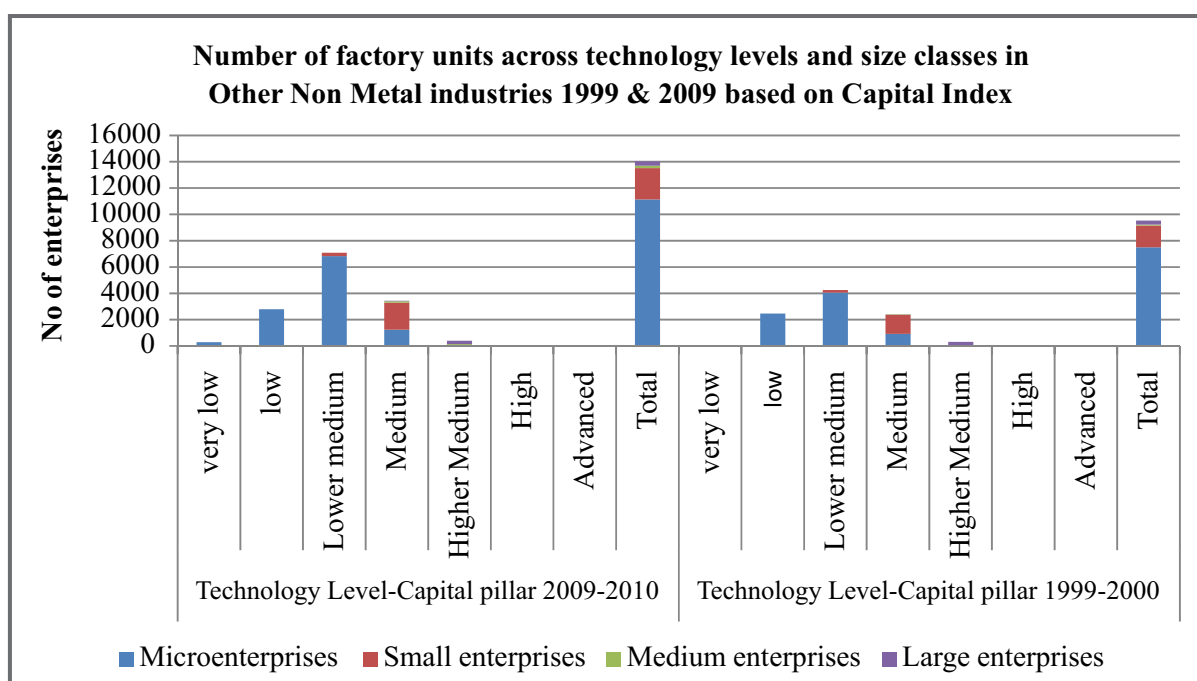


Figure 3.9c: Number of factory units across technology levels and size classes in other non-metallic minerals Industries based on output pillar, 1999 & 2009

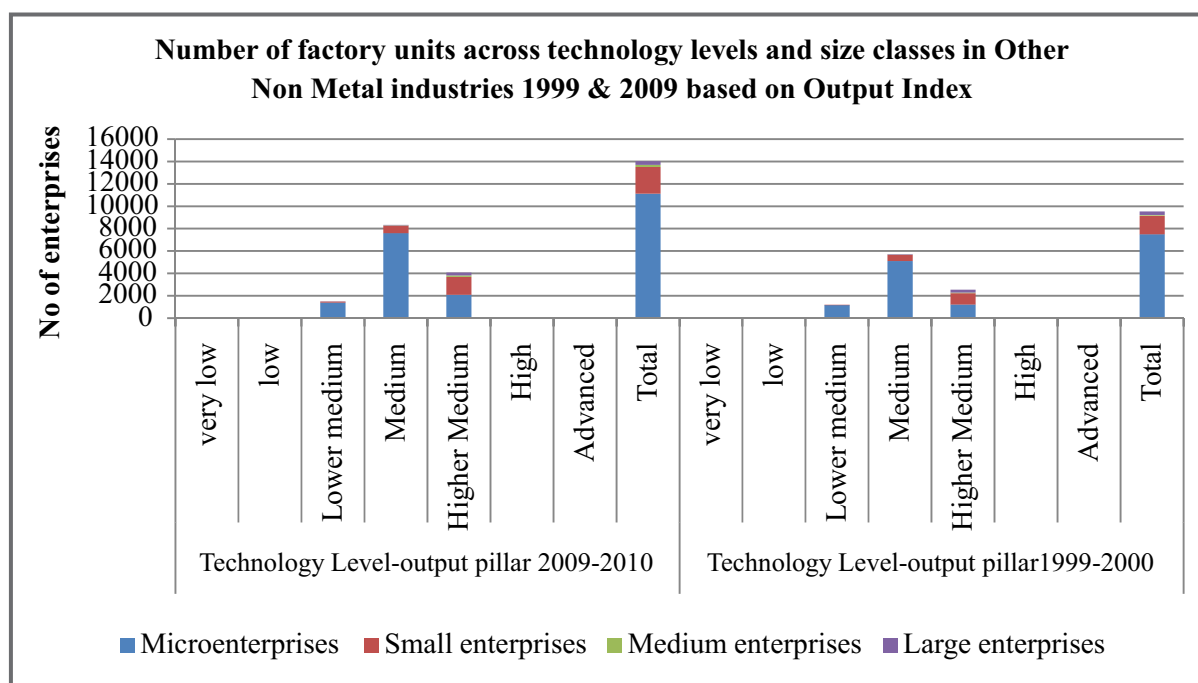
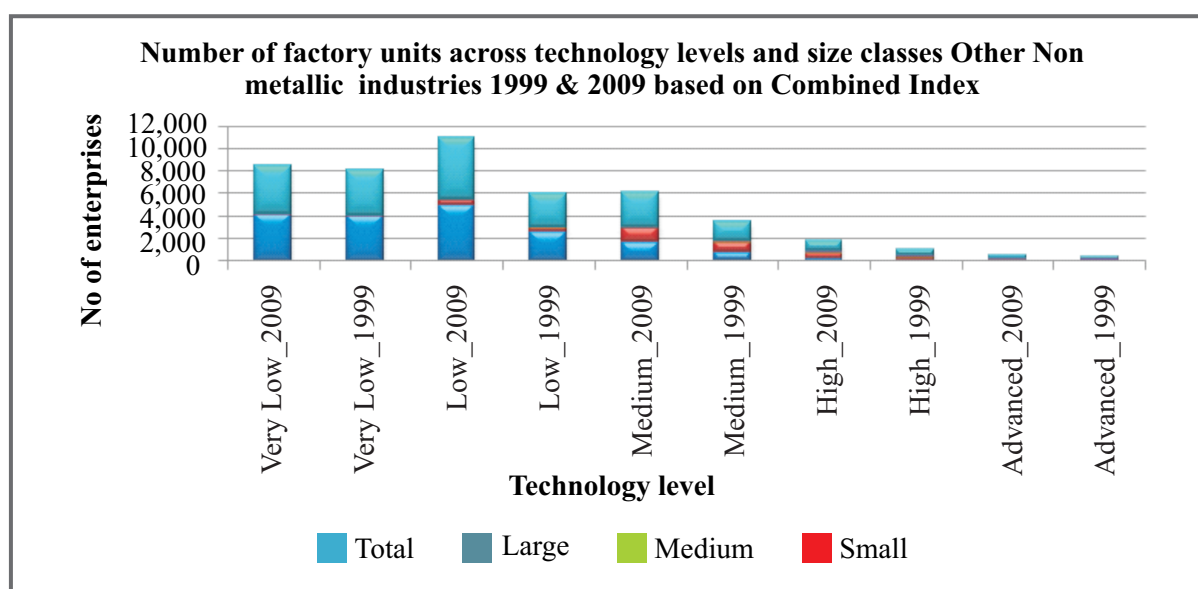


Figure 3.9d: Number of factory units across technology levels and size classes in other non-metallic minerals Industries based on combined index, 1999 & 2009



In brief, micro and small size classes are the most innovative and best performers in respect of each of the three pillars and the medium size however made moderate progress in this regard.

- v. **Basic metals industry:** This industry substantially raised the number of performing enterprises - several higher medium and high technology units are added. Also several micro enterprises scaled up and moved to higher size classes with the result of decline in the number of micro enterprises. The most striking feature of the development of this industry is that innovations or technological progress took place in all the size classes where the number of performing units increased in the higher medium technology group. In addition to this the medium and large size classes added some manufacturing units to high technology group. However the number of medium technology units increased at faster rates in small, medium and large size classes leading to decline in the shares of their higher technology groups. Further, it seems many micro enterprises moved from lower medium and medium technology groups to higher medium technology group and also to small size class. All this suggests substantial innovations made by the basic metal industry with much greater innovativeness of the micro units.

Figure 3.10a: Number of factory units across technology levels and size classes in basic metals Industries based on input pillar, 1999 & 2009

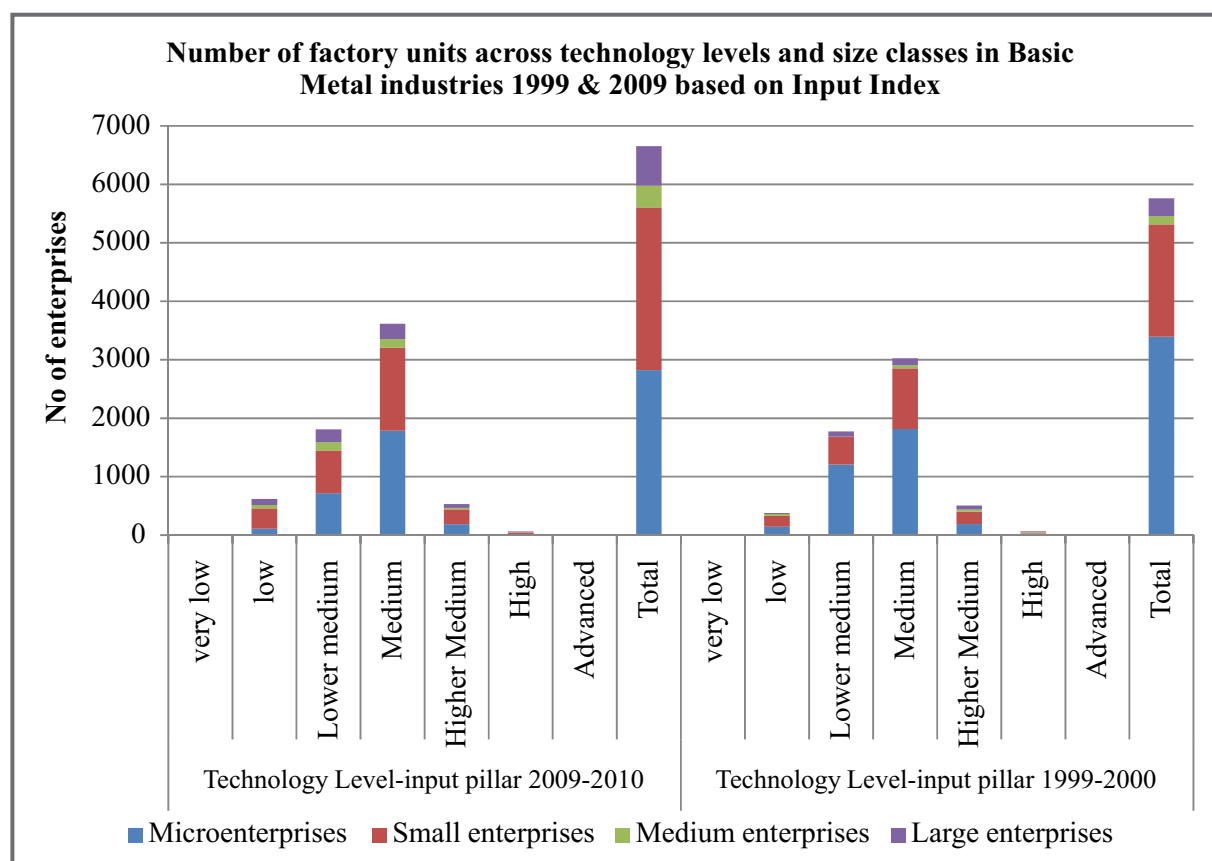


Figure 3.10b: Number of factory units across technology levels and size classes in basic metals Industries based on capital pillar, 1999 & 2009

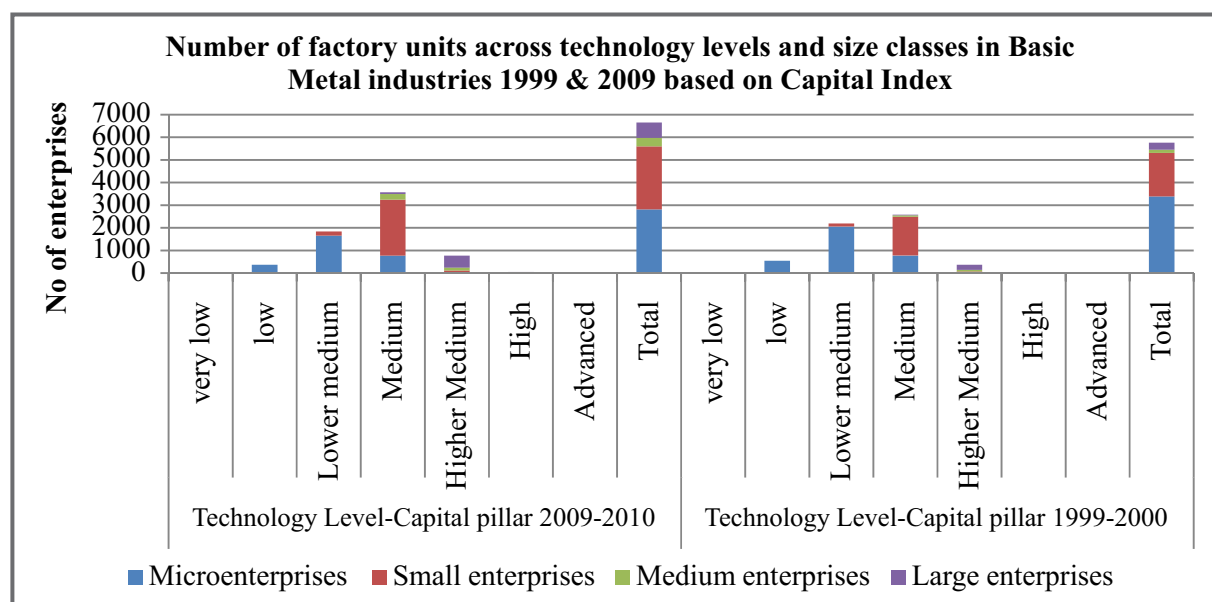


Figure 3.10c: Number of factory units across technology levels and size classes in basic metals Industries based on output pillar, 1999 & 2009

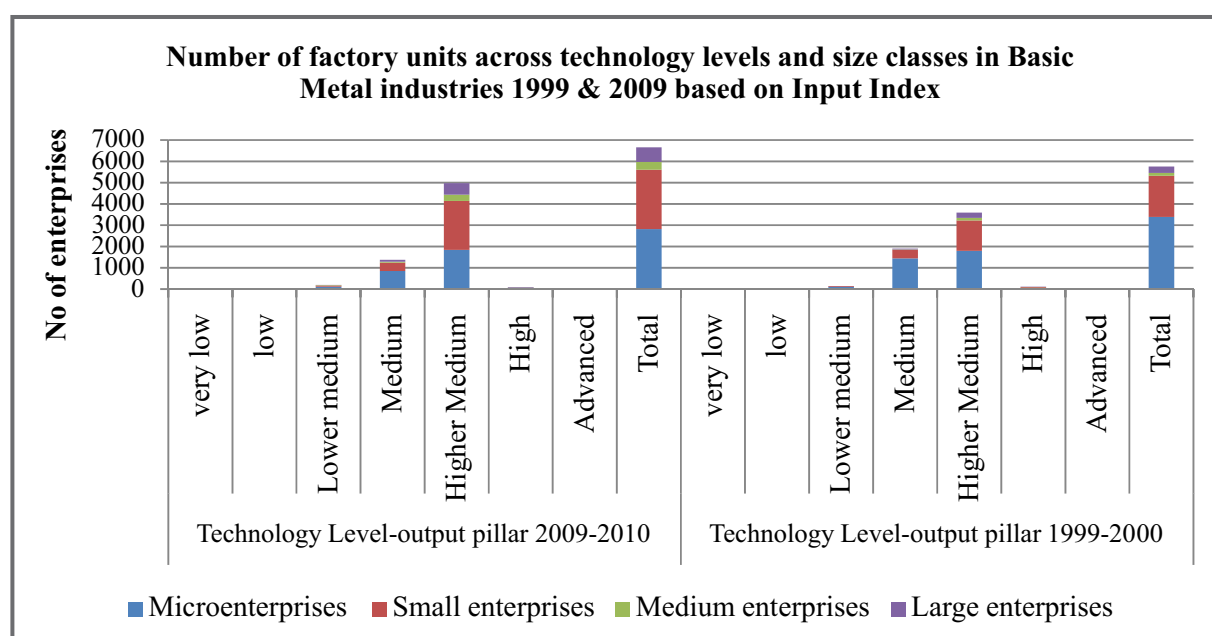
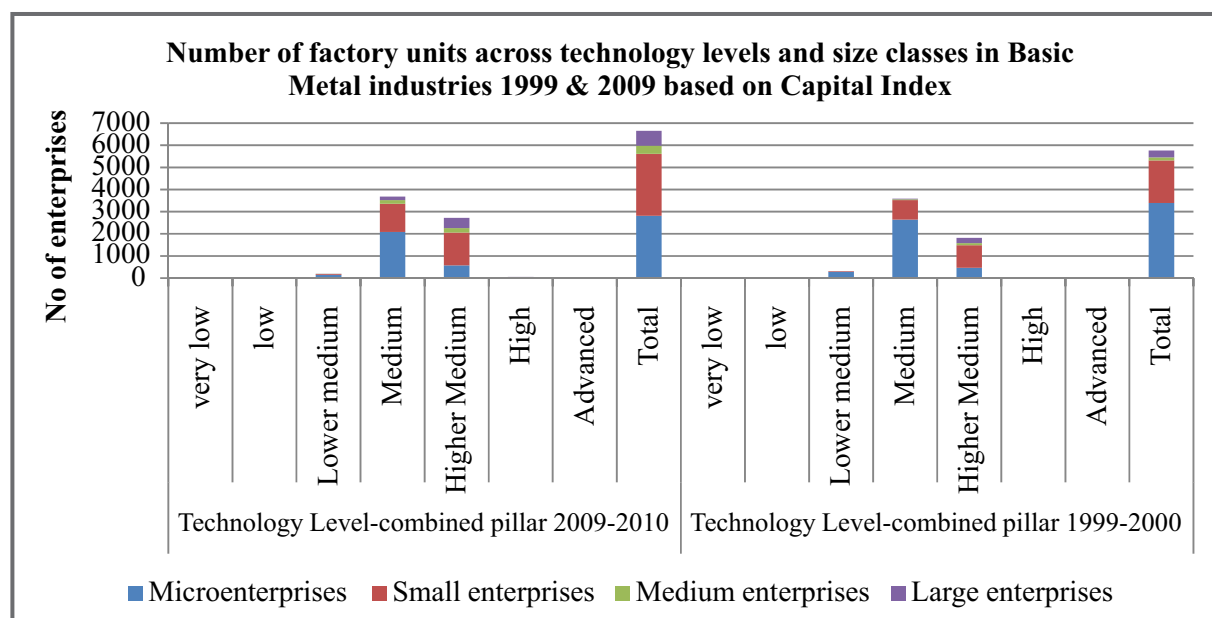


Figure 3.10d: Number of factory units across technology levels and size classes in basic metals Industries based on combined index, 1999 & 2009



Input Pillar data however suggest substantial growth of low and lower medium technology units particularly in small, medium and large size classes. Micro size class on the other hand considerably reduced the number of low and lower medium technology units. As a result the share of lower technology units declined in micro size class and increased in small, medium and large size classes. Capital Pillar data indicate technological progress by small, medium and large size classes – micro size class reduced the number of enterprises in low and lower medium technology groups, small and medium size classes raised the number of enterprises in medium and higher medium technology groups and the large size class raised the number of enterprises in medium and higher technology groups. Common pattern of the two pillars is that the distribution is skewed towards lower technology groups, which however tilts towards higher technology groups as the size class increases. As opposed to these two pillars, Output Pillar however shows much larger proportion of the micro units belong to higher medium technology group and further their number increased over the period. Similar pattern is also found for the small size class.

In brief, there is more broad based technology progress across all size classes enabling each of the higher technology groups to raise the number of performing units and even micro sized units not only moved from low and very low technology units to higher technology units but also to higher size classes altogether. There is a possibility of cooperation between small and large enterprises of the basic metal industry.

- vi. **Machinery Industry:** There has been a substantial decline in the number of performing units in the micro size class and the number remained same in medium size class and increased in case of small and large size classes. According to Combined Index, within the

micro size class the number of enterprises declined more or less uniformly across all the technology groups whereas for the small size class new units are added only to medium technology groups and for the large size class only higher medium technology group witnessed increase in the number of units. It appears that global competition, particularly from the Chinese machine tools industries, largely affected the uncompetitive micro sized enterprises.

Input Pillar also shows that very low technology micro enterprises were the most affected group. The proportion of higher medium technology units however did not decline in micro size class whereas for all other size classes the proportion higher technology units declined and that of lower technology units increased. Capital Pillar on the other hand shows that medium technology small and medium size units and higher medium technology large size units were the beneficiaries who could make capital related innovations. As compared to Capital or Input Technology Pillar, Output Pillar shows fewer lower technology enterprises and many higher technology enterprises in the micro and small size groups.

In brief, global competition largely affected micro enterprises. For the other size classes there is no definite trend as regards technological progress, although they have high proportion of manufacturing units with medium, higher medium advanced technology. It may be apparent that the large and medium sized enterprises failed to help out the micro enterprises.

Figure 3.11a: Number of factory units across technology levels and size classes in Machinery Industries based on input index, 1999 & 2009

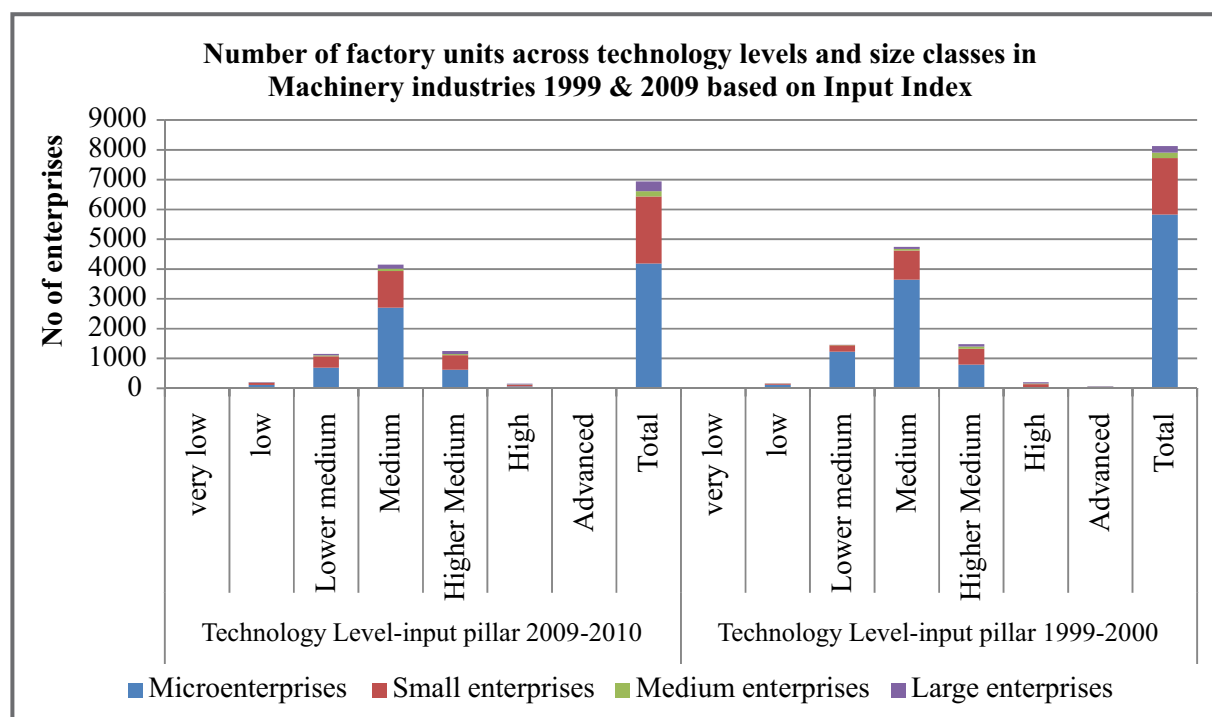


Figure 3.11b: Number of factory units across technology levels and size classes in Machinery Industries based on capital index, 1999 & 2009

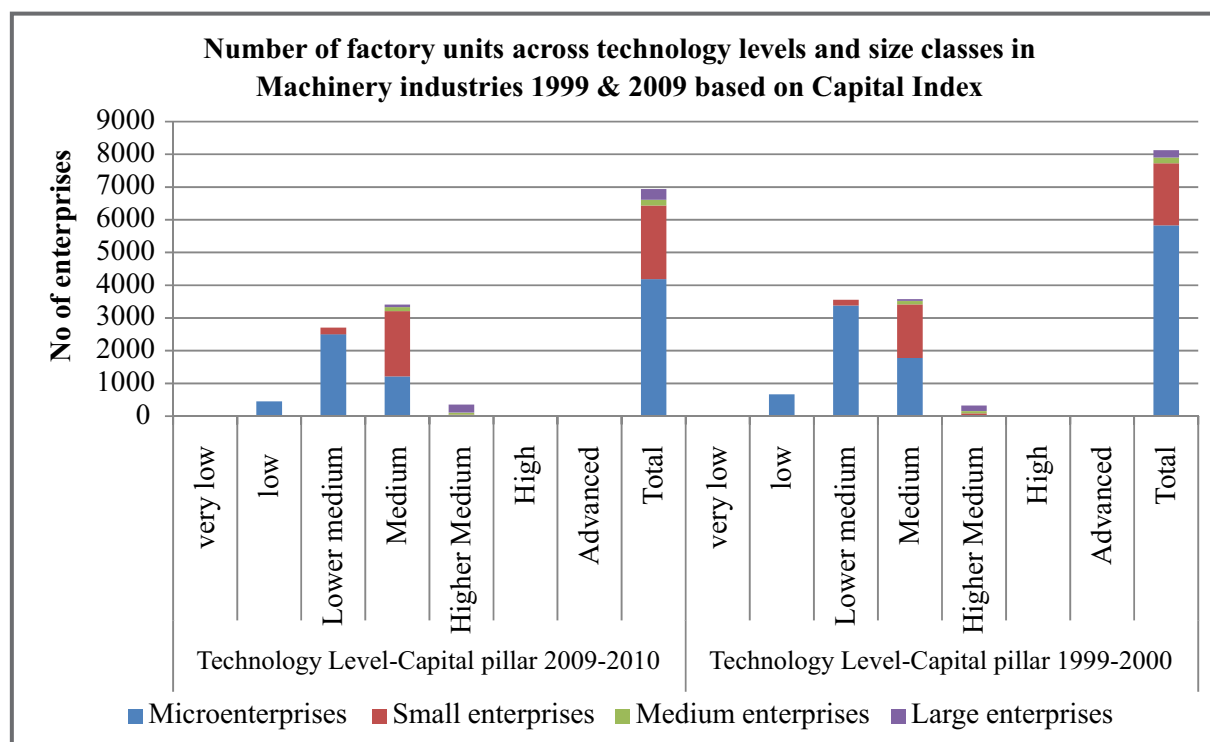


Figure 3.11c: Number of factory units across technology levels and size classes in Machinery Industries based on output index, 1999 & 2009

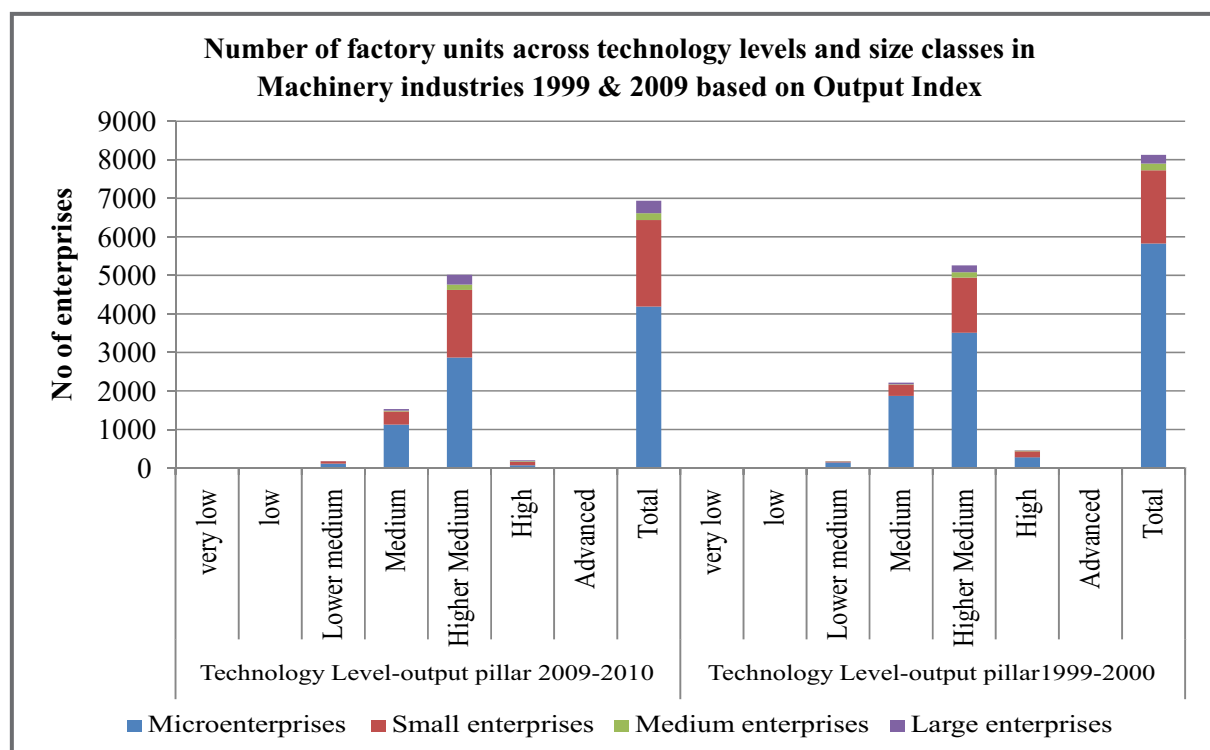
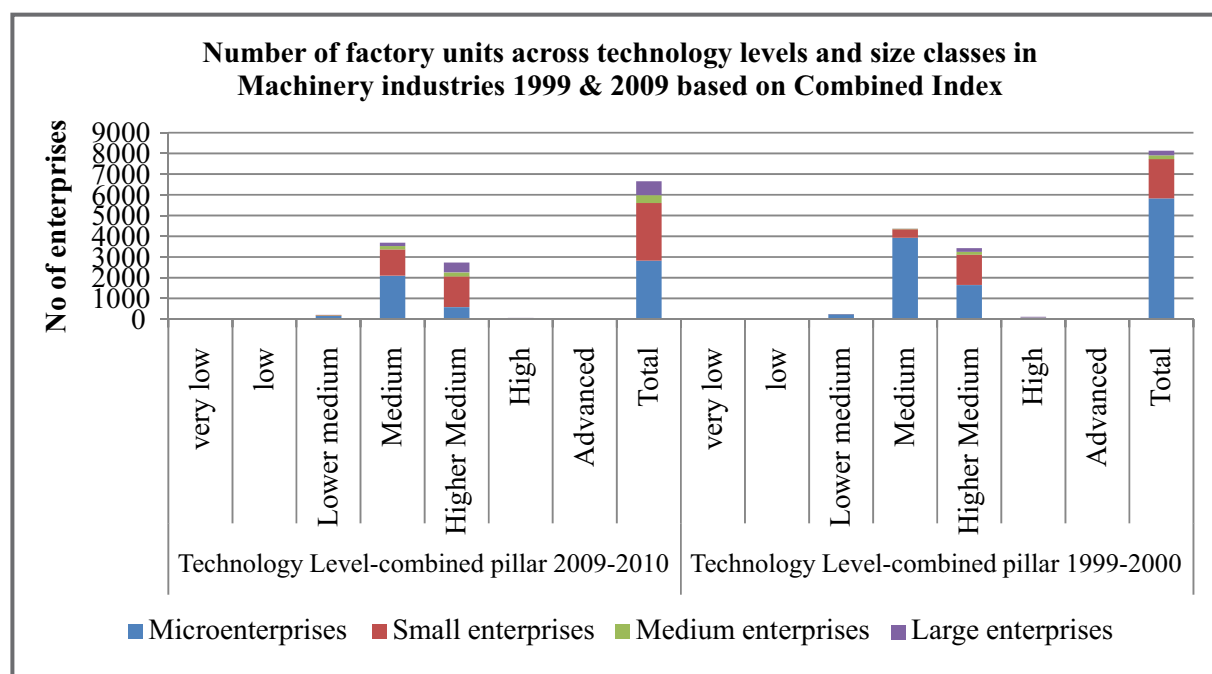


Figure 3.11d: Number of factory units across technology levels and size classes in Machinery Industries based on combined index, 1999 & 2009



Chapter : 4

Regional pattern of innovations and changes in the distribution of manufacturing units across technology levels

Based on the technology indices of manufacturing units developed in Chapter 2 we would estimate technology-wise distribution of manufacturing units across states. This would help to see which states are technologically more advanced. Temporal changes in the distribution would also show the states that are more innovative and that raised the proportion of manufacturing units with higher levels of technology. We would then see if there is any possibility of inter-linkages among different size classes of enterprises that helped the innovation and growth or industrial agglomeration facilitated the changes.

We have already classified manufacturing units/enterprises into seven technology levels by using indexes based on twelve parameters of enterprise characteristics. We have noted that distribution of enterprises across technology levels is generally more dispersed for individual parameters and more concentrated around medium technology level when a collection of parameters is used. When all the twelve parameters are used simultaneously for Combined Index, the distribution at both the tail ends, viz, very low and advanced technology groups, becomes negligible. Combined Index is also used here to obtain distribution of enterprises across technology levels for each state. The same way as we have classified manufacturing sectors as low technology, medium technology and high technology, states are also classified into three broad groups-low technology states, medium technology states and high technology states. Each broad group is further divided in keeping with the seven technology groups/levels of the enterprises:

- i. Low Technology States have two subgroups, namely very low and low technology states***
 - a) Very low technology state: Combined share of Very low, Low and Lower medium technology enterprises exceeds 30% of the total enterprises of the state.
 - b) Low technology state: Combined share of Higher medium, High and Advanced technology enterprises is below 25% of the total manufacturing enterprises of the state.
- ii. Medium Technology States have three subgroups, namely lower medium, medium and higher medium technology states***
 - a) Lower Medium technology state: Combined share of Higher medium, High and Advanced technology units lies between 25 to 33%
 - b) Medium technology state: Combined share of Higher medium, High and Advanced technology units lies between 33 to 42%
 - c) Higher Medium technology state: Combined share of Higher medium, High and Advanced technology units lies between 42 to 50%.

iii. High Technology States have two subgroups, viz, high technology and advanced technology states

- a) Higher technology state: Combined share of Higher medium, High and Advanced technology units lies between 50 to 75%.
- b) Advanced technology state: Combined share of Higher medium, High and Advanced technology enterprises exceeds 75% of the total.

Table 4.1: Technology levels of states

	% share of technology groups				Technology level		Change of level of technology between 1999-2009
	2009-10		1999-00		2009-10	1999-00	
	L+Lm	Hm+H	L+Lm	Hm+H			
Andhra Pradesh	17.91	20.29	26.76	15.73	L	L	No
Assam	21.13	14.60	19.92	16.50	L	L	No
Bihar	41.28	20.54	35.90	14.37	VI	VI	No
Delhi	1.14	43.73	0.74	46.93	Hm	Hm	No
Goa	2.54	47.61	3.90	63.23	Hm	H	Down
Gujarat	5.73	36.27	7.97	32.40	M	Lm	Up
Haryana	6.90	42.80	12.84	38.94	Hm	M	Up
Himachal Pradesh	1.66	58.26	1.51	54.91	H	H	
Jammu & Kashmir	5.79	19.96	12.21	20.99	L	L	
Karnataka	4.42	42.15	10.95	36.32	Hm	M	Up
Kerala	25.59	20.83	22.58	20.84	L	L	
Madhya Pradesh	8.27	30.14	8.95	28.22	Lm	Lm	
Maharashtra	4.31	42.69	7.01	40.41	Hm	M	Up
Orissa	16.74	25.51	25.31	17.78	Lm	L	Up
Punjab	23.49	26.93	9.04	29.50	Lm	Lm	
Rajasthan	17.81	28.67	10.17	35.06	Lm	M	Down
Tamil Nadu	10.09	29.43	18.42	24.28	Lm	L	Up
Tripura	77.96	2.63	51.59	2.55	VI	VI	
Uttar Pradesh	12.98	33.86	11.17	33.10	M	M	
West Bengal	12.65	25.45	9.70	24.55	Lm	L	Up
Puducherry	4.18	37.80	5.26	45.61	M	M	

Note: i. VI – very low, L – low, Lm – lower medium, M – medium, Hm – higher medium, H – high; ii. 2009-10 figures for Uttar Pradesh includes Uttarakhand, Bihar includes Jharkhand, Madhya Pradesh includes Chhattisgarh.

Our criterion of advanced technology state as the one having the proportion of higher medium, high and advanced technology manufacturing units exceeding 75% is not fulfilled by any state, so none of the Indian states would be considered as advanced technology state. The criteria of high technology state, as the one with the proportion of higher medium, high and advanced technology

units exceeding 50%, is fulfilled only by Himachal Pradesh. But the state is small sized with total number of factory units is very low (1265 factories). In 1999-00 Goa was a high technology state based on this criteria but reduced to higher medium technology state in 2009-10. It may be mentioned that States / UTs with a few factory units are excluded from this discussion. Apart from Goa, Delhi, Haryana, Karnataka and Maharashtra are now considered as higher medium technology states with the share of higher medium, high and advanced technology manufacturing units lie between 42 to 50%. Of these states, Haryana, Karnataka and Maharashtra moved up from medium technology states to higher medium technology states over the decade. Gujarat, Uttar Pradesh and Puducherry are considered as medium technology state with the share of higher medium, high and advanced technology enterprises ranging between 33 to 42%. Among these medium states, Gujarat moved up from lower medium technology state. There are quite a number of lower medium technology states, namely, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu and West Bengal. Out of these six states, West Bengal, Tamil Nadu and Orissa moved up from low technology states, and Rajasthan moved down from medium technology state. Bihar and Tripura are the very low states whereas Kerala, Jammu & Kashmir, Assam and Andhra Pradesh are traditionally low technology states. It may be seen that a third of the 21 states are able to improve their technology levels over the decade. Because of the presence of a large number of old technology manufacturing units, traditionally industrialized states like, Tamil Nadu, Punjab, West Bengal, UP and Gujarat are technologically lower ranked despite the recent development of modern industries along with many large factories in some of these states, which is partly reflected in terms of changes in the technology status over the period. It thus seems that the pace of advancement of technology and innovation would be better understood through the growth of higher technology manufacturing units and the distribution of the added higher technology units among different size classes. We would then see whether the growth is confined to a single sector or in several sectors.

Figure 4.1: Number of enterprises across states based on Combined Index

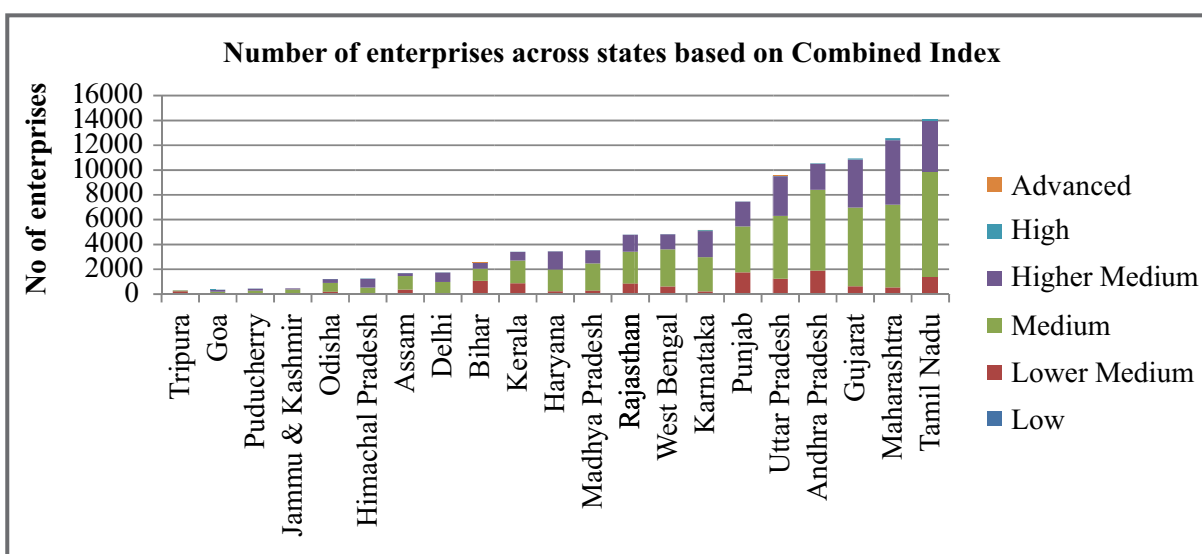
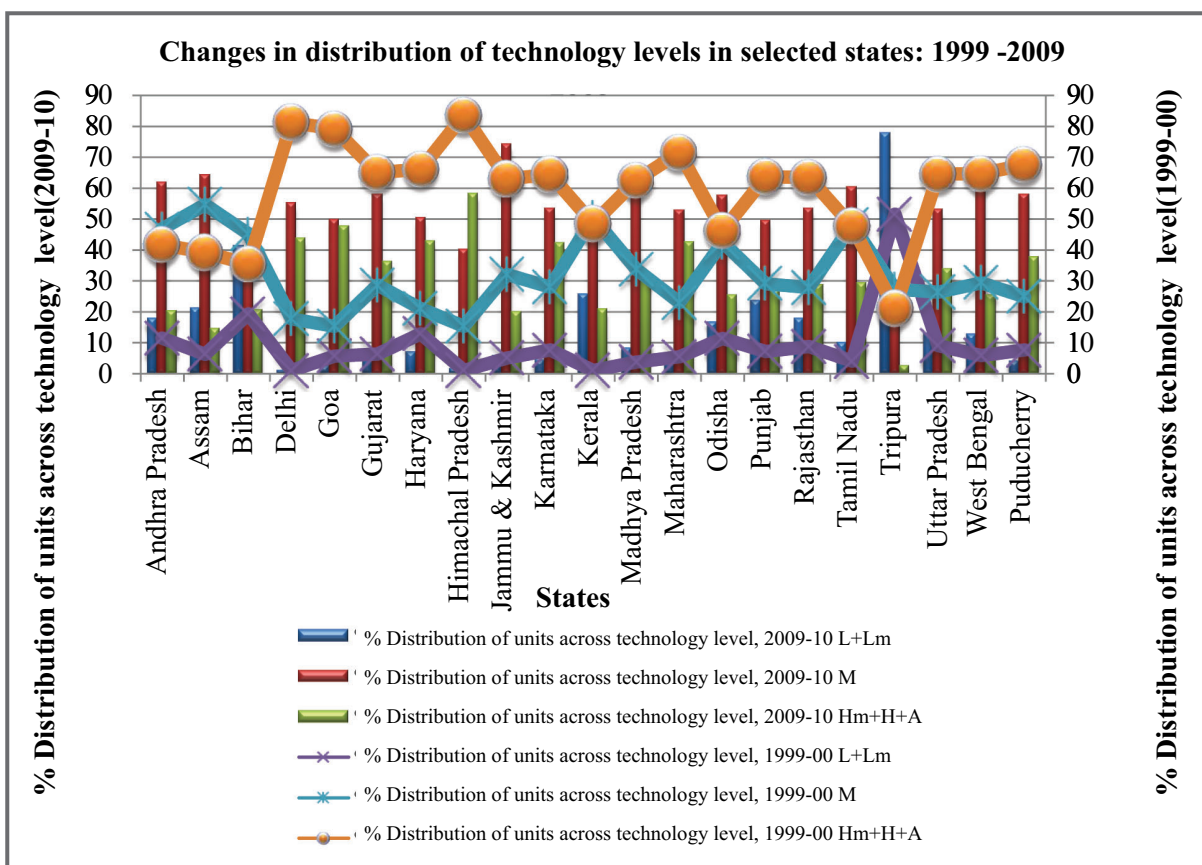


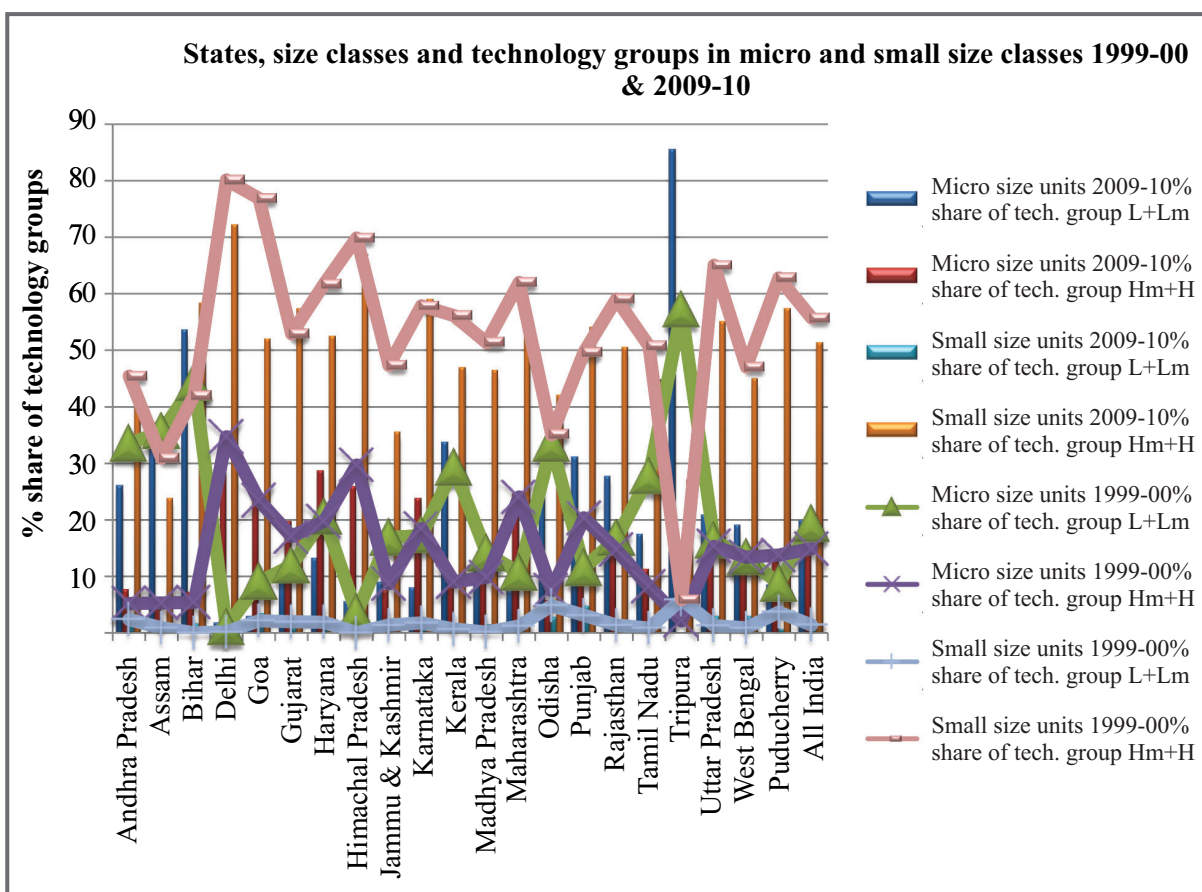
Figure 4.2: Changes in distribution of technology levels in selected states: 1999 -2009



Note: Lm=Lower Medium, M=Medium, L=Low, Hm=Higher Medium, H=High, A=Advanced ; * For comparison with 1999-00 figures, we have clubbed Chhattisgarh with MP, Jharkhand with Bihar, Uttarakhand with UP.

Among the large states Punjab, Andhra Pradesh, Rajasthan, UP (combined with Uttarakhand), Bihar (including Jharkhand) and Assam witnessed some rise in performing units but it declined in the other large states. The rate of decline is highest in Delhi which is followed by Maharashtra, Gujarat, Tamil Nadu and Kerala. But in the large states the percentage share of higher medium and high technology units increased excepting Punjab and Rajasthan where the proportion declined. This indicates that the entry or exit of performing units occur in low or lower medium technology groups. The states that have raised the number of medium and higher medium technology units are Andhra, Tamil Nadu, Himachal, Bihar, (including Jharkhand), Maharashtra, Madhya Pradesh, Karnataka, UP (including Uttarakhand), Haryana, Gujarat and Orissa. This shows that some states have high proportion of higher medium technology and high technology units and a few others have lower proportion of the same but increased over the period. We shall see below in which size classes the changes are confined.

Figure 4.3a: States, size classes and technology groups in micro and small size classes 1999-00 & 2009-10

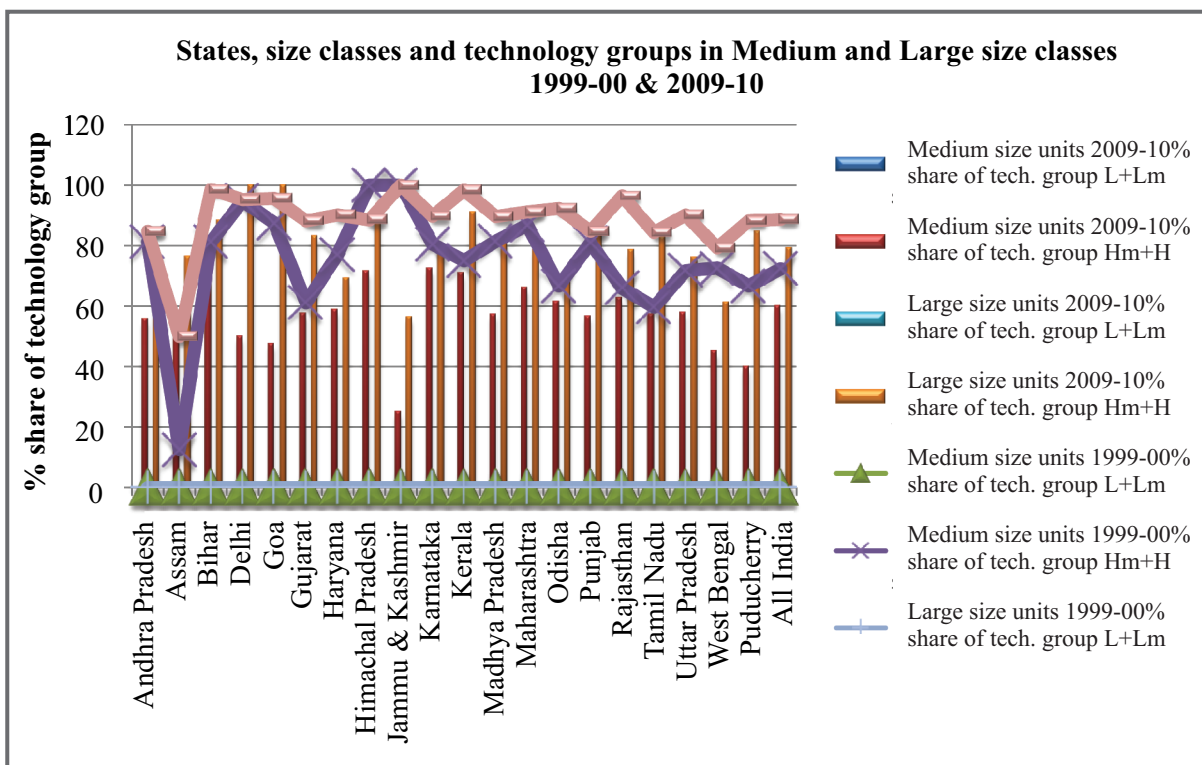


Tamil Nadu, Maharashtra, Gujarat and Andhra Pradesh, the top four states, witnessed sizeable decline in the number of performing micro units and the decline is primarily confined to lower medium technology group in Andhra Pradesh, to lower medium and medium technology groups in Gujarat and Tamil Nadu, and to lower medium, medium and higher medium technology groups in Maharashtra. Further, Maharashtra and Gujarat have high proportion of micro units in the higher medium technology group. Punjab and Rajasthan are the two important states where the number of micro enterprises increased but the new enterprises joined mainly the lower medium technology group in Punjab and in Rajasthan they joined lower medium, medium and higher medium technology groups.

In the case of small size class, excepting Gujarat all the other three major states witnessed increase in the number of manufacturing units. In the states of Tamil Nadu and Maharashtra these new units joined the medium technology group whereas in Andhra Pradesh new units joined the medium as well as upper medium technology groups. Here both Maharashtra and Gujarat have high proportion of units with higher medium technology level. Among the remaining states, UP,

Orissa, Madhya Pradesh, Punjab, Maharashtra, Rajasthan, West Bengal, and Himachal Pradesh also witnessed increase in the number of small size enterprises. However, in most of the cases the new units joined the medium and higher medium technology groups. In general small enterprises belong to medium and higher medium technology groups where new units joined.

Figure 4.3b: States, size classes and technology groups in medium and large size classes: 1999-00 and 2009-10



Excepting Rajasthan, all the top 12 states, ranked in terms of total number of performing units, experienced increase in total number of large sized manufacturing units and in most of the states these new units joined the medium technology group leading to decline in the share of higher medium technology group. Largest addition of new units is however found in Tamil Nadu, presently the largest state, where majority of the new units belong to the medium and higher medium technology groups. Similar to the case of large units, the number of medium sized units also increased in most of the states where new units joined lower medium and medium technology groups. In general, irrespective of size classes, new units joined the middle level technology groups such as lower medium, medium and higher medium technology groups. We will analyse and the pattern of technological change or innovativeness in some of the major states.

i. Tamil Nadu

This state has the largest number of performing units. Presence of large sized manufacturing units is quite visible in almost all the important 2-digit industry groups like food products, textiles, apparel, paper, chemicals, pharmaceuticals, rubber and plastics, other non-metallic minerals, basic metals, fabricated metals, machinery and equipment manufacturing, computer, electronics and optical fibers, electrical machinery and motor vehicles. Further, in all these industry groups excepting textiles and fabricated metals, the number of large sized manufacturing units, particularly those with higher medium technology, increased significantly over the period. Quite a few of them scaled up from being medium sized. Small sized units made sizeable improvement in technology as their number in medium and higher medium technology groups increased in food products, apparel, other non-metallic mineral products, basic metals, fabricated metals and motor vehicles. Many micro units with very low and low level technologies declined in several industries.

Food products industry is one of the few largest manufacturing sectors in Tamil Nadu. A sizeable number of manufacturing units are found in each size class and for almost every technology group, excepting the very low and advanced technology groups. The number of manufacturing units increased in the higher medium technology group in all the size classes. Additionally, for the small size class it increased in lower medium and medium size class and for large size class a few high technology units have come up. All this indicates some sort of vertical cooperation or inter-linkages promoting each other.

Textiles industry has the opposite experience: the number of lower medium, medium and higher medium technology units declined in all size classes excepting the large size class where the number increased for the medium and higher medium technology groups. It seems there has been some sort of consolidation of units in the face of fierce global competition.

In 1999-00, apparel industry was almost insignificant, particularly for medium and large size classes, which increased in all the size classes subsequently. A number of micro, small, medium and large units with medium and higher medium technologies have come up. Here the possibility of mutual interdependency or vertical cooperation appears to be quite high.

There has been marked deterioration in chemical industries. Number of large units declined substantially – many high or advanced technology large units scaled down to move to medium size classes. Overall numerically, micro units declined and small units increased in medium and upper medium technology groups.

In pharmaceuticals industry, a number of large units have joined higher medium technology group. But in other size classes the number of units has come down significantly. This indicates severe competition, consolidation and scale economy.

Other non-metallic minerals products group has made a lot of improvement in each size class: increase in the number of units in the lower medium, medium and higher medium technology

groups for micro size class, in medium and upper medium technology groups for small size class, in medium, upper medium and high technology groups for medium and large size classes. There is a likelihood of vertical cooperation among manufacturing units.

In basic metals industry there is a substantial technological improvement as indicated by a sizeable growth in the number of medium and higher medium technology enterprises in small size class and higher medium and high technology units in large size class. There is also a possibility of mutual vertical cooperation among enterprises.

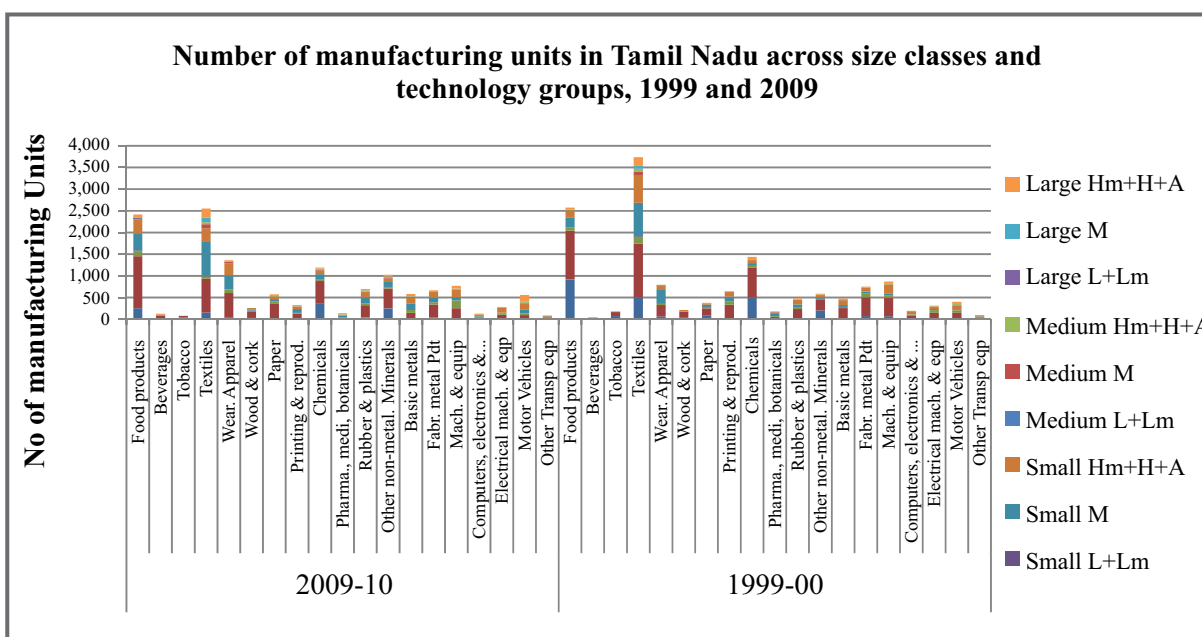
Machinery and equipment industry and computer, electronics and optical fibers industry underwent significant technological changes and increase in concentration as several higher medium and high technology units came up in large size class but no corresponding improvement is visible in other size classes.

Rapid growth of large size units with medium, upper medium and high technology characterizes the motor vehicles industry of Tamil Nadu. Apparently many medium sized units moved up along the size class. Similarly many micro units moved up scale of production to join small size class with improved technology levels. This rapid transformation of smaller units is possible through inter-linkages of small units with the larger ones and the latter assisting the former.

In general, beverage, wearing apparel, paper, rubber & plastic, other non-metallic mineral products, basic metals industries and motor vehicles experienced increase in number of enterprises in Tamil Nadu. New entrants are found mostly in medium and higher medium technology groups. In other non-metallic minerals, and rubber & plastics new entrants are also found to a significant extent in lower medium technology group. Beverage, wearing apparel, paper, rubber & plastics, other non-metallic minerals increased in number of micro units. For beverage the increase is in medium technology group, for wearing apparel and paper the rise is in medium and upper medium technology groups and decline in lower medium. For rubber & plastic and other non-metallic the rise is in lower medium, medium and upper medium groups.

In the case of small size class, in food products industry there has been some increase in number of enterprises in lower medium, medium and upper medium groups, in wearing apparel, wood & cork, chemicals, rubber, other non-metallic minerals, basic metals, fabricated metals, computers, electrical, and motor vehicles industries new units are added to medium and upper medium technological groups. In the medium size class, wearing apparel, chemicals, rubber, other non-metallic minerals, basic metals and fabricated metals new enterprises increased in medium and upper medium technology groups. In addition to this, chemicals and non-metallic minerals also gained some high technology units. In the case of large size class, substantial increase in the number of enterprises, mostly in the higher medium technology group, is found in food product, textiles, paper, printing, rubber, other non-metallic minerals, basic metals and motor vehicles industries.

Figure 4.4: Number of manufacturing units in Tamil Nadu across industries, size classes and technology groups, 1999 and 2009



Geographical concentration of manufacturing activities in Tamil Nadu is quite significant – as much as a quarter of the MSMEs and a fifth of the large sized manufacturing units are located in a particular district, Coimbatore. It is apparent that agglomerative forces facilitate the operation of so many MSMEs and large units through cost cutting, because of infrastructure development, and inter-industry exchanges such as among basic metals, fabricated metals, machinery and equipment. There are quite a few other industrialized districts in the state two of which are even more dynamic technologically with more higher technology units. Thus combining Figures 4.4 and 4.4a one may see that there exist highly diversified industries with significant innovativeness and they are dispersed in quite a few districts.

Figure 4.4a: Number of manufacturing units in Tamil Nadu districts across technology groups in 2009-10

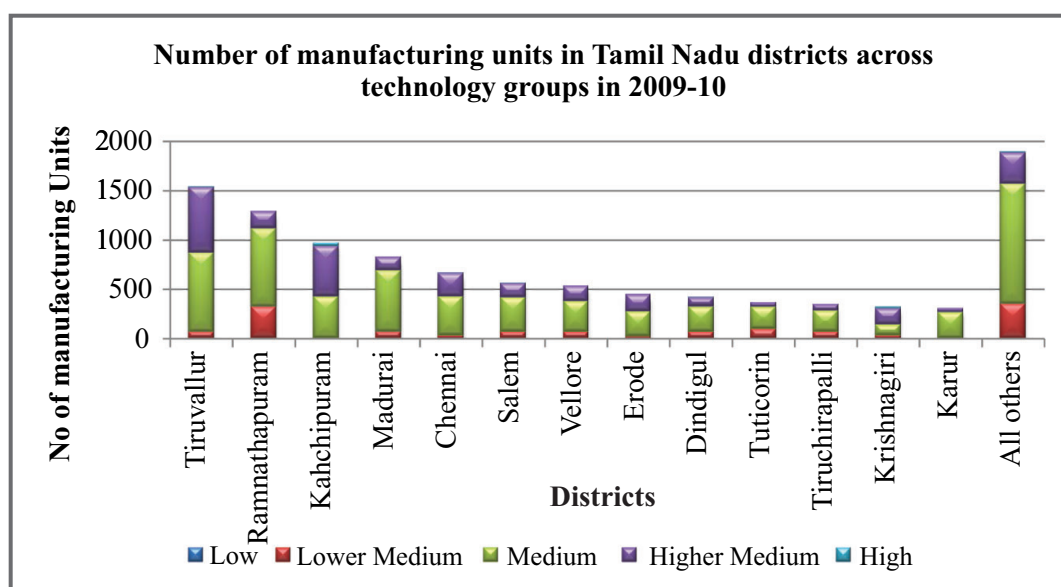
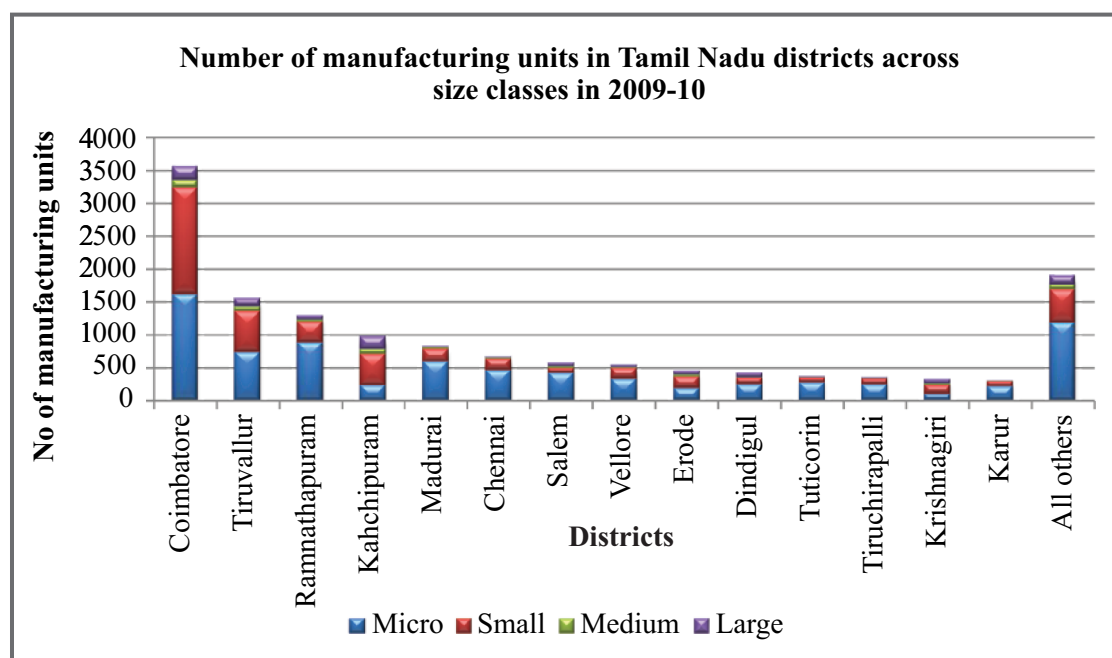


Figure 4.4b: Number of manufacturing units in Tamil Nadu districts across size classes and technology groups in 2009-10



ii. Maharashtra

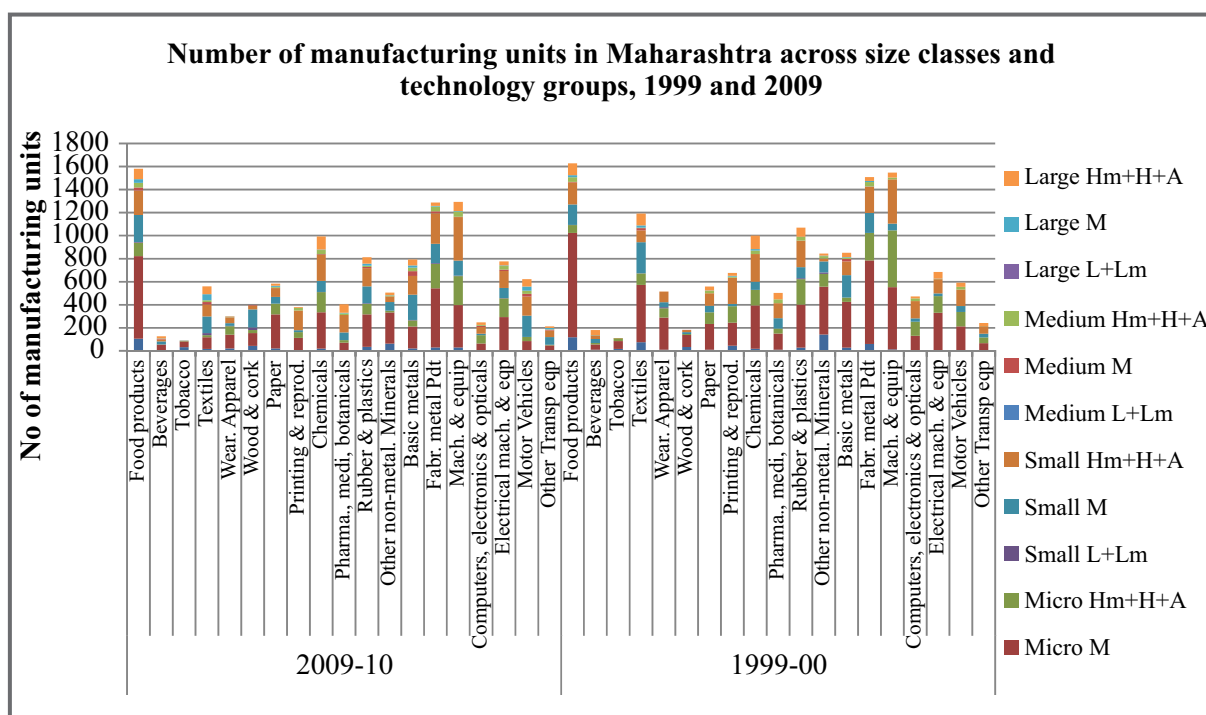
Total number of manufacturing units in the state declined 20% between 1999 and 2009. The decline however took place only in the micro size class. Small, medium and large size classes on the other hand experienced some increase in the number of enterprises. Out of 19 manufacturing industry sectors, four major ones namely, pharmaceuticals, basic metals, machinery & equipment and motor vehicles have experienced substantial increase in the number of large sized manufacturing units. Most of these new units have joined the higher medium technology group, and quite a few in medium and high technology groups. The number of large units in the other two major sectors, namely food products and textiles remained unchanged, although, many moved from higher medium and high technology groups to medium technology group. In the case of chemical industry and electrical machinery industry the number of high technology units declined.

Most of the important industries, such as food, textiles, printing, coke & petroleum, chemicals, basic metals, fabricated metals, machinery and equipment, electrical machinery and motor vehicles raised the number of medium sized enterprises primarily in the medium and higher medium technology groups. Many enterprises of the medium sized pharmaceutical industry apparently moved to large size class. In the case of small size class, several industries like food, wood & cork, basic metals, fabricated metals, machinery & equipment, electrical machinery and motor vehicles were able to raise the number of medium and higher medium technology enterprises. On the other hand, textiles, wearing apparel, paper, printing, rubber and computer witnessed substantial decline in the number of small enterprises. Number of micro enterprises declined in almost all the industry sectors.

Food products is one of the most important industries in Maharashtra and despite having large number of small, medium and large scale, mostly medium and higher medium technology units, a sizeable number of micro sized manufacturing units, belonging to lower medium and medium technology groups declined. In fact for the small and medium size classes the number of units increased in the medium and higher medium technology groups. In a sense the relationship between large and MSMEs is the one of competitive.

In keeping with the national trend, textiles industry in Maharashtra has experienced important transformation - many micro and small sized units declined and the medium and large units consolidated their positions. Chemical industry has been moderately affected - number of enterprises belonging to micro and large size classes declined whereas the number of units in the small and medium size classes increased.

Figure 4.5: Number of manufacturing units in Maharashtra across industries, size classes and technology groups, 1999 and 2009



Manufacturing activities in Maharashtra is located in the region around Mumbai – three districts, namely, Thane, Greater Mumbai and Pune shared more than 55% of the manufacturing units. The region acts as agglomeration of different types of industries where the large number of MSMEs can take advantage of market and intermediate inputs. Presence of so many large units would not only create industry friendly environment and infrastructure but also develop inter-linkages with the MSMEs for various kinds of business transactions. It may be seen that medium and higher medium and advanced technology units are proportionately higher in other districts like Nasik, Nagpur, Raigarh, Aurangabad, etc. Thus Figures 4.5 and 4.5a together indicate industries in the state are highly diversified and dispersed in number of districts, MSMEs have made significant progress in technology and their development together with large units reflects inter-linkages.

Figure 4.5a: Number of manufacturing units in Maharashtra districts across size classes and technology groups in 2009-10

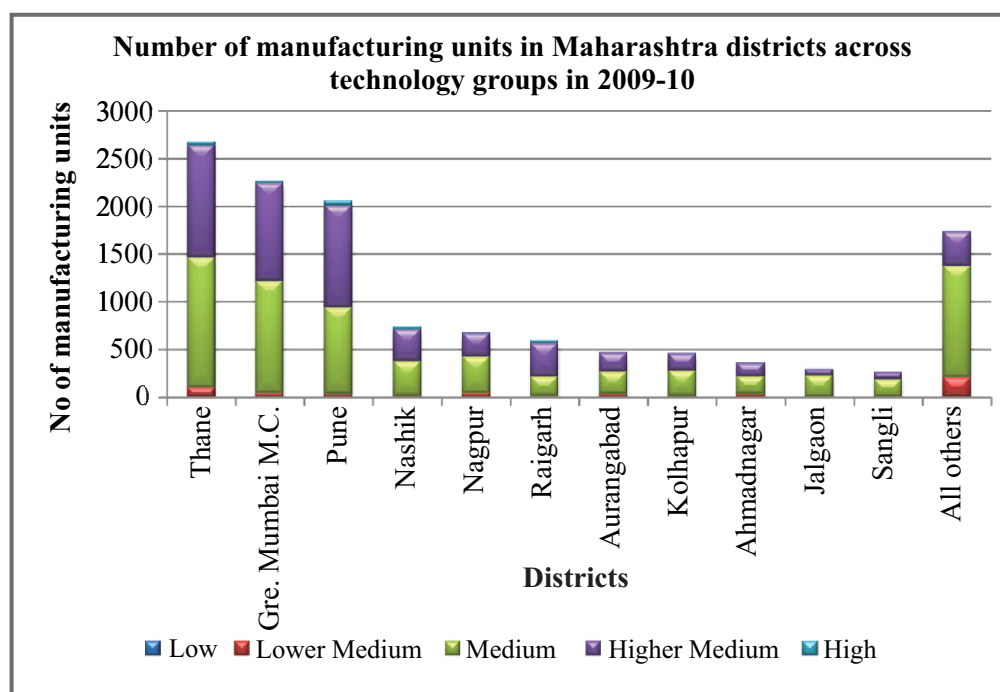
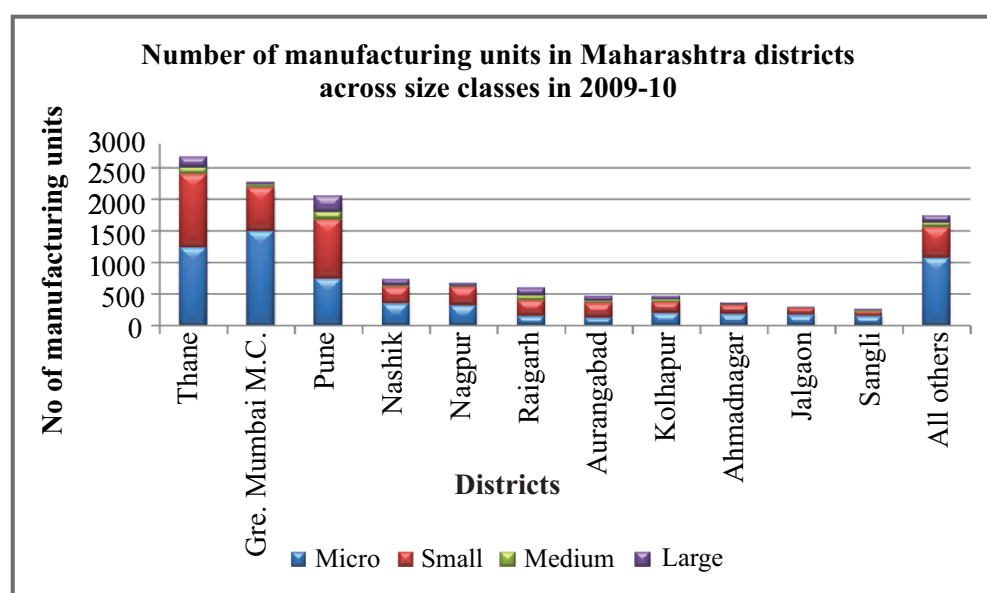


Figure 4.5b: Number of manufacturing units in Maharashtra districts across size classes in 2009-10



iii. Gujarat

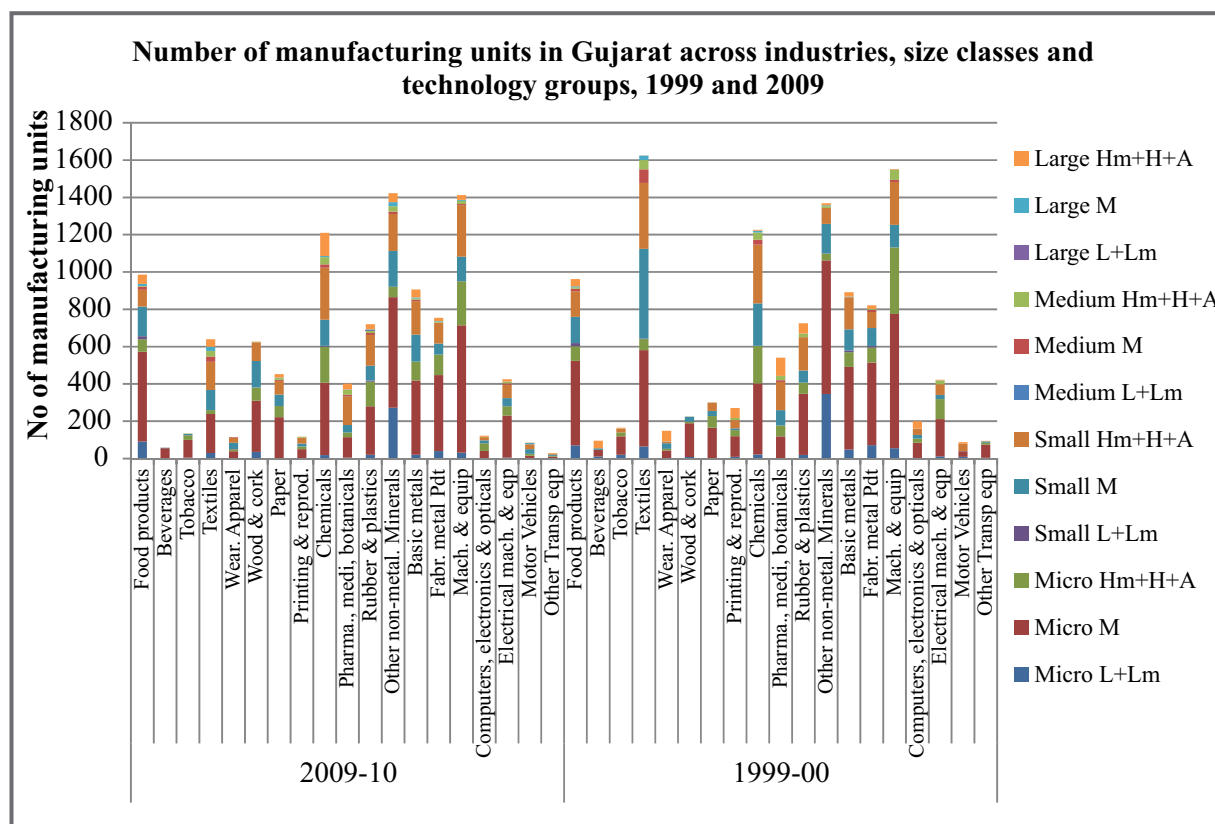
This state also experienced some decline in the total number operating manufacturing enterprises. This decline was more in lower medium and medium technology groups. Number of enterprises with higher level technology (above medium level) however increased which shows technological dynamism of the state. Out of 21 manufacturing sectors only in six major industries the state has experienced significant increase in the number of enterprises. These industries are food products, wood products, paper, rubber & plastic basic metals and non-metallic mineral products. In all these industries the number of large scale units increased. In addition to this, important industries like chemicals, fabricated metals, computer, electrical, motor vehicle also experienced increase in the number of large scale units. Most of the new units are added to the higher medium technology group and quite a few to high technology group. Major decline of large units was however confined to textiles, paper, pharmaceuticals and machinery and equipment industries.

In the medium sized class also the number of machinery and textiles units declined but the number of paper and pharmaceuticals units increased. Apparently some medium sized chemical and fabricated metals units as well as few motor vehicles units moved to large size class. Paper, rubber and other non-metallic minerals witnessed substantial rise in the number of units.

Tobacco, textiles, printing, chemicals, pharmaceuticals, fabricated metals, machinery, computers industries experienced rapid decline in the number of manufacturing units in the both the micro and small size classes. Majority of the decline in the micro size class was confined to lower medium and medium technology groups. Overall the number of higher technology enterprises in the micro size class remained more or less unchanged with decline in some industries is compensated by rise in other industries. For the small size the decline is however confined to medium technology group whereas in the higher technology group it increased in some industries and decline in others leaving the total of the group almost unchanged.

Overall food products, other non-metallic minerals, basic metals, fabricated metals, electrical and motor vehicles witnessed increase in the number of enterprises in higher technology groups across all size classes. There appears to be a broad based technological progress and consolidation of the industries. It is likely that inter-linkages among enterprises of different size classes have facilitated such progress.

Figure 4.6: Number of manufacturing units in Gujarat across industries, size classes and technology groups, 1999 and 2009



Industries in Gujarat are well dispersed throughout the state, although Ahmedabad has a major chunk. However, maximum number of large units as well as higher technology units is found in Bharuch. Dispersion across districts indicates some sort of specialization based on availability of local resources and relevant infrastructure. A close look at Figures 4.6 and 4.6a would reveal that growth and/or technological progress occurred in particular size classes of MSMEs in particular industries and although higher technology units are concentrated mainly in three districts, high as well as medium technology units are quite evenly distributed in proportion to number of units across districts.

Figure 4.6a: Number of manufacturing units in Gujarat districts across size classes and technology groups in 2009-10

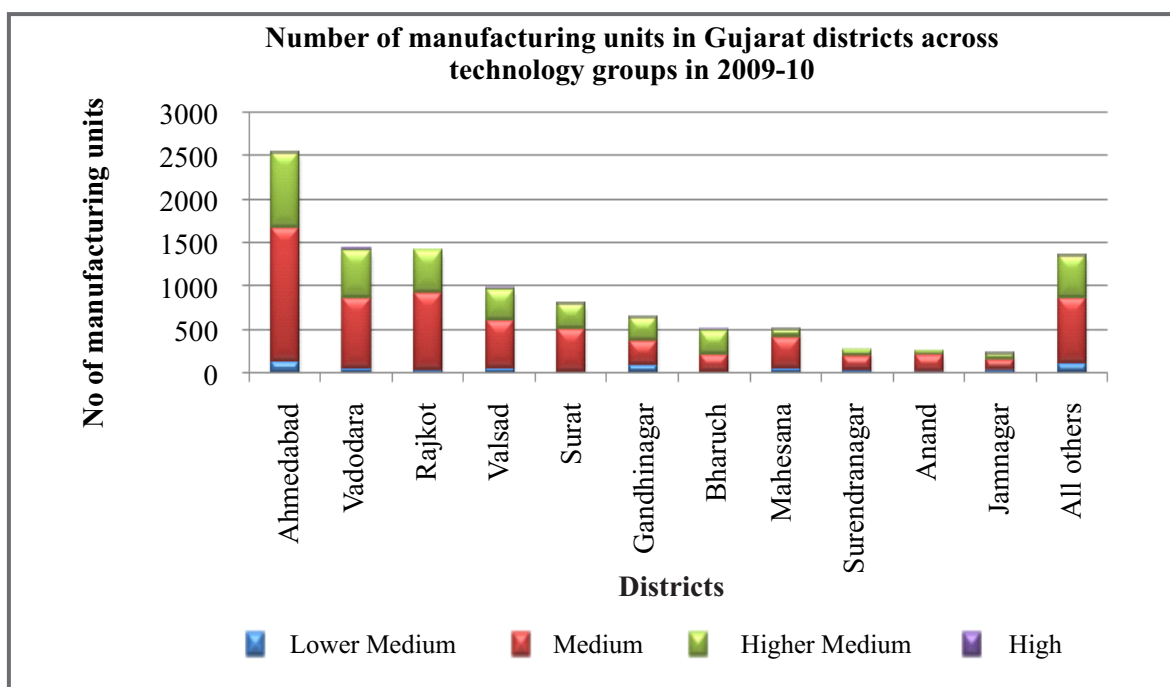
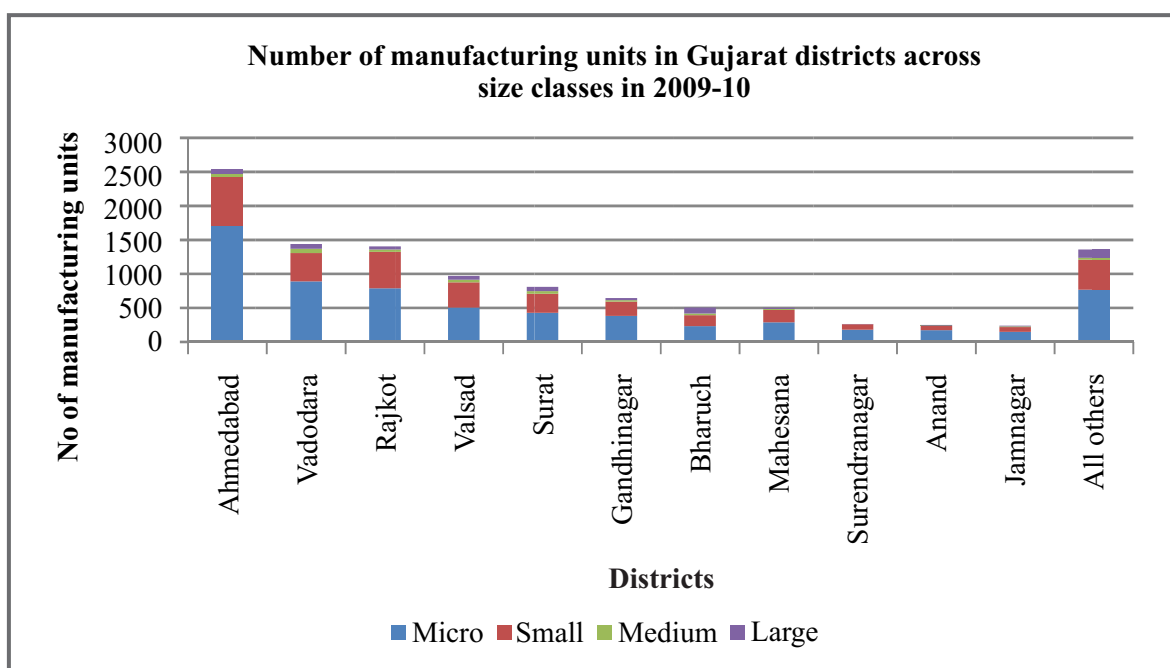


Figure 4.6b: Number of manufacturing units in Gujarat districts across size classes in 2009-10



iv. Andhra Pradesh

Unlike Tamil Nadu, Maharashtra or Gujarat, Andhra Pradesh witnessed increase in total number of operating enterprises over the period. Excepting the micro size class, all the other size classes in Andhra Pradesh experienced this growth. An important aspect of the technological progress in the state is that despite the overall rise in the number of enterprises, the number of lower medium technology enterprises declined and that of medium and higher medium technology enterprises increased.

Number of large units increased in several industries, like beverage, textiles, paper, pharmaceuticals, basic metals, fabricated metals, machinery, computers and electrical machinery, whereas it declined only in food products, coke and petroleum, rubbers and other non-metallic minerals. The rise in the number of large enterprises is however confined mainly to medium technology group, although quite a few higher medium technology units are also added. Among the medium size class, basic metals, fabricated metals, rubber, printing, textiles, and food products witnessed some increase in number of enterprises in the medium and higher medium technology groups. Barring tobacco and textiles, all the industries in the small size class witnessed significant rise in the number of enterprises. This addition of enterprises in the small size class is found in medium and higher medium technology groups. As already mentioned, number of microenterprises declined a bit (by around 4%), and the decline is thinly spread over a large number of industries, excepting textile where the decline is very large. On the other hand, industries like wood, paper, rubber, other non-metallic minerals and basic metals received a large number of new entrants. The decline in the number of microenterprises is mainly confined to lower medium technology group and to small extent in medium technology group. In the higher medium technology group, the number of microenterprises increased.

Food products and other non-metallic mineral products are traditionally the two most important industries of Andhra Pradesh. The former witnessed substantial increase in the number of small and medium enterprises and a decline of micro and large enterprises. The decline is more in the lower technology groups and the increase is more in the medium and higher medium technology group indicating the competition led selection of more innovative and technologically superior enterprises. In the latter industry, there is substantial rise of micro and small enterprises mostly belonging to medium and higher medium technology groups. A few medium and many large size units in the latter industry however declined and a majority of these units belonged to higher medium technology group. The trend in the textile industry is just opposite to that of non-metallic mineral product industry – a large number of large and medium size units are added and many more micro and small units declined. The decline is in the lower medium, medium and higher medium technology groups and the rise is in the medium and higher medium technology groups. Basic metals and fabricated metals witnessed more balanced growth, number of enterprises increased across all size classes and a major part of the new units joined medium and higher medium technology groups. All this shows innovativeness of several manufacturing industries and possibilities of inter-linkages among enterprises in Andhra Pradesh.

Figure 4.7: Number of manufacturing units in Andhra Pradesh districts across size classes and technology groups in 1999 and 2009

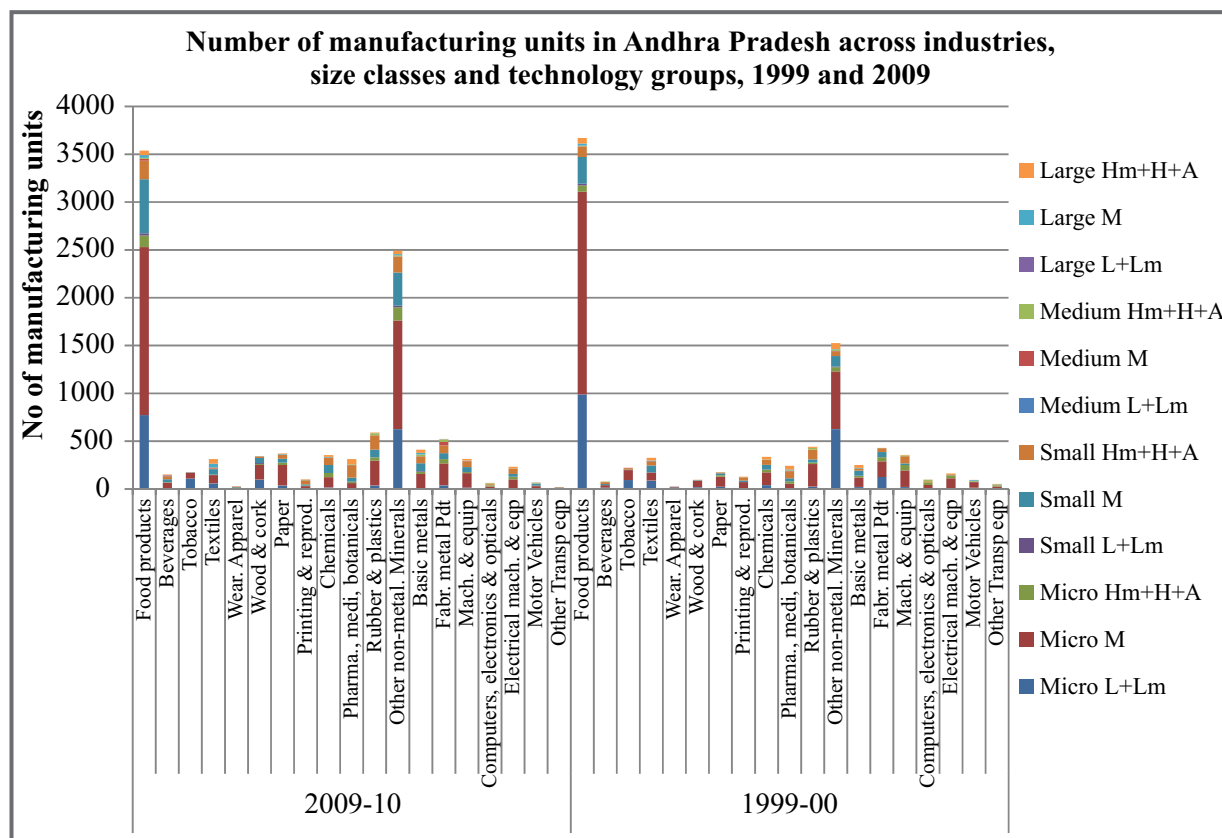


Figure 4.7a: Number of manufacturing units in Andhra Pradesh districts across technology groups in 2009-10

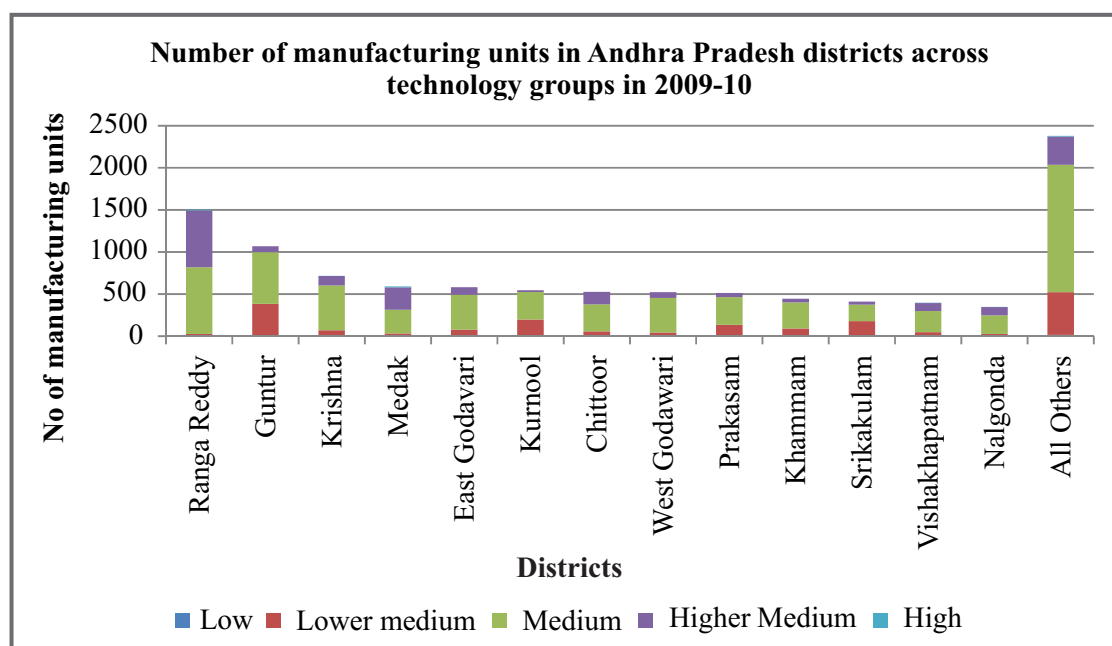
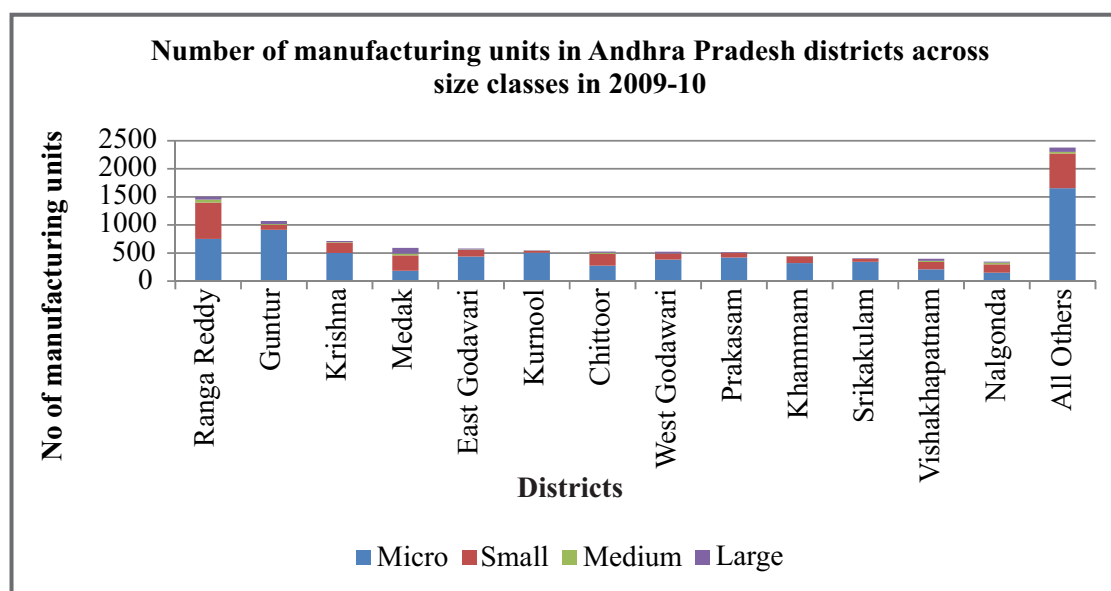


Figure 4.7b: Number of manufacturing units in Andhra Pradesh districts across size classes in 2009-10



Industries in Andhra Pradesh are dispersed over several districts, although Hyderabad, Guntur and Medak are very important not only for the largest number of large units but also for the largest number of medium and higher medium technology units. Large presence of industries in and around Hyderabad is the result of the benefits received from the developed infrastructure of the state capital and the business friendly environment created by the state.

v. Karnataka

Karnataka experienced a minor decline in the total number of its factory sector performing units. The decline is confined only to the micro size class whereas in the small, medium and large size class the number increased indicating a minor change in the industry structure. Further, most of the micro enterprises which declined during the decade belonged to textiles and apparel industries and a small part belonged to tobacco, printing, fabricated metals, machinery and computer industries. There are several industries, notably, food products, wood products, paper, chemicals, pharmaceuticals, rubber, furniture, which experienced increase in the number of micro enterprises. It is striking to note that the decline of micro enterprises is found more in lower medium and medium technology groups while the growth of micro enterprises is more in higher medium technology group indicating operation of market in selecting technologically better-off units.

Food products, wood products, chemical, pharmaceuticals, rubber, other non-metallic minerals, basic metals, machinery and fabricated metal industries observed increase in the number of their small enterprises. Here again, textiles and wearing apparel faced decline in the number of small

enterprises. Medium and large size units are more successful in basic metals, fabricated metals and machinery sectors where micro and small units are also successful. New units primarily joined lower medium, medium and higher medium technology groups. Overall, considering all the size classes more innovative and better performing sectors are food products, chemicals, pharmaceuticals, basic metals, fabricated metals and machinery industries.

Regional concentration of industries in Karnataka is very high – state capital, Bangalore district alone share more than half of all the factory units of the state. Agglomeration of different types of industries in Bangalore created some infrastructure and market for final and intermediate goods. This has provided great opportunities to the MSMEs who took advantages of infrastructure, market and availability intermediate goods. A kind of dynamism has been created as a result of agglomeration economies, leading to cost cutting and further technological progress.

Figure 4.8: Number of manufacturing units in Karnataka across industries, size classes and technology groups, 1999 and 2009

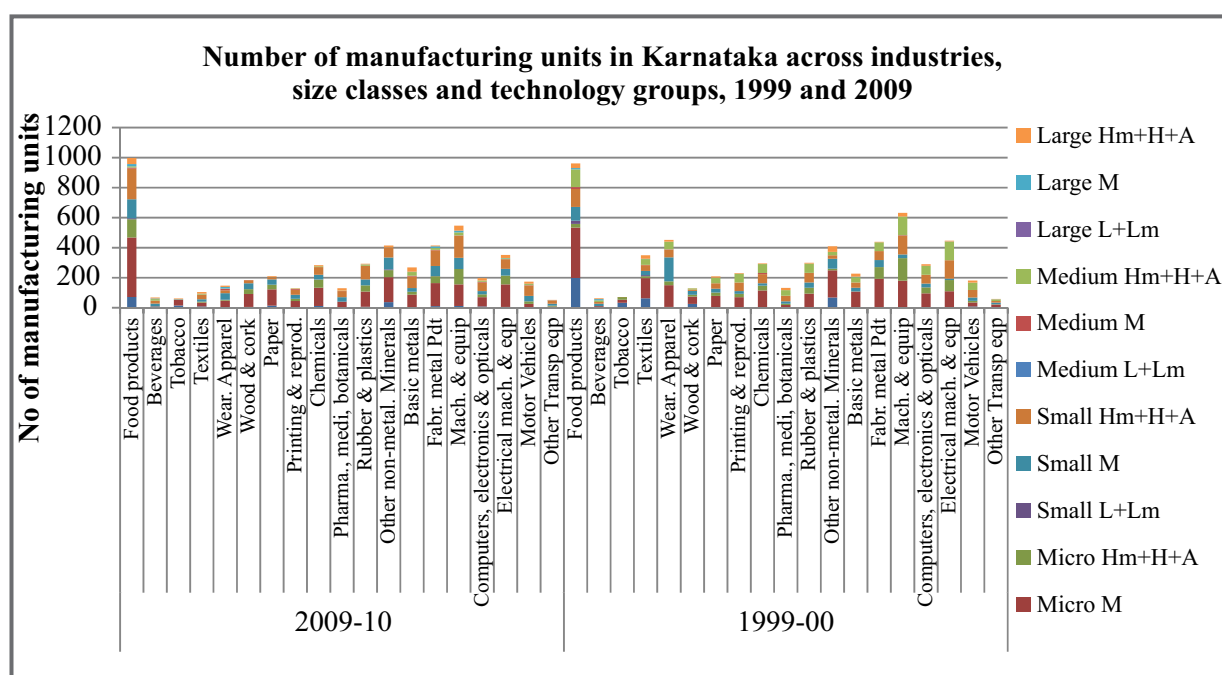


Figure 4.8a: Number of manufacturing units in Karnataka districts across technology groups in 2009-10

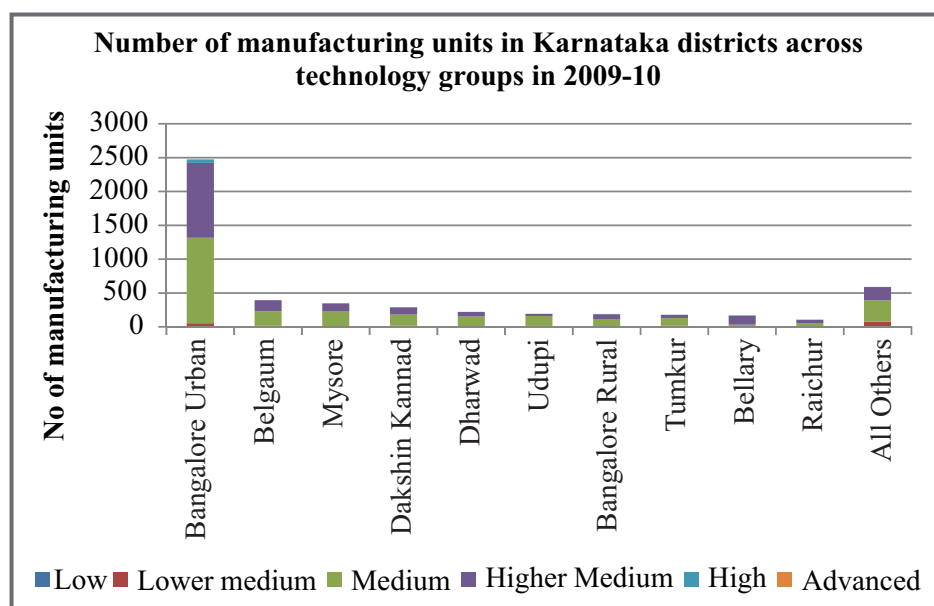
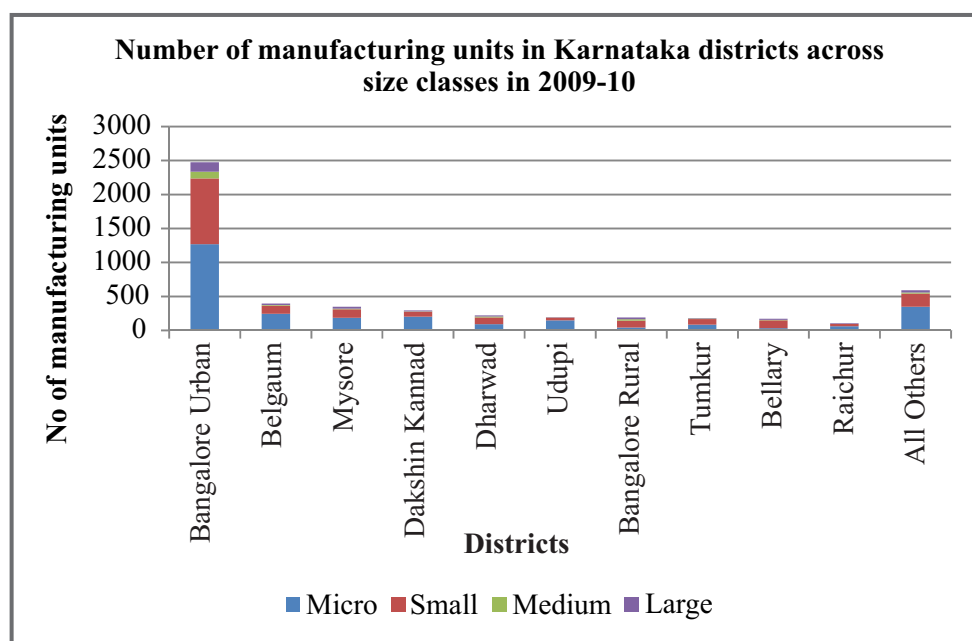


Figure 4.8b: Number of manufacturing units in Karnataka districts across size classes in 2009-10



The state wise analysis does indicate possibilities of inter-linkages, and vertical cooperation based growth and technological progress of the MSMEs and large enterprises. There are also indications of progress of MSMEs without such cooperation, possibly benefitted from conglomeration of several industries. Development of infrastructure investor friendly environment facilitated the progress of MSMEs in certain regions.

Chapter 5

Concluding Remarks

More than two decades of liberalization and globalization has made the Indian economy very much integrated with the global economy. Resultant competition along with the rapid change in the technology at the global level and unprecedented inflow of FDI in India would lead the country's manufacturing sector to make rapid advancement in technology. Further, the global turmoil in the second half of the 2000s must have forced the Indian manufacturing sector to innovate, particularly for cost cutting, in order to survive in the midst of severe competition and crisis.

Combined index based on all the twelve parameters of technology indicators reveals that there is neither very low technology unit nor advanced technology unit. Only 1.2% of the total manufacturing units have low level technology and these units conspicuously belong to micro size class. Around 0.3% of the units are of high technology level and these units belong to medium and large size classes. Most of the units however belong to lower medium, medium and higher medium technology groups. Between 1999 and 2009 there has not been any perceptible change in distribution across technology levels or across size classes. Input pillar estimates however do not display any indication of innovativeness, although in general micro or small enterprises are found to be less innovative as compared to medium or large enterprises. Similar to input pillar, capital pillar estimates also show no improvement in the technology levels of the enterprises irrespective of size classes. Output pillar indices however show some technological improvement as the proportion of lower technology units (technology levels being lower medium or below) marginally declined and that of higher level technology units (higher medium or above technology levels) increased a bit.

Combined index based on all the parameters shows that food products, wood and cork, printing, chemicals, basic metals, fabricated metals and furniture industries made some technological progress, pharmaceuticals, machinery and equipment, and motor vehicles also made minor improvement, with the increase in the proportion of higher technology units. Further, all these sectors generally have larger number of factory units with higher medium and high technology levels.

In terms of percentage share of higher medium and high technology units at present, the top states are Himachal, Goa, Delhi, Haryana, Maharashtra, Karnataka, and Gujarat with the share varying between 58% and 36%. In terms of the total number of factory units, Tamil Nadu is the largest state, followed by Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh, and Karnataka.

It is therefore highly imperative that the manufacturing sector as a whole needs to be more innovative and for which suitable innovation policies are required. The policies should encompass all the three pillars so that innovations would take place in capital pillar, input pillar

and output pillar. It also requires that innovation should not be confined to select few industries; policies should aim at creating enabling environment for all the industry sectors to make innovations. High technology small scale units are rare; there should be many more such units. Technology up-gradation schemes for the MSMEs should be widened and the conditions should be made easier for the enterprises to get the benefits. Finally, too much regional concentration of industries, particularly higher technology industries and large sized industries, needs to be avoided; based on geographical distribution of natural resources and other man made inputs at local levels decentralized industrialization policies promoting MSMEs are required.

The state-wise analysis does indicate possibilities of inter-linkages, and vertical cooperation based growth and technological progress of the MSMEs and large enterprises. There are also indications of progress of MSMEs without such cooperation, possibly benefitted from conglomeration of several industries. Policies must aim at nurturing inter-linkages or vertical cooperation among enterprises as a route to innovation and industrialization.



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