



Industry Structure and the Pattern of Innovation: Chemical Industry of India, 2000 to 2010

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Summary

The importance of the chemical industry in the national economy of India can be guessed from the fact that it contributes as much as 7% of the total GDP of the country. In spite of various drawbacks a small section of the industry has been able to come up with some alternative means so as to compete with its peers globally, manufacture highly competitive products and innovate new and efficient techniques of production. The chemical industry has two main sub-groups: (1) Manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms (201), and (2) Manufacture of other chemical products (202). In both these sub-groups the contribution of informal sector enterprises to gross value added (GVA) has been very low and whatever the little contribution of the informal sector be, it is done by the micro size class.

Within the formal sector of the chemical industry GVA contributions by the micro, small and medium enterprises (MSMEs) are also quite low as compared to large industries. Market concentration estimates using both ASI and CMIE data is found to be very high for several product categories (4-digit) of chemical industry.

Gujarat turns out to be the leading state in terms of GVA generated by the industry subgroup *'Manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms'* (National Industrial Classification (NIC) Code 201). For the *'Other chemical products'* (NIC 202), Gujarat leads the narrower four-digit product category, *'Manufacture of pesticides and other agrochemical products'* (NIC 2021) and Maharashtra ranks second, whereas Maharashtra turns out to be the leader state for the four-digit product category, *'Manufacture of paints, varnishes and similar coatings, printing ink and mastics'* (NIC 2022).

Modal business linkages among the factory units irrespective of size classes is found to be *'Contracting in but not contracting out'* indicating that certainty of market is most important for the manufacturers and that the ultimate contracting out firms lie outside the manufacturing sector, possibly in trading. Further, contracting in is much more evident for young enterprises while contracting out is very low and increases with age.

A large proportion of the micro and small enterprises in all these industry categories are young and therefore they are expected to be more dynamic, while majority of the medium and large enterprises are old and experienced and therefore are more established having market linkages and enjoying sound financial conditions.

The productivity, measured in terms of value added per labor is much higher in large firms as compared to the MSMEs irrespective of the product category to which they belong. Also, the capital per labor or capital intensity is very low in case of MSMEs as compared to large firms for all product categories. To be more precise, productivity and capital intensity systematically increase with size classes.

The productivity, measured in terms of GVA per unit of labour (GVA/L), of micro and small sized enterprises is higher for those engaging in '*Both contracting in and contracting out*' for all the product categories except micro sized enterprises in '*basic chemicals*' and small sized enterprises in '*paints, varnishes and similar coatings, printing ink and mastics*'.

Within group 201, '*basic chemicals*' and within group 202, '*pesticides and other agrochemical products*' contribute the most towards exports. Further, the share of MSMEs in total exports is very low for all product categories except '*paints, varnishes and similar coatings, printing ink and mastics*' for which, the share of MSMEs in total exports is much higher than the large firms within this category.

There are no exporting micro sized enterprises involved in either '*Manufacture of fertilizers and nitrogen compounds*' or in '*Manufacture of plastics and synthetic rubber in primary forms*'. For microenterprises involved in '*other chemical products*' category, the enterprises which contract in but do not contract out, contribute the highest to the total exports.

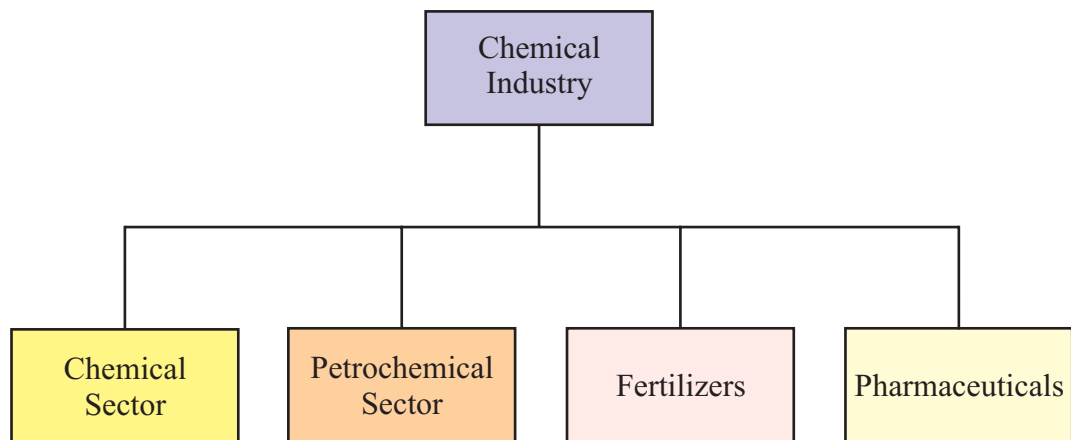
In order to understand the technology innovation across chemical industries we have considered three major parameters namely (1) those related to inputs, (2) those related to capital and (3) those related to output. (1) Input related parameters as available from our dataset, are about the extent of the use of white colour managerial and supervisory staff, contract labour, use of imported inputs and wage-rates paid to workers; (2) similarly, the capital related parameters are about the extent of land and building assets in total asset, 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 (3) output related parameters are about output per labour, value added per labour, contract work, export orientation of production and sale of others' products. Based on the values of these parameters it is observed that majority of the chemical manufacturing units mainly deploy low to medium level of technology. Apparently this sector requires a substantial investment towards research and development so as to become technologically competent enough to face market competition from their peers worldwide.

Chapter 1:

Introduction

Chemicals are an integral part of human life. They contribute significantly to improve the quality of life as well as to the overall economic development. Apart from being a part of the basic goods industry, chemicals form a critical input for industrial and agricultural development. The chemical industries in India contribute about 7% of country's GDP¹. Indian chemical industries is amongst the oldest industries of the country and it is the third largest producer of chemicals in Asia and the 12th largest in the world (ibid). Indian chemical industries produce a wide range of products and the manufacturing plants consist of MSMEs as well as large scale units. The demand for the chemical products is expected to rise fast in India with the growth of the various end use industries, to which the chemical industry provides raw materials and other intermediate inputs. Chemicals industry is highly capital intensive but also makes significant contribution to employment generation². This industry is most diversified, covering over thousands of commercial products. This chapter begins with a brief description of the major products, and of the industry which is followed by an overview.

Chemical industry is classified into the four major sectors as described below:



¹Indian Chemical Industry, 12th Five Year Plan report, (undated), p. 14.

²Ibid; The industry is expected to grow at a rate of 11% p.a. during the 12th five year plan, and over 15 years create 8-9 million jobs (ibid, p.14)

1. **Chemical Sector:** It includes basic organic chemicals (methanol, acetic acid etc.), basic inorganic chemicals (caustic soda, chlor-alkali etc.) along with the specialty chemicals (colorants, water treatment etc.) and agrochemicals (pesticides etc.).
2. **Petrochemical sector:** Petrochemicals include polymers, synthetic fibers, surfactants and elastomers.
3. **Fertilizers:** Include all types of Nitrogen, Phosphorous & Potassium based fertilizers like Urea, DAP etc.
4. **Pharmaceuticals³:** It includes formulations, APIs, biotechnology etc.

Among the three segments analyzed in the report, chemical segment holds the largest share. Also, in terms of growth, this sector is the fastest growing, followed by petrochemicals.

1. Chemical Sector

This sector also has four sub sectors as under.

1.1. Basic Organic Chemicals

Organic chemicals industry is the most significant sector of chemical industry. It provides finished products as well as intermediate goods, used as inputs in several other sectors of the industry like paints, adhesives, pharmaceuticals, dye stuffs and intermediates, leather chemicals, pesticides etc.

Indian Organic Chemicals Industry (Industry Overview)

Major chemicals produced in India are Methanol, Aniline, Alkyle Amines and its derivatives like Formaldehyde, Acetic Acid and Phenol. These account for around 2/3rd of Indian basic organic chemical industry⁴.

1.2. Basic Inorganic Chemicals

Inorganic chemicals sector comprises of those sectors, which are not carbon based, but are of mineral origin. The output of this industry generally consists of intermediate goods that are used as inputs in industrial and manufacturing processes.

Segments of Inorganic chemical industry⁵:

Basic Inorganic chemicals

- Aluminium Fluoride
- Calcium Carbide
- Carbon Black

³Pharmaceutical Sector is not a part of this report, as 'Manufacture of Pharmaceuticals, Medicinal Chemical and Botanical Products' has been treated as a separate industry division (Division 21), by the Central Statistics Office (MoSPI) in its National Industrial Classification (NIC 2008), and thus will be dealt with separately.

⁴Indian Chemical Industry, 12th Five Year Plan report

⁵Inorganic Chemicals: Market and Opportunities [Report by KPMG & IBEF]

- Potassium Chlorate
- Sodium Chlorate
- Titanium Dioxide
- Red Phosphorus

Alkali chemicals

- Soda Ash
- Caustic Soda
- Liquid Chlorine

Among basic inorganic chemicals, Carbon Black holds the largest share, and among the Alkaline chemicals, Soda Ash has the highest share.

1.3. Specialty Chemicals

Specialty Chemicals are relatively high valued, low volume chemicals, popular for their performance enhancing properties and known for their end-use applications. It is a highly knowledge driven sector, which aims at meeting consumer application needs at a favorable price-performance ratio⁶.

Segmentation of Specialty Chemical Sector

- Paints & coatings
- Specialty polymers
- Home care surfactants
- Plastic additives
- Textile chemicals
- Construction chemicals
- Water chemicals
- Person care ingredients
- Foods- Flavours and Fragrances
- Paper chemicals
- Printing inks

⁶Indian Chemical Industry, 12th Five Year Plan report

1.4. **Agrochemicals**

Agrochemicals are manufactured through chemical or biochemical processes. These include a broad range of pesticides, including insecticides, herbicides and fungicides. In addition, it may include synthetic fertilizers, hormones and other chemical growth agents, and concentrated raw animal manure.

“India is the fourth largest producer of crop protection chemicals globally, after United States, Japan & China.”⁷

2. **Petrochemical Sector**

Petrochemicals are the chemical products derived from petroleum. Growth of this industry is significantly related with the growth of the economy. This sector is responsible for the growth in other sectors of the economy as well.

The two major segments of petrochemicals are:

- a. Basic Petrochemicals
- b. End-Product Petrochemicals

Basic Petrochemicals can be further classified into:

- Olefins (Ethylene, Propylene and Butadiene)
- Aromatics (Benzene and Xylene)

These are derived from feedstock.

3. **Fertilizers**

Fertilizers comprise of three main nutrients⁸:

- i. Nitrogen (N): Nitrogen is the main source of proteins. It is essential for growth and development in plants. Supply of nitrogen determines a plant's growth, vigor, color and yield.
- ii. Phosphorous (P): Phosphorous is a key nutrient which facilitates adequate root development and helps the plant to resist drought. It is also a vital agent helping plant growth and development.
- iii. Potassium (K): Potassium is a crucial nutrient which facilitates Photosynthesis within plants, and for high-yielding crops. It helps in improving crop resistance to lodging, disease and drought.

⁷Handbook on 'Indian Chemical and Petrochemical Industry' [TATA Strategic Management Group & FICCI (2012)]

⁸Yara Fertilizer Industry Handbook (2012)

Chemical fertilizers have played a vital role in making the nation self reliant in food grain production.

Given the sizeable contribution of the chemical industry to GDP, its numerous product varieties and tremendous importance in almost all the spheres of economic life, and the weight bestowed on the sector in the 12th five year plan document for future economic development, it is imperative to study the structure of the industry, including, size structure, organizations and inter-linkages, major constraints and recent growth performance, as well as its innovativeness. This may be useful to understand its true potential and relevance for policy purposes. While this chapter being introductory, rest of the report is organized as follows. Next chapter, Chapter 2, identifies the major constraints faced by the chemical industry and narrates the growth performance achieved by the industry in the last decade. Chapter 3 makes an analysis of the structure of the chemical industry and links it with growth performances using disaggregated unit level data. MSMEs form a major part of the industry and facilitate bringing about dynamism. Chapter 4 analyses the innovativeness of the industry. Finally Chapter 5 makes a succinct summary and suggests broad policy indications.

Chapter 2:

Constraints and growth of the chemical industries during 2000 – 2010

Policy approaches of the state

The chemical industry in India contributes about 7% of India's GDP and it is the third largest producer of chemicals in Asia and the 12th largest in the world. Indian chemical industry consists of numerous MSMEs and several large enterprises. Due to liberalization policies post 1991 these enterprises were open to investments from various global players and also provided the domestic chemical industries opportunities to expand their operations globally. Manufacture of most of the chemical products is presently de-licensed and 100% FDI is allowed in the chemical sector of India⁹. It may be further noted that the Indian chemical industries also consume about 33% of the total produce itself. Consequently the domestic consumption of the chemical products in our country is quite high and therefore domestic consumption is one of the primary driving factors for the growth of chemical industries. Further, the growing demand generated from rapidly growing housing sector and automobile industry adds to the domestic demand. End products of various chemical industries are the vital ingredients of various chemical formulations used in housing, and similarly for the petrochemicals, which in turn is the driving agent for the rapidly developing automobile industry. Indian chemical industry is highly diversified in terms of the various products and by products it produces and also this industry has conglomeration of scientific manpower. Indian chemical industry is also one of the promising sectors with respect to the exports. Indian agrochemicals and dyes are few of the popular export articles. Since the GOI has recognized the Indian chemical industry as a key to the growth of Indian economy, various initiatives with respect to investments policies and other issues have been taken up. Few of the initiatives recommended by the government in the 12th 5 year plan (2012-2017) are as under.

Investment policies:

- Target to increase the share of manufacturing in GDP to at least 25% by 2025 (from current 16%). Investments in manufacturing in the chemical sector are absolutely essential to ensure growth of the Indian chemical industry.
- Government's proposal to set up of a technology up-gradation fund of ~USD 80 Mn in the 12th plan for chemicals¹⁰.
- Proposal to establish an autonomous USD 100 Mn chemical innovation fund by securing 10% of the total inclusive national innovation fund set up by the National Innovation Council to encourage commercialization efforts for innovations generating inclusive growth.

⁹FCCI, (undated), *Indian chemical Industry*. (http://www.ficci.com/sector/7/Project_docs/Chemical-Petrochemical-sector.pdf)

¹⁰Ibid

Other relevant initiatives:

- Government readiness to provide incentives for bio-based raw materials to reduce dependence on crude oil, encourage companies to seek “Responsible Care Certification” and facilitate priority loans to those who meet environment norms.
- Government's plan to expedite the consolidation of multiple legislations governing the chemical industry into one Integrated Chemical Legislation. This legislation should cover the entire life cycle of chemicals. This will act as REACH like legislation for safe use of chemicals for protection of human health & environment
- Chemical industry could be granted tax and duty reductions for specific identified products such as import duty reduction on inputs like coal, furnace oil, naphtha, etc., inclusion of a wider range of inputs under CENVAT credit and encouraging companies to set up captive power plants
- Policies have been initiated to set up integrated petroleum, chemicals and petrochemicals investment
- Simplified procedures for FDIs as most of the chemical sector products fall under the automatic approval route for FDI/NRI investment up to 100%.

Major constraints

In spite of various factors driving the growth of Indian chemical Industries it faces certain constraints. Few of such constraints have been discussed below in detail:

Fluctuating prices of basic raw material: Feed stocks or the raw materials constitute a major share of the cost of production in a manufacturing unit. And this share ranges from 30% to 60%. Most of the chemical manufacturing plant primarily depends on natural gas and crude petroleum as its staple resource. The market prices of these commodities fluctuate frequently and therefore affect their corresponding manufacturing units. The high price of the feed stock increases the cost of production of the chemical industries whereas a sudden crash in the prices also skews the budget of the chemical industries. Plants involved in manufacture of food products, paints, cosmetics, medicines and automobile industries depend on the output of the chemical industries. Any fluctuation of the price of the feed stock used by the chemical industries is a serious threat to the various downstream industries which depend on the chemical industries for various manufacturing activities.

Fragmented Structure of the industry: Indian chemical industry is highly fragmented with a majority of manufacturing units being small scale¹¹. The production capacity of the various small scale chemical manufacturing units is limited and the volume of chemicals produced by these small scale plants is lesser when compared to the typical global chemical manufacturing plants.

¹¹It is discussed in the next chapter that MSMEs often form alliances with large enterprises and operate as a part of a network enabling advantages of scale and division of jobs.

Small scale units in India are already laden with various critical issues such as scarcity of funds, lack of upgraded production technology, lack of infrastructural facilities and market exposure, and lack of trained and skilled workers. The small scale chemical plants with its limited capacity of production coupled with the other drawbacks put the Indian chemical industries at a disadvantage.

Limited use of information technology in chemical Plants: Chemical manufacturing units are technology driven and require the use of high end information technology tools for simulation which has a positive impact in reducing the time involved in product development. Since majority of the chemical plants are small scale these units they have very limited scope of information technology usage and hence fail to extract the benefits of a shortened process development time. Information technology is also a key ingredient in the research and development activities. Since the current ICT usage in the chemical sector is on a lower scale the prospects of rigorous R&D is also at a very nascent stage.

Lower investments on Research & Development: Indian manufacturing units are still in the process of moving a step ahead towards usage of high and advanced level of technology. It is already mentioned that the global chemical industry is highly technology driven, but in India it has not experienced any noteworthy technological up gradation. This sector has witnessed a very low R&D investment which is about 0.3% of the total sales revenue. This value seems to be low when compared to the other manufacturing units located globally. Ideally Indian chemical industries must increase the investments made in the R&D sector while focusing on innovating techniques of production which may lead to a decrease in the cost of production, development of new and improved quality of products as well as product diversification for domestic and global market demand. In Chapter 4 we have analysed the various types of innovations made by the manufacturing units of Indian chemical industry.

Difficulty to adhere to various environmental regulations: Chemical Industries are different from other manufacturing industries with respect to adherence to various environmental regulations such as Occupational Safety and Health and Process Safety Management regulations. A large scale specialized chemical manufacturing unit producing a single chemical in large quantity faces few challenges in getting the approval from various environmental regulatory boards due to the limited type of chemical it produces¹². However the small scale enterprises which are engaged in the manufacture of a wide range of chemicals find it very difficult to get the concerned approvals associated with several and particular types of chemicals. Apart from this the small scale manufacturing units also face scarcity of funds due to which they fail to invest on getting various environmental safety equipment/approvals. Consequently we observe that many chemical producing small scale plants fail to adhere to various environmental regulations and

¹² EXIM bank report on chemical Industry, occasional paper no:117

hence are often forced to close down on the grounds of health and environmental hazards associated with such plants.

Infrastructural issues: Pace of industrialisation has been quite fast in India and Indian manufacturing units have witnessed prosperity and grew with time. In spite of various steps taken in favour of manufacturing in our country there are still several loopholes and deficiencies, particularly in the infrastructure. Chemical manufacturing units have also been a prey to the negative impacts of such an infrastructural pattern. Road, rail, water and air transport have developed to a large extent in our country. Yet the demand and supply chain with respect to the chemical and petrochemical industries are highly affected due to lack of certain basic infrastructure facilities. The chemical industry is sensitive in nature due to the different chemical properties of the products and byproducts it produces. Therefore this sector requires specialized infrastructure during manufacture as well as transportation. Currently various chemical units establish their own set of specialized infrastructure required during freight and production. The efforts and investments made towards achieving this seems to be redundant in nature. Such a scenario mainly comes into picture in case of the downstream industries which depend on one or more of chemical components for its manufacturing activities. Considering the example of a dye industry, this is a sub category of the chemical industry and depends on various other chemicals (organic and inorganic compounds) for its manufacturing activities. Therefore the raw material supply chain in case of this industry necessitates special facilities for the different chemicals used as input. There occurs a repetition of efforts and investments which are made to accomplish a smooth inflow of raw materials to the industries. Had there been an already existing infrastructural support to handle such a situation or the chemical manufacturing units would have been in a close proximity then the necessary infrastructure could be integrated vertically resulting in reduction of production costs.

Recent business trends in chemical industries: Indian chemical industries currently focus on improving its competence on specialized products. The nature of chemical and petrochemical industry is such that most of the manufacturing units that exist globally are focusing and innovating on one or more of the specialized products so as to compete with their peers in the global market. But the focus on the specialized product also requires to be chosen in such a way that Indian chemical industry holds profitable position with respect to the production costs and market value of that product. Since Indian chemical industry is one of the key driving factors of the Indian economy, it is quite important that this sector upgrades technology in order to compete globally. Although at the global level technology innovations have been an ongoing process, Indian chemical industries have only recently started investing on R&D so as to improve production processes and curtail production costs. Few of the chemical industries have also made it a point to develop processes so as to minimize environmental pollutions. As per the FICCI report few of the examples of such chemical industries have been illustrated below:

- Kanoria Chemicals & Industries Limited (KCI) floated “waste to wealth” program at its Ankleshwar plant with an end in view to recoup the recyclable water from the distillery effluent. This plant adopted the reverse osmosis technology in order to maximize retention and minimize disposal
- The Arulpuram common effluent treatment plant in Tirupur also adopted the reverse osmosis strategy in order to recycle the used water and re-utilize the salt content obtained in the process
- Bristol-Myers Squibb incorporated the pre-evaporation technology along with constant volume distillation operation and with this it attained a 56% reduction the THF emissions and 93% reduction in the waste generated.

Strengthening technological competence would help chemical manufacturing units to develop cost effective process as well as specialized products. As the EXIM bank report on Indian chemical industry suggests that the industry “has a good record of management expertise. This could be further leveraged with techniques such as Good Manufacturing Practices, Good Laboratory Practices, Total Quality Management, Total Production Management and Risk Management”. Chemical Industries produce substances that are used in the manufacture of certain processed chemicals such as cosmetics, paints, dyes etc. Hence chemical manufacturing units make sure that the management of various substances released during various steps of production is accomplished in a proper way. This step is also required by the chemical plants in order to get various environmental clearances while setting up a plant. A sustainable nature of manufacturing end products is what is demanded across the globe. In order to gain popularity in the global as well as domestic market the chemical manufacturing plant makes it a point to keep in mind while innovating technology, for both product and process development. The chemical industries in India are also taking the steps required to invest a major proportion of funds towards research and development. One such step is encouraging the use of information and communication technology among the chemical manufacturing units. Another crucial step in this direction is the partnership between academia and the industry. This would help in interchanging of ideas between the two groups and also via such linkages the Indian chemical industries could exploit the various resources and opportunities available in various educational and research institutions of the country. It is mentioned in the KPMG's report as well as the EXIM bank report that consolidation of various chemical industries through merger and acquisitions could be beneficial in terms of technology usage, efficient supply chain management, reduction in cost of raw material procurement as well as accessory and marketing expenses. Further, through this consolidation Indian chemical industries could expand their spectrum of operation. However, collaborations and joint ventures between various chemical manufacturing units lead to benefits at the cluster level in terms of sharing of common infrastructure as well as at the firm level in terms of technology usage and market knowledge.

Growth of number of enterprises, capital intensity and labour productivity between 2000 and 2010

Three main data sources, namely ASI, NSSO and CMIE, have been used. As table 1 depicts, the number of micro-sized enterprises as well as that of large sized enterprises remained more or less unchanged over the decade during 2000-10. On the other hand, the number of small-sized and medium-sized enterprises has increased by around 17% and 7% respectively. This shows that the growth in the number of formal sector enterprises in Basic Chemicals Industry has been contributed by the small and medium sized enterprises.

<i>Table 1: No. of firms in the formal sector of Basic Chemicals Industry</i>			
	1999-00	2009-10	1999-00 – 2009-10
Size	No. of Enterprises	No. of Enterprises	% change
Micro	3,748	3,714	-0.91
Small	1,709	2,007	17.44
Medium	217	233	7.37
Large	464	459	-1.08

Source: Authors' own estimates based on ASI unit level data

Capital intensity (Capital-Labor ratio) and labour productivity (measured in terms of value added per unit of labor) are also indicators of growth performances, shown in Table 2. As one can easily see, the productivity has increased in all size classes of enterprises over the period. The largest increase being recorded by the medium sized enterprises. Also, the largest decline in capital intensity has been recorded by the medium sized enterprises, suggesting a greater emphasis towards labor intensive production in this sector by the medium sized enterprises and efficient use of resources. There has been a fall in the capital intensity for all but micro sized enterprises. Capital intensity for micro enterprises has risen by close to 11%. The industry seems to have undergone a general increase in the efficiency of resource use.

Table2: Productivity & Capital intensity in formal sectors of Basic Chemicals Industry (in Rs)

	2009-10	1999-00	2009-10	1999-00		
Size	Productivity (GVA/L)	Productivity (GVA/L)	Capital Intensity (K/L)	Capital Intensity (K/L)	% change in productivity (2000-2010)	% change in capital intensity (2000-2010)
Micro	285205	223032	102345	92469	27.88	10.68
Small	1056979	752795	537178	589937	40.41	-8.94
Medium	1510769	1007497	863075	1723199	49.95	-49.91
Large	2602091	2414973	3137420	5153275	7.75	39.12

Source: Authors' own estimates based on ASI unit level data

The largest number of formal sector enterprises was found in Gujarat during 2009-10, though declined by 8.26% as compared to 1999-00. Overall, the number of enterprises increased in Uttar Pradesh and Andhra Pradesh, while declined in Gujarat, Maharashtra and Tamil Nadu. In Uttar Pradesh, the number of enterprises has declined in none of the size classes of enterprises but increased in some of them.

In Gujarat, the number of enterprises has declined for MSMEs over the period, 1999-00 to 2009-10, while it has increased for the large enterprises. This change may be seen as a positive sign, as it may lead to increase in employment generation, improvement of technology, infrastructure etc.

However, this trend may also have some adverse impacts such as a greater concentration of large firms in the industry, which may hinder the survival of other MSMEs.

As shown in Annexure table a2, in all of the top five states, the labor productivity has declined over the period 2000-10. Tamil Nadu experienced the largest decline.

One may easily see that in Andhra Pradesh, the labor productivity for all size classes has increased, except for the large enterprises, for which it has declined by around a significant 56%. This may be seen as a positive sign, in terms of growth of MSMEs in the sector in Andhra Pradesh, and a reduced dominance of large enterprises. However, this may adversely affect the employment, technology and infrastructure facilities within the sector.

The capital intensity across top 5 states (in terms of GVA contribution) in formal sector of basic chemicals industry is presented in Annexure table a3. One interesting fact that comes out is that, overall, out of the five states four states experience an increase in the capital intensity. Tamil Nadu, being the only state among the top five states to experience a reduction in capital intensity. The highest increase in capital intensity is recorded in Uttar Pradesh.

Given this broad pattern of growth performance, the constraints faced by the industry and the policy changes, we would see the nature of industry structure, how it help improve performance/ productivity of the enterprises in different segments of the industry. Enterprise/ manufacturing factory unit level data are used for the analysis.

Annexure Tables to Chapter 2

Annexure Table a1: Number of Firms across states in formal sector of Basic Chemicals Industry

States	micro (99-00)	micro (09-10)	% change	small (99-00)	small (09-10)	% change	medium (99-00)	medium (09-10)	% change	large (99-00)	large (09-10)	% change	Total (99-00)	Total (09-10)	% change
Gujarat	604	599	-0.83	542	424	-21.77	66	56	-15.15	107	131	22.43	1319	1210	-8.26
Maharashtra	530	511	-3.58	310	321	3.55	31	43	38.71	129	118	-8.53	1000	993	-0.70
Tamil Nadu	1230	903	-26.59	133	223	67.67	6	39	550.00	69	27	-60.87	1438	1192	-17.11
U.P.	288	332	15.28	135	179	32.59	23	23	0.00	23	43	86.96	469	577	23.03
Andhra	200	168	-16.00	104	160	53.85	11	8	-27.27	26	26	0.00	341	362	6.16

Note: (99-00) implies 1999-00 and (09-10) implies 2009-10

Source: Authors' own estimates based on ASI unit level data

Annexure Table a1: Labour productivity (VAD/L, in Rs) across states in formal sector of Basic Chemicals Industry

States	micro (99-00)	micro (09-10)	% change	small (99-00)	small (09-10)	% change	medium (99-00)	medium (09-10)	% change	large (99-00)	large (09-10)	% change	Total (99-00)	Total (09-10)	% change
Gujarat	180351	142307	-21.09	589709	453270	-23.14	1594592	789581.8	-50.48	4187642	3784581	-9.625	744409	675558	-9.25
Maharashtra	123095	108131	-12.16	596508	1029537	72.594	3431310	1095523	-68.07	5401292	3039257	-43.73	1053295	797056	-24.33
Tamil Nadu	21582.5	26902	24.646	541169	304621	-43.71	4383150	805528.4	-81.62	7017019	3236011	-53.88	423502	177022	-58.20
U.P.	165245	136589	-17.34	568088	544922	-4.078	777082	495629.5	-36.22	5808775	3173178	-45.37	587968	503873	-14.30
Andhra	86931.7	210697	142.37	375290	450854	20.135	566294	713230.1	25.947	7231940	3193563	-55.84	735121	542188	-26.24

Note: (99-00) implies 1999-00 and (09-10) implies 2009-10

Source: Authors' own estimates based on ASI unit level data

Annexure Table a3: Capital Intensity (K/L) across states in formal sector of Basic chemicals industry

States	micro (99-00)	micro (09-10)	% change	small (99-00)	small (09-10)	% change	medium (99-00)	medium (09-10)	% change	large (99-00)	large (09-10)	% change	Total (99-00)	Total (09-10)	% change
Gujarat	282068	304677	8.02	661494	775036	17.16	530443	2126945	300.97	1622487	4135036	154.86	559146	968525	73.22
Maharashtra	367450	360962	-1.77	981182	1950909	98.83	415353	1108008	166.76	2808154	2149375	-23.46	874042	1119802	28.12
Tamil Nadu	74783.6	91908	22.90	395439	360577	-8.82	1792809	1365656	-23.83	3045985	2557466	-16.04	254177	239693	5.70
U.P.	156217	307386	96.77	364558	1298549	256.20	1046892	794724.8	-24.09	1850010	1573514	-14.95	342931	728652	112.48
Andhra	161519	173114	7.18	281949	661929	134.77	1287686	577465	-55.15	2133035	1292644	-39.4	384897	478509	24.32

Note: (99-00) implies 1999-00 and (09-10) implies 2009-10

Source: Authors' own estimates based on ASI unit level data

Chapter 3

Industry structure and the performance of the basic chemical industry:

A disaggregated analysis

The chemical industry in India is one of the most diversified industrial sectors, including products such as basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber, pesticides, paints, varnishes etc. The sector covers over 70,000 such commercial products. According to NIC 2008, chemical industry has two groups at 3-digit level: (i) Group 201 Manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms; and (ii) Group 202 Manufacture of other chemical products, with manufacture of pesticides and other agrochemical products, and manufacture of paints, varnishes and similar coatings, printing ink and mastics as subgroups. Both MSMEs and large enterprises are involved in chemicals manufacturing. Further, a large number of the enterprises belong to informal sectors. Present discussion would cover both the MSMEs and large enterprises as well as formal and informal sectors. In fact chemical industry structure is made of these various kinds of enterprises and their interrelations which help develop the industry; this would be analysed primarily by using unit level ASI and NSSO data. For convenience we would analyse these two 3-digit groups of chemical industries separately.

A: Manufacture of Chemical Products (code 201)

Industry Structure

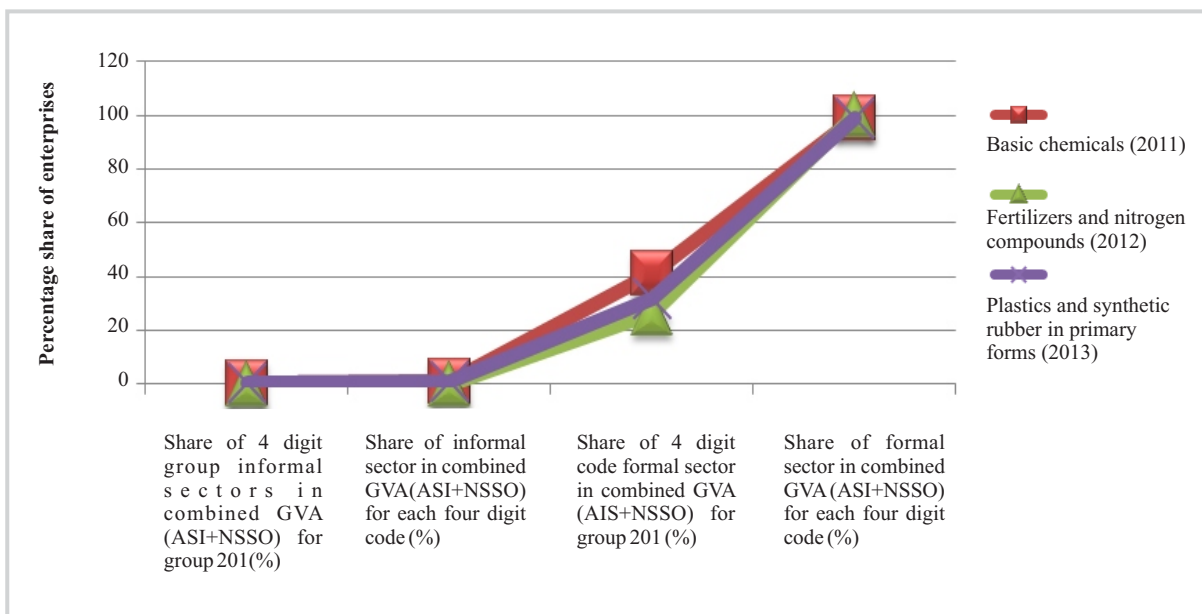
i. Formal and Informal sectors involved in manufacture of Chemicals

In general the contribution of informal sector is very low in chemicals. For example, in manufacture of fertilizers and nitrogen compounds, of the total GVA generated by formal as well as informal sector enterprises under code 201, informal sectors hold a negligible share of less than 0.01% (Figure 1). Similar pattern can be seen for the other 4 digit groups as well.

Therefore, one could argue that the chemical industry, (particularly the firms relating to the manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms) is primarily run by the formal sector enterprises. Very little contribution by the informal sector could be attributable to the various constraints that the informal sector faces today. These constraints include lack of capital, insufficient markets to produce and a large pool of unskilled labor together with high cost of carrying out business and insufficient, irregular and expensive electricity.

Informal sector generally acts as a sponge for the skilled workers, which absorbs all the laborers, who do not get employed in the formal sector. However in the chemical industry per se, the laborers which are thrown out of the formal sector are not willing to work in the informal sector, as working in the chemical industry involves high risk of coming in contact with the toxic and hazardous chemicals, the return that they get there is not sufficient to compensate them for the risk that they undertake. Thus, there is a dearth of skilled workers in the informal sectors of chemical industries.

Figure 1 : Distribution of GVA across formal and informal sectors of chemical industries



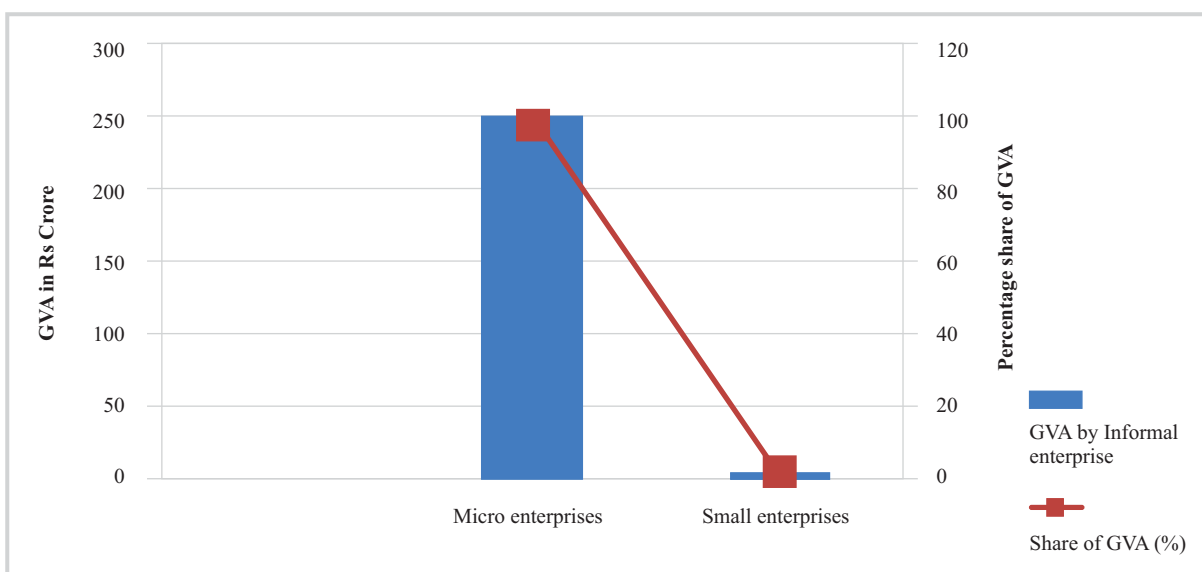
Source: Own estimates based on ASI 2009-10 data and 67th Round NSSO data

MSMEs in Informal sectors

As we have discussed above, Figure 1 clearly depicts that the contribution of informal sector in terms of Gross Value Added (GVA) in chemical industry is negligible. However, it remains to be seen how, within the informal sector, the GVA is shared by the MSMEs.

Based on the total GVA generated across all the informal sectors under group 201, we see that Microenterprises contribute majority of the share (98.07%) of total informal sector GVA (Graph 2). A dearth of facilities such as an easy access to finance and little opportunities for investment in the informal sector makes it difficult for the entrepreneurs in this sector to expand their enterprises and therefore, most of the enterprises keep operating at micro level (having plant and machinery of value less than Rs. 25,00,000).

Figure 2 : Share of GVA across Micro and small enterprises in informal sectors of chemical industries

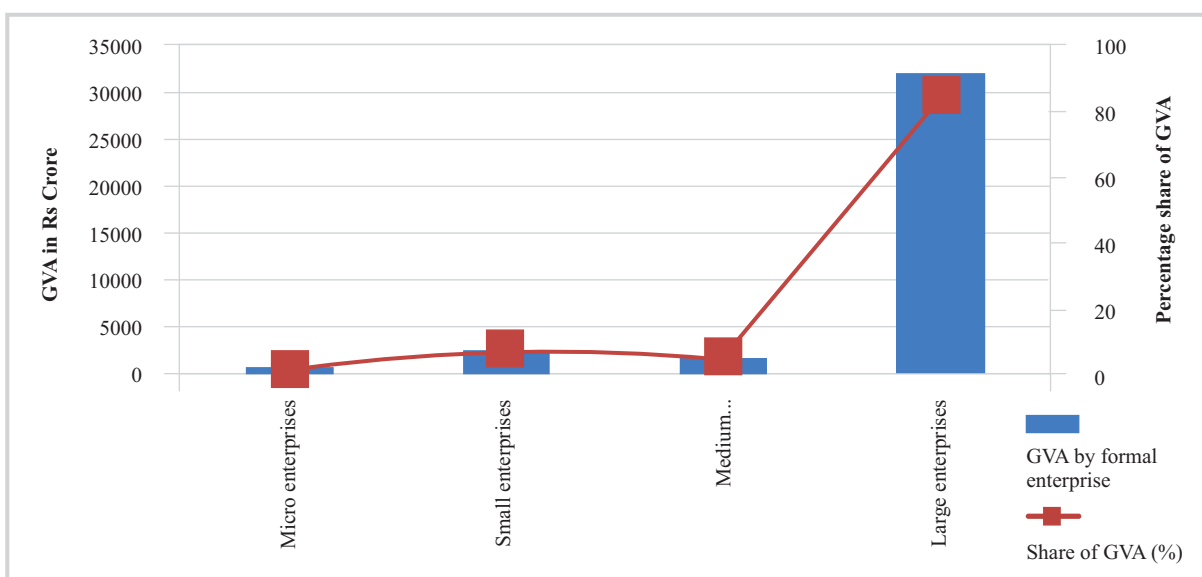


Source: Own estimates based on NSSO 67th Round data

ii. MSME in Formal Sectors:

If we consider the total GVA generated as a whole by the formal sectors in group 201 then micro, small and medium enterprises contributed 2.26%, 7.39%, 5.26% respectively of total GVA (Figure 3). Within the formal sector the large scale enterprises contribute much more to GVA, which is around 84.92%.

Figure 3 : Share of GVA across MSMEs in formal sectors of chemical industries

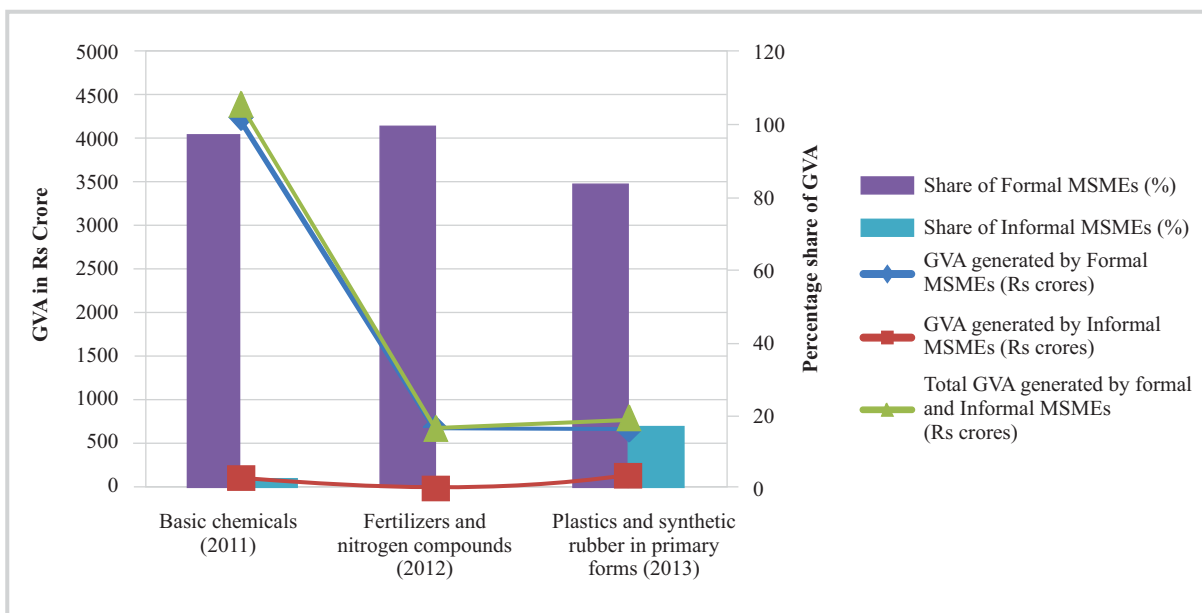


Source: Own estimates based on ASI 2009-10 data

Chemical industry is generally characterized by capital intensive, high volume, low margin products. Large scale operation seems compelling, as it would bring in economies of scale and would therefore help the entrepreneur to reduce per unit cost. Moreover, in the formal sector, there happens to be lesser problems associated with access to credit and investment opportunities, so entrepreneurs can afford to increase their scale of operation. This could probably be the reason behind the biasness of contribution towards GVA in favor of large enterprises.

Figure 4 compares the share of formal and informal MSMEs, in terms of contribution to GVA for each product category separately. As we can easily make out, distribution is biased towards formal enterprises.

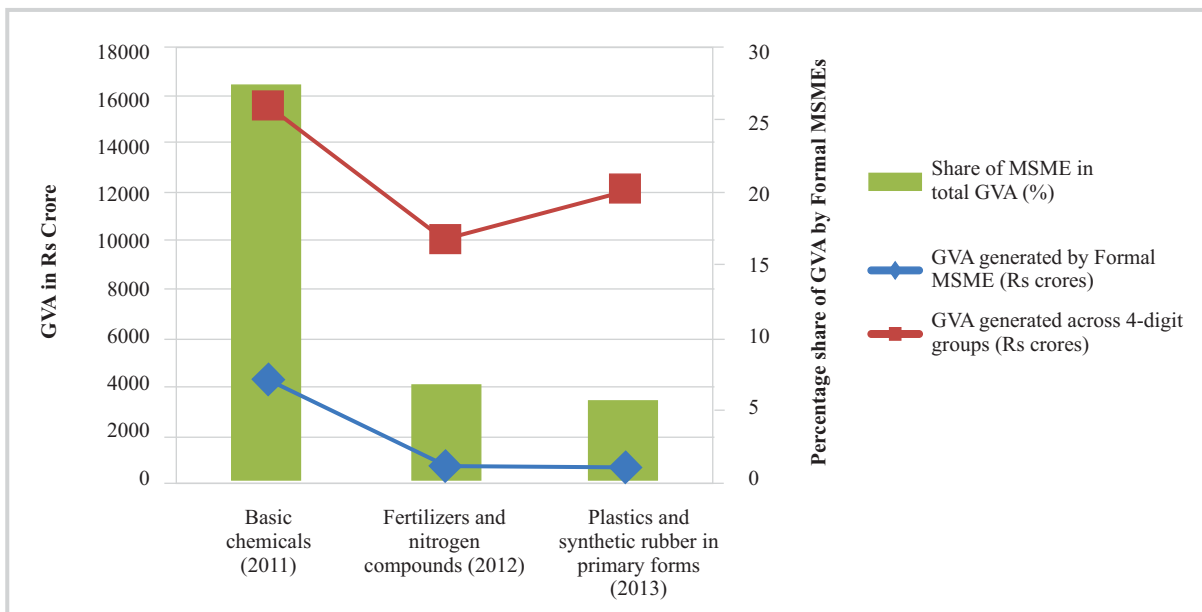
Figure 4 : Share of formal and Informal MSMEs in total GVA generated across 4 digit codes by MSMEs



Source: Own estimates based on ASI 2009-10 data and NSSO 67th Round data

Distribution of share of formal MSMEs in total GVA across each 4 digit product category under code 301 is depicted in Figure 5. It may be seen that as compared to other groups, 'Manufacture of basic chemicals' has the highest contribution of MSMEs to the total GVA. This is simply because the number of MSMEs involved in the 'Manufacture of basic chemicals' is much higher than the enterprises involved in other activities. This seems to be quite explicable, as this activity produces a large number of compounds that are used as inputs into a number of modern-day manufacturing processes.

Figure 5 : Distribution of share of Formal MSMEs in total GVA across 4 digit codes



Source: Own estimates based on ASI 2009-10 data

Concentration of Enterprises

Concentration is analysed through Lorenz curve using two data sources. CMIE data cover only the listed enterprises. Using this data we will analyse the concentration of sales among the listed enterprises. ASI data also will be used. This data will show the concentration of value added among the registered factory units.

Figure 6 : Market Concentration (CMIE)

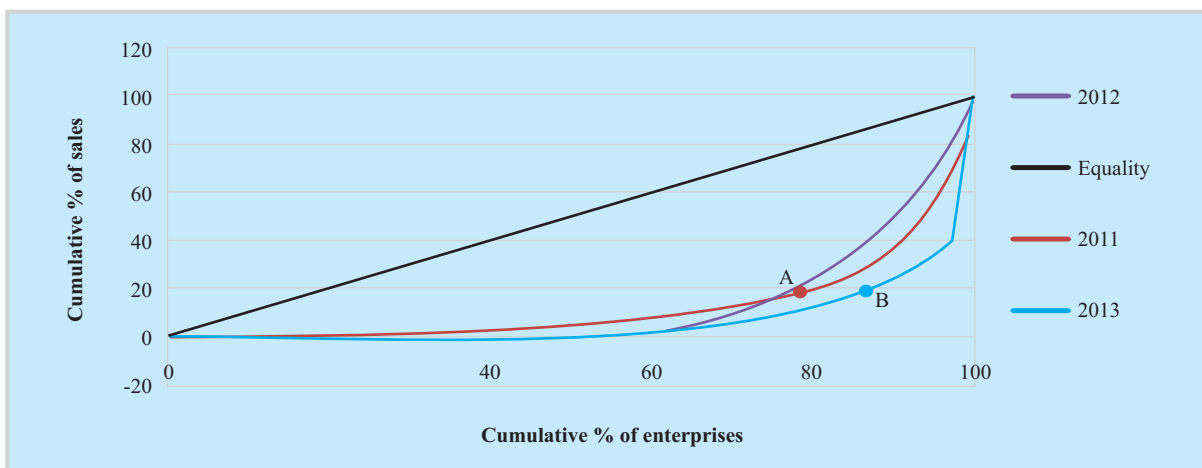


Figure 6 depicts the well known *Lorenz Curve*, describing the market concentration among enterprises under the three product categories as per CMIE data. Horizontal axis represents the cumulative percentage of enterprises, whereas the vertical axis represents the cumulative percentage of sales by the listed companies. The blue colored 45-degree line represents the line of equality and the other three curves labeled 2011, 2012 and 2013 represent the respective product categories. The farther away a particular curve is from the line of equality, the more would be market concentration. One can clearly figure out just by looking at the figure that for all the three product categories, the total sales is quite unequally distributed, as the three curves (2011, 2012 and 2013) sink fairly below the line of equality.

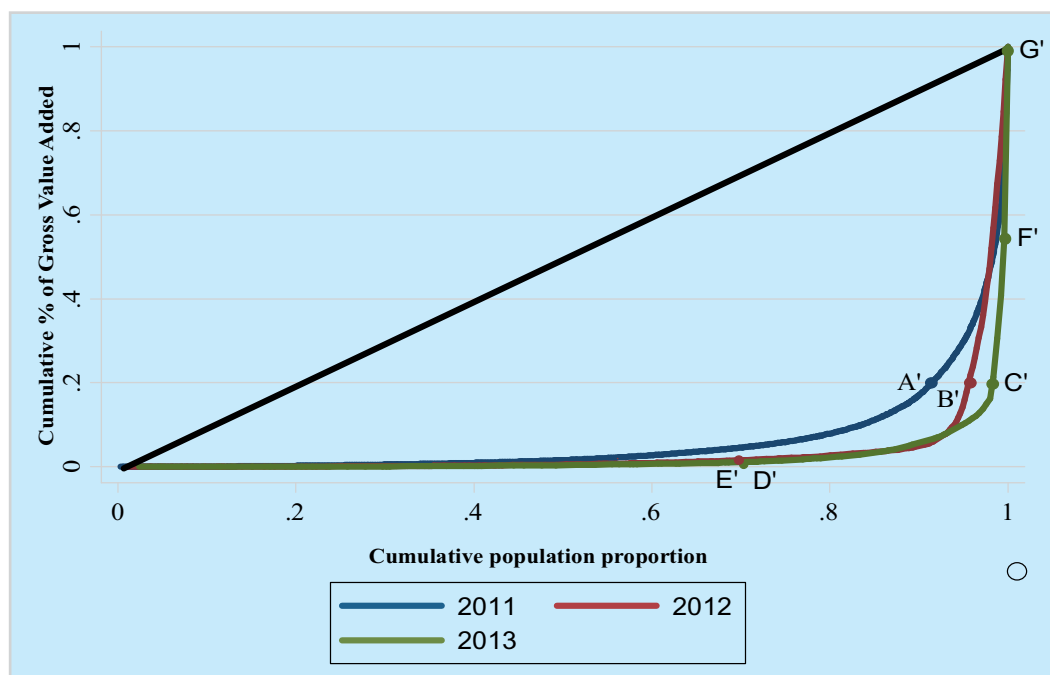
Figure 7 shows the market concentration of enterprises as per ASI unit level data. The total sales as per ASI appears to be highly unequally distributed, as the three curves (2011, 2012 and 2013) sink extremely below the line of equality.

As per CMIE, under 2011 (Manufacture of basic chemicals), lowest 80% of enterprises capture approximately 20% of the total sales (*see Figure 6, point A*). This means that top 20% enterprises capture around 80% of the total sales. Thus, under manufacture of basic chemicals, a large part of market is being captured by just a few enterprises. Therefore, we may say that a oligopolistic kind of a market structure is present for this product category as per CMIE data.

As per ASI, under the same product category viz. 2011, lowest 90% of enterprises contribute merely 20% of the total GVA generated under this product category, and the rest 80% of the total GVA is being contributed by just the top 10% of enterprises (*see Figure 7, point A'*). This reinforces our conclusion for the enterprises under 2011, as per CMIE, that there seems to be a oligopolistic kind of a market structure present for this product category, because a large part of the market is being captured by just a few enterprises.

Next, under 2012 (Manufacture of fertilizer and nitrogen compounds), as per CMIE, lowest 80% of enterprises capture approximately 20% of the total sales (*In Figure 6, Lorenz curve for 2012 intersects the Lorenz curve for 2011 at point A*). This means that again, top 20% enterprises capture around 80% of the total sales. Thus, under manufacture of fertilizer and nitrogen compounds as well, there seems to exist a oligopolistic kind of a market structure.

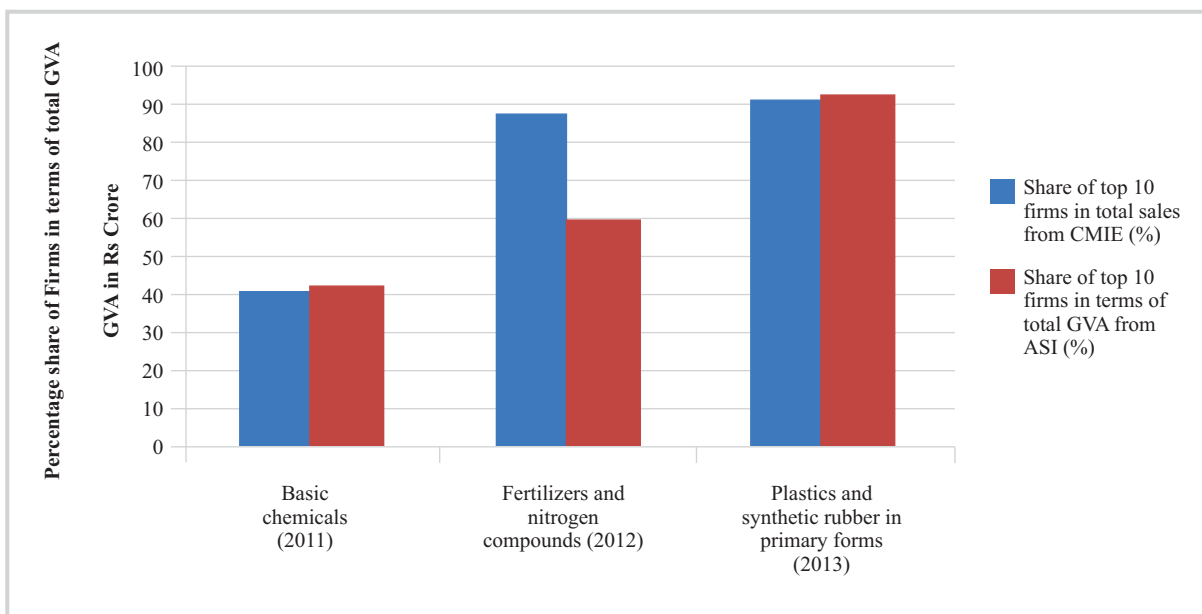
As per ASI, under 2012, lowest 95% of enterprises capture just about 20% of the total GVA generated under this product category, and the rest 80% of the total GVA is being captured by just the top 5% of enterprises (*See Figure 7, point B'*). Also, the lowest 70% enterprises (approx.) capture almost negligible share of total GVA (*see Figure 7, point E'*). This again reinforces our conclusion for the enterprises under 2012, as per CMIE, that there seems to be a oligopolistic kind of a market structure present for this product category, because a large part of the market is being captured by few enterprises.

Figure 7 : Market Concentration (ASI)

Under 2013 (Manufacture of plastics and synthetic rubber in primary forms), as per CMIE, lowest 85% (approx.) of enterprises capture just 20% of the total sales. This means that the top 15% (approx.) enterprises capture around 80% of the total sales. Thus, under manufacture of plastics and synthetic rubber in primary forms, a large part of market is being captured by just a few enterprises. Therefore, we may say that an oligopolistic kind of a market structure is present for this product category as well, as per CMIE data.

As per ASI, under 2013, as one can clearly see in Figure 7, the lowest 70% enterprises (approx.) capture almost negligible share of total GVA (*see point D'*) and the lowest 97% enterprises (approx.) capture merely 20% of the total GVA (*see point C'*). Also, the vertical line segment F'G' along the Lorenz curve for 2013 indicates that the enterprise with the highest GVA captures almost 50% of the total GVA generated by all enterprises under 2013.

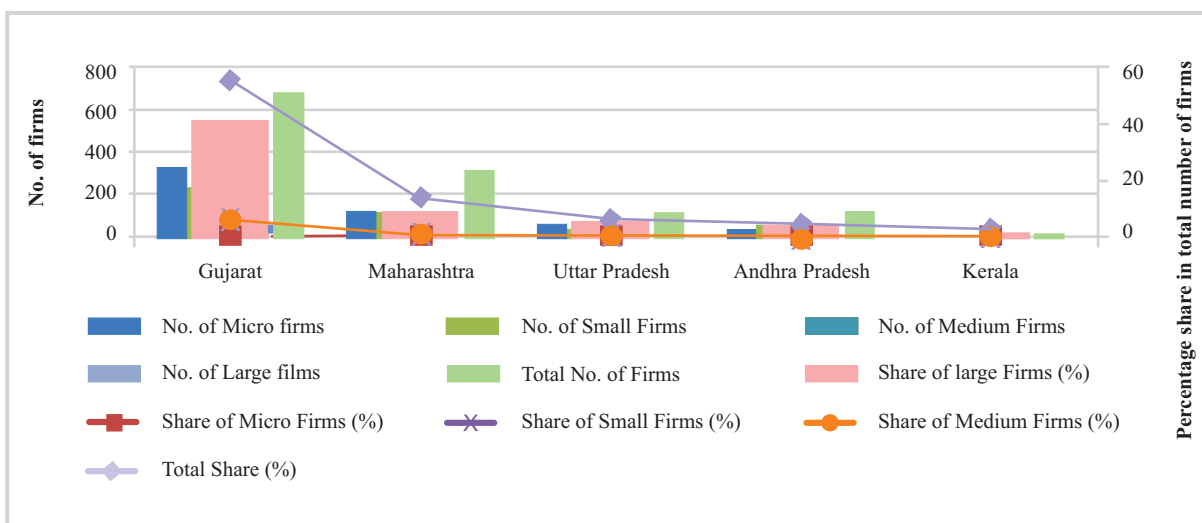
Thus, for all the product categories relating to the chemical industry, we can say that a large part of the market is captured by just a few enterprises, indicating that a high degree of monopoly power is enjoyed by the top chemical enterprises of the country.

Figure 8 : Market concentration of firms under each 4 digit code

Source: Own estimates based on ASI 2009-10 data and CMIE data

Regional distribution of enterprises:

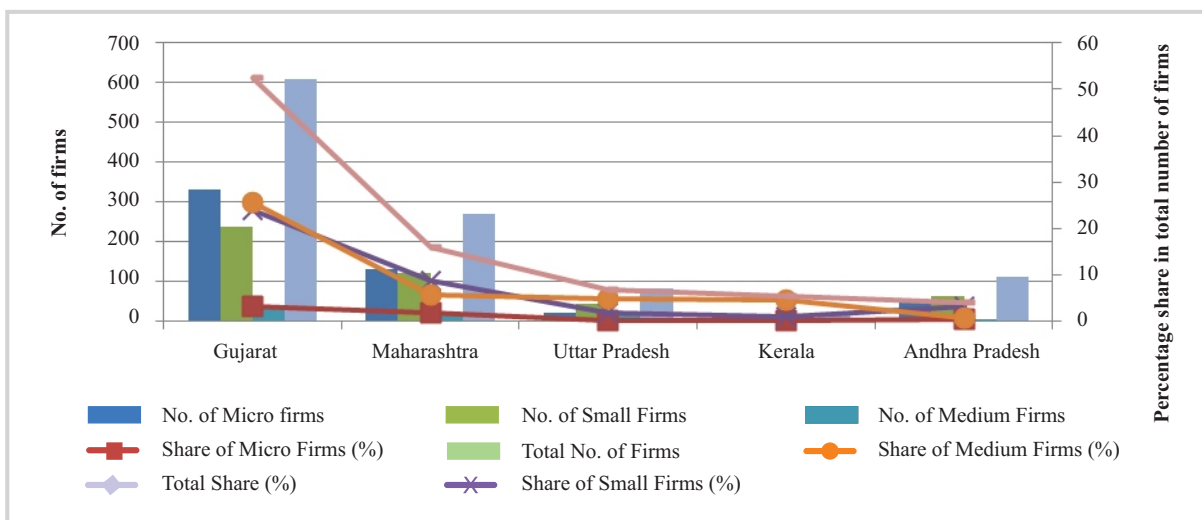
Manufacture of basic chemicals:

Figure 9 : State wise Distribution of shares across different size classes in the total GVA generated under 2011

Source: Own estimates based on ASI 2009-10 data

Clearly, Gujarat outperforms in terms of contribution to the total GVA generated under 'Manufacture of Basic Chemicals' (around 56%) (Figures 9 and 10). Such high contribution by Gujarat is partly due to the fact that the number of enterprises involved in 'Manufacture of basic chemicals' in Gujarat is much higher than that in the other states. But, apart from that, Gujarat also accounts for the highest production of major chemicals in India (53%; 2005-06). Also, manufacturing of chemicals and chemical products contribute to around one fifth of the total employment in Gujarat. [<http://www.vibrantgujarat.com/chemicals-petrochemicals.htm>]. Maharashtra ranks second (14.09%), followed by Uttar Pradesh (6.67%), Andhra Pradesh (5.01%) and Kerala (3.28%).

Figure 10 : State wise Distribution of shares across different size classes in the total GVA generated by MSMEs under 2011



Source: Own estimates based on ASI 2009-10 data

Even if we consider the MSMEs, Gujarat still remains as the leading state in terms of contribution to the total GVA generated under 'Manufacture of Basic Chemicals' (52.59%) followed by Maharashtra (15.90%), Tamil Nadu (6.61%), Kerala (5.35%) and Andhra Pradesh (4%).

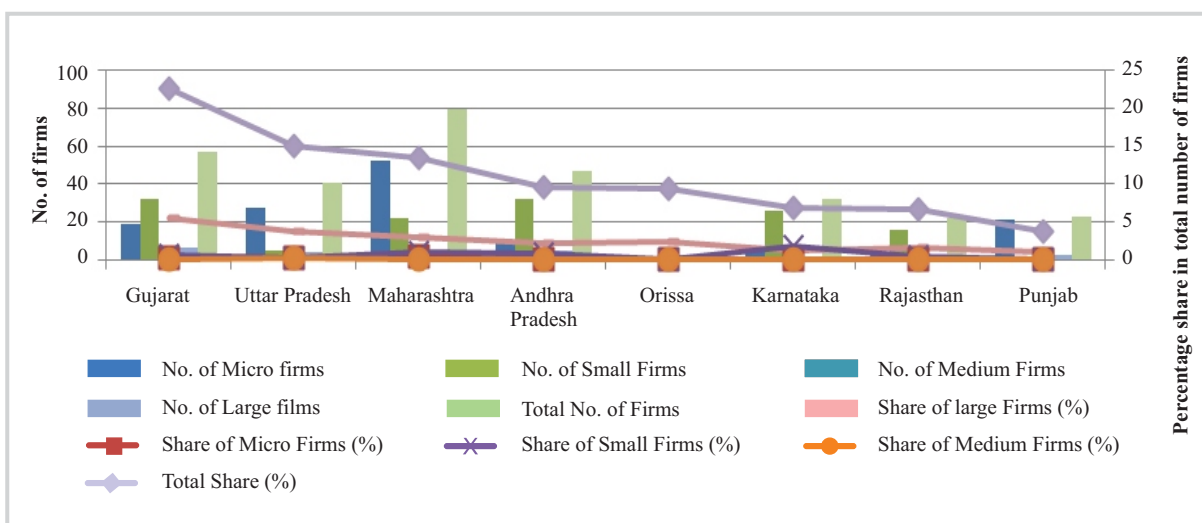
Manufacture of fertilizers and nitrogen compounds:

Under 'Manufacture of Fertilizers and Nitrogen Compounds' also, the highest contribution to total GVA is by Gujarat (22.70%), followed by Uttar Pradesh (14.97%), Maharashtra (13.52%), Andhra Pradesh (9.49%) and so on (Figures 11 and 12).

Gujarat State Fertilizer and Chemical Ltd. (GSFC) and Gujarat Narmada Valley Fertilizers Company Ltd. (GNFC) are two of the largest public sector units located in Gujarat. GSFC is the sole producer of Melamine and largest producer of Caprolactum in India, whereas GNFC is one of the leading fertilizers company in the country. (*Gujarat Specialty Chemicals Conclave-2013 Report*).

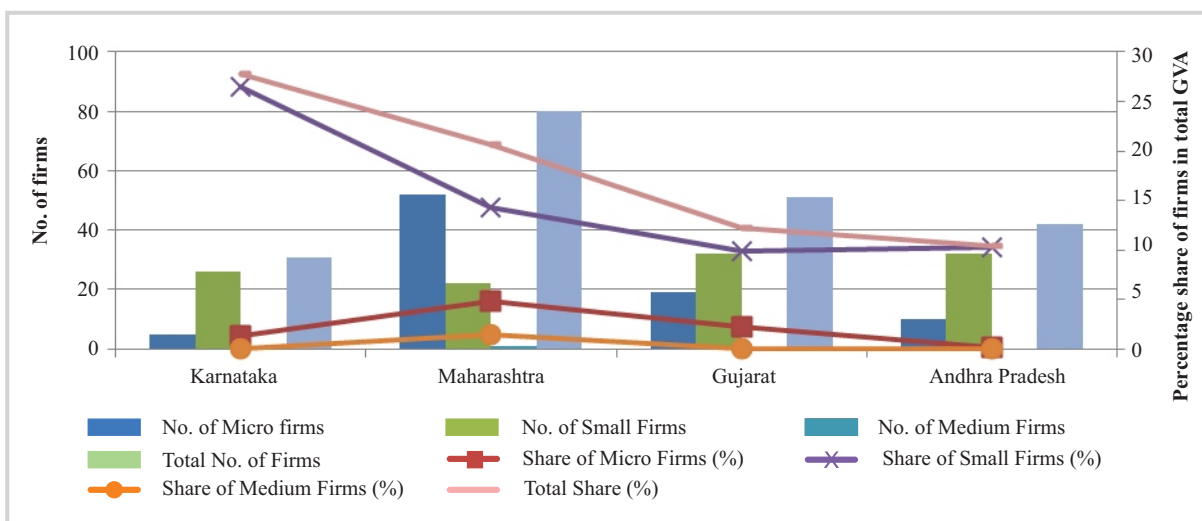
However, in case of MSMEs, under the same category, the scenario is slightly different. The leading state turns out to be Karnataka contributing around 27.8% to the total GVA generated by MSMEs under 'Manufacture of Fertilizers and Nitrogen Compounds' followed by Maharashtra (20.71%). Gujarat ranks third with a contribution of 12.16%.

Figure 11 : State wise Distribution of shares across different size classes in the total GVA generated under 2012



Source: Own estimates based on ASI 2009-10 data

Figure 12 : State wise Distribution of shares across different size classes in the total GVA generated by MSMEs under 2012

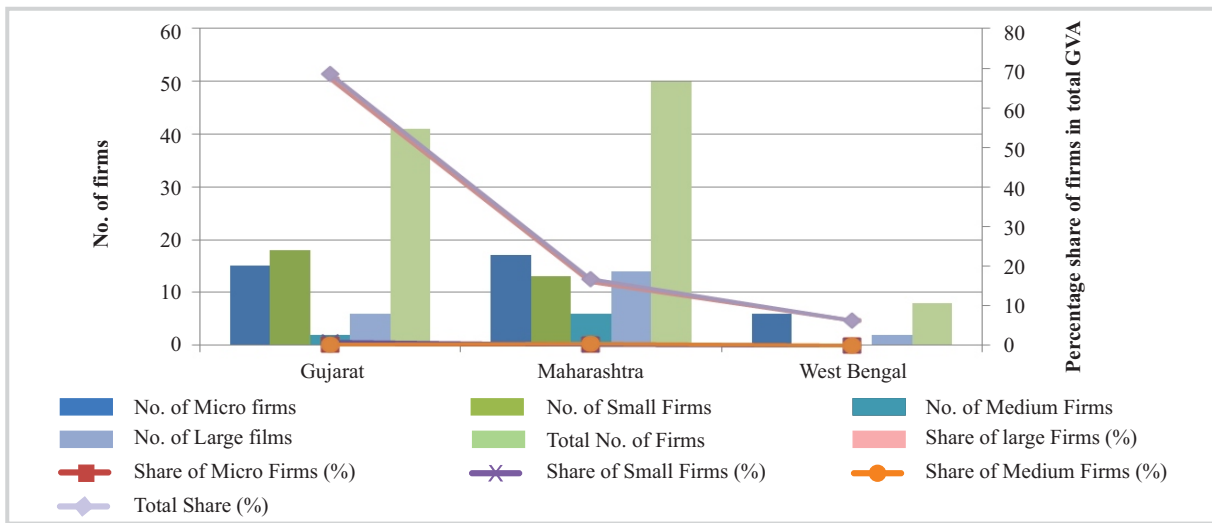


Source: Own estimates based on ASI 2009-10 data

Manufacture of plastics and synthetic rubber in primary forms:

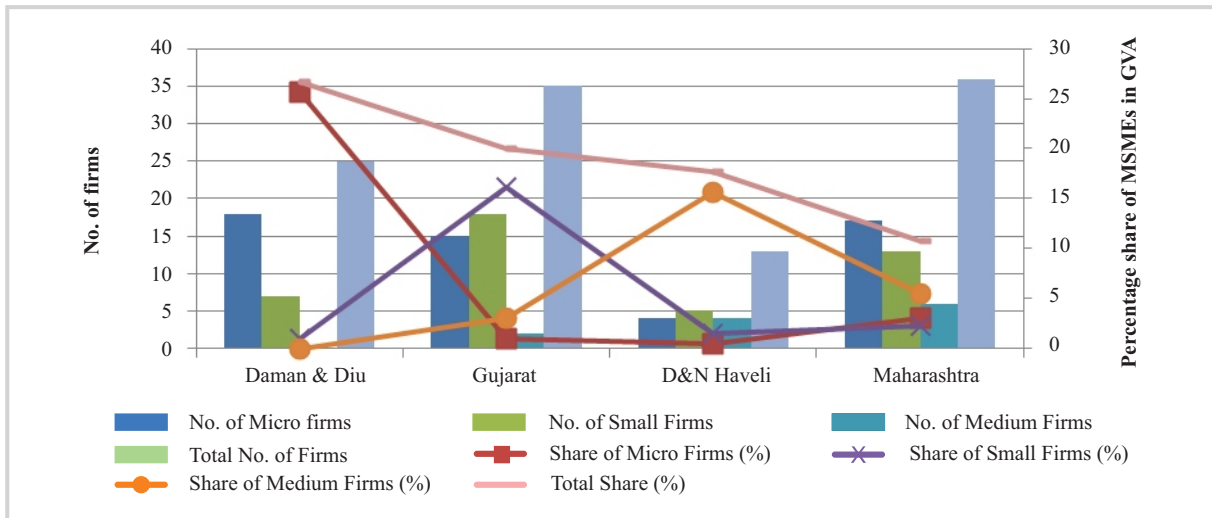
Under '*Manufacture of Plastics and Synthetic rubber in primary forms*', Gujarat once again emerges out as a leader and tops the list by contributing around 68.45% to the total GVA generated by all firms under this product category. Gujarat is followed by Maharashtra (16.65%) and West Bengal (6.13%) (Figure 13). In case of MSMEs Daman & Diu tops the list by contributing around 26.66% to the GVA generated by MSMEs under the given product category (2013). Gujarat, though not the leader state, is not far behind, contributing to the tune of 20%, followed by D&N Haveli (17.70%) and Maharashtra (10.71%).

Figure 13 : State wise Distribution of shares across different site classes in the total GVA generated under 2013



Source: Own estimates based on ASI 2009-10 data

Figure 14 : State wise Distribution of shares in total GVA generated by MSMEs under 2013



Source: Own estimates based on ASI 2009-10 data

Gujarat emerges out as a clear winner in terms of contribution to total GVA. Also, it is worth appreciating that out of the total contribution by all firms in Gujarat, the highest contribution has been from the large enterprises (see also figure 13 and 14). This shows that the enterprises in the state have a good access to organized sources of credit and the state is quite advanced in terms of infrastructure. Apart from having sound infrastructure facilities, skilled manpower, excellent domestic as well as international connectivity and availability of raw materials in Gujarat, a key factor responsible for Gujarat being an undisputed leader (as far as contribution towards total GVA generated by the Indian chemical industry is concerned), could be Gujarat's investor-friendly policy towards industrial development.

“The industrial infrastructure of Gujarat is very supportive for business development. The state's manufacturing industry is supported by 0.34 million MSMEs. Currently, Gujarat has 83 product clusters. The Cluster Development Scheme has been launched for furthering the growth of product clusters. Some of the successful clusters include ceramics cluster at Morbi, brass-parts cluster at Jamnagar, fish processing cluster at Veraval and power-looms cluster at Ahmedabad. Gujarat has 184 industrial estates established by the Gujarat Industrial Development Corporation (GIDC) for specific sectors such as chemicals, electronics, gems, apparels and granite. The State Government has taken care to set up industrial estates on non-agricultural land after assessment of industrial viability. Such availability of product cluster ensures opportunity across the value chain.”

[‘Gujarat Specialty Chemicals Conclave-2013’ Report]

Business linkages between Large scale enterprises and MSMEs

Next we move to the business linkages (contractual arrangements) between different MSMEs and large scale enterprises. There exist four different kinds of business linkages: (1) Contracting in but not contracting out; (2) Contracting out but not contracting in; (3) Both contracting in and out; (4) Neither contracting in nor contracting out. (1) Contracting in but not contracting out: Those enterprises come under this category, which do not outsource their work to other outside firms, but do work for other enterprises. (2) Contracting out but not contracting in: This category includes those enterprises which do not work for other firms, however do outsource their work to other firms. (3) Both contracting in and out: Those enterprises, which both, work for other enterprises as well as outsource their work to other enterprises. (3) Neither contracting in nor contracting out: Those enterprises, which neither work for other firms, nor do they outsource their work to other firms.

Annexure table b1 depicts the distribution of firms across different business linkages for micro, small, medium and large enterprises. One can easily deduce that out of the total of 1714 micro enterprises involved in 'Manufacture of basic chemicals', 837 (around 48.83%) enterprises contract in as well as contract out.

This category involves extraction of hazardous fuel gases like methane, ethane, butane and propane, and also manufacturing them in a petroleum refinery. This requires a relatively larger scale of operation, as it is not possible for a petroleum refinery to operate at a micro level and also, extraction of such hazardous fuel gases requires high-level skill and expertise, which workers employed in micro-enterprises generally lack. Thus, it seems apparent that these micro firms might outsource some of these activities to relatively large enterprises. Also, many large firms might be interested in developing relationships with such micro enterprises in order to reduce their procurement, production and distribution costs. Thus, many large firms might outsource a part of their work to these micro enterprises. This might be the reason why such a significant proportion of micro enterprises involved in 'Manufacture of Basic Chemicals' contract in as well as contract out.

Moreover, as many as 630 (around 36.75%) enterprises contract in but not contract out and merely 44 (around 0.23%) enterprises contract out but not contract in. A similar pattern can be seen for the other two product categories. Under 'Manufacture of fertilizers and nitrogen compounds', out of a total of 436 micro enterprises, as many as 201 (around 46.10%) enterprises contract in but do not contract out, whereas just 8 (around 1.18%) enterprises contract in but not contract out. Under 'Manufacture of plastics and synthetic rubber in primary forms', out of a total of 231 micro enterprises, 90 (around 38.96%) 'Contract in but not contract out'.

This fact is explicable as most of the large enterprises depend on local micro and small enterprises, as buying inputs and raw materials from these small enterprises can help these larger firms cut costs and increase flexibility.

Similarly for small producers the majority of the enterprises 'contract in but not contract out' - 450 out of 776 (57.99%) in code 2011, 100 out of 193 (51.81%) in code 2012 and 54 out of 106 (50.94%) in code 2013.

In case of medium size enterprises a majority of the enterprises fall either under 'Contracting in but not contracting out' or under 'Both contracting out and contracting in'; there are hardly any enterprises which 'contract out but not contract in'. This means that most of the medium sized enterprises work for the other smaller or larger enterprises. The most obvious reason for this is the opportunity to raise revenues by developing new markets.

The scenario is no different for the large enterprises. Most of these enterprises under all the three categories contract in but not out. Apart from exploring opportunities to raise revenues, another reason could be that innovations that target the local micro and small enterprises, may prove relevant in larger enterprises as well, a phenomenon Mc Kinsey & Co. has termed "*innovation blowback*", which in economics terms, a positive externality.

Age wise pattern of contractual linkages

The pattern of contractual linkages based on age groups substantiates the fact that a very high proportion of the young enterprises contract in but not out. This seems to be quite obvious. During the initial stages of operation the entrepreneurs may not have access to preferred market. Also, initially, they might not have sufficient capital and funds so as to start production right away (particularly true for micro enterprises).

Estimates of the age-wise distribution of contractual linkages for micro, small, medium and large enterprises are presented in the Annexure tables b2.1, b2.2, b2.3 and b2.4 respectively across each of the four digit product category.

Considering micro enterprises first, out of the total firms which have started not more than 10 years ago, for the product category, '*Manufacture of basic Chemicals*', 65.74% firms, contract in but not out, for the product category, '*Manufacture of fertilizers and nitrogen compounds*', around 90.32% firms contract in but not out and for the product category, '*Manufacture of plastics and synthetic rubber in primary forms*', 63.41% firms contract in but not out.

Now considering the small enterprises, out of the total firms which have started not more than 10 years ago, for the product category, '*Manufacture of basic Chemicals*', around 63.73% firms contract in but not out, for the product category, '*Manufacture of fertilizers and nitrogen compounds*', around 49.50% firms contract in but not out and for the product category, '*Manufacture of plastics and synthetic rubber in primary forms*', 58.46% firms contract in but not out.

There are too few medium enterprises, which have started not more than 10 years ago, for any definite analysis to be drawn.

In case of large enterprises, out of the total firms which have started not more than 10 years ago, for the product category, '*Manufacture of basic Chemicals*', around 56.72% firms contract in but not out, for the product category, '*Manufacture of fertilizers and nitrogen compounds*', 60% firms contract in but not out and for the product category, '*Manufacture of plastics and synthetic rubber in primary forms*', around 71.43% firms contract in but not out.

Thus, we may infer that most of the enterprises, when young, contract in but not contract out. As this scenario is true for all sized enterprises, viz. micro, small and large, we may speculate that these enterprises might be contracting in from some enterprises lying outside chemical industry.

Also, as the last column of Annexure tables b2.1, b2.2, b2.3 and b2.4 shows, for each product category, there are a very low percentage of micro, small and medium enterprises which were started more than 31 years ago. This is a positive sign because this means that most of the MSMEs are young and therefore, a relatively larger number of enterprises would survive for a given period, as compared to a situation where there are just a few young enterprises.

On the other hand, for the large enterprises, there are a relatively larger proportion of enterprises which were started more than 31 years ago. Thus, most of the large enterprises are old and thus more experienced and solvent.

Productivity and Capital Intensity of MSMEs

Productivity, measured in terms of value added per labor is much higher in large firms as compared to the MSMEs in formal sector (Annexure table b3). The reason behind such low productivity in MSMEs could be the use of more labor intensive conventional techniques instead of up graded machine technology. MSMEs also usually fail to switch to modern technologies due to their inability to mobilize sufficient funds. MSMEs are mostly owned and managed by single individuals or family members many of whom are ignorant about the IPR and trade related policies, which might lead to a fall in the productivity of the enterprises.

Further, the capital per labor or capital intensity is much lower in case of MSMEs as compared to large firms (Annexure table b3), which is quite obvious too. Although, chemical industry is considered to be one of the most capital intensive industries, but the MSMEs generally remain devoid of enough funds as well as skilled workers, to be able to afford and maintain the required amount of capital, and therefore fall short in terms of capital labour ratio. However, within MSMEs, both value added per labour and capital per labour, with few exceptions, systematically increase with the increase in size class in these industries.

MSMEs in chemical industry face a number of challenges, including high cost of capital, onerous regulatory compliance (especially in terms of health, safety and environment), dearth of technical skills, difficult or no access to international markets, an inflexible labour market and increasing competition. It is quite surprising to see that the capital intensity or the capital labor ratio for the product category, '*Manufacture of Basic chemicals*' in informal sector is higher than that in the formal sector.

Productivity of Formal enterprises and business links

Annexure table b4 displays GVA per labor (or labor productivity) and capital per labour (or capital intensity) of formal sector micro, small, medium and large enterprises under different types of business linkages. It is worth noting that the labor productivity (GVA/L) of small sized enterprises is highest for the ones, which contract in as well as contract out, irrespective of the product category. This might be because of the fact that while 'contracting in', on the one hand, workers may be provided with considerable exposure to the market and technology which may increase their efficiency by making them more professional in their approach and thereby augmenting labor productivity. Contracting out, on the other hand, may facilitate greater specialization as it allows the enterprises to specialize in producing the goods in which they are relatively more productive and out source a part of their work, rather than producing within own factory, to other specialized firms. This leads to specialization, technological change and an increase in labour productivity.

The capital labor ratio (or capital intensity), for the product category, '*Manufacture of Basic Chemicals*' is highest under 'Contracting in but not Contracting out' for the micro and large firms, whereas, for the small firms, it is under 'Neither contracting in nor contracting out' indicating that they are more self-sufficient. Medium sized firms however prefer to 'Contracting out but not contracting in'.

Now, considering the productivity figures (GVA/L) for the product category, '*Manufacture of plastics and synthetic rubber in primary forms*', for all the MSMEs, it is highest for the firms 'Both contracting in and contracting out'. But the large firms prefer 'Contracting out but not contracting in'. This may be because, for micro and small enterprises it is relatively more important to build goodwill with the other firms and maintain good relations with them in order to access capital, infrastructure, markets etc. Thus, contracting in and out helps them deal with these challenges and facilitates efficient operation. Large firms on the other hand outsource part of their manufacturing jobs and non-core works to micro and small enterprises. In the process large enterprises help the smaller ones to upgrade technology and skills through various means like, providing advances, finance, design, machinery, training, etc. Thus the linkages established between MSMEs and the large enterprises facilitate development of the MSMEs as well as the industry as whole.

Export Scenario

Annexure table b5 shows the contribution of each product category under code 201 of the chemical industry towards exports. It may be seen that the highest contribution is made by the *Basic Chemicals* (81.32%). This is quite obvious as, we have already seen, the same product category was the highest contributor towards the total GVA (formal and informal).

“India's export of basic chemicals amounted to over US\$ 7 billion in 2005-06. India exported US\$ 4.85 billion worth of organic chemicals, US\$ 775 million worth of inorganic chemicals, US\$ 847 million worth of tanning and colouring materials, and US\$ 649 million worth of pesticides, in the year 2005-06. In addition, India exported petrochemicals valued nearly US\$ 4 billion.” [Export Import Bank of India, “Indian Chemical Industry: A Sector Study”; *Occasional Paper No. 117*]

Annexure table b6.1 displays the contribution of firms in total exports for each four digit code. It may be seen that the contribution by MSMEs to total exports is negligible as compared to that by the large firms for all the product categories. The contribution to total exports by MSMEs for the product category, '*Basic Chemicals*' is just 22.36% and the rest is by the large firms. On the other hand, for the product category, '*Fertilizer and nitrogen compounds*', the contribution by MSMEs is even lower. MSMEs contribute just 3.22% to the total exports, whereas for the product category, '*Manufacture of plastics and synthetic rubber in primary forms*', the contribution by MSMEs is merely 1.19%.

Large firms with their vast resources and influential position have an edge over smaller firms in catering to the needs of domestic as well as international markets. This kind of behavior is also found to be true in many other countries. Bonaccorsi (1992) carried out a survey of research studies that dealt with the relationship between firm size and export behavior with focus on Italian manufacturing industry. He found that though on the whole the findings of the literature on the relationship were mixed but majority of the studies emphasized a positive relationship. Other recent empirical studies that have found a positive relationship between firm size and export competitiveness include Basile (2001) again for Italian manufacturing firms, Aggarwal (2001) for Indian medium and low technology industries, Zhao and Zou (2002) for Chinese manufacturing firms, and Narayanan (2006) for the Indian Automobile industry¹³.

Thus, large firms play a pivotal role in bringing in foreign exchange earnings through exports of chemicals and in the growth of the chemical industry in the country. Also, it is quite interesting to see that for the latter two product categories, only small and large firms are involved in exporting.

Now, Annexure table b6.2 shows the distribution of firms across different business linkages and their relative exports for all size classes. As one may see, for the manufacture of basic chemicals, the micro enterprises, which contract in but do not contract out contribute the highest to the total exports, i.e. 56.29%. This high contribution may be attributed to the fact that under this product category, largest number of exporting firms also falls under 'Contracting in but not contracting out'. This may be due to the fact that during the initial stages, when the firm is micro sized, it may be very difficult for it to operate at international level.

For the small enterprises in *Basic chemicals*, although majority of the firms operate under the category 'Contract in but not out', the highest contribution to total exports is made by the firms lying under the category, 'Both Contracting in and Contracting out'. Therefore, a relatively fewer small enterprises, which both contract in and out, contribute to a relatively large extent to the total exports by the product category, '*Manufacture of Basic Chemicals*'. The small firms who cannot meet export demand through own production, contract out part of the production and enjoy pecuniary benefit.

For the small enterprises, involved in the other two product categories; '*Manufacture of fertilizer and nitrogen compounds*' and '*Manufacture of plastics and synthetic rubber in primary forms*' all the small exporting firms belong to the categories 'Neither contract in nor out' and 'Contracting in but not out' respectively.

¹³See also Bhat, Savita, and K. Narayanan (2009), "Technological Strategies, Firm Size and Exports in Indian Basic Chemical Industry."

Firms involved in '*Manufacture of fertilizer and nitrogen compounds*' export very little of their output. This is because the Government of India has received complaints of smuggling of subsidized fertilizers to the neighboring countries. Keeping in view the availability of the fertilizers in the country and the subsidy paid thereon (MCF, GOI), it may be a matter of coincidence that all those very few small exporting firms involved in '*Manufacture of fertilizer and nitrogen compounds*' neither contract in nor contract out.

Next, Annexure tables b7.1, b7.2, b7.3 and b7.4 show the regional distribution of exports by micro, small, medium and large enterprises respectively. Among the exporting micro enterprises involved in '*Manufacture of Basic Chemicals*', around 51.38% of them are located in Maharashtra. As discussed earlier, there are no exporting micro enterprises involved in either '*Manufacture of fertilizer and nitrogen compounds*' or '*Manufacture of plastics and synthetic rubber in primary forms*'

Among the exporting small enterprises involved in '*Manufacture of Basic Chemicals*', around 47.44% are located in Gujarat, of those involved in '*Manufacture of fertilizer and nitrogen compounds*', 100% (all) are located in Rajasthan, and of those involved in '*Manufacture of plastics and synthetic rubber in primary forms*', 71.12% are located in Rajasthan.

Among the exporting medium enterprises involved in '*Manufacture of Basic Chemicals*', 90.46% are located in Kerala, and as we had discussed earlier, there are no exporting medium enterprises involved in either '*Manufacture of fertilizer and nitrogen compounds*' or '*Manufacture of plastics and synthetic rubber in primary forms*'

Among the exporting large enterprises involved in '*Manufacture of Basic Chemicals*', 40.74% are located in Maharashtra, of those involved in '*Manufacture of fertilizer and nitrogen compounds*', 84.23% are located in Maharashtra, and of those involved in '*Manufacture of plastics and synthetic rubber in primary forms*', 69.54% are located in Maharashtra.

We may conclude from the above figures that the overall regional distribution of exports is similar for the categories '*Manufacture of fertilizer and nitrogen compounds*' and '*Manufacture of plastics and synthetic rubber in primary forms*'. Further, Maharashtra has emerged as the major centre of chemical products and exporting hub, possibly due to port facility and trade, insurance and finance centre of Mumbai.

B: Manufacture of other Chemical Products (code 202)

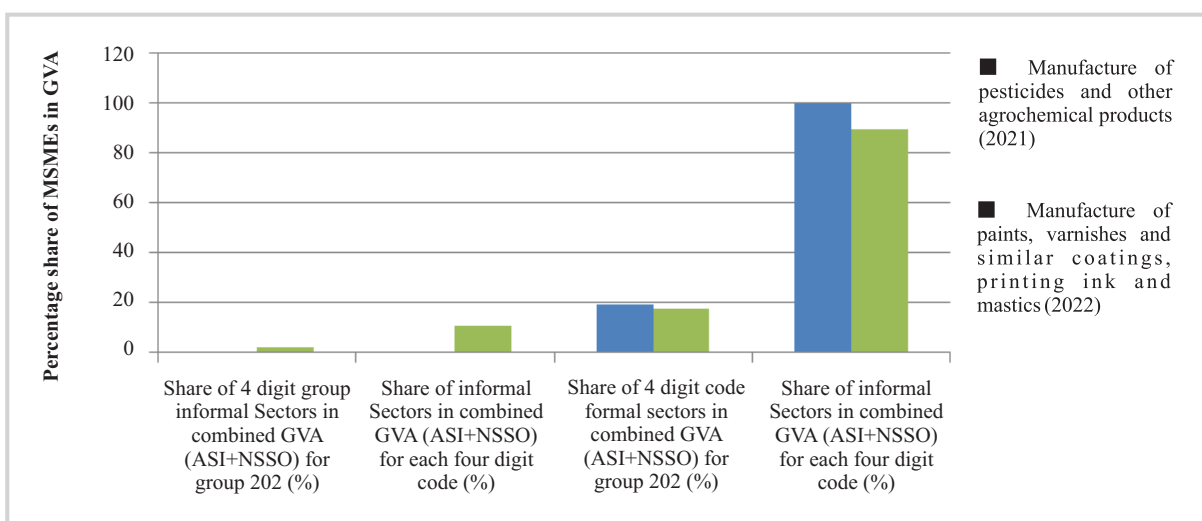
Industry Structure

Formal and Informal sectors

As discussed above, in general, the contribution of informal sector is very low in chemicals. For example, in manufacture of pesticides and other agrochemical products, of the total GVA generated by formal as well as informal sector enterprises under group 202 (Manufacture of other chemical products), informal sectors hold a negligible share of 0.01% (Figure 15). Taking each

four digit group separately, we can easily figure out that the share of informal sector is quite low as compared to the share of formal sector. For the '*Manufacture of pesticides and other agrochemical products*', the share of formal sector is as high as 99.95%, whereas the share of informal sector is around 0.04%, which is negligible. On the other hand, for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', the share of formal sector is 89.46%, whereas the share of informal sector is merely 10.53%. Such little contribution by the informal sector could again be attributed to the various constraints that the informal sector faces today. These constraints include lack of access to capital, insufficient markets, a large pool of unskilled labor, high cost of carrying out business and insufficient, irregular and expensive electricity.

Figure 15 : Distribution of GVA across formal and informal sectors of other chemical industries



Source: Own estimates based on ASI 2009-10 data and NSSO 67th Round data

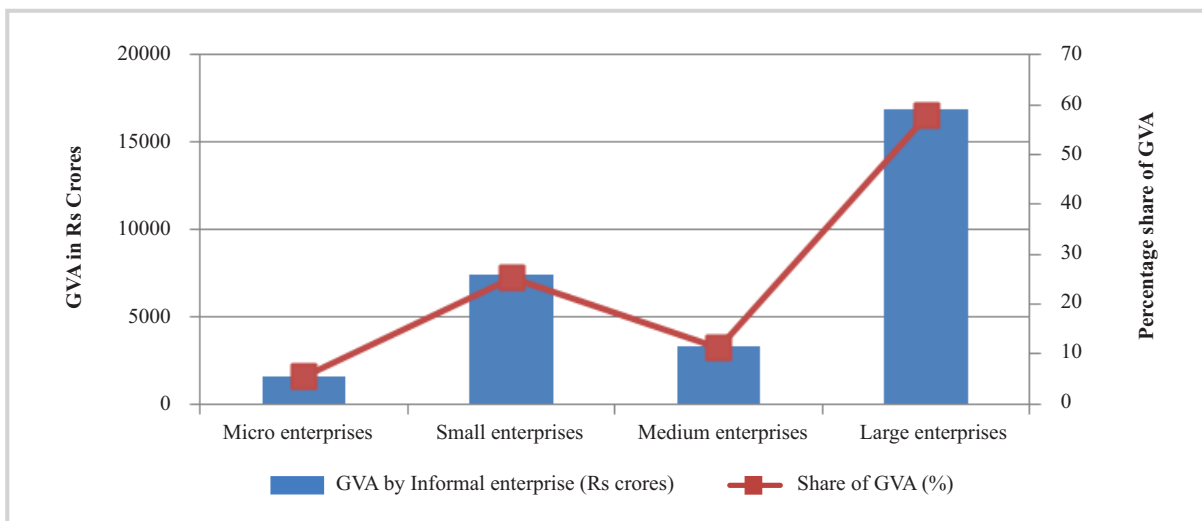
MSMEs in Informal sectors

Among the informal sector enterprises only micro enterprises are found to be involved in Manufacture of other chemical products. Their contribution to GVA is worth Rs 634 crores. Small and medium sized informal sector enterprises are conspicuously absent in the manufacturing of other chemical products.

MSME in Formal Sectors:

If we consider the Total GVA generated on a whole by the formal sectors in group 202, we observe that micro, small and medium enterprises hold 5.48%, 25.34%, 11.27% share of total GVA respectively (Figure 16). Within the formal sector the large scale enterprises contribute much more to GVA, which is around 57.88%.

Figure 16 : Share of GVA across various size classes in formal sectors of chemical industries

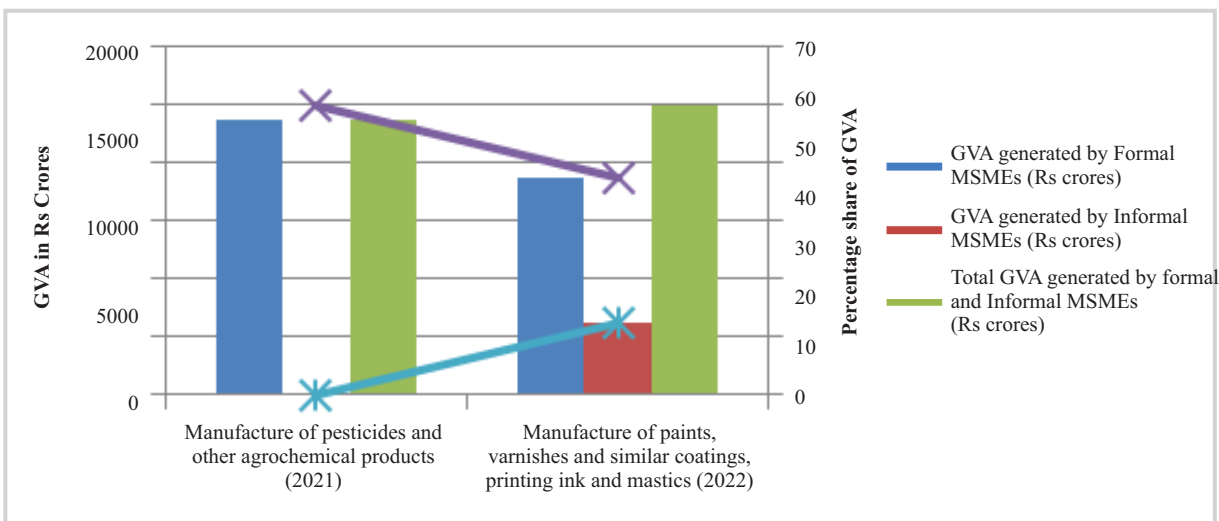


Source: Own estimates based on ASI 2009-10 data

It is discussed above that operating on a large scale seems compelling, as it would bring in economies of scale and would help the entrepreneur to reduce per unit cost and hence enable him/her to cope-up with the low margin that he faces. Moreover, in the formal sector, there happens to be lesser problems associated with access to credit and investment opportunities, so entrepreneurs can afford to increase their scale of operation.

Figure 17 compares the share of formal and informal MSMEs, in terms of contribution to GVA for each product category separately. As we can easily make out, distribution is biased towards formal enterprises.

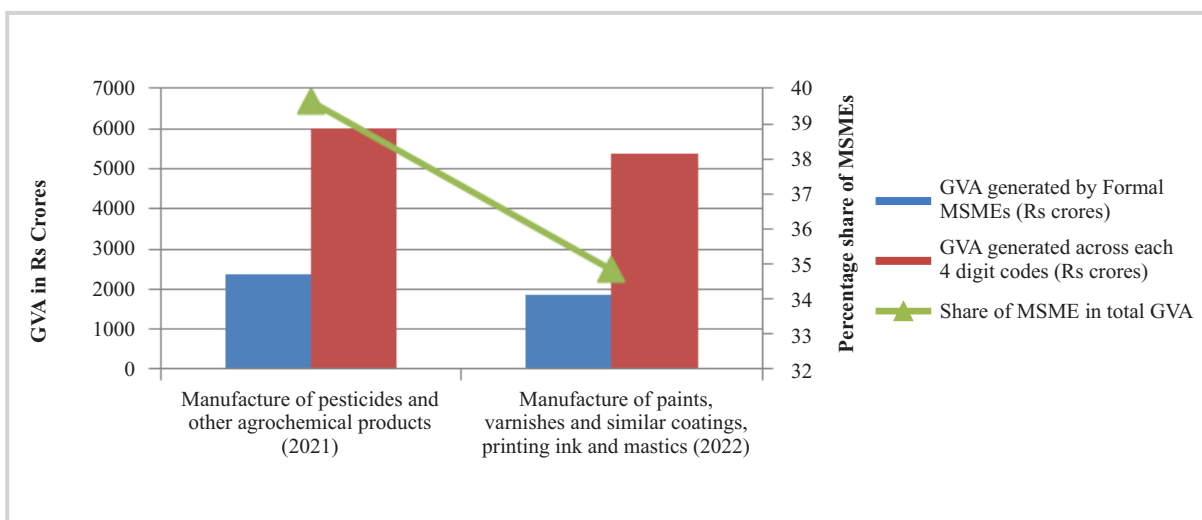
Figure 17 : Share of formal and Informal MSMEs in total GVA generated across each 4 digit code by MSMEs



Source: Own estimates based on ASI 2009-10 data and NSSO 67th Round data

Distribution of share of formal MSMEs in total GVA across each 4 digit product category is depicted in Figure 18. Among all the four digit product categories under 202, MSMEs involved in 'Manufacture of pesticides and other agrochemical products' contribute much more than the category, 'Manufacture of paints, varnishes and similar coatings, printing ink and mastics' to the total GVA. However, it is interesting to note that the number of enterprises involved in the former category is much lesser than those involved in the latter.

Figure 18 : Distribution of share of Formal MSMEs in total GVA across each 4 digit code



Source: Own estimates based on ASI 2009-10 data

Concentration of Enterprises

Concentration is analysed through Lorenz curve using two data sources. CMIE data cover only the listed enterprises. Using this data we will analyse the concentration of sales among the listed enterprises. ASI data also will be used. This data will show the concentration of value added among the registered factory units.

Figure 19 : Market Concentration (CMIE)

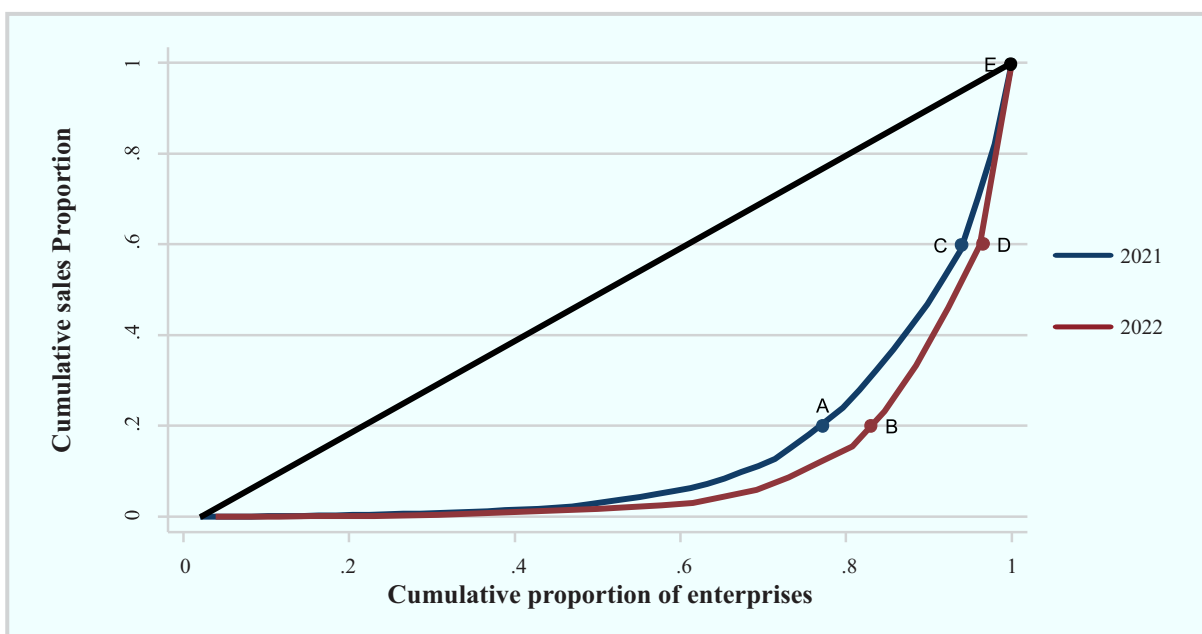


Figure 19 depicts the well known Lorenz Curve in order to explain the market concentration among enterprises under the two product categories. One can clearly figure out that for both the product categories, the total sales is quite unequally distributed, as the two curves (2021 and 2022) sink fairly below the line of equality. Figure 20 shows the market concentration of enterprises as per ASI data. The total GVA as per ASI also appears to be highly unequally distributed, as both the curves (2021 and 2022) sink extremely below the line of equality.

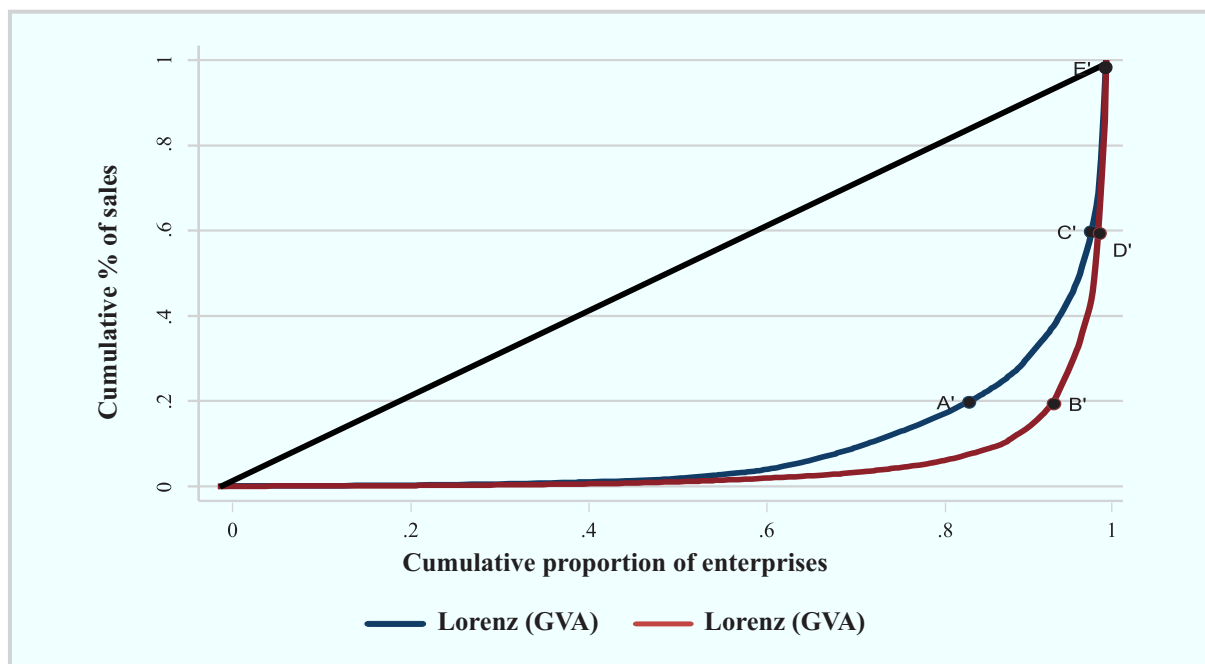
As per CMIE, under 2021 (*Manufacture of pesticides and other agrochemical products*), lowest 75% of enterprises approximately capture 20% of the total sales (see Figure 19, point A). This means that top 25% enterprises capture around 80% of the total sales. Also, line segment CE in figure 19 shows that 40% of the total sales is captured by just the top 10% enterprises. Thus, under this category, a large part of market is being captured by just a few enterprises. Therefore, we may say that a monopolistic kind of a market structure is present for this product category as per CMIE data.

As per ASI, under the same product category viz. 2021, lowest 85% of enterprises approximately, capture merely 20% of the total GVA generated under this product category, and the rest 80% of the total GVA is being captured by just the top 15% of enterprises (*see Figure 20, point A'*). Also, the (almost) vertical line segment C'E' shows that 40% of total sales is captured by top 1% enterprises. This support our conclusion for the enterprises under 2021, as per CMIE, that there seems to be an oligopolistic kind of a market structure present for this product category, because a large part of the market is being captured by just a few enterprises.

Next, under 2022 (*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*), as per CMIE, lowest 85% of enterprises capture approximately 20% of the total sales (*See Figure 19, point B*). This means that top 15% enterprises capture around 80% of the total sales. Also, line segment DE shows that 40% of total sales is captured by just the top 5% enterprises. Thus, under '*Manufacture of pesticides and other agrochemical products*' as well, there seems to exist a highly concentrated market structure.

As per ASI, under 2022, lowest 95% of enterprises capture just about 20% of the total GVA generated under this product category, and the rest 80% of the total GVA is being captured by just the top 5% of enterprises (*See Figure 20, point B'*). Also, the lowest 50% enterprises (approx.) capture almost negligible share of total GVA and the vertical line segment D'E' shows that around 40% of the total GVA is being captured by the top 1% enterprises. This again reinforces our conclusion for the enterprises under 2022, as per CMIE, that there seems to be an oligopolistic kind of a market structure present for this product category, because a large part of the market is being captured by just a few enterprises.

Thus, for both the product categories relating to chemical industry, we may say that a large part of the market is captured by just a few enterprises, indicating that a high degree of monopoly power is enjoyed by the top chemical enterprises of the country.

Figure 20 : Market Concentration (ASI)

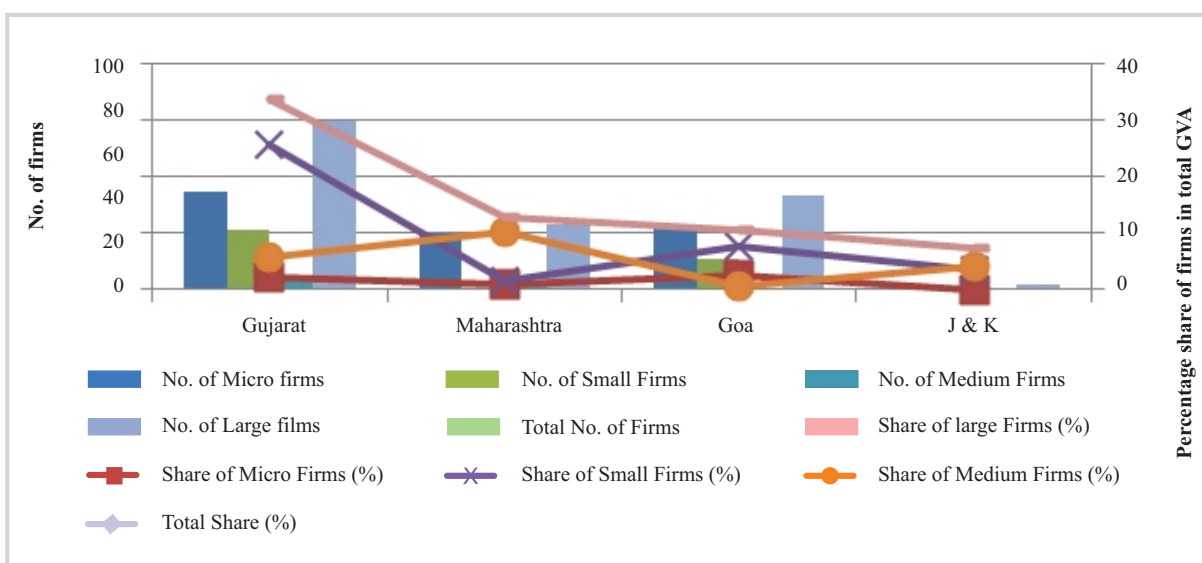
Note: Middle curve for code 2021 and extreme right curve for 2022

Regional distribution of enterprises:

Manufacture of pesticides and other agrochemical products (code 2021):

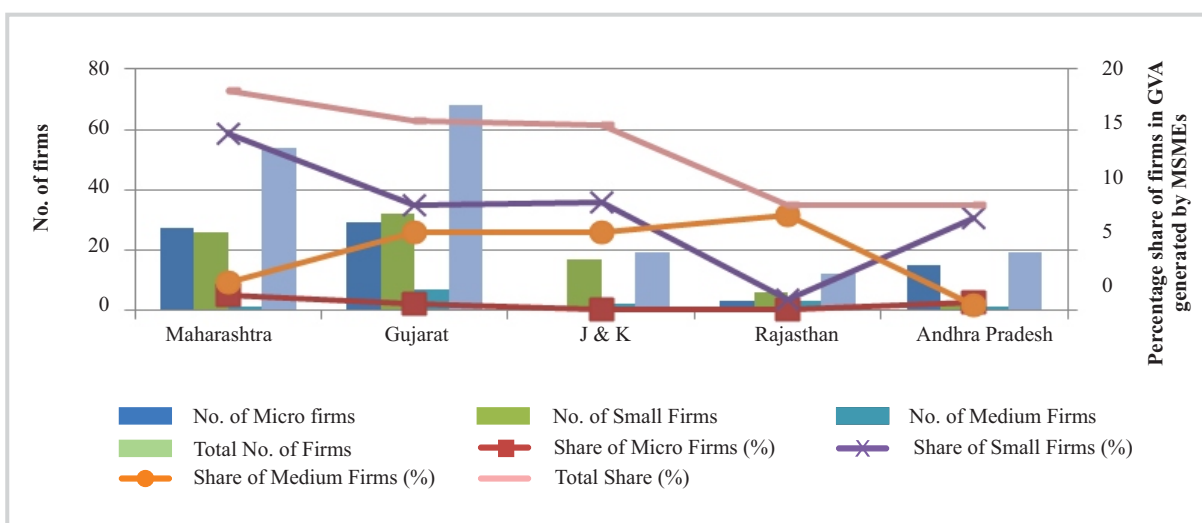
It may be seen in Figure 21 that Gujarat outperforms in terms of contribution to the total GVA generated under 'Manufacture of pesticides and other agrochemical products' (around 43.67%). Such a high contribution by Gujarat is partly due to the fact that the number of enterprises involved in this category in Gujarat is much higher than those in the other states. But, apart from that, as we saw earlier (in case of group 201), Gujarat also accounts for the highest production of major chemicals in India (53%; 2005-06). [*Indian Chemical Industry, XIIth Five Year Plan Report*]. Maharashtra ranks second (14.09%), followed by Goa (12.57%) and Jammu and Kashmir (6.72%).

Figure 21 : State wise Distribution of shares across different size classes in the total GVA generated under 2021



Source: Own estimates based on ASI 2009-10 data

Figure 22 : State wise Distribution of shares across different size classes in the total GVA generated by MSMEs under 2021



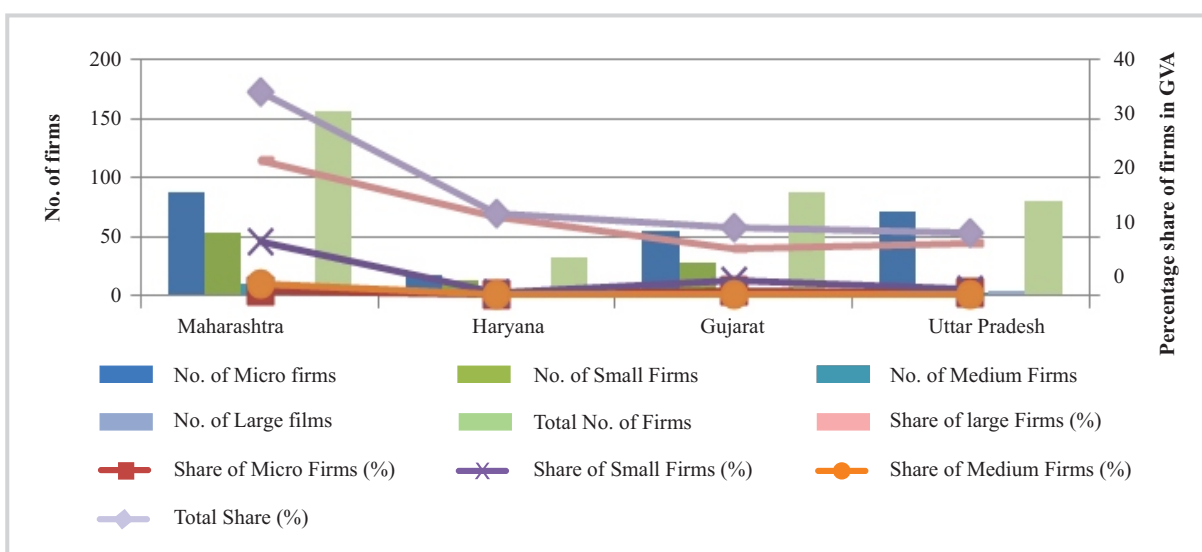
Source: Own estimates based on ASI 2009-10 data

Now, if we consider the MSMEs only, Maharashtra comes out as the leading state in terms of contribution to the total GVA generated under '*Manufacture of pesticides and other agrochemical products*' (18.19%), followed by Gujarat (15.76%), J & K (15.38%), Rajasthan (8.74%) and Andhra Pradesh (8.65%) (Figure 22).

Manufacture of paints, varnishes and similar coatings, printing ink and mastics (code 2022):

Under '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', the highest contribution to total GVA is by Maharashtra (34.58%), followed by Haryana (13.94%), Gujarat (11.46%), Uttar Pradesh (10.50%) and so on (Figure 23).

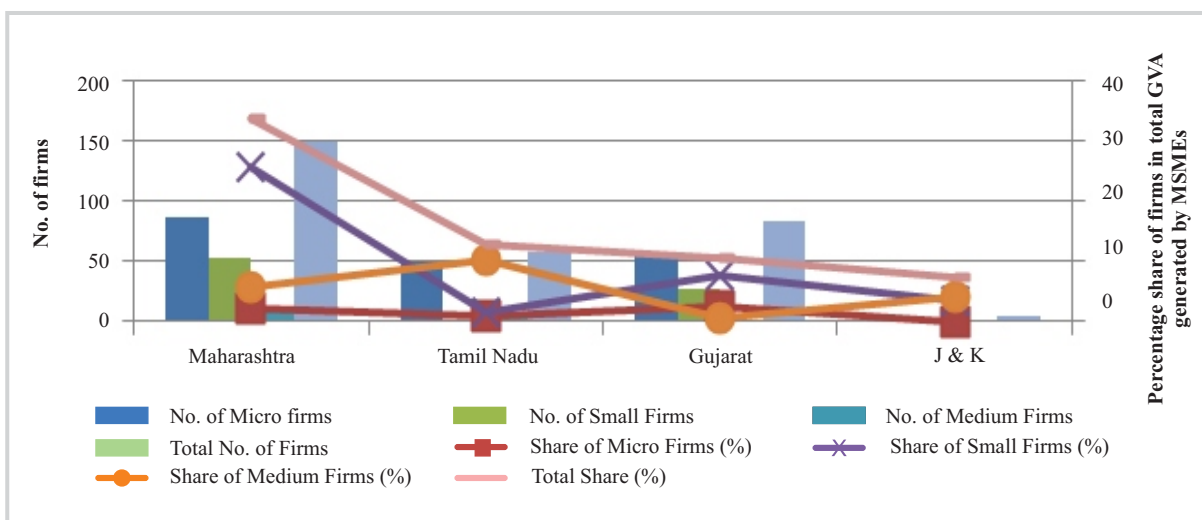
Figure 23 : State wise Distribution of shares across different size classes in the total GVA generated under 2022



Source: Own estimates based on ASI 2009-10 data

In case of MSMEs also the scenario is quite similar. Maharashtra remains as the leading state, contributing around 33.64% to the total GVA generated by MSMEs under '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*'. This state is followed by Tamil Nadu (12.78%). Gujarat ranks third with a contribution of 10.48% (Figure 24).

Figure 24 : State wise Distribution of shares across different size classes in the total GVA generated by MSMEs under 2022



Source: Own estimates based on ASI 2009-10 data

Business linkages between Large scale enterprises and MSMEs

As discussed above, there exist four different kinds of business linkages (contractual arrangements) between different MSMEs and large scale enterprises: (1) Contracting in but not contracting out; (2) Contracting out but not contracting in; (3) Both contracting in and out; (4) Neither contracting in nor contracting out.

Annexure Table b8 depicts the distribution of firms across different business linkages across size classes. One can easily deduce that out of the total of 172 micro enterprises involved in '*Manufacture of pesticides and other agrochemical products*', 118 (around 68.60%) enterprises contract in but not contract out. Also, out of the total of 448 enterprises involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', 310 (around 69.20%) enterprises contract in but not contract out.

It is apparent that these micro firms might outsource some of these activities to relatively large enterprises. Also, many large firms might be interested in developing relationships with such micro enterprises in order to reduce their procurement, production and distribution costs. This might be the reason why such a significant proportion of micro enterprises involved in both these product categories, 'contract in but not contract out'. On the other hand, merely 31 (around 18.02%) enterprises belonging to the former category and just 52 (around 11.61%) enterprises belonging to the latter category contract in as well as contract out. This fact is explicable as most of the large enterprises depend on local micro and small enterprises, as buying inputs and raw materials from these small enterprises can help these larger firms cut costs and increase

flexibility. It can raise quality, traceability and sustainability of supply.

It may also be seen that for the product category, '*Manufacture of pesticides and other agrochemical products*', a majority of the enterprises fall under 'Both contracting out and contracting in'. Also, for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', there are a relatively much higher proportion of enterprises involved in 'Both contract in and contract out'. This shows that as the enterprise expands, the business linkages with other enterprises improve, which seems to be quite explicable because, for a micro level enterprise, it may be very difficult to approach larger firms. Also, the potential output is not so high, which would require it to outsource some of it to other firms.

A similar kind of a scenario can be seen for the product category '*Manufacture of pesticides and other agrochemical products*'. Most of the large enterprises under this category, 'Both contract in and contract out'. Out of a total of 37 enterprises, 24 (around 64.86%) enterprises, both contract in and contract out'.

However, for the other product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', a majority of large enterprises fall under 'Contracting in but not contracting out'. Out of a total of 26 enterprises, 18 (around 69.23%) enterprises fall under 'Contracting in but not contracting out'. However, one could argue that the total firms in this category are too few to infer anything. Still, if we are to give a probable reason for such a scenario, this might be because these large firms may be looking to explore opportunities to raise revenues.

Age wise pattern of contractual linkages

The pattern of contractual linkages based on age groups substantiates the fact that a very high proportion of the young enterprises contract in but not out. This seems to be quite obvious. During the initial stages of operation the entrepreneurs might want to assure their business and to get input and output markets. Also, initially, they might not have sufficient capital and funds so as to start production on a larger scale (particularly true for micro enterprises).

Estimates of the age-wise distribution of contractual linkages for micro, small, medium and large enterprises are provided in Annexure tables b9.1, b9.2, b9.3 and b9.4 respectively across each of the four digit product category. Considering micro enterprises first, out of the total firms which started not more than 10 years ago, for the product category, '*Manufacture of pesticides and other agrochemical products*', 51.92% firms, contract in but not out, for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', around 64% firms contract in but not out.

In the case of small enterprises, out of the total firms which have started not more than 10 years ago, for the product category, '*Manufacture of pesticides and other agrochemical products*', around 50.53% firms contract in but not out, and for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', around 56.25% firms contract in but not out.

Here again there are too few medium and large enterprises, which have started not more than 10 years ago, for any analysis to be drawn.

Still, for the large enterprises involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*' we observe that out of 12 firms, which were started not more than ten years ago, 10 firms are found to 'Contracting in but not contracting out', which accounts for around 83.33%. Thus, we may infer that most of the enterprises, when young, contract in but not contract out. As this scenario is true for all sized enterprises, viz. micro, small and large, we may speculate that these enterprises might be contracting in some of their works from other enterprises lying outside chemical industry.

Also, as the last columns of the tables indicate there are a very low percentage of small and medium enterprises which started more than 31 years ago. This suggests that most of the SMEs are young. On the other hand, for the large enterprises, there are a relatively larger proportion of enterprises which started more than 31 years ago. They are more established, matured and solvent. Also, there is a large proportion of micro enterprises, which started more than 31 years ago but did not grow in size.

Productivity and Capital Intensity of MSMEs

The productivity, measured in terms of value added per labor is much higher in large firms as compared to the MSMEs in the formal sector (Annexure table b 10.1). In fact value added per labour systematically increases with the size classes and so is the capital intensity. The reason behind such low productivity in micro and small enterprises could be the use of more labor intensive techniques instead of up graded machine technology. MSMEs often do not have access to up dated technologies, as a result continue manufacturing goods using conventional and labor intensive technologies. Although, chemical industry is considered to be one of the most capital intensive industries, but the micro and small units generally remain devoid of enough funds as well as skilled workers.

It is thus apparent that MSMEs in chemical industry face a number of challenges, including high cost of capital, onerous regulatory compliance (especially in terms of health, safety and environment), dearth of technical skills and difficult or no access to international markets.

Productivity of Formal enterprises and business links

Annexure Table 11 shows GVA per labor (or labor productivity) and capital per labour (or capital intensity) of formal micro, small, medium and large enterprises, under each business linkage and across each product category. It is worth noting that the labor productivity (GVA/L) of micro sized enterprises is highest for the ones, which contract in as well as contract out, irrespective of the product category in which they are involved. This might be because of the fact that while 'contracting in', on one hand, may provide the workers with considerable exposure to the market and technology and may increase their efficiency by making them more professional in their approach and thereby augmenting labor productivity. Contracting out, on the other hand, may

facilitate greater specialization as it allows the enterprises to specialize in producing the goods in which they are relatively more productive and contract out a part of their prospective output to other firms. This leads to an increase in labour productivity.

The capital labor ratio (or capital intensity), for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*' is highest under 'Contracting in but not Contracting out' for the micro and large firms, whereas, for the small and medium firms, it is under 'Neither contracting in nor contracting out'.

Now, considering the productivity figures (GVA/L) for the product category, '*Manufacture of pesticides and other agrochemical products*', for all the enterprises, barring medium sized enterprises, the labour productivity (GVA/L) as well as the capital intensity (K/L) are the highest, under the same business linkage category. In other words, for all the micro, small and large enterprises involved in '*Manufacture of pesticides and other agrochemical products*', having the highest labour productivity and capital labour ratio, respectively, belong to the same business linkage category. Thus, it might be quite interesting to study the correlation between the capital intensity and labour productivity over a period of time for a particular sized firm.

Export Scenario

Annexure Table b12 shows the contribution of each product category under code 202 in the chemical industry towards exports. As we can clearly see, the highest contribution is made by the product category, '*Manufacture of pesticides and other agrochemical products*' (36.17%).

Annexure Table b13.1 displays the contribution of firms in total exports for each four digit code. As we have seen in the case of code 201, the contribution by MSMEs to total exports is very low, as compared to that by the large firms for the product category, '*Manufacture of pesticides and other agrochemical products*'. Further, contribution to total exports by MSMEs for the product category, '*Manufacture of pesticides and other agrochemical products*' is just 27.38% and the rest is by the large firms. On the other hand, for the product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', the contribution by MSMEs is very high. MSMEs contribute around 62.49% to the total exports. This is quite surprising and may be seen as a positive sign. This shows that probably, MSMEs are more competent and efficient in producing export oriented commodities. MSMEs may be more cost efficient, as the investment involved is lower than the large firms and the risk involved is relatively low.

Annexure table b13.2 shows the distribution of firms across different business linkages and the exports for each size classes. It may be seen that for both the product categories, the micro enterprises, which contract in but do not contract out contribute the highest to the total exports, i.e. 89.68% and 95.65% respectively. Also, it is worth specifying that the number of firms falling under this business linkage category for the former product category is extremely low (around 25%). Thus, one may infer that a high proportion of micro firms involved in '*Manufacture of pesticides and other agrochemical products*' which are highly efficient in producing export oriented commodities.

Also, as we can see, there is not even a single MSME in either product category, which contracts out but does not contract in. As we had explained in case of group 201, this may be due to the fact that during the initial stages, when the firm is relatively small in size, it may be very difficult for it to deal with the international firms directly, in the sense that contracting out a part of their potential output to the international firms may involve various challenges like, setting of wages of the international workers, as initially, entrepreneur may have very little idea about the situation of the global labor market. Moreover, in the chemical industry particularly, there is very little scope for product differentiation, which provides the importing international firm with a range of options to choose from. Thus, in case an international firm finds that a domestic firm is dependent on other firms for a part of their output (i.e. contracting out), it may decide against placing the order of export to that firm and may choose some other firm, from a bunch of firms, selling more-or-less, a similar kind of product.

For large enterprises, the largest number of exporting firms belongs to the category of 'Both contracting in and out', for both the product categories. This seems to be logical, considering the fact that as a firm expands in size, it builds new relationships with other firms, by working for them as well as outsourcing some of the work to them.

Annexure tables b14.1, b14.2, b14.3 and b14.4 display regional distribution of exports by micro, small, medium and large enterprises respectively. Among the exporting micro enterprises involved in '*Manufacture of pesticides and other agrochemical products*', around 88.98% are located in Tamil Nadu. Among those involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', 95.74% are located in Uttar Pradesh.

In the case of the exporting small enterprises in '*Manufacture of pesticides and other agrochemical products*', around 73.81% are located in Haryana, of those involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', 98.68% are located in Maharashtra.

Among the exporting medium enterprises involved in the '*Manufacture of pesticides and other agrochemical products*', 57.27% are located in Maharashtra and around 39.56% in Gujarat, and of those involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', 60.94% are located in Uttar Pradesh, while the remaining 39.06% are located in Gujarat. These are the only two states which have exporting medium sized enterprises in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*'.

Among the exporting large enterprises involved in '*Manufacture of pesticides and other agrochemical products*', 56.65% are located in Maharashtra, of those involved in '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*', 92.48% are located in Maharashtra.

Annexure Tables to Chapter 3

<i>Annexure Table b1 : Distribution of firms across different business linkages for Microenterprises</i>					
<i>Product Category</i>	<i>Contracting in but not contracting out</i>	<i>Contract out but not contract in</i>	<i>Both contract out and contract in</i>	<i>Neither contract in or contract out</i>	<i>Total Number of Micro enterprises</i>
Micro					
Basic chemicals	630	44	837	203	1,714
Fertilizers & nitrogen compounds	201	8	184	43	436
Plastics & synthetic rubber	90	-	116	25	231
Small					
Basic chemicals	450	46	166	114	776
Fertilizers & nitrogen compounds	100	14	39	40	193
Plastics & synthetic rubber	54	13	19	20	106
Medium					
Basic chemicals	48	6	32	10	96
Fertilizers & nitrogen compounds	5	-	10	5	20
Plastics & synthetic rubber	8	-	6	-	14
Large					
Basic chemicals	98	0	89	22	209
Fertilizers & nitrogen compounds	23	1	10	4	38
Plastics & synthetic rubber	19	1	10	5	35

Source: Own estimates based on ASI 2009-10 data

Annexure Table b2.1: Agewise distribution of contractual linkages of Micro enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of basic chemicals (2011)	1	6				6	0.71
	2	11		6		17	2.01
	3	18		10		28	3.30
	4	26				26	3.07
	5	19		7		26	3.07
	6 to 10	85	9	16	38	148	17.45
	11 to 15	130	15	20	36	201	23.70
	16 to 20	70	5	15	26	116	13.68
	21 to 30	104	15	40	40	199	23.47
	31 to 50	43		11	12	66	7.78
	Above 51	4			11	15	1.77
	All	516	44	125	163	848	
Manufacture of fertilizers and nitrogen compounds (2012)	1	6		6		12	5.36
	2	11				11	4.91
	3	9				9	4.02
	4	5				5	2.23
	5	10	2			12	5.36
	6 to 10	43			1	44	19.64
	11 to 15	44	6	2	16	68	30.36
	16 to 20	23			11	34	15.18
	21 to 30	7		6	6	19	8.48
	31 to 50	7			3	10	4.46
	Above 51						0
	All	165	8	14	37	224	
Manufacture of plastics and synthetic rubber in primary forms (2013)	1	5				5	4.67
	2	1				1	0.93
	3						0
	4	10		5	5	20	18.69
	5						0
	6 to 10	10			5	15	14.02
	11 to 15	16			5	21	19.63
	16 to 20	23		3		26	24.30
	21 to 30	8		4		12	11.22
	31 to 50	1			6	7	6.54
	Above 51						0
	All	74		12	21	107	

Source: Own estimates based on ASI 2009-10 data

Annexure Table b2.2:Agewise distribution of contractual linkages of Small enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of basic chemicals (2011)	0	2				2	0.3
	1	7				7	1.057
	2	18	5	11	10	44	6.65
	3	26		8	6	40	6.04
	4	11		5		16	2.42
	5	49	10	11		70	10.57
	6 to 10	75	5	10	26	116	17.52
	11 to 15	59	10	37	31	137	20.69
	16 to 20	36	11	18	5	70	10.57
	21 to 30	58		34	16	108	16.31
	31 to 50	19	4	10	1	34	5.14
	Above 51	12	1	5		18	2.72
	All	372	46	149	95	662	
Manufacture of fertilizers and nitrogen compounds (2012)	0			1		1	0.61
	1	1				1	0.61
	2	10				10	6.1
	3	12		4	5	21	12.8
	4	11			5	16	9.76
	5	5	5		9	19	11.59
	6 to 10	11	9	13		33	20.12
	11 to 15	16		8	15	39	23.78
	16 to 20	1		5	6	12	7.32
	21 to 30	8		1		9	5.49
	31 to 50	3				3	1.83
	Above 51						
	All	78	14	32	40	164	
Manufacture of plastics and synthetic rubber in primary forms (2013)	0						0
	1	3				3	3.37
	2	9				9	10.11
	3		5	1	5	11	12.36
	4	5				5	5.62
	5	5		6		11	12.36
	6 to 10	16			10	26	29.21
	11 to 15	1	2			3	3.37
	16 to 20	1				1	1.12
	21 to 30	6	6	6		18	20.22
	31 to 50	1				1	1.12
	Above 51	1				1	1.12
	All	48	13	13	15	89	

Source: Own estimates based on ASI 2009-10 data

Table b2.3: Agewise distribution of contractual linkages of Medium enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of basic chemicals (2011)	1			1		1	1.04
	2			2		2	2.08
	6 to 10	1		11	5	17	17.71
	11 to 15	10		5	5	20	20.83
	16 to 20	1	5			6	6.25
	21 to 30	34	1	8		43	44.79
	31 to 50	2		5		7	7.29
	Above 51						0.00
	All	48	6	32	10	96	
Manufacture of fertilizers and nitrogen compounds (2012)	1			1		1	12.50
	2						0.00
	6 to 10						0.00
	11 to 15						0.00
	16 to 20						0.00
	21 to 30				5	5	62.50
	31 to 50						0.00
	Above 51			2		2	25.00
	All			3	5	8	
Manufacture of plastics and synthetic rubber in primary forms (2013)	1						0.00
	2						0.00
	6 to 10						0.00
	11 to 15	5		6		11	78.57
	16 to 20	2				2	14.29
	21 to 30	1				1	7.14
	31 to 50						0.00
	Above 51						0.00
	All	8		6		14	

Source: Own estimates based on ASI 2009-10 data

Annexure Table b2.4:Agewise distribution of contractual linkages of Large enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of basic chemicals (2011)	0						0.00
	1	6		5	1	12	6.19
	2	2			1	3	1.55
	3	5		2		7	3.61
	4	3		5		8	4.12
	5			4		4	2.06
	6 to 10	22		6	5	33	17.01
	11 to 15	7		19	5	31	15.98
	16 to 20	11		16	4	31	15.98
	21 to 30	11		15	1	27	13.92
	31 to 50	17		9	1	27	13.92
	Above 51	2		7	2	11	5.67
	All	86		88	20	194	
Manufacture of fertilizers and nitrogen compounds (2012)	0	1				1	2.86
	1						0.00
	2						0.00
	3	1				1	2.86
	4	1			1	2	5.71
	5				1	1	2.86
	6 to 10						0.00
	11 to 15						0.00
	16 to 20	2				2	5.71
	21 to 30	5		4	1	10	28.57
	31 to 50	11	1	3	1	16	45.71
	Above 51			2		2	5.71
	All	21	1	10	3	35	
Manufacture of plastics and synthetic rubber in primary forms (2013)	0				1	1	3.03
	1			1		1	3.03
	2	9				9	27.27
	3			1	1	2	6.06
	4	5				5	15.15
	5	5		6		11	33.33
	6 to 10	6				6	18.18
	11 to 15			2	1	3	9.09
	16 to 20	2	1	1		4	12.12
	21 to 30	7		2		9	27.27
	31 to 50	3		3	1	7	21.21
	Above 51						0.00
	All	18	1	10	4	33	

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b3:VAD/L for MSME and large firms under each four digit code in formal sector</i>							
		<i>Formal Sector Enterprises</i>				<i>Informal Sector Enterprises</i>	
		Micro	Small	Medium	Large	Micro	Small
<i>Manufacture of Basic chemicals</i>	<i>Total GVA (Rs Crores)</i>	509	1980	1790	11200	118	-
	<i>K/L (Rs)</i>	179894	577168	945014	3046432	223459	-
	<i>GVA/L (Rs)</i>	362821	693358	1772452	2877963	95392	-
<i>Manufacture of Fertilizer and Nitrogen compounds</i>	<i>Total GVA (Rs Crores)</i>	124	534	303	8850	3.52	-
	<i>K/L (Rs)</i>	129486	394242	1017293	4211700	9421	-
	<i>GVA/L (Rs)</i>	297059	740453	449035	2236608	18342	-
<i>Manufacture of plastics and synthetic rubber in primary forms</i>	<i>Total GVA (Rs Crores)</i>	222	278	173	11500	128	4.92
	<i>K/L (Rs)</i>	131521	606604	1298600	5328807	104049	472500
	<i>GVA/L (Rs)</i>	449400	626835	1340444	2751926	84302	25208

Source: Own estimates based on ASI 2009-10 data

Annexure Table b4: Pattern of VAD/L and K/L for MSMEs and Large enterprises across different patterns of business links for the four digit product categories (Figures in Rs)					
Product Category	Items	Contracting in but not contracting out	Contracting out but not Contracting in	Both Contracting in and Contracting out	Neither Contracting in nor Contracting out
Micro enterprises					
2011	K/L	213552.3	60246.64	147307.9	130718.1
	GVA/L	370526.3	241289.8	502895.5	269939.2
2012	K/L	127244.7	83114.91	200904.6	122486.2
	GVA/L	234005.7	703213.1	359829.8	466673.5
2013	K/L	118780.2		133764	177561.3
	GVA/L	445124.5		524063.8	422617
Small enterprises					
2011	K/L	517738.3	609790.5	518422.8	872543.8
	GVA/L	697728.1	739481.9	798990.2	497346.3
2012	K/L	464498.9	453851.9	318180	297227.1
	GVA/L	598051.5	458956.9	645700.9	1192463
2013	K/L	739279.9	502167.3	483861	402813.5
	GVA/L	556970.4	420737.5	1059377	543464.4
Medium enterprises					
2011	K/L	851376.7	1431186	945180.5	1102232
	GVA/L	2124645	1483546	1518752	1067110
2012	K/L			1170982	925080.4
	GVA/L			528979	401068.2
2013	K/L	460421.3		2416172	
	GVA/L	828242.1		2023379	
Large enterprises					
2011	K/L	3286498		2851372	2860413
	GVA/L	1188847		1836060	14800000
2012	K/L	4721304	862766.1	3685447	3514959
	GVA/L	2384606	615096	1865449	2978323
2013	K/L	4391543	12600000	7361015	2636370
	GVA/L	3095549	6890387	2472994	868334.6

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b5: Distribution of Export across each four digit code</i>			
<i>Product categories</i>	<i>Export under each group (Rs crores)</i>	<i>Total export of formal enterprises under group 201 (Rs. crores)</i>	<i>Share of each 4 digit code (%)</i>
2011	4530	5571	81.32
2012	66.8	5571	1.20
2013	974	5571	17.48

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b6.1: Contribution of Firms in total exports of each four digit code</i>											
<i>Product code</i>	<i>Total export (Rs Crores)</i>	<i>Micro enterprises</i>		<i>Small enterprises</i>		<i>Medium enterprises</i>		<i>Large enterprises</i>		<i>Total share of MSMEs</i>	<i>Total</i>
		<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>		
2011	4530	1.03	4.75	15.08	10.75	6.25	13.54	77.48	23.59	22.36	100
2012	66.8	0	0	3.22	2.44	0	0	96.86	8.57	3.22	100
2013	974	0	0	1.19	14.89	0	0	98.77	36.36	1.19	100

Source: Own estimates based on ASI 2009-10 data

Annexure Table b6.2: Distribution of firms across different business links and their relative exports across size classes									
Product code	Total export (Rs Crores)	Contracting in but not out		Contracting out but not in		Both in and out		Neither in nor out	
		Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)
Micro									
2011	46.9	56.29	35.71	6.33	23.81	26.23	16.67	11.215352	23.81
2012	0	0	-	0	-	0	-	0	-
2013	0	0	-	0	-	0	-	0	-
Small									
2011	683	43.34	45.83	0.46	8.33	51.83	30.55	4.42	15.28
2012	2.15	0	0	0	0	0	0	100	100
2013	11.6	100	100	0	0	0	0	0	0
Medium									
2011	283	0.52	7.69	4.27	7.69	92.93	46.15	2.42	38.46
2012	0	0	-	0	-	0	-	0	-
2013	0	0	-	0	-	0	-	0	-
Large									
2011	3510	70.65	50	0	0	28.38	39.96	1.13	13.04
2012	6470	84.23	66.67	0	0	15.76	33.33	0	-
2013	962	45.84	75	0	0	52.81	16.67	1.41	8.33

Source: Own estimates based on ASI 2009-10 data

Annexure Table b7.1: Regional distribution of exports by Micro enterprises			
States	Manufacture of basic chemicals (2011) (% share)	Manufacture of fertilizers and nitrogen compounds (2012) (% share)	Manufacture of plastics and synthetic rubber in primary forms (2013) (% share)
Maharashtra	51.38		
Gujarat	38.17		
Haryana	9.04		
Delhi	1.33		
Others	0	-	-
Total	100	-	-

Annexure Table b7.2: Regional distribution of exports by Small enterprises

<i>States</i>	<i>Manufacture of basic chemicals (2011)</i>	<i>Manufacture of fertilizers and nitrogen compounds (2012)</i>	<i>Manufacture of plastics and synthetic rubber in primary forms (2013)</i>
Gujarat	47.44		
Maharastra	38.21		19.40
Andhra Pradesh	9.11		
Kerala	3.54		7.94
Uttar Pradesh	1.68		
Rajasthan		100	71.12
Haryana			1.79
Other	0	0	0
Total	100	100	100

Annexure Table b7.3: Regional distribution of exports by Medium enterprises

<i>States</i>	<i>Manufacture of basic chemicals (2011)</i>	<i>Manufacture of fertilizers and nitrogen compounds (2012)</i>	<i>Manufacture of plastics and synthetic rubber in primary forms (2013)</i>
Kerala	90.46		
Maharastra	9.15		
Uttar Pradesh	0.52		
Others	-	-	-
Total	100	-	-

<i>Annexure Table b7.4: Regional distribution of exports by Large enterprises</i>			
<i>States</i>	<i>Manufacture of basic chemicals (2011)</i>	<i>Manufacture of fertilizers and nitrogen compounds (2012)</i>	<i>Manufacture of plastics and synthetic rubber in primary forms (2013)</i>
Maharastra	40.74	84.23	69.54
Uttar Pradesh	22.48		
Punjab	21.34		
Kerala		15.77	
West Bengal	0.28		24.84
Andhra Pradesh			5.69
Other	15.16	0	0
Total	100	100	100

<i>Annexure Table b8: Distribution of firms across different business linkages across size classes</i>					
<i>Product Category</i>	<i>Contracting in but not contracting out</i>	<i>Contract out but not contract in</i>	<i>Both contract out and contract in</i>	<i>Neither contract in or contract out</i>	<i>Total Number of Micro enterprises</i>
Micro Size					
2021	118		31	23	172
2022	310	1	52	85	448
Small Size					
2021	60	6	53	23	142
2022	84	20	42	27	173
Medium Size					
2021	6	1	16	1	24
2022	15		10	2	27
Large Size					
2021	9	2	24	2	37
2022	18		5	3	26

Source: Own estimates based on ASI 2009-10 data

Annexure Table b9.1: Agewise distribution of contractual linkages of Micro enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of pesticides and other agrochemical products (2021)	1						
	2	2				2	1.16
	3			5		5	2.91
	4	1			3	4	2.33
	5	11				11	6.40
	6 to 10	13		9	8	30	17.44
	11 to 15	15		7	6	28	16.28
	16 to 20	23				23	13.37
	21 to 30	27				27	15.70
	31 to 50	18		5	5	28	16.28
	Above 51	8		5	1	14	8.14
	All	118		31	23	172	
Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022)	1	4				7	0.89
	2	11			5	16	3.57
	3	10		5		15	3.35
	4	10				10	2.23
	5	6		6		12	2.68
	6 to 10	39		8	21	68	15.18
	11 to 15	55	1	4	1	61	13.62
	16 to 20	27		5	5	37	8.26
	21 to 30	88		19	24	131	29.24
	31 to 50	42		5	24	71	15.85
	Above 51	18			5	23	5.13
	All	310	1	52	85	448	

Source: Own estimates based on ASI 2009-10 data

Annexure Table b9.2: Agewise distribution of contractual linkages of Small enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of pesticides and other agrochemical products (2021)	0		1			1	0.70
	1	5				5	3.52
	2	8		1		9	6.34
	3	5		5	6	16	11.27
	4	1		5		6	4.23
	5	18		10	2	30	21.13
	6 to 10	11	5	9	3	28	19.72
	11 to 15	1		8		9	6.34
	16 to 20	7		1	8	16	11.68
	21 to 30	2		14	4	20	14.08
	31 to 50	2				2	1.41
	Above 51						
	All	60	6	53	23	142	
Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022)	0			1		1	0.58
	1	20			4	24	13.95
	2		10	5	5	20	11.63
	3	3			5	8	4.65
	4	2				2	1.16
	5	20		2		22	12.79
	6 to 10	18	5	7	5	35	20.35
	11 to 15	6	5	15	7	33	19.19
	16 to 20	12		10		22	12.79
	21 to 30	2		1		3	1.75
	31 to 50	1		1		2	1.16
	Above 51						
	All	84	20	42	26	172	

Source: Own estimates based on ASI 2009-10 data

Annexure Table b9.3: Age wise distribution of contractual linkages of Medium enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of pesticides and other agrochemical products (2021)	1						0.00
	2						0.00
	3		1			1	4.17
	4	1				1	4.17
	5						0.00
	6 to 10	2		3		5	20.83
	11 to 15	1		7		8	33.33
	16 to 20	1				1	4.17
	21 to 30			6		6	25.00
	31 to 50				1	1	4.17
	Above 51	1				1	4.17
	All	6	1	16	1	24	
Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022)	1					1	3.70
	2	6		5		11	40.74
	3						0.00
	4						0.00
	5				1	1	3.70
	6 to 10	1		5		6	22.22
	11 to 15	1				1	3.70
	16 to 20	5				5	18.52
	21 to 30	1				1	3.70
	31 to 50						0.00
	Above 51	1				1	3.70
	All	15		10	2	27	

Source: Own estimates based on ASI 2009-10 data

Annexure Table b9.4: Agewise distribution of contractual linkages of Large enterprises across Four digit product categories							
Product Category	Age (In years)	Contracting in but not contracting out (In numbers)	Contract out but not contract in (In numbers)	Both contract out and contract in (In numbers)	Neither contract in or contract out (In numbers)	All	% within each code
Manufacture of pesticides and other agrochemical products (2021)	1				1	1	2.70
	2						0
	4			1		1	2.70
	5			2		2	5.41
	6 to 10			3		3	8.11
	11 to 15	2		7		9	24.32
	16 to 20	3		4		7	18.92
	21 to 30	2	1	2	1	6	16.22
	31 to 50	2	1	4		7	18.92
	Above 51			1		1	2.70
	All	9	2	24	2	37	
Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022)	1	2				2	7.69
	2	6				6	23.08
	4						0
	5				2	2	7.69
	6 to 10	2				2	7.69
	11 to 15	3				3	11.54
	16 to 20	3			1	4	15.38
	21 to 30	2				2	7.69
	31 to 50			3		3	11.54
	Above 51			2		2	7.69
	All	18		5	3	26	

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b 10.1: VAD/L for MSME and large firms under each four digit code in formal sector</i>					
		Micro	Small	Medium	Large
2021	<i>Total GVA (Rs Crores)</i>	125	1430	823	3620
	<i>K/L (Rs)</i>	106794	283323	503702	1715330
	<i>GVA/L (Rs)</i>	292086	976735	1304746	2352643
2022	<i>Total GVA (Rs Crores)</i>	216	1100	552	3490
	<i>K/L (Rs)</i>	82454	482005	1269003	1036625
	<i>GVA/L (Rs)</i>	252432	1107062	1754423	2617963

<i>Annexure Table b 10.2: VAD/L for MSME and large firms under each four digit code in informal sector (Figures in Rs)</i>			
		Micro	Small
2021	<i>Total GVA (Rs Crores)</i>	25500000	-
	<i>K/L</i>	12450	-
	<i>GVA/L</i>	22711	-
2022	<i>Total GVA</i>	6310000000	-
	<i>K/L</i>	63948	-
	<i>GVA/L</i>	122668	-

Annexure Table b 11: Pattern of VAD/L and K/L for different enterprises across different patterns of business links for the four digit product categories (Figures in Rs)					
Product Category		Contracting in but not contracting out	Contracting out but not Contracting in	Both Contracting in and Contracting out	Neither Contracting in nor Contracting out
Micro enterprises					
2021	GVA/L	259901		392074	322437
	K/L	106766		109093	103841
2022	GVA/L	258036	177577	336066	181710
	K/L	89580	25307	87004	54352
Small enterprises					
2021	GVA/L	608406	974533	1178255	1473793
	K/L	287418	214996	220412	435435
2022	GVA/L	1027035	763362	1708037	675781
	K/L	492146	452168	415519	575977
Medium enterprises					
2021	GVA/L	2236410	1784543	968257	618799
	K/L	347708	1073849	546750	180750
2022	GVA/L	2245141		1153910	1076597
	K/L	807356		918880	6481974
Large enterprises					
2021	GVA/L	1444896	2289193	2807637	1041026
	K/L	1117830	1196760	1980130	1745041
2022	GVA/L	2046890		2674282	5950536
	K/L	1182334		692467	735969

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b12: Distribution of Export across each four digit code</i>			
<i>Product categories</i>	<i>Export under each group (Rs crores)</i>	<i>Total export of formal enterprises under group 201 (Rs crores)</i>	<i>Share of each 4 digit code (%)</i>
2021	2340	6470	36.17
2022	299	6470	4.62

Source: Own estimates based on ASI 2009-10 data

<i>Annexure Table b13.1: Contribution of Firms in total exports of each four digit code</i>											
<i>Product code</i>	<i>Total export (Rs Crores)</i>	<i>Micro enterprises</i>		<i>Small enterprises</i>		<i>Medium enterprises</i>		<i>Large enterprises</i>		<i>Total share of MSMEs</i>	<i>Total</i>
		<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>	<i>Share in total export (%)</i>	<i>Share of firms (%)</i>		
2021	2340	0.54	9.76	17.14	48.78	9.70	7.32	72.65	34.15	27.38	100
2022	299	1.69	5.88	50.84	79.41	9.97	5.88	37.46	8.82	62.49	100

Source: Own estimates based on ASI 2009-10 data

Annexure Table b13.2: Distribution of firms across different business links and their relative exports across size classes									
	Total export (Rs Crores)	Contracting in but not out		Contracting out but not in		Both in and out		Neither in nor out	
		Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)	Share in total export (%)	Share of firms (%)
Micro									
2021	12.6	89.68	25	0	0	0	0	10.71	75
2021	5.06	95.65	50	0	0	0	0	4.26	50
Small									
2021	401	8.93	10	0	0	90.02	85	0.99	5
2021	152	23.88	55.56	0	0	75.66	25.92	0.15	18.52
Medium									
2021	227	42.55	66.67	0	0	0	0	57.27	33.33
2021	29.8	100	100	0	0	0	0	0	0
Large									
2021	1700	26.53	14.29	2.37	7.14	71.18	78.57	0	0
2021	112	1.32	33.33	0	0	99.11	66.67	0	0

<i>Annexure Table b14.1: Regional distribution of exports by Micro enterprises</i>		
<i>States</i>	<i>Manufacture of pesticides and other agrochemical products (2021) (% share)</i>	<i>Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022) (% share)</i>
Rajasthan	10.63	
Tamil Nadu	88.98	
Uttar Pradesh		95.74
Maharastra		4.26
Others	-	-
Total	100	100

<i>Annexure Table b14.2: Regional distribution of exports by Small enterprises</i>		
<i>States</i>	<i>Manufacture of pesticides and other agrochemical products (2021) (% share)</i>	<i>Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022) (% share)</i>
Haryana	73.81	
Uttar Pradesh	1.69	
Gujarat	8.70	1.25
Maharastra	15.51	98.68
Others	0.22	0.27
Total	100	100

Source: Own estimates based on ASI 1999-00 and 2009-10 data

<i>Annexure Table b14.3: Regional distribution of exports by Medium enterprises</i>		
<i>States</i>	<i>Manufacture of pesticides and other agrochemical products (2021) (% share)</i>	<i>Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022) (% share)</i>
Gujarat	39.56	39.06
Maharastra	57.27	
Andhra Pradesh	2.99	
Uttar Pradesh	-	60.94
Others	-	-
Total	100	100

Source: Own estimates based on ASI 1999-00 and 2009-10 data

<i>Annexure Table b14.4: Regional distribution of exports by Large enterprises</i>		
<i>States</i>	<i>Manufacture of pesticides and other agrochemical products (2021) (% share)</i>	<i>Manufacture of paints, varnishes and similar coatings, printing ink and mastics (2022) (% share)</i>
Punjab	4.68	
West Bengal	1.09	7.52
D & N Haveli	25.41	
Maharastra	56.65	92.48
Tamil Nadu	9.29	
Others	2.88	0
Total	100	100

Source: Own estimates based on ASI 1999-00 and 2009-10 data

Chapter 4 :

Technological Innovation in chemical Industries during 2000 to 2010

Technology innovations lead to changes in the level of technology. Many occasions it becomes difficult to directly measure/capture changes in technology or innovation. There are however multiple ways of measuring the technology 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. Biswas and Banerjee (2014) has developed a simplified approach to measure technology levels of enterprises, distribution of enterprises across technology levels for industry, sector, region or size class of enterprises in a given year. Temporal changes in the distribution, as suggested by Biswas and Banerjee (2014), would reflect innovations.

Methodology of indexing technology

Methodology used by these authors to measure innovations is summarized below:

The relevant parameters for identifying technology level of manufacturing units have been clubbed into three broad groups; namely (1) those related to inputs, (2) those related to capital and (3) those related to output.

(1) 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; (2) 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 (3) 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 formed. 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 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.

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.

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.

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.

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).

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.

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.

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 uses 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.

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%.

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 is higher medium technology (level 5), more than 5 up to 6 is high technology (level 6) and above 6 is advanced technology (level 7).

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 Rs 1-5 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.

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 Rs 1-5 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.

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%.

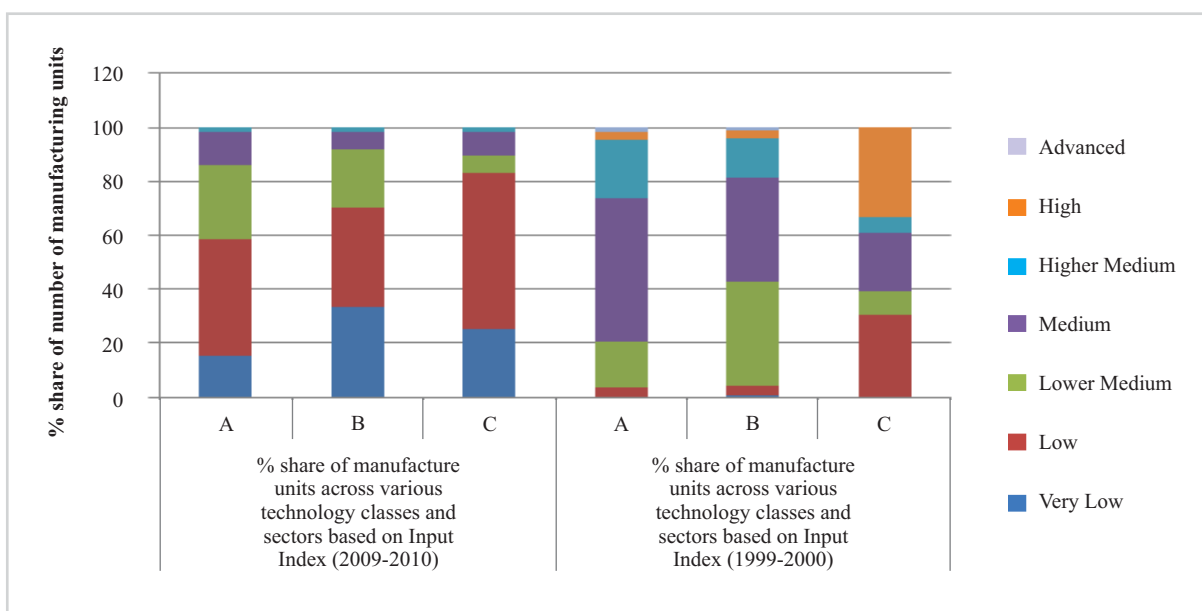
iv. Value of goods sold in the same condition as purchased: This category of product includes the goods that an enterprise buys from a third party vendor and markets the same together with selling own products. (It also includes some raw materials sold on the same condition as purchased. All sales of 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%.

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).

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).

Estimates of technological change

Figure 25 : Manufacture units across various technology classes and sectors based on Input Index



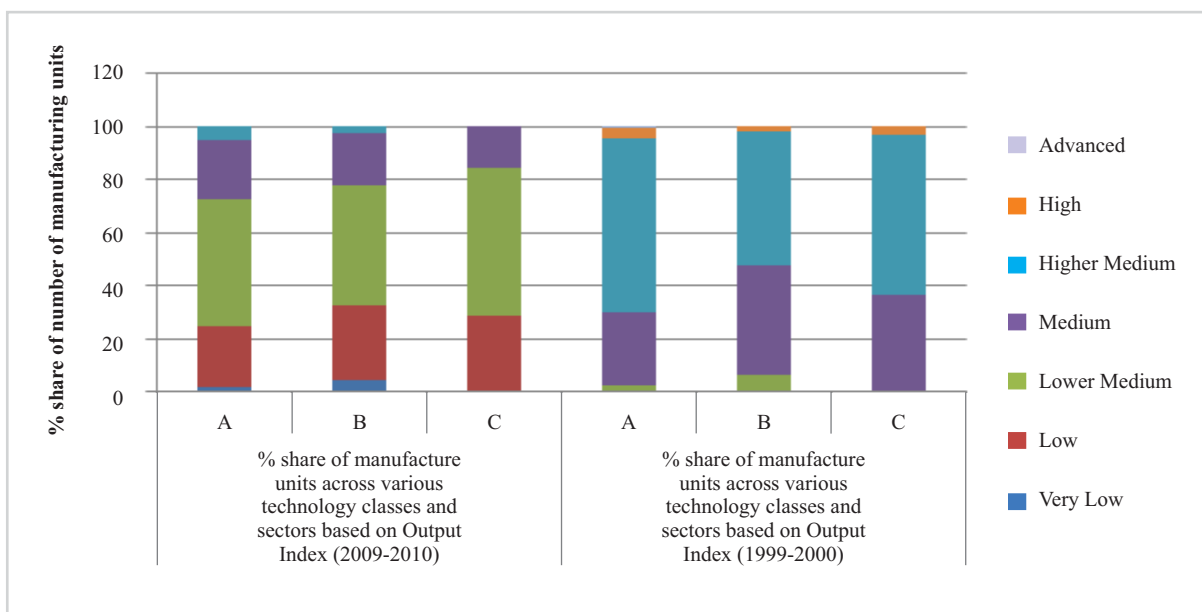
A: Code 201- manufacture of basic chemicals, fertilizers and plastic in primary form; B: Code 202 – Other chemical products; C: Code 203 – manufacture of man-made fibers.

Source: Own estimates based on ASI 1999-00 and 2009-10 data

The input index estimates of the various chemical industries presented in Figure 25 indicate that about 58% of the basic chemical industries in 2009-10 employ very low to low levels of technology while this figure was close to 4% in 1999-2000. The data also illustrates that around 91% of the firms in 1999-2000 counted on medium level technologies of production while this number declined to approximately 41% in 2009-10. About 4.67% of basic chemicals manufacturing firms deployed high to advanced methods of production in 1999-2000 while in 2009-10 none of the firms manufacturing basic chemicals used high or advanced technology. Between 2000 and 2010 there has been a sizeable increase in the number of basic chemical manufacturing firms and for many of these startups, constrained by shortage of capital among others, it is not feasible to adopt high end technologies of production within few years of establishment. Further, it may happen that global competition affected the several medium and high technology firms that operated in the domestic market and got exposed to competition. We can also hypothesize that few of the firms that used medium or high technology of production had to shut down operations due to scarcity of capital, lack of appropriate infrastructure, shortage of skilled labors and improper marketing knowledge and strategies.

A similar scenario may be noted in case of firms engaged in production of other chemicals and man-made fibers. There has been a partial deterioration of technology across size classes in this sub-sector. Apart from this, the number of firms engaged in manufacture of other chemicals declined between 2000 and 2010. This might be due to one or more of the constraints, mentioned above, that the chemical industries faced. We can also speculate that a decrease in demand for the goods manufactured by this sector might have resulted in closure of few of the firms. Possibly increase in competition from peers and the inability of Indian firms to manufacture high quality goods using efficient technologies of production added to their misery. The man-made fiber producing industries have witnessed an increase in the number of manufacturing units. This is probably due to the rise in demand for the man-made fibers in the market. It is apparent that there came up several startups which mainly deployed very low to low and medium level technology. In a nutshell it can be argued that an increase in number of startups and the closure of few non-operational or non-profit earning firms must have been the two of the primary reasons for the deterioration of technology used by the basic chemical manufacturing firms.

Figure 26 : Manufacture units across various technology classes and sectors based on output Index

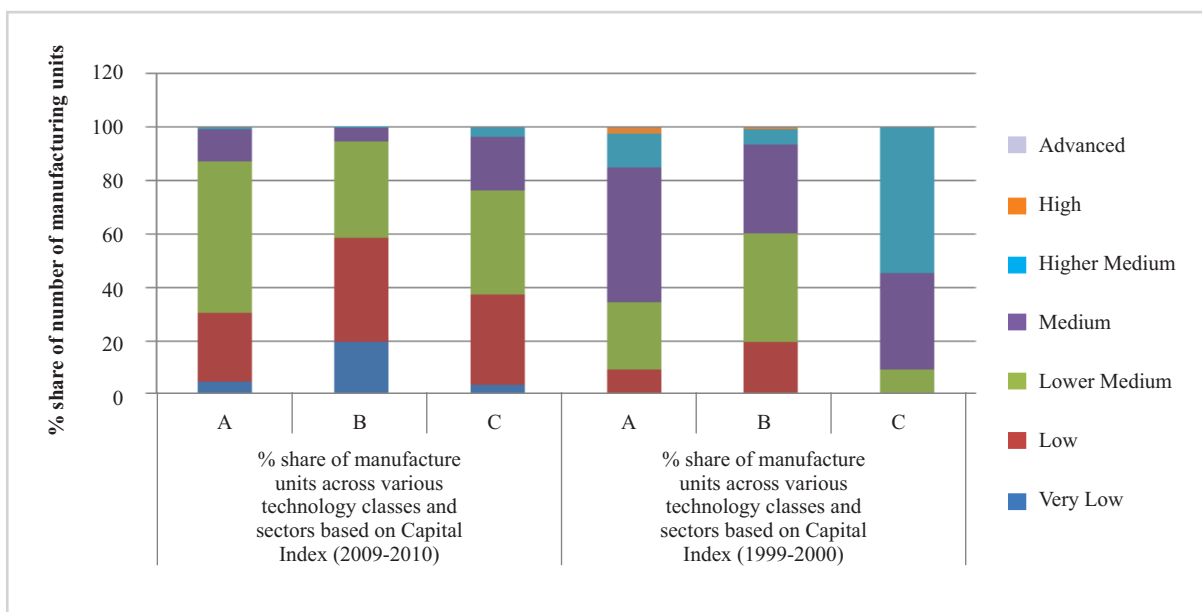


A: Code 201- manufacture of basic chemicals, fertilizers and plastic in primary form; B: Code 202 – Other chemical products; C: Code 203 – manufacture of man-made fibers.

Source: Own estimates based on ASI 1999-00 and 2009-10 data

Estimates of the output index of technology levels as shown in Figure 26 also reveal a similar picture as in the case of input index figures. It may be noted that about 95-98% of the chemical sector industries use lower medium to higher medium technology levels in their manufacturing activities in 1999-2000 however this figure ranged between 67-75% in 2009-10. The output index figures further substantiates the fact that this decade has seen an upsurge in number of startups due to which the firms under various chemical manufacturing industries had about 27-32% of the manufacturing units that relied on very low to low edge technology.

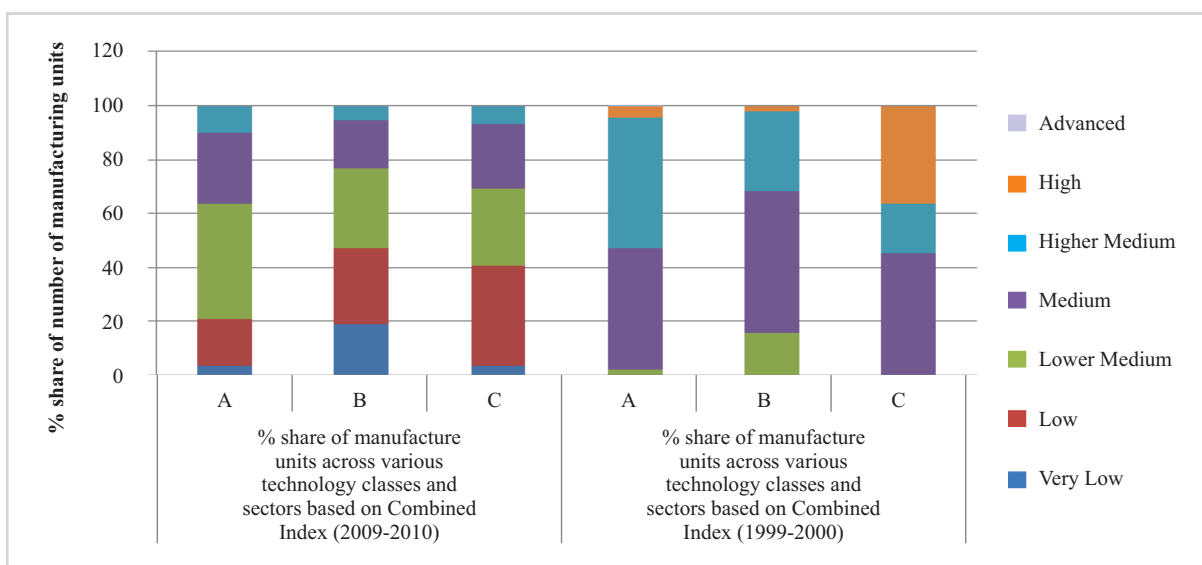
Figure 27 : Manufacture units across various technology classes and sectors based on Capital Index



A: Code 201- manufacture of basic chemicals, fertilizers and plastic in primary form; B: Code 202 – Other chemical products; C: Code 203 – manufacture of man-made fibers.

Source: Own estimates based on ASI 1999-00 and 2009-10 data

Figure 28 : Manufacture units across various technology classes and sectors based on Combined Index

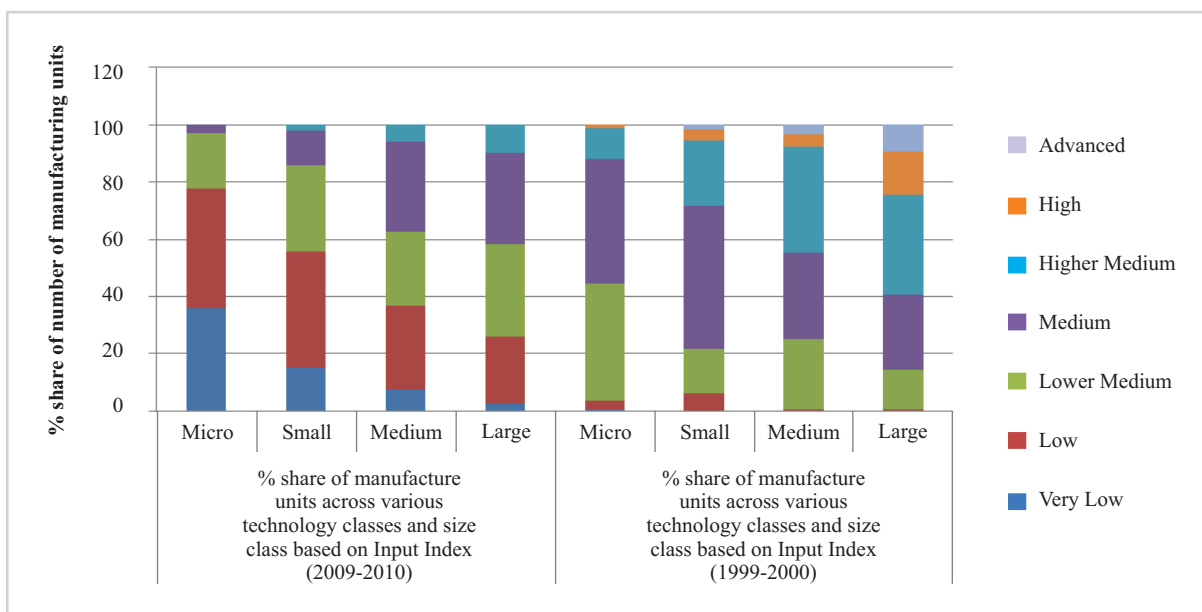


A: Code 201- manufacture of basic chemicals, fertilizers and plastic in primary form; B: Code 202 – Other chemical products; C: Code 203 – manufacture of man-made fibers.

Source: Own estimates based on ASI 1999-00 and 2009-10 data

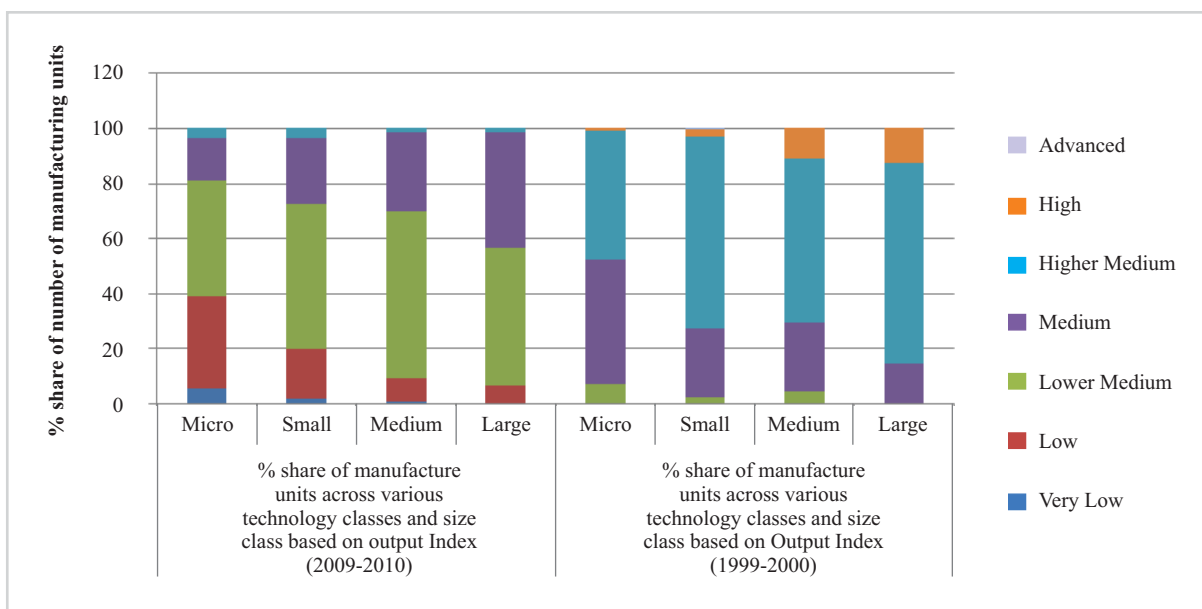
Figures 27 and 28 present the estimates of the capital index and the combined index values which also corroborate the fact that major proportion of chemical industries mainly depend on lower medium to higher medium technology for their manufacturing process. An accretion of manufacturing units relying on lower technology levels is a clear implication of the fact that the decade has seen a rise in fledgling manufacturing units which probably have come into existence due to the rising demand for chemical industry products in the domestic market as well as due to the pressure from its peers globally. Since chemical industries are one of the key industries of the developing economy of India, government has been taking initiatives in favor of setting up more manufacturing units for the production of chemicals. Nonetheless the count of the manufacturing units has increased but these units suffer various drawbacks, such as lack of capital, infrastructure, marketing strategies, low investments in R&D, absence of promising collaborations and joint ventures between startups and MNCs, lack of skills and competence. All these factors together severely constrain technology innovation by these manufacturing units. Consequently a majority of the chemical manufacturing units presumably new entrants end up using low end technologies of production. It can also be postulated from the estimates based on input, output, capital and combined indices for the various technology levels that chemical industries lack the rigor in innovating advanced technology of production which seemingly stems from the fact that Indian chemical manufacturing industries are suffering from the paucity of funds for R&D and the opportunities supporting a promising ambience for research and development of cost effective and time efficient high end technologies of production which are environment friendly and sustainable in nature. Nevertheless we cannot ignore the fact that some innovations have taken place within the chemical industries which mainly involve the adoption of production techniques which minimize waste effluent production while increasing the utilization of certain harmless effluents. A notable contraption has also been marked in few of the chemical manufacturing firms, as discussed in the previous chapters, towards achieving a production processes that is efficient in terms of cost, time, output and waste production.

Figure 29 : Manufacture units across various technology classes and size class based on input Index



Source: Own estimates based on ASI 1999-00 and 2009-10 data

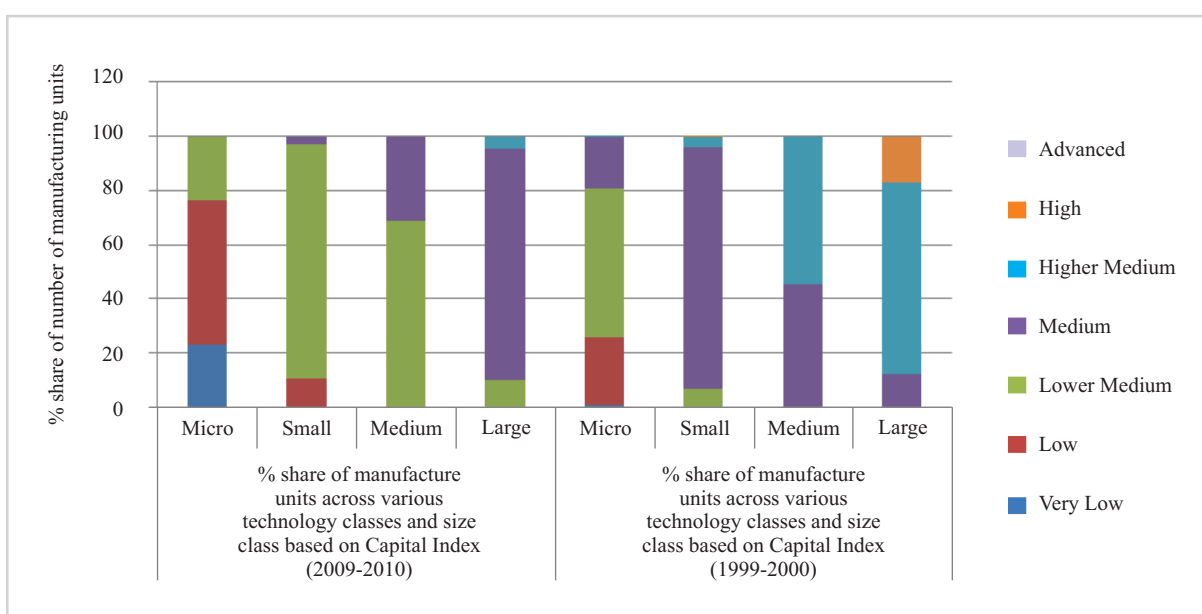
Figure 30 : Manufacture units across various technology classes and size class based on Output Index



Source: Own estimates based on ASI 1999-00 and 2009-10 data

The estimates of technology indices across sizes and technology levels depict the fact that the decade 2000-2010 is marked by a fall in number of micro units whereas there has been an increase in the number of small and medium units of manufacture in the chemical sector. The proportion of large manufacturing units in total did not change significantly. Two plausible explanations for this pattern of distribution of firms across various size classes are: (i) The scaling up of micro production units across various chemical manufacturing sectors to small and medium units, and ii) The closure of few micro units due to one or more of the drawbacks that such units commonly face in our country. Considering the fraction of firms distributed across various technology and size classes implies that a major chunk of micro units (77%) and small units (55%) in 2009-10 depended on very low to low technology of production, whereas these fractions were way less in 1999-2000, around 3% of micro units and 6% of the small units relying on low levels of technology. Presumably there seems some deterioration in terms of technology usage among micro and small units which is probably due to the inability of these units to garner sufficient funds required to maintain the existing technology levels or to update themselves. Since this period has also witnessed a scale up in terms of size of the manufacturing units, it is evident that as soon as the micro units increase their scale of production they fail to invest a wholesome amount towards technology advancement. These firms also need some time to establish in the market so as to attract investments from global peers and other MNCs in terms of technical knowledge and usage. Such firms also require some time to garner funds and arrange various infrastructures required in favor of high end technologies of production.

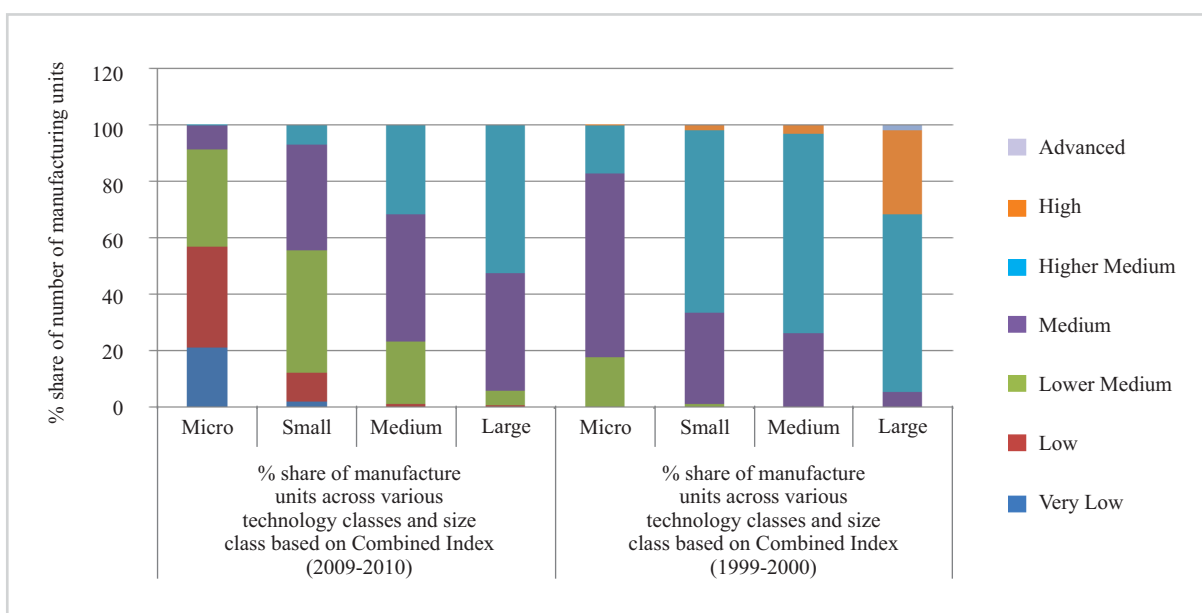
Figure 31 : Manufacture units across various technology classes and size class based on Capital Index



Source: Own estimates based on ASI 1999-00 and 2009-10 data

The scenario of medium and large units is slightly different - 63% of the medium units and 74% of the large units deployed lower to higher medium technology for manufacturing process. This number was higher in 1999-2000 with 91% of the medium units and around 75% of the large units depended on lower to higher medium technologies of production. The decade also witnessed an increase in the number of medium and large firms using very low to low end techniques. This manifests the problems affecting the chemical industries in general and impeding these units to move towards technology advancements. On further interpreting the data with regard to output based, capital based and combined index across various size and technology classes it can be apprehended that the decade, from 1999-2000 to 2009-10, has seen an increase in the number of firms that depend on very low to low end technologies. Such a declining trend with respect to technology usage implies that the chemical sector has not witnessed much progress in terms of technology innovation.

Figure 32 : Manufacture units across various technology classes and size class based on Combined Index



Source: Own estimates based on ASI 1999-00 and 2009-10 data

The downfall in overall technology levels of production may also be due to the loss of market value of the various processed and crude chemical industry commodities which most likely led to a decline in the profits earned. The problem has been aggravated as a result of the competition from the low cost alternative high quality products manufactured by the global peers. On the whole it can be summarized that most of the chemical manufacturing industries either rely on very low to low end technologies of lower to higher medium levels of technology. Being quite fragile in nature due to the risks involved and the precautions to be taken during the manufacturing activities and freight in chemical industries, most of the capital available is diverted towards achieving a hassle free production and transportation. Due the heavy peer pressure most of the smaller units and start up may adopt cheap techniques of production with a motive to earn instant profit. In the course such firms fail to address the call for cost effective and time efficient techniques. The limited resource available to these small units and upcoming firms also prevents these firms from investing a significant proportion of capital towards research and development.

Considering the current technology usage trend within the chemical manufacturing unit it is quite evident that this sector requires to invest quite a significant proportion of the available funds towards development of high end techniques of production and should also focus on bringing up more of joint ventures and collaborations with the MNCs and other highly established global peers so as to import technology as well as knowledge related to use of updated techniques of production.

Chapter 5:

Summary and Policy Implications

The importance of the chemical industry in the national economy of India can be guessed from the fact that it contributes as much as 7% of the total GDP of the country. In spite of various drawbacks a small section of the industry has been able to come up with some alternative means so as to compete with its peers globally, manufacture highly competent products and innovate new and efficient techniques of production. The chemical industry has two main sub-groups: (1) Manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms (201), and (2) Manufacture of other chemical products (202). In both these sub-groups the contribution of informal sector enterprises to GVA has been extremely low and whatever be the little contribution of the informal sector, it is done by the micro size class.

Within the formal sector of the chemical industry GVA contributions by the micro, small and medium enterprises (MSMEs) are also quite low as compared to large industries. Market concentration estimates using both ASI and CMIE data are found to be very high for several product categories (4-digit) of chemical industry.

Gujarat turns out to be the leading state in terms of GVA generated by the industry subgroup '*Manufacture of basic chemicals, fertilizer and nitrogen compounds, plastics and synthetic rubber in primary forms*' (NIC 201). For the '*Other chemical products*' (NIC 202), Gujarat leads the narrower four-digit product category, '*Manufacture of pesticides and other agrochemical products*' (NIC 2021) and Maharashtra ranks second, whereas Maharashtra turns out to be the leader state for the four-digit product category, '*Manufacture of paints, varnishes and similar coatings, printing ink and mastics*' (NIC 2022).

Modal business linkages among the factory units irrespective of size classes is found to be 'Contracting in but not contracting out' indicating that certainty of market is most important for the manufacturers and that the ultimate contracting out firms lie outside the manufacturing sector, possibly in trading. Further, contracting in is much more for young enterprises while contracting out is although very low but increases with age.

A large proportion of the micro and small enterprises in all these industry categories are young and therefore expected to be more dynamic, while majority of the medium and large enterprises are experienced and therefore more established having market linkages and sound financial conditions.

The productivity, measured in terms of value added per labor is much higher in large firms as compared to the MSMEs irrespective of the product category to which they belong. Also, the capital per labor or capital intensity is very low in case of MSMEs as compared to large firms for all product categories. To be more precise, productivity and capital intensity systematically increase with size classes.

The productivity (GVA/L) of micro and small sized enterprises is higher for the ones, which are *'Both contracting in and contracting out'* for all the product categories except micro sized enterprises in *'basic chemicals'* and small sized enterprises in *'paints, varnishes and similar coatings, printing ink and mastics'*.

Within group 201, *'basic chemicals'* and within group 202, *'pesticides and other agrochemical products'* contribute the highest towards exports. Further, the share of MSMEs in total exports is extremely low for all product categories except *'paints, varnishes and similar coatings, printing ink and mastics'* for which, the share of MSMEs in total exports is much higher than the large firms within this category.

There are no exporting micro sized enterprises involved in either *'Manufacture of fertilizers and nitrogen compounds'* or in *'Manufacture of plastics and synthetic rubber in primary forms'*. For microenterprises involved in *'other chemical products'* category, the ones which contract in but do not contract out, contribute the highest to the total exports.

In order to understand the technology innovation across basic metal industries we have considered three major parameters namely (1) those related to inputs, (2) those related to capital and (3) those related to output. Based on the values of these parameters it is observed that majority of the chemical manufacturing units mainly deploy low to medium level of technology.

It is quite clear that this sector requires substantial investments - first, to equip the MSMEs with modern technologies and, second, to carry on research and development so as to make the Indian chemical industries technologically competent enough to face market competition from their peers worldwide. Both public and private institutes and enterprises should be involved in the R&D. It goes without saying that infrastructure and finance are essential prerequisite for the development of the MSMEs and the state has to take the necessary measures to circumvent these problems. With proper directions FDI may be helpful for both infrastructure as well as R&D.

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