GROWTH AND PRODUCTIVITY PERFORMANCE OF INDIAN AND CHINESE MANUFACTURING DURING 1998-99 TO 2011-12: A COMPARATIVE ANALYSIS

Thesis submitted to Jawaharlal Nehru University
for the award of the Degree of

DOCTOR OF PHILOSOPHY

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DECLARATION

I, Veerpal Kaur, hereby declare that the thesis entitled "**GROWTH AND PRODUCTIVITY PERFROMANCE OF INDIAN AND CHINESE MANUFACTURING DURING 1998-99 TO 2011-12: A COMPARATIVE ANALYSIS**" submitted by me to the School of Social Sciences, Jawaharlal Nehru University, New Delhi for the award of the degree of **DOCTOR OF PHILOSOPHY** is a bonafide work and that it has not been submitted so far in part or in full, for any degree or diploma of this university or any other university.

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JNU, New Delhi
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LIST OF ABBREVIATIONS

ASI	-	Annual Survey of Industries
CD	-	Cob Douglas
CSO	-	Central Statistical Organization
CSY	-	China Statistical Yearbook
CV	-	Coefficient of variation
FDI	-	Foreign Direct Investment
FFEs	-	Foreign Funded Enterprises
GDP	-	Gross Domestic Product
GLF	-	Great Leap Forward
GVA	-	Gross Value Added
GVO	-	Gross Value of Output
HCI	-	Heavy capital goods industries
HI	-	Herfindahl Index
IMF	-	International Monetary Fund
NBS	-	National Bureau of Statistics
PIM	-	Perpetual Inventory Method
PRC	-	People's Republic of China
SOEs	-	State Owned Enterprises
TVEs	-	Town and Village Enterprises
H-T	-	High technology industries
M-H-T	-	Medium-High Technology industries
M-L-T	-	Medium-Low Technology industries () and ().
L-T	-	Low Technology
GFCF	-	Gross Fixed Capital Formation
UVR	-	Unit Value Ratio

Chapter – 1
Introduction

1.1 Background

Comparison between India and China both being the most populous emerging economies in the world, has been of long standing interest to academics and policy makers. While reviewing the literature in this area one comes across studies which even date back to 1950s. This symbolises that both these economies have had some elements in common or in stark contrast which drew the attention of scholars since the formation of India and China as modern independent states in 1947 and 1949 respectively.

The exiting research literature on the comparison of India and China spreads over varying time periods and sheds light on various theoretical and empirical factors which led to economic growth in both economies. India and China have been compared on varying themes pertaining to growth accounting, structural change analysis, role of institutional set-up, political economy, economic reform process and the role of the external sector. Many researchers Weisskopf (1975), Bloom et.al (2006) Bosworth and Collins (2007), Patnaik (2009) and Li et.al (2011) and many more, have tried to put India and China on varying and sometimes the same scale from time to time. Some researchers have made projections about their convergence and others projected divergent growth levels for India and China.

The tremendous growth shown by both economies since 1990s once again brought them into limelight. The rush to analyse the growth trajectories followed by both countries gained momentum in economic development literature.

With a third of the world's population and nearly two-thirds of the world's poor (Aziz, 2008), India and China managed to become the fastest growing economies of the world in recent times. How these two countries sustained such high growth rates clearly holds important lessons for both development theorists and practitioners. The general observation made about the dynamics of growth pattern followed by both these economies hints at the spectacular performance of the services sector in the Indian economy and the manufacturing sector in China. But the fast growth of the services sector in the Indian economy did not seem to have given the Indian economy the much needed push whereas the manufacturing sector took Chinese economy on a much higher trajectory of economic growth.

If we put aside the absolute difference in the magnitude of the economies of India and China, the comparison of their growth experience provides us two distinct growth paths accompanied by contrasting structural shifts.

While comparing India and China, one must be aware of the fact that the development objectives of the political leadership of the two countries have differed in important ways. Within the framework of overriding social objectives, to fulfil its economic objectives of rapid economic growth, China has gradually transformed into a market driven economy and India also learned from its planning era and embarked on the track of opening up of its economy.

China followed a conventional path in transiting from an agricultural economy to a robust industrial economy. China has built vital linkages between agricultural, industrial and service sectors and systematically encouraged domestic consumption in parallel with a sharp focus on exports. China's market orientation has been guided by the firm hand of government which is gradually loosening its hold so that economy follows a right path.

But the case of India is quite different. India started its initial planning with giving basic industries a preference but gradually shifted to emphasize growth of the agricultural sector. India had been trying to balance the growth and preference of both agriculture and industry. But the sudden downturn in 1990s forced India to adopt a market oriented strategy to fulfil the obligation arising from the help received from IMF. So the policy break was not planned as such, as was the case of China which deliberately chose the opening up. The growth experience of India reveals that it is attempting to leapfrog from a predominantly agricultural economy to a knowledge – based service economy. Chinese economy has set up an example for India demonstrating that the importance of a conventional structural change path cannot be denied.

1.2 Process of Economic Growth: A Theoretical Perspective

Analysis of the process of economic growth was a central feature in the works of Classical economists represented chiefly by the works of Adam Smith, Thomas Malthus and David Ricardo (Harris. D.J, 1987). In the views of Adam Smith, economic progress was seen as the growth of national wealth. His theory endeavoured to show that individual efforts under freely competitive markets could lead to beneficial results for society as a whole. The classical economists identified accumulation and productive investments (reinvestment of profit) as the driving force for growth of national wealth. Adam Smith placed emphasis on division of labour but could not provide an empirical framework for doing the same. Later on, Marx criticized the Classical theory and developed his theory of capital (Marx, 1967).

During the times of great recession of 1930s a school of thought became widely popular and that was Keynesian economics. In contrast to classical economists, Keynes stressed more upon role of government in stimulating aggregate demand and investment in the economy. Later on Harrod-Domar (Harrod, 1939 and Domar, 1946) extended the Keynesian analysis of income and employment to the long-run setting and therefore, considered both the income generating and capacity effects of investment. Harrod-Domar models of economic growth explained the rate at which investment should increase so that steady growth is possible in an advanced capitalist economy. According to the growth models of Harrod-Domar, the rate of capital accumulation plays a crucial role in the determination of economic growth. The problem of present-day mature economies lies in averting both secular stagnation and secular inflation. It was the pioneering work of Harrod and Domar that set the ball rolling in regard to this issue, i.e., the maintenance of steady growth in advanced industrialised countries. The Harrod and Domar models seek to determine the unique rate at which investment and income must grow so that full employment level is maintained over a long period of time, i.e., equilibrium growth is achieved. Harrod-Domar model laid the foundation for exogenous growth theory.

Neoclassical economists claimed shortcomings in the Harrod–Domar model, in particular the instability of its solution (Scarfe, 1977) and by the late 1950s, started an academic dialogue that led to the development of the Solow model. Solow’s theory featured a production function with smooth substitution between factors of production in contrast to the fixed proportions structure of the Harrod-Domar model. Solow’s production function implied that capital-output ratios could vary across time and countries in response to variations in saving behaviour.

This wave of exogenous growth theory started by Solow (1956) is still the basis of the current understanding of the concept of economic growth. In the Solow model, capital accumulation is a major factor contributing to growth. When the economy's capital stock and its level of real GDP are growing at the same proportional rate, its capital-output ratio, the ratio of the economy's capital stock, K, to annual real GDP, Y, is constant, and the economy is in balanced-growth equilibrium. In equilibrium, the capital-output ratio K/Y will equal the constant ratio $s / (n + g + \delta)$. The standard growth model analysis shows how this balanced-growth equilibrium is determined by four factors: the economy's saving-investment ratio (s), the economy's labour force growth rate (n), the growth rate of the efficiency of labour (g), and the capital stock depreciation rate (δ). According to the Solow growth model, capital intensity and growth in the efficiency of labour together determine the destiny of an economy. The value of the equilibrium balanced-growth, capital-output ratio and the economy's diminishing-returns-to-investment parameter determine the multiple that balanced-growth output per worker is of the current efficiency of labour. The growth rate of output per worker along the economy's balanced growth path is equal to the growth rate of the efficiency of labour. And if the economy is not on its balanced-growth path, the Solow growth model tells us that it is converging to it, although this convergence might take decades. In Solow's model, productivity growth, measured as an increase in output per worker, results from increases in the amount of capital per worker, or capital accumulation (Fagerberg, 1994). The rate of technological progress is assumed to be constant and not impacted by economic incentives. But later on, endogenous growth theory, initiated by Romar (1986, 1990) and Lucas (1988), focused on explaining the Solow residual. Here technological change which becomes endogenous to the model is a result of the allocative choices of economic agents. Technological progress is driven by R&D activities which in turn are fuelled by private firm's aim to earn profit from inventions. Unlike other production inputs, ideas and Knowledge are non- rivalrous (Romar, 1990). Technological change and innovation are essential sources of structural change. In Schumpeter's view, innovations lead to "creative destruction". More productive and profitable sectors and firms displace less productive and less profitable ones and aggregate productivity increases. Technological change is thus at the very centre of modern economic growth. Based on the observation that technological change took place mainly in manufacturing sector, authors like Kaldor (1970) and Cornwall (1977) have asserted that the expansion of this sector is a driving force for economic growth. Moreover, Cornwall (1977) saw technological change in certain manufacturing sectors as the driving force for productivity growth in several other sectors. Syrquin (1986) observes that when overall growth accelerates, manufacturing typically leads the way and grows faster than other sectors. This is clearly visible in case of China also. At the low income levels, the share of manufacturing in GDP is, however, low and its immediate contribution to aggregate growth is minor. When manufacturing increases its output share, often as comparative advantage, faster sectoral growth noticeably raises the aggregate growth rates of output and labour productivity.

Manufacturing sector is the sector in which technological change along with allocation of surplus labour plays an important role in the growth of overall economy. There are powerful empirical and theoretical arguments in favour of industrialization as the engine of growth in economic development. As said by Chenery (1960) "Industrialization is the main hope of the most of the poor countries trying to increase their levels of income". Adam Szirmai (2009), in his study, highlighted the importance of industrial sector in overall development of an economy. He pointed out that there is an empirical correlation between the degree of industrialization and economic growth. Productivity is higher in the industrial sector than in the agricultural sector. The transfer of resources from agriculture to manufacturing provides a structural change bonus. The other point highlighted by Szirmai, is that, as compared to agriculture, the manufacturing sector offers special opportunities for capital accumulation in developing countries. Capital accumulation can be more easily realized in spatially concentrated manufacturing than in spatially dispersed agriculture. This is one of the reasons why the emergence of manufacturing has been so important in growth and development. Capital intensity is high in mining, manufacturing utilities and transport. It is much lower in agriculture and services. As theory shows, capital accumulation is one of the aggregate sources of growth. Thus an increasing share of manufacturing will contribute to aggregate growth. The manufacturing sector also offers special opportunities for economies of scale, which are less available in agriculture and services. The manufacturing sector offers special opportunities for both embodied and disembodied technical progress (Cornwall, 1977). Linkages and spillovers effects are stronger in manufacturing than in agriculture or mining. As per capita income rises, the share of agriculture in total expenditure declines, and the share of expenditure on manufacturing increases (Engel's law).

The discussion above highlights the role of industrialization and especially manufacturing in the proper growth of an economy. All these growth theories represent two major views, one is towards resource shift and the other is towards productivity improvement and technological change. For sustainable growth of an economy improving overall and sectoral productivity levels is important.

1.3 Growth of India and China

The present section tries to give a comprehensive picture of economic performance of both India and China and trace the speed of economic growth in various periods. Such an analysis will also bring forward the important phases of economic development faced by both economies in context of the policy framework. The statistics related to level of GDP and its growth are presented in Table 1.1 and Table 1.2.

Table 1.1: GDP and PCGDP in India and China (1960-2013)

Year	GDP at Constant US$		Per Capita GDP at Constant US$	
	India	China	India	China
196	102.7	88.0	228.3	131.9
197	151.7	107.5	273.3	131.3
198	204.0	217.5	291.8	221.7
199	350.2	548.5	403.1	483.2
200	602.7	1417.0	578.2	1122.3
200	1039.8	3182.9	885.2	2402.8
201	1458.7	4864.0	1165.0	3583.4

Source: WDI, Various Years.

Table 1.1 reveals that in 1960 India's GDP (Gross Domestic Product) and PCGDP (Per Capita Gross Domestic Product) were more than China. Till this time both economies were trying to follow the Soviet growth model by stressing more on heavy and basic industries to achieve self-reliance. Adopting the five-year plan strategy and following the guidelines provided by PC Mahlanobis, India strived on the path of self-reliance by assigning priority to basic and heavy industries. Agriculture was neglected in the earlier years of independence which kept India as a net importer of food grains. Especially during the second plan period stress was laid on accumulating and enhancing capacity in steel, aluminium, engineering, chemicals, fertilizers, petroleum products, heavy electrical equipment, heavy foundry forge, heavy engineering machinery, heavy plates and vessels (Bhagwati and Desai, 1970). As India is a labour intensive and capital scarce country, ignoring agriculture and labour intensive industries during this period kept Indian economic performance below its frontier production. Wars with China and Pakistan in 1962 and 1965 respectively had shaken the Indian economy. Rising pressure of food imports, threat of uncertain supplies of food grains by U.S under PL 480 and low foreign reserve was also a cause of concern during this period. During 1960-61 to 1969-70 Indian GDP grew at a rate of 3.5 percent. During this decade Indian GDP and its growth was higher than Chinese GDP.

Similarly, by the end of the decade of 1950s China was struggling through the Mao's policy of "Great Leap Forward" initiated in 1958. In this, Mao tried to establish local industrial base at the cost of rural agricultural development. As depicted by Maddison (1998), thousands of workers were forced to work in local industries to produce goods like iron, steel, cement etc. to prepare a base for further industrial production. But without proper technique and skills the products produced at that time turned to be futile leading a huge stock of inventories and wastage of scarce capital. The result of such a strategy was acute shortage of agricultural produce and famine (1959-61). As a result, even in terms of the growth rates of GDP and PCGDP during 1960-61 to 1969-70, China lagged behind India.

It can be said that both the economies were performing below their potential level leading to a huge difference between their actual achievement and their potential known as "X-inefficiency"[1]. During this decade China was trying to come out of the damage done by Great Leap Forward. With this aim, the size of Communes was reduced and emphasis was given to agriculture for attaining self-sufficiency. Subsequently, rural markets were opened and rural industries were encouraged under the Commune system so as to make these Communes self-sufficient among themselves.

Table 1.2: Compound Annual Growth Rate of GDP and PCGDP in India and China (Percent)

Year	GDP		PCGDP	
	India	China	India	China
1960-61 to 1969-70	3.5	2.9	1.4	0.7
1970-71 to 1970-80	3.4	6	1	4.1
1980-81 to 1989-90	5.4	10.8	3.1	9.2
1990-91 to 1999-2000	6	11.1	4.1	9.9
2000-01 to 2008-09	7.6	10.9	6	10.2
2009-10 to 2013-14	6.4	8.7	5.1	8.2

Source: WDI, Various Years.

India was hit by droughts in the first two years of the period 1970-71 to 1979-80. A war with Pakistan in 1971 and the oil price shock of 1973 and 1980 also pulled the growth of Indian economy downwards. It was only in late 1970s, that the Indian economy

[1] The concepts of X-inefficiency was introduced by Leibenstein (1966). It refers to the difference between efficient behaviour of businesses assumed or implied by economic theory and their observed behaviour in practice.

picked up a little speed and managed a compound annual growth rate of 3.4 percent during 1970-71 to 1979-80.

During late 60s and mid of 70s, China experienced another huge setback caused by the so-called "Cultural Revolution".

For spurring economic growth and social welfare a revival of earlier model of growth was needed. But it was not easy to shed the long followed philosophy and attitude. Due to death of Mao in 1976 the political hierarchy underwent a change and new policies came into force after 1978 with gradual march towards opening up. The result was that by the end of 1980s China managed to grow faster than India and there was no looking back afterwards. This was the period (1980-81 to1989-90) when China achieved double digit growth rate and India had just managed to come out of a phase of stagnant growth (Panagariya, 2011). This spectacular growth performance of China can be attributed to the fact that a large pool of resources was either under-utilised or misallocated during the Mao's era which got right direction under the reformist policies of Deng Xiaoping. The move towards household cultivation was the first change which changed people's attitude by providing them incentives for working harder. This led to increase in incomes and a lot of people were keen to move out of agriculture and look for alternative source of income and employment. As asserted by Chenery and Syrquin (1975), sometimes just removal of bottlenecks can also play an important role in pushing economy on the path of growth rather than only emphasizing on providing stylized facts of economic growth. Once the limit on household income was lifted, people started making efforts for tapping extra income and use their full potential. Rural industries expanded during this period. Many studies outline that several historical and institutional features were key to the success of rural industrialization (Otsuka, 1998; Bai, Li, and Wang, 2001; Lin and Yao, 2001)

India faced huge foreign exchange crisis at the beginning of 1990s leading to sudden dependence on international institutions and forcing India to make policy changes towards liberalization. India continued to grow gradually at the pace set during late 1980s and during 1990-91 to 1999-2000 Indian GDP grew at a rate of 6 percent whereas Chinese GDP grew at a rate of 11.3 percent. This period witnessed various reform measures imposed due to the obligations of International Monetary Fund (IMF) and World Bank tariff and non-tariff barriers on imports were demolished to a large extent, private sector involvement was encouraged, Foreign Direct Investment(FDI) was made easier, Public sector control over banking and finance was decreased and state monopolies in many sectors like iron, steel, telecommunication etc. were dismantled through private sector participation in these sectors. This period witnessed a permanent shift in the policy regime of India and led to an ever increasing integration of India into world economy.

But still the impact of these policy changes could not uplift the Indian economy in a manner that was followed in China. Once China followed the open door policy in 1978 it never looked back and grew at a much faster pace than India. During 1990-91 to 1999-2000 China grew at the fastest rate for almost a decade. One reason could be that Chinese reforms were much more planned and indigenous in nature as compared to the forced liberalisation exercise practiced in India during 1990s.

After the global recession of 2008 both economies experienced a slowdown in their growth rates but still managed to emerge out of the recession without incurring serious damages. By the year 2013 Chinese GDP was more than triple of Indian GDP and also PCGDP of China was more than three times of Indian PCGDP. The fastest growth of GDP and PCGDP in India was observed during the period of 2000-01 to 2008-09 whereas China grew at all-time highest rate during 1990-91 to 1999-00. So to compare the growth performance of India and China a concrete analysis needs to be done. One needs to identify the factors which could have played vital role in speeding up both economies and their differential outcomes.

1.4 Path of Structural Change in India and China

One of the ways to identify role-players in the growth experience of India and China is to look at the structure of both economies. Analysing the path of structural change throws light on the forces behind economic growth of an economy. The higher growth level achieved by an economy could be attributed to the structural shift. The long term sustainability of the high growth rates in these economies will depend upon the structure and productivity performance of different sectors of the economy. It becomes essential to look at the structural composition of growth. Growth theories since Adam Smith (1776) have emphasized that the structural transformation from a predominantly agrarian economy to a predominantly urban and industrial economy provides a casual contribution to the growth process. Lewis (1954) followed the classical economists in depicting agriculture as a sector of diminishing returns and industry as a sector of increasing returns. The modern growth empirics' literature has also tended to find that larger initial shares of manufacturing and smaller shares of agriculture or mining are associated with faster subsequent growth in per capita GDP (Durlauf et al. 2005). Developing countries may follow this evolution from agriculture, to light industry, to heavy industry and finally a noticeable rise in the share of services in GDP. It is likely that individual countries may depart from this average pattern to a substantial degree. To check this, India and China can become important case studies. These economies were at a quite similar stage in 1980 since both countries were of similar size and at similar levels of development as measured by GDP per capita. Moreover, both of these economies showed really fast growth in last two decades. But one difference which many observers have stressed is the much greater importance of service sector growth in India's acceleration as opposed to China's traditional path of industry led structural transformation.

Bosworth and Collins (2008), Herd and Draughtry (2007), Fan and Felipe (2006), Valli and Saccone (2009) and Gupta (2008) have adopted growth accounting and shift share analysis to trace factors behind economic growth and prevailing differences between India and China. All these studies highlight the role of structural change, resource allocation, industrial growth (especially manufacturing sector), capital accumulation and productivity growth leading to better performance of China as compared to India.

Husiin and Yik (2012) carried out analysis with the objective of quantifying the contribution of various sectors namely, agriculture, manufacturing and services in overall economic growth of China and India during 1978 to 2007. The study concludes that in case of China manufacturing has been found to be the highest contributor to economic growth whereas in India the services sector has been the major player in growth of GDP.

Keren (2009), Patnaik (2009), Gylfason (2005), Mukherjee and Zhang (2005) and Dhal (2015) have emphasized the role of institutional set-up and political economy in determining the fate of both India and China. Political set-up, government policies regarding human capital, labour laws and legal system have been discussed in these studies. Mathur (2011) and Basu (2007) accounted better implementation of economic reform process as a reason behind better performance of Chinese economy and its various sectors as compared to India.

Table 1.3 reveals that in 1960 the structure of Indian GDP was dominated by agriculture followed by services sector. Disregard of the policies of import substitution and self-reliance Indian economy could not manage to move up the ladder of structural shift. The results of the "Great Leap Forward" are apparent from the figures in table 1.3 where the share of agriculture was the lowest in GDP of China. But a reversal of policies can be made clear from the figure of 1970 where share of agriculture rose at the cost of services. Industry still dominated the scene. Emphasis was given to growth of agriculture.

Table 1.3: Sectoral Share in GDP (Percent)

Year	China			India		
	Agriculture	Industry	Services	Agriculture	Industry	Services
1960	23.4	44.5	32.1	42.6	19.3	38.1
1970	35.2	40.5	24.3	42.0	20.5	37.6
1980	30.2	48.2	21.6	35.4	24.3	40.3
1990	27.1	41.3	31.5	29.0	26.5	44.5
2000	15.1	45.9	39.0	23.0	26.0	51.0
2008	10.7	47.4	41.8	17.8	28.3	53.9
2013	10.0	43.9	46.1	18.2	24.8	57.0

Source: UN, National Accounts data, Various Years.

In India in 1970 there was a slight increase in the share of industry with minimal decline in share of both agriculture and services. This was the time when India witnessed “Green Revolution”. But due to biased tilt of Green revolution, agricultural share in GDP declined a little. China witnessed highest share of industry in GDP in 1980, after which the share of industry fell a little and share of services started increasing accompanied by a fall in share of agriculture in GDP. On the other hand, highest share of industry in Indian GDP was in 2008 and in the same year agriculture had the lowest share since 1950s. So the share of services has always been quite substantial in case of India with industry playing the least role.

Table 1.4: Absolute Change in Sectoral Share (Percent)

Year	China			India		
	Agriculture	Industry	Services	Agriculture	Industry	Services
1960-70	11.83	-4.00	-7.84	-0.61	1.18	-0.57
1970-80	-5.04	7.73	-2.69	-6.57	3.81	2.76
1980-90	-3.06	-6.88	9.94	-6.37	2.21	4.16
1990-2000	-12.05	4.58	7.48	-6.00	-0.49	6.49
2000-08	-4.33	1.53	2.80	-5.24	2.29	2.95
2008-13	-0.72	-3.55	4.27	0.42	-3.52	3.10

Source: Calculated by author using data from UN, National Accounts, Various Years.

Table 1.5: Compound Annual Growth Rate of Sectoral Value Added (Percent)

Year	China			India		
	Agriculture	Industry	Services	Agriculture	Industry	Services
1960-61 to 1969-70	6.4	6.0	2.9	1.5	5.7	4.0
1970-71 to 1970-80	2.2	8.0	5.4	1.7	4.4	4.6
1980-81 to 1989-90	6.1	11.6	14.4	3.0	5.7	6.6
1990-91 to 1999-2000	4.2	14.4	10.4	3.3	6.2	7.7
2000-01 to 2008-09	4.4	11.9	11.7	3.1	8.6	9.0
2009-10 to 2013-14	**4.3**	**9.5**	**8.7**	**4.6**	**4.2**	**7.3**

Source: Calculated by author using data from UN, National Accounts, Various Years.

As can be seen in the above analysis that industry has always played a dominant role in the GDP of China and Indian GDP has seen a structural shift from agriculture to services rather than industry. The role of agriculture has declined in both economies and the declining share of agriculture seems to be filled by service sector in both economies rather than by industry. The share of Industry did not see any gradual or dramatic shift in both India and China. This presents a very complicated picture of the path of structural change and both economies do not seem to follow the average conventional path. To get a better understanding of the development of the non-agricultural sector we need to look into more detailed disaggregation of non-agricultural growth in both economies. We need to trace out the sectors among non-agricultural sector which filled the gap created by declining role of agriculture in GDP during the course of economic growth.

1.5 Role Played by Different Sectors in Non-Agricultural Growth of India and China

To understand the contrasting paths of structural change followed by India and China one needs to breakdown the secondary and tertiary sector into their different constituents.

Table 1.6 provides the figures of contribution made by various sectors in non-agricultural value added in India at various points of time. Secondary Sector 1 means mining, Quarrying and utilities plus Manufacturing and Secondary Sector 2 includes Construction along with Mining, Quarrying and utilities and Manufacturing.

Since 1970s, the share of non-agricultural value added has been increasing with its share rising from 56.5 percent in 1970 to 82.6 percent in 2012. A disaggregated look at non-agricultural value added of India reveals that tertiary sector has played the most important role in driving the total non-agricultural growth in India. Share of tertiary sector in Indian value added rose from 36.3 percent in 1970 to 56.9 percent in 2012. Manufacturing has never been in limelight since 1970. The peak value of share of manufacturing in value added of India was in the year 1995 with a value of 18 percent which is very low for a country to take off on the path of industrial development. It was the time when license permit system was demolished and many new sectors within industrial sector were opened for private sector. Share of construction has also been rising since 1970. But the disappointing fact is that the Indian manufacturing sector has seen an absolute change of -3.7 percent in its share in non-agricultural value added from 1970 to 2012.

Some researchers argue that one of the reasons for higher growth of services in India after the1991 liberalization episode is the demand from U.S. and other developed countries (Konana et al 2005). But even before 1991 in 1990 the service sector had a huge share of 42.4 percent in Indian value added. So the service led growth of Indian economy is not a recent phenomenon[2] or is not because of liberalization and privatization. The Indian pattern of structural change stands in deep contrast with the standard growth theories of structural change which identify an almost universal pattern of structural change, almost similar for both developed and developing countries[3]. This has led to a considerable debate around the issue of service led growth in India. A lot of literature emerged regarding the factors which led to dominance of service sector, its desirability and long run implications.[4]

A look at distribution of Chinese non-agricultural value added (Table 1.7) reveals that the secondary sector has always been dominant in the total value added. Share of

[2] Batacharya and Mitra (1990) discussed the issue of excess growth of service sector during the period 1950-51 to 1986-87.

[3] Chenery and Syrquin (1975).

[4] Papola (2006), Banga (2005), Joshi (2004).

manufacturing has been above 30 percent since 1970s. The Share of tertiary sector has witnessed an increasing trend over the course of years and has shown an absolute change of 9.7 percent during 1970 to 2012. Now here it can be asserted that there were some particular factors inherent in the Chinese economy which led to more emphasis on manufacturing and secondary sector rather than services in contrast to India. One of the reasons was the following of Marxist theories and national accounting earlier which ignored the presence of the tertiary sector. Secondly during the Great Leap Forward, as mentioned in the earlier section of this chapter Mao tried to build capacity within the economy to run the industrial sector indigenously.

The rural population was forced to work in industrial outlets. The Great Leap was a gigantic failure but this gave an experience to the Chinese authorities and people. As the agricultural incomes increased and reforms set in during late 1970s people used their accumulated capacity and skills. Opening of coastal areas provided healthy competition, necessary know how and cheap labour which led to prosperous growth of rural industry in 1980s. So it can be generalized here that Chinese economy had certain inbuilt factors which led to the path of structural change it followed over the years of economic growth.

Thomas E. Weisskopf (1975) asserted that Chinese economy has been far more planned than the Indian economy. Chinese strategy has always led to institutional changes along with new policies but sadly in India liberalization, technological upgrading etc. have been attempted but without giving proper attention to institutional changes required before implementing new policies. Chinese experience depicts the practical implementation of Lewis model, stylized facts of Chenery and Sqyrin, importance of manufacturing sector as described by Solow and Kaldor and stages of economic growth presented by Rostow. Even following the socialist ideology, Chinese economy has been successful in generating some particular conditions which could be found in its economy and institutional framework only.

Table 1.6: Share of Value Added of Non-Agricultural Sector by Economic Activity in India

Year							Peak Value of Share in Aggregate VA		Change in Percentage Share	
Sector	**1970**	**1980**	**1990**	**2000**	**2008**	**2012**	**Year**	**Value**	**1970-1990**	**1990-2012**
Mining, Quarrying and Utilities	2.2	3.5	5.1	4.9	4.4	4.1	1985,1986, 1997,1998, 2002	5.2, 5.3	2.9	-0.9
Manufacturing	13.8	16.3	17.2	15.8	15.6	13.5	1995	18	3.5	-3.7
Construction	4.3	4.4	5.3	5.7	8.4	8.1	2007, 2008	8.4	1.0	2.8
Secondary Sector 1	**15.9**	**19.8**	**22.3**	**20.7**	**20.0**	**17.6**	**2007**	**29.2**	**6.4**	**-4.7**
Secondary Sector 2	**20.3**	**24.2**	**27.6**	**26.4**	**28.5**	**25.8**	**1995**	**23.2**	**7.3**	**-1.8**
Wholesale, retail trade, restaurants and hotels	8.4	11.5	12.4	14.4	16.7	18.7	2012	18.7	4.0	6.2
Transport, storage and communication	4.0	4.3	6.5	7.7	7.8	6.8	2004	8.3	2.5	0.3
Other Activities	23.9	23.2	23.5	28.3	29.3	31.4	2012	31.4	-0.4	7.9
Tertiary Sector	**36.3**	**39.0**	**42.4**	**50.4**	**53.9**	**56.9**	**2012**	**56.9**	**6.2**	**14.4**
Non-Agricultural Sector	**56.5**	**63.2**	**70.0**	**76.8**	**82.3**	**82.6**	**2012**	**82.6**	**13.5**	**12.6**

Source: Calculated by author using data from National Accounts Statistics (NAS), CSO, Various Years.

Table 1.7: Share of Value Added of Non-Agricultural Sector by Economic Activity in China

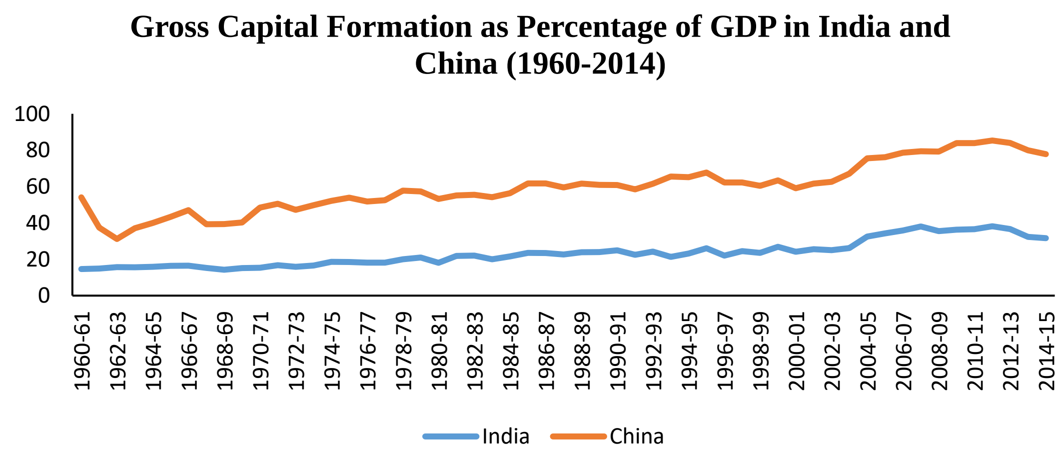
Year							Peak Value of Share in Aggregate VA		Change in Percentage Share	
Sector	**1970**	**1980**	**1990**	**2000**	**2008**	**2012**	**Year**	**Value**	**1970-1990**	**1991-2012**
Mining, Quarrying and Utilities	2.8	3.7	4.0	8.2	8.8	7.4	1997 , 2006	8.8, 9.3	1.2	4.8
Manufacturing	33.7	40.2	32.7	32.1	32.7	31.1	1978-1980	40.5	-1.1	0.0
Construction	3.7	4.3	4.4	5.6	6.0	6.8	1993 , 2012	6.6 , 6.8	0.7	1.6
Secondary sector 1	**36.5**	**43.9**	**36.7**	**40.4**	**41.5**	**38.5**	**1978-1980**	**44.1**	**0.2**	**4.8**
Secondary sector 2	**40.2**	**48.2**	**41.1**	**45.9**	**47.4**	**45.3**	**1980 , 2006**	**47.9**	**0.8**	**6.4**
Wholesale, retail trade, restaurants and hotels	7.3	5.3	8.9	10.4	10.4	11.5	1988	12.5	1.6	1.5
Transport, storage and communication	5.2	4.7	6.6	6.2	5.2	4.8	1991	6.9	1.3	-1.4
Other Activities	11.9	11.6	16.6	22.4	26.2	28.2	2012	28.2	4.7	9.5
Tertiary Sector	**24.5**	**21.6**	**32.1**	**39.0**	**41.8**	**44.6**	**2012**	**44.6**	**7.6**	**9.7**
Total Non-Agricultural Sector	**64.7**	**69.8**	**73.2**	**84.9**	**89.3**	**89.9**	**2011**	**90**	**8.5**	**16.1**

Source: Calculated by author using data from China Statistical Yearbook , Various Years.

1.6 Saving and Investment

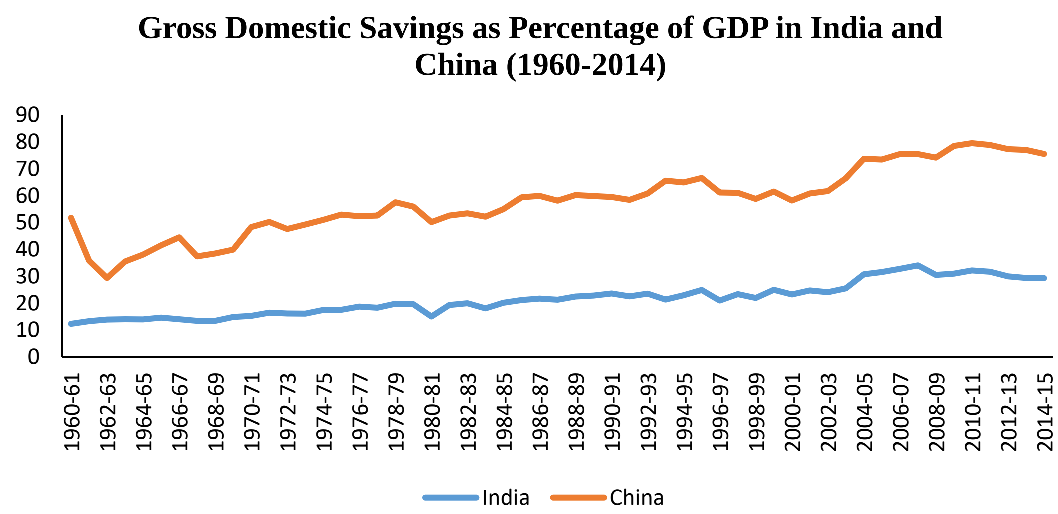
There has been a general consensus on the issue that the growth of the Chinese economy and industry has been driven by high capital formation and one of the reason behind India's slow growth is its low level of investment. Graph 3.3 proves these points as it can be seen that one of the major contributor to Chinese GDP has been capital formation whereas share of capital formation in total Indian GDP has been quite low. Capital formation presents a rising trend in both India and China for the whole period but a little downturn in the latest year.

Graph - 1.1



Source – Prepared by author using WDI, 2015.

Graph – 1.2



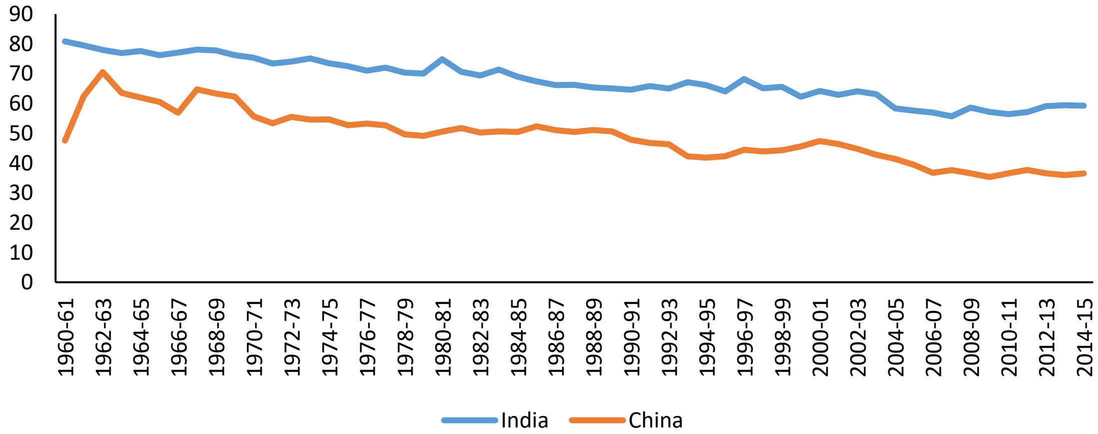
Source – Prepared by author using WDI, 2015.

Chinese capital formation has been backed up by high rate of savings. Here again China has been far ahead of India in accumulating high savings. Saving has seen a rising trend in India in the latest period whereas it shows a small decline for China in the most recent years.

Other source of difference in India and China is the household consumption level. This also explains the high level of capital formation and savings in China as compared to India. Consumption level has always been high in India as compared to China. Both countries have been experiencing decreasing household consumption share in total GDP in the recent years.

Graph – 1.3

Household Consumption Expenditure as Percentage of GDP in India and China (1960-2014)



Source – Prepared by author using WDI, 2015.

1.7 External Sector

A lot of theoretical and empirical literature has analysed the hypothesis that "openness" of the economy plays a positive role in economic growth (e.g. Frankel and Romer, 1999; Bensidoun et al., 2009). Most of the studies confirm the positive effects of "openness" on economic growth of a country. Panagariya (2007), Lu and Lio (2009), Dimaranan et al (2007), Veeramani (2012), Marelli and Marcello Signorelli (2011), Tian and Yu (2012), Kumari and Malhotra (2014), Nunes et al (2013), Wei (2005) and Coutinho and Fontoura (2012) analysed various facets of external sector like exports, FDI, trade expansion and trade pattern of both India and China at a comparative scale. All of these studies highlight better performance of Chinese external sector backed up by strong industrial base and FDI as compared to its Indian counterpart.

Table 1.8 compares various indices relating to external openness of India and China during 1985 to 2012. Exports of goods and services as percentage of GDP has remained higher in China since 1985. Indian economy improved its export content from 5.2 percent of GDP in 1985 to 24 percent in 2012. Whereas Chinese exports as a percentage of GDP stood at 9.2 in 1985 and rose to 27.3 percent in 2012. The recent period shows a decline in export content of Chinese economy as the export to GDP ratio came down from the highest value of 37.1 percent in 2005 to 27.3 percent in 2012.

Now coming to imports as percentage of GDP we can see that in the earlier years Indian imports to GDP ratio was lower than China but in 2012 India outpaced China with higher import content of its GDP with China having an import to GDP ratio of 24.5 percent whereas India had import to GDP ratio of 30.7 percent.

The difference in FDI to GDP ratio among India and China is quite stark with China having almost double of this ratio. FDI has played a much larger role in China as compared to India. The total Direct Foreign Investment(DFI) inflow into India rose from just $97 million in 1990 to $2.3 billion in 2000. In China the figures for these same years were $2.7 billion and $37.5 billion (Panagariya, 2007). As can be seen in the table 1.8, the share of net inflows of FDI as percentage of GDP has been 1.3 percent in India and 3.6 percent of GDP in China. Such minimal performance of India in comparison with China has been the result of trade and investment policies of both economies.[5]

Now if we look at role of manufactured exports and imports in both economies it can be observed that manufacturing sector has been the major contributor to exports of both India and China. In India share of manufactured exports in total merchandise exports increased from 58.1 percent in 1985 to 64.8 percent in 2012. Whereas in China it increased from just 26 percent to 93.9 percent. These figures highlight the importance gained by manufacturing sector in Chinese economy. Indian policy makers failed to promote a strong manufacturing base of the country which eventually led to poorer performance in the export front too.

In the 1980s and early 1990s, China saw a massive growth in the exports of light manufacturing: apparel, toys, sporting goods, footwear and the like. Subsequently, as physical and human capital accumulation progressed, China moved onto exports of

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[5] Lardy (2002), Srinivasan and Tendulkar (2003) and Panagariya (2004) provide detailed account of openness policies followed by both economies.

somewhat more sophisticated products that, nevertheless, still employed large volumes of labour.

These products have included office machines, telecommunications and electronic apparatus and equipment, and electrical machinery. In contrast, most of the leading exports of India are either skilled-labour intensive or capital intensive: IT and ITES, textiles, petroleum and petroleum products and iron and steel. Apparel is a major contributor but it has declined in recent years. Even auto and auto parts and pharmaceutical industries that are said to be growing rapidly currently (though they did not appear significantly in the export data until 2004) are skilled-labour or capital intensive[6]. These developments hint towards the lack of a proper policy and initiative to promote the labour intensive sector especially in a labour abundant country like India.

Table 1.8: External Openness Indices of India and China (1985 – 2012)

	India						China					
	1985	**1990**	**1995**	**2000**	**2005**	**2012**	**1985**	**1990**	**1995**	**2000**	**2005**	**2012**
Exports of goods and services (% of GDP)	5.2	6.9	10.7	12.8	19.3	24.0	9.2	14.7	20.2	23.3	37.1	27.3
Foreign direct investment, net inflows (% of GDP)	0.0	0.1	0.6	0.8	0.9	1.3	0.5	1.0	4.9	3.2	4.9	3.6
Imports of goods and services (% of GDP)	7.5	8.3	11.8	13.7	22.0	30.7	13.3	12.0	18.6	20.9	31.5	24.5
Manufactures exports (% of merchandise exports)	58.1	70.7	73.5	77.8	71.1	64.8	26.4	71.6	84.1	88.2	91.9	93.9
Manufactures imports (% of merchandise imports)	54.4	51.2	53.8	46.7	52.2	43.2	52.2	79.8	79.0	75.1	73.1	55.2

Source: Prepared by author using WDI, 2015

The comparative analysis carried out for India and China in the previous sections of this chapter provides the background for studying the manufacturing sector of both countries in more detail to trace factors underlying the varying performance of this sector in both India and China.

[6] This paragraph has been taken from Panagariya (2009).

1.8 Rationale of this Study

Cross country comparisons are always fruitful and help to guide further growth trajectories. India and China both can learn a lot from each other. The long term sustainability of the high growth rates in these economies will depend upon the structure and productivity performance of different sectors of the economy. It becomes essential to look at the structural composition of growth. Since developing countries generally follow an evolution from agriculture, to light industry, to heavy industry and finally a noticeable rise in the share of services in GDP. But individual countries may depart from this average pattern to a substantial degree. To check this, India and China can become important case studies. These economies were at a quite similar stage in 1980 when both countries were of similar size and at similar levels of development as measured by GDP per capita. Both of these economies also showed really fast growth in the last two decades. But one difference which many observers have stressed is the much greater importance of service growth in India's growth acceleration as opposed to China's traditional path of industry led structural transformation.

The spectacular growth performance in China and India has attracted the attention of economists and analysts. As discussed in the previous section many studies have examined the role and contribution of the economic reform process and the differing nature of the growth and development policies in these two countries. It is generally recognized that the relative growth and productivity performance of the two countries varies across different sectors. Hulten and Srinivasan (1999) concluded that Indian manufacturing performance has been sound and in line with the general experience of the 'Asian Tigers'. Nagaraj (2005) has studied the industrial growth in China and India making use of the recently available industrial output series for China by Wu (2002) and concluded that the size and growth of India's industrial sector and exports has been modest in comparison with China. However, Nagaraj (2005) concluded that the Indian performance has been supported by a firm microeconomic, legal and institutional framework and that with sizeable increase in public investment, India may be able to close the gap.

Bosworth and Collins (2007), in their study, conducted detailed growth accounting of the performance of agriculture, industry and services sectors in India and China. They did not find evidence to suggest any deceleration in TFP growth in Chinese industry in the recent years. The weak performance of industry in India, especially in comparison with its service sector, has been highlighted in their study.

Herd and Dougherty (2007) reviewed the growth prospects and concluded that there are a large number of growth accounting studies on China (OECD 2005; Chow and Li 2002; IMF 2003; and Holz 2006) and on India (Pallikara 2004; Rodrik and Subramaniam 2004; Singh and Berry 2004; Sivasubramoniam 2004; and Ghosh and Narayana 2005). They have recognized that there are few studies that have explicitly compared China with India using directly comparable framework or little attention has been given to measurement issues.

Lee, Rao and Shepherd (2007) have attempted a direct comparison of the level of output and labour productivity in the manufacturing sector in China and India by computing PPPs for the manufacturing sector. Adopting the standard approach used in international comparisons of output and productivity (ICOP) studies pioneered by Angus Maddison at the University of Groningen, Lee et al (2007) presented results based on the benchmark year 1984-85 which showed a clear divergence in labour productivity with India lagging behind since early 1990s. One aspect which diminishes the present relevance of this study is that their work and findings have been based on a benchmark year which is nearly two and a half decades old. The other aspect is that this study mainly focused on comparable labour productivity estimates for China and India, expressed in Chinese Yuan and the trends in labour productivity. Thus there is considerable scope for expanding their study to explicitly account for capital intensity that could be a factor explaining differential levels and trends in labour productivity. Further, a very important aspect of manufacturing growth missed out by this study has been the growth of Total Factor Productivity (TFP).

It can be asserted here that studies highlight various aspects of structural change taking place in both of these economies. Manufacturing sector of China has surely performed much better than Indian manufacturing. The literature stresses the superior performance of Chinese industry over Indian industry and considers factors like productivity, ownership diversification, reformed institutional framework and government policies as the factors for Chinese better performance over India. This superiority of Chinese industry is seen as the most significant factor which led to faster growth of Chinese economy. The value added by the manufacturing sector in India is less than 15 percent or one-eighth of the value added of manufacturing sector of China (Kumar and Gupta, 2008). Manufacturing sector gives employment to 83 million people in China as compared to 47 million in India. Still no study has taken a detailed comparative account of very important facets of manufacturing industry in both economies like TFP and efficiency of manufacturing industry.

Hence, in the present study, an attempt has been made to analyse the performance of both Indian and Chinese manufacturing. Such an analysis has helped to trace the reasons of China's faster growth than India. Our major area of focus has been the comparison of productivity and efficiency of manufacturing industry of both economies and to find out the factors which led to the better performance of Chinese manufacturing over India both at national and regional level.

1.9 Framework of the Study

The study has been organized into seven chapters including the present one which aims at introducing the major concepts and phenomenon and reviewing existing empirical studies. Chapter 2 aims at providing with the objectives and research questions of the present study. Data sources and methodology used in the other chapters is also discussed in this chapter. Next, Chapter 3 looks into the overall growth of manufacturing sector and its structure in both the economies. Chapter 4 carries out an analyses of the labour cost, labour productivity and efficiency of manufacturing sector of both economies. Chapter 5 analyses the regional level performance of manufacturing sector of India and China in terms of growth of value added, employment and partial factor productivity. This chapter aims at bringing out the contrasts in the spatial spread of manufacturing sector in both economies. Next in chapter 6, productivity level has been estimated in terms of both labour productivity and total factor productivity. This chapter also explores the relationship between agglomeration economies and TFPG of regions in both economies. Lastly chapter 7 concludes the findings of the study.

Chapter – 2

Objectives, Research Questions and Empirical Methodology

The present Chapter provides the analytical framework developed and implemented in this study for the fulfilment of aims and objectives of the study.

2.1 Scope and Coverage of the Present Study

This study carries out a comparative analysis of manufacturing sector in both India and China. Indian manufacturing sector is divided into two components registered manufacturing and unregistered manufacturing. Registered sector covers only those factories which are registered under section 2m (i) and 2m (ii) of the Factory Act, 1948. The sections 2m (i) and 2m (ii) refer to any premises including the precincts thereof (a) whereon ten or more workers are working or were working on any day of the preceding twelve months and in any part of which a manufacturing process is being carried on with the aid of power or is carried on or (b) whereon twenty or more workers are working in any day of the preceding twelve months and in any part of which a manufacturing process is being carried on without the aid of power or is ordinarily so carried on. All remaining factories which do not fill any of the above mentioned criterion fall within the range of unorganised manufacturing sector. The present study will cover only registered manufacturing sector in India.

As in India the manufacturing activities in China also occur in two types of organizations: i) Enterprises with independent accounting system and ii) Units with dependent accounting system. The former has been defined as legal persons that fulfil the following requirements: i) they have been established in accordance with the law, have their own name and organization as well as location of activity, and can be held responsible under civil law; ii) they independently possess and use assets, assume liabilities and have the right to enter contracts with other units; iii) they maintain their own profit and loss account and draw up their own balance sheet. The latter are units that do not fulfil these requirements. The present study has covered data on enterprises with independent accounting system only as it seems that this concept coincides with the Indian concept of registered manufacturing. It can be safely said that Registered manufacturing in India and enterprises at/above designated size in China provide a comparable dataset.

Manufacturing sector has been analysed at a disaggregated level of both two-digit and three-digit industrial classification and regional level (state level in India and Province level in China). The proposed time period of the study is 1998-1999 to 2011-2012.

2.2 Objectives of the Study

Present study aimed at fulfilling following objectives:

1) To examine and compare the growth trends in organised manufacturing sector's output and employment in both India and China at two-digit sectoral level and at regional level.
2) To compare the labour cost and competitiveness of manufacturing sector in both economies.
3) To examine and compare the labour productivity, technical efficiency and total factor productivity of manufacturing sector in both countries at sectoral level.
4) To examine and compare the regional spread of partial and total factor productivities in manufacturing sector of both countries.
5) To identify factors affecting the total factor productivity growth of manufacturing sector in India and China.

2.3 Research Questions

Based on the above objectives, the present study has attempted to answer following research questions

1) Is China's manufacturing more competitive than India's manufacturing in terms of labour cost?
2) Is Chinese manufacturing labour more productive than Indian manufacturing labour?
3) Has growth of manufacturing been input driven or productivity driven in both India and China over the period of time?
4) Is the regional spread in China capable of generating more agglomeration economies?
5) What factors influence the growth of TFP in India and China?

2.4 Data Sources

The present study has used secondary data on manufacturing sector of India and China covering the period of 1995-96 to 2012-13 for two-digit level analyses of the manufacturing sector and while undertaking three-digit analysis and regional level analysis the time period taken has been 1998-99 to 2011-12 as per the availability of data. The study has relied on following data sources:

1) **Annual Survey of Industries (ASI):** For India data available from Annual Survey of Industries (ASI) at two-digit level, 3-digit level and regional level of organized manufacturing industries has been used. Both published reports of ASI and unit level data has been used to build a compatible data series on various variables.
2) **Central Statistical Organisation, India (CSO):** CSO has been referred to get price deflators for various manufacturing industries.
3) **China Industrial Economy Yearbook (CIEY):** For China, data has been taken from China Statistical yearbook (CSY) at two-digit level covering "independent accounting units (IAUs) at/above township level", before 1998 and afterwards CSY covered enterprises classified as "at/above designated size" but both these classifications are largely the same. Registered manufacturing in India and enterprises at/above designated size provide a comparable dataset.
4) **China Data Online, University of Michigan (CDO):** This data source has been used for 3-digit level manufacturing data and 2-digit level regional data of China for the years 1999-2000 to 2011-12. This data set has the same industrial enterprise covering as the CIEY.
5) **China Statistical Yearbook (CSY):** For some variables like price deflators, Exports, FDI, CSY have been referred.
6) United Nations' Commodity Trade Data.
7) World Development Indicators: www.*data.worldbank.org*
8) United Nations (UN) online database: www.data.un.org.

2.5 Methodology Employed in Constructing Variables Used in the Study

This section provides details of the methodology used to construct various variables for carrying labour cost, labour productivity, technical efficiency and TFPG analysis.

2.5.1 Output

Many earlier studies have raised questions on the reliability of Chinese GDP and output figures. All these problems were due to the following of Material Product System (MPS). But from 1993 onwards System of National Accounts (SNA) has been adopted, which hopefully solves many of the problems relating to the aggregation and measurement of the variables. As the period of the present study is from 1998-99 to 2011-12, so the present analysis has relied on official Gross Value Added (GVA) figures. For making productivity analysis GVA at constant prices has been taken as the measure of manufacturing output for both India and China. The choice between Gross Output and GVA has been made following Goldar (1986). In his study Goldar has mentioned that the majority of studies on productivity prefer GVA. Griliches and Ringstad (1971) advanced the following arguments in its favour:

i) It facilitates comparison of results for different industries with different material intensities. It improves comparability of data for individual establishments even within the same industry.
ii) It facilitates aggregation of output across industries.
iii) Inclusion of ‘material’ as an argument in the production function leads to the problem of dominant variable. In such a formulation almost all variation in output tends to get explained by ‘material’ thereby obscuring relations of greater interest.

Based on the above discussion GVA from CSY for China and ASI for India has been taken as a measure of manufacturing output. To obtain real GVA at constant 2005 prices the series has been deflated using official sector-wise WPI (Wholesale Price Index) available in national accounts of India and China.

2.5.2 Employment

Indian manufacturing employment data is much more consistent and reliable than Chinese statistics especially the data for registered manufacturing. As this study focuses on registered manufacturing only, so the employment data available in ASI has been taken. Data on “number of employees” has been taken from ASI. It is defined to include persons employed directly or through any agency for wages or not and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process or in any other kind of work incidental to or connected with the manufacturing process or the subject of the manufacturing process. The number of employees is an average number obtained by dividing man-days worked by the number of the days the factory had worked during the reference year.

The shortcomings of China's official statistics are also evident in its industrial employment data. Investigations by Szirmai and Ren (2000), Szirmai et al. (2001) and Wu (2002b) on different Chinese sources reveal discrepancies in the employment data that are largely due to coverage issues. Szirmai and Ren (2000) and Szirmai et al. (2001) compared the employment data across different sources: The Industrial Census, China Statistical Yearbook (CSY), China Industrial Economy Statistical Yearbook (CIESY) and the China Labour Statistical Yearbook (CLSY). Their findings in both studies showed some similarities as well as significant discrepancies across these sources. The reasons for this have been unclear coverage and inconsistencies in coverage. Szirmai et al. (2001) also found that while output data between the CSY and the Industrial Census were consistent, the employment data were not. This implied that output and employment data published in the CSY were not consistent in coverage with each other, thus implying that the employment data were understated and unreliable. Wu (2002b) also found discrepancies in the industrial employment data between the CIESY and CLSY. These were largely due to coverage issues. The difference in coverage for 'persons engaged' in 1994 showed the CIESY figure being 40% higher than the CLSY figure. Even after allowing for the different coverage of 'independent units' and 'attached units', this gap could not be explained (see Wu, 2002). Investigation between these two sources in this study for 'persons engaged' reveal that CIESY's figure was 25% and 31% higher than the CLSY figure, for 1992 and 1993, respectively. Wu attempted to re-estimate China's industry and manufacturing employment. Close investigation revealed that this discrepancy in employment figures was predominantly due to coverage levels in the manufacturing sector. Some of the published sources contain data on the whole economy covering each level of enterprises whereas some of the sources limited their coverage only to units with independent accounting system. Another discrepancy among various sources of published data arises from the fact that some of the published figures on employment are for all the sectors of economy whereas some published sources limited their information to the employment in urban sector units only. So while doing productivity analysis one needs to make sure that output and labour data have same coverage. This could be a daunting task if one has to do a disaggregated level analysis.

For the present study we needed a variable of industrial labour in China which could be comparable to labour data of Indian registered manufacturing. So the employment figure from NBS with the coverage of independent accounting enterprises at or above the rural-township level served the purpose of this study. Present study has used the official employment series from "China Data Online" without making any adjustments as data on all variables come in a single table which solves the coverage and discrepancy issues discussed in the literature. To represent Chinese manufacturing employment, the concept of "Total Persons Employed" has been used which is defined as persons employed who receive payment from units of state ownership, collective ownership, joint ownership, shareholding ownership, foreign ownership and ownership by entrepreneurs from Hong Kong, Macao and Taiwan and other type of ownership and their affiliated units.

2.5.3 Capital Input

The measurement of capital stock has been a controversial issue both in theoretical and in empirical literature. There is no universally accepted method for its measurement and several methodologies are used in estimation of capital stock. As the official data on net capital stock in both countries is given in book value so in the present study Perpetual Inventory Method (PIM) has been used to get capital stock at replacement cost. In this method it is the addition to capital stock that is deflated, rather than the stock itself. The stream of investment generated in such a manner is added to a bench-mark estimate. The basic idea of Perpetual Inventory Method is to interpret an economy's capital stock as an inventory. The stock of inventory increases with capital formation (Investment). Once an investment enters an inventory it remains there forever and provides services to the inventory owner. The quantity of services, the investment provides is at maximum directly after the investment has been made and decreases in course of time. The amount by which the capital stock falls per period is the depreciation rate. However, while the value of investment decreases in the course of time, it never falls to zero. Thus an investment principally has a perpetual use. In order to be able to apply the PIM to calculate the current capital stock, we need:

(i) a time series of investment data,

(ii) information on the initial capital stock at the time when the investment time series starts and

(iii) information on the rate of depreciation of the existing capital stock.

2.5.3 (A) Construction of Capital Stock Series for India

A substantial amount of literature on capital input estimates for productivity analysis in the Indian economy, and in particular in the organized manufacturing has appeared over last few decades. Reddy and Rao (1962), Krishna and Mehta (1968), Hashim and Dadi (1973), Mehta (1974, 1975), Narasimhan and fabrcy (1974), Asit Banerjee (1975), Goldar (1986a, b), Ahluwalia (1985, 1991) Balakrishnan et al (1994), Mohan Rao (1994), Raychaudhuri (1996) and Das (2004) are a few to name among the vast literature. However, the measurement of capital input in studies on India's productivity is far from satisfactory (Goldar, 1986). In the studies that use capital stock using perpetual inventory method, there have been substantial differences in their approach in many respects. This includes differences in the use of gross versus net capital stock, the choice of bench mark year for calculating the initial capital stock, treatment of land as a capital good, assumption regarding depreciation and the choice of appropriate investment price deflators. Also often there have been differences in the definitions of investment and capital data used in different studies. While some studies use book value figures of fixed capital, others have used working capital or total productive capital or gross fixed capital stock at replacement cost.

The method used in the present study resembles the method used in the studies namely Ahluwalia (1991), Balakrishnan and Pushpangadan (1994) and Trivedi (2006) except that the concept of depreciation rate which has been taken from the study of Erumban and Das (2014). The time-series on capital stock at current prices has been generated by using following equation:

$$K_t = I_t + (1-\delta) K_{t-1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.1)$$

Notations used in these equations are as follows:

I is the gross fixed capital formation which represent annual investment flows. K is the stock of capital at current prices. δ represents depreciation rate. Subscript t has been used to denote time.

Data on fixed capital stock available in ASI is the historical data on book value and it is inappropriate to use this data as it does not reflect the replacement cost. In order to circumvent this problem, the data on capital stock of registered manufacturing sector at replacement cost has been taken from CSO. The proportion of capital stock for each sector has been obtained from the ASI fixed capital and then these proportions have been applied to the CSO data on capital stock. Similarly, the CSO capital stock series has been broken among various states at two-digit sectoral level. This method involves the assumption of proportionality. But any other method would also have involved some other kind of assumptions[7]. This data from CSO serves as initial capital stock. Annual flow of investment (I_t) has been generated from ASI gross fixed capital (GFC) series as follows:

$$I_t = GFC_t - GFC_{t-1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.2)$$

[7] Trivedi et al (2011).

Next issue is to determine an appropriate depreciation rate for capital stock. The depreciation available from ASI is also at book value which again poses a problem in appropriate measurement of capital stock for Indian registered manufacturing sector. Besides being sensitive to the specific methodology used estimation of capital stock is sensitive to a measure of true depreciation. Ideally, if it was possible to device a measure of true economic depreciation, it would be desirable to use the estimates of net capital stock other wise use the estimates of gross capital stock (Erumban and Das,2014). Existing estimates of depreciation are either tax-based accounting concepts or based on certain rules of thumb. Banerji (1975), Hashim & Dadi (1973) and Goldar (1981) believe that measurement of economic depreciation is a very complex exercise, and it is preferable to work with estimates of gross capital stock. However, a few studies measure net capital stock through perpetual inventory method using existing concepts for estimating depreciation, for example Roychaudhry (1977) used depreciation at book value which is grossly overstated, while [Goldar (2004) and Banga & Goldar (2006)] assumes the rate of annual depreciation as 5 per cent. The present study relies on the estimates of Erumban and Das (2014) for depreciation rate. The depreciation rate has been calculated by using detailed tables from NAS on assumed life of various assets. The implicit aggregate depreciation rate for various sectors has been derived as weighted depreciation rate of individual assets. This study has estimated depreciation rate of manufacturing sector as 5.8 percent for the period of 1998-2011. Finally, the series obtained from equation (2.1) has been deflated by investment deflator which has been calculated from the series of Gross Fixed Capital Formation available in CSO, both at current prices as well as constant prices of 2004-05.

2.5.3 (B) Construction of Capital Series for China

The NBS way of calculating OVFA is to add the value of investment in fixed assets in current year embodying a mix of buildings (factories, offices and dwellings), equipment and machinery, with the value of the existing stock at historical or acquisition prices. Assuming that official depreciation method can be accepted, NVFA (OFA – Depreciation) cannot be used because it ignores two problems: inaccurate valuation and improper coverage. One of the major problem which comes while using official fixed assets data is that there is no proper deflator that can deflate a capital stock mixed with assets bought at different prices. So to solve this problem the flow of investment series has been derived using Wang and Szirmai (2011). The following equation has been used:

$$I_t = OFA_t - OFA_{t-1} \ldots\ldots (2.3)$$

In the next step the initial capital stock has been calculated by using Growth rate approach. Many studies like Young (2003), Nadiri and Prucha (1996) and Wu (2011) have used this method for calculating initial value of capital stock. This is done by using following equation:

$$K_t = I_t / (\delta + \varphi^*) \ldots\ldots (2.4)$$

The above equation implies that the incremental capital stock or realized investment in period 1 is the sum of the depreciated capital stock in period 0 and new capital stock created. The latter is assumed to grow at the constant rate of φ^*which is often replaced by the average growth rate of the incremental capital stock in the initial period, say, five years. In practice, authors have also used the rate of growth of investment or GDP when incremental capital stock data are not available.

The published official depreciation rates are unusually low from an international Perspective (Wu, 2014). Furthermore, the official depreciation method in China assumes a straight-line depreciation function that is different from the geometric depreciation function supported by established empirical studies. Due to the lack of empirical evidence of the service lives of equipment and structures and their depreciation patterns in China, many studies simply adopt the official depreciation rates (Chen et al., 1988a; Chow, 1993; Hu and Khan, 1997), whereas a few set their depreciation rates based on the experience of market economies (Huang et al., 2002; Li et al., 1993) or arbitrary assumptions (Young, 2000a). Nonetheless, researchers' choices of different depreciation rates together with different deflators, *ceteris paribus*, could significantly affect the estimated growth rate of capital stock. In the present study, the depreciation values (δ) have been taken from Wu (2014) which provides detailed two-digit sectoral level depreciation rates for manufacturing for the period 1993-2010. Finally, the net capital stock for Chinese economy has been calculated using equation 2.1. The series thus obtained has been deflated using implicit investment deflator from national accounts.

2.5.4 Wages

In case of India total emoluments are taken as an indicator of labour cost. In case of China CSY provides information on average wages to labour which are defined as follows:

Average Wage = Total wage bill of staff and worker at a reference period of time/ Average

number of staff and workers at a reference period of time.

Nominal wages have been used in calculating labour cost.

2.6 Methodology

Methods and measures adopted for the empirical analysis in this study are as follow:

2.6.1 Growth Rates

To explain the growth of different factors in Indian and Chinese economies compound annual growth rates have been calculated. Following equation is used to calculate growth rate:

$$Y_t = at^b . e^{U_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.5)$$

Transforming equation (2.5) in linear form:

$$\text{Log } Y_t = \text{Log } a + b \text{ Log } t + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2.6)$$

Where, Y_t is the value of the variable at time period t whose growth rate is to be calculated

t is the trend variable, u is the disturbance term and a and b are constants.

From the estimated value of regression co-efficient ‘b’ the compound annual growth ‘r’ is calculated as follows:

$$r = \text{antilog } (b – 1) * 100.$$

2.6.2 Labour Cost

Labour cost (LC) is taken as the value of wages per worker and has been calculated for India as follows:

$$LC = Wages_i / L_i$$

Where sub script i refers to i^{th} industry. L denotes total number of workers.

2.6.3 Labour Productivity

Labour productivity (LP) has been taken as gross value added per worker as follows:

$$LP = GVA_i / L_i$$

2.6.4 Labour Intensity

Labour intensity (LI) is defined as number of workers per unit of net fixed capital stock.

$$LI = L_i/K_i$$

Following Sen (2008) and Kapoor (2013) industries have been categorised as labour intensive or capital intensive on the basis of L/K of each industry. Industries having an above average L/K are said to be labour intensive and industries showing below average L/K has been considered capital intensive. This has been done both at national level and regional level.

2.6.5 Technical Efficiency (TE) and Total Factor Productivity Growth (TFPG)

There are several definitions of TFPG, and there has been a debate in the literature[8] on the exact definition of TFPG (Lipsey & Carlaw, 2001; Mahadevan, 2003). Total factor productivity growth (TFPG) is simply defined as that part of output growth which cannot be explained by growth in factor inputs. It includes technological progress and technical efficiency. It is also called the 'Solow residual' because this concept gained prominence due to Solow's seminal work on the measurement of TFPG. However, the foundations of this concept have been traced back to the work of Tinbergen (1942). Mahadevan, (2003) has also summarized the alternative definitions of TFPG as follows.

TFPG = Output growth – Input growth

= Technical/Technological Change/ Progress

= Changes in Technical Efficiency + Technological Progress

Source: Mahadevan (2003)

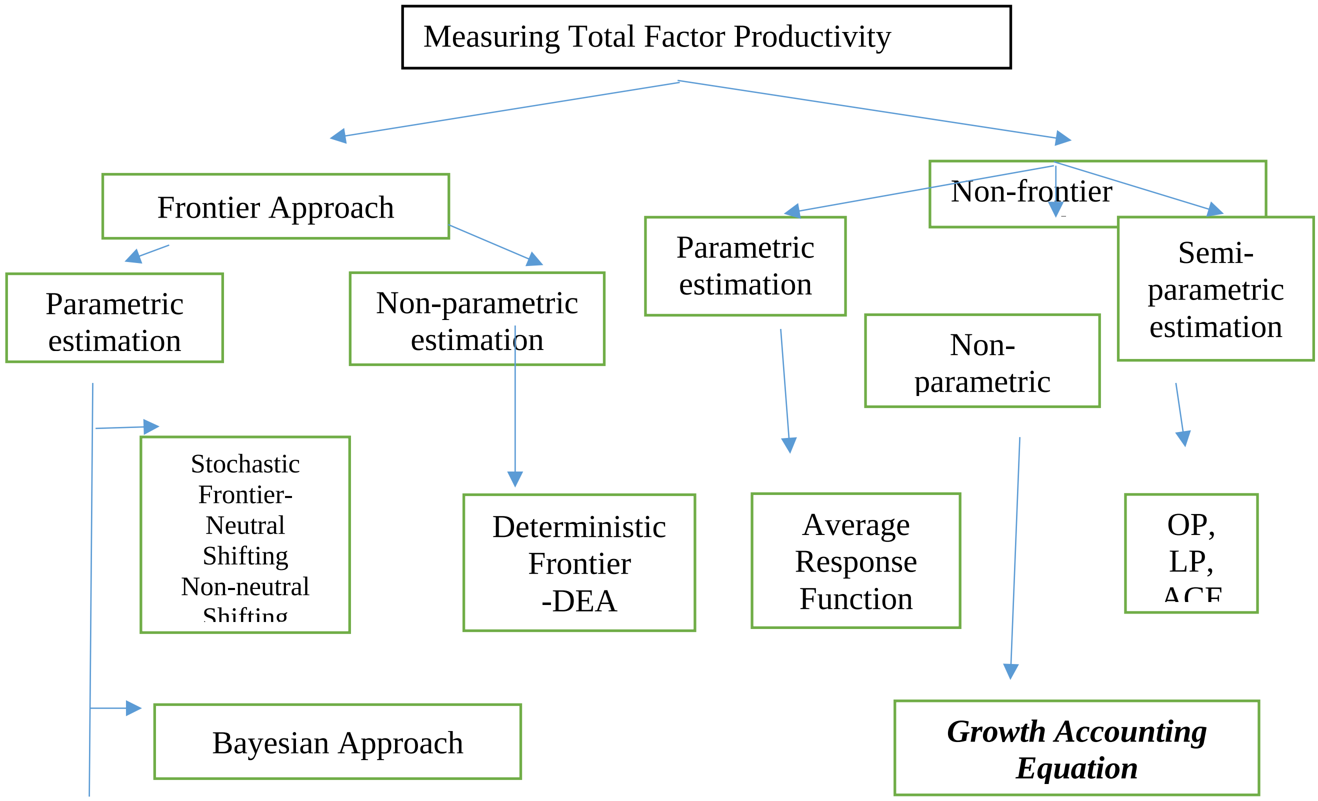
The third and fourth definitions are equivalent as embodied technical change measures changes in technical efficiency and disembodied technical progress is technological

[8] See Lipsey & Carlaw (2001) for a summary of alternative interpretations of TFPG used in the literature.

progress which causes a shift of the production frontier. Embodied technical change causes a movement along the frontier resulting from better and efficient utilization of existing inputs. It includes better managerial capabilities, improvement in the quality of labour, learning by doing effects etc. On the other hand, disembodied technical progress relates to new methods, processes and advances in knowledge. It is called disembodied because it does not alter the efficiency with which factor inputs are utilized.

There are various approaches in the literature to measure TFPG. Figure 1 presents the different approaches which are used in the literature to measure TFPG. Kathuria et al (2014) and Mahadevan (2003) have explained in detail the different approaches to estimate TFPG. They have also analysed the relative merits and demerits of these alternative approaches to estimate TFPG. As figure 1 shows, TFPG can be estimated using frontier and non-frontier approaches.

Figure 2.1: Alternative Approaches to measure TFPG



Source: Mahadevan (2003) & Kathuria et al (2014).
Note: OP: Olley-Parks; LP: Levinsohn and Petrin approach; ACF: Ackerberg, Caves and Frazer model.

As Mahadevan (2003) states, "the crucial distinction between frontier and non-frontier approaches lies in the definition of frontier. In the frontier approach, the aim is to find the bounding function i.e. the best obtainable positions given the inputs or the prices." On the other hand, non-frontier approach is based on an average response function which is estimated through OLS. The non-frontier approach assumes that firms are technically efficient whereas frontier approach decomposes TFPG into two components: technological progress and technical efficiency.

Both these approaches can be estimated with parametric or non-parametric methods. The crucial difference between these methods is that the former imposes a functional form and then econometric techniques are used to estimate the parameters; while the latter does not impose any functional form. There is no consensus in the literature with respect to the best approach to estimate TFPG; which ultimately depends on the objectives of the study.

The calculation of TFPG involves several issues, and the variation in the estimates of TFPG arises from some of these. TFP calculation is sensitive to various measurement issues like choice of the variables, choice of deflators, calculation of capital stock, etc. Dholakia (2002) has summarized the important issues that arise in the estimation of TFPG. These issues are: "(1) whether the productivity measurement should be based on the gross output function or the value added function, (2) whether the estimates of real value added should be based on single deflation method or double deflation method, (3) the base year for the deflators, (4) construction of an appropriate input price deflator, (5) appropriate measurement of weights to be assigned to the labour input, the capital input, and the material input."

In the present study Stochastic Frontier Production (SFP) Function has been employed to calculate TFPG. It decomposes TFP into Technical efficiency change and technical progress. This methodology helps to fulfil two main objectives of this study. Firstly, it provides the estimates of technical efficiency and TFPG which have been compared for both India and China in the study. Secondly the TFPG estimates provided by this technique have been employed in the regression analysis for studying the relationship between agglomeration and productivity[9]. This technique has also helped to answer the

[9] This study uses TFP and not labour productivity for studying relationship between agglomeration and productivity at regional level. The agglomeration literature has shifted to the use of TFP in place of labour productivity. Duranton & Puga (2010) point out that output per worker is not an appropriate measure of productivity in this context and more intensive use of capital would lead to upward bias if

research question that whether the growth of manufacturing has been input driven or productivity driven in both India and China during the study period.

2.6.5 (A) The Stochastic Production Frontier (SPF)

The economic theory on efficient production argues that producers always produce at the maximized output level with given inputs. The empirical estimation on output, cost, and profit functions could produce variation in production efficiency (Farrell, 1957). The SFP decomposes TFP into technical progress and technical efficiency. It helps us to identify the presence of underlying inefficiencies in the production process. SPF has been augmented by Aigner et.al (1977) and Meeusen and Broeck (1977). Initially proposed for cross-sectional data later the SPF has been extended to panel data analysis also[10]. Battese and Coelli (1992) proposed a time varying model for technical efficiency effects in the SPF panel data[11]. All these modes are based on the assumption of Hicks-neutral technology which implies parallel shifts of the production frontier over time.

The stochastic frontier production function without random shock can be stated as:

$$y_i = f(x_i)\exp(-u_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.7)$$

where y_i is the observed scalar output and x_i is a vector of inputs for i^{th} firm. The positive value of u_i is supposed to measure technical inefficiency. Technical efficiency can be written as:

$$TE_i = \frac{y_i}{f_i} = \exp(-u_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

which is the ratio of observed output to maximum feasible output. It shows the output of the ith firm relative to the stochastic frontier output that could be produced by a fully-efficient firm utilizing the same vector of inputs. Such an output-oriented measure of technical efficiency takes a value between zero and one. If $TE_i = 1$, then the firm is technically efficient. By incorporating technical progress into the technical inefficiency specified in Equation (2.7), we represent the production function at time t, without the subscript i for firm, as:

$$y_t = f(X_{1t}, X_{2t}, \ldots\ldots\ldots\ldots X_{kt}, t)e^{-ut} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.9)$$

where y_t is output and x_{jt} is the j input, j = $1,2, \ldots, k$, at time t. Taking logarithm-differentiation of Equation (2.9) with respect to time, it gives:

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agglomeration economies are estimated using output per worker. Therefore, we use TFP as our measure of productivity

[10] See Pitt and lee (1981), Cornwell et al (1990), Kumbhakar (1990).

[11] Present study also employs Battese and Coelli (1992) model for efficiency measurement. More detailed discussion on functional form has been carried out in chapter-4 of the present study.

$$y_i = \sum_j \frac{\partial f}{\partial x_{jt}} \frac{x_{jt}}{f} x_{jt} + \frac{\partial f}{\partial t}\frac{1}{f} - \frac{\partial u_t}{\partial t},$$
………………………….. (2.10)

Where $y_i = \frac{\partial y_t}{\partial_t}\frac{1}{y_t}$ is the growth of output and $X_i = \frac{\partial x_{it}}{\partial_t}\frac{1}{Xi_t}$ is the growth of input x_{jt}. The technical progress is $A_t = \frac{\partial f}{\partial_t}\frac{1}{f}$ and Technical efficiency is $TE_t = \frac{y}{f} = e^{-ut}$ while the growth of the technical efficiency is $TE_t = -\frac{\partial u_t}{\partial_t}$. Next, $e_{it} = \frac{\partial f}{\partial X_{it}}\frac{X_{it}}{f}$ denotes the output elasticity with respect to input x_{jt}. The output growth can be represented as:

$$y_t = \sum_j e_{jt} x_{jt} + A_t + TE_t$$
………………………………….. (2.11)

The first term in the above decomposition can further be decomposed into two different terms using the cost minimization condition. Consider the cost minimization problem of the objective function: $\min_{x_{jt}} C_t$, where $C_t = \sum_i W_{it} X_{it}$, subject to the constraint in Equation (2.9). In the Lagrangian form, the objective function and the constraint are written as:

$$L(x_{jt}, \lambda) = \sum_j w_{jt} x_{jt} + \lambda(y_t - fe^{-u_t}),$$
……………………(2.12)

where λ is the Lagrange multiplier. The first-order condition for minimization is:

$$w_{jt} = \lambda \frac{\partial f}{\partial x_{jt}} e^{-u_t},$$
…………………………………..(2.13)

Multiplying both sides by x_{jt},

$$w_{jt} x_{jt} = \lambda \frac{\partial f}{\partial x_{jt}} x_{jt} e^{-u_t} = \lambda \frac{\partial f}{\partial x_{jt}} \frac{x_{jt}}{f} fe^{-u_t}\ \lambda e_{jt} y_t.$$
………………………………..(2.14)

Taking the sum for all input, the total cost C_t is:

$$C_t = \sum_j w_{jt} x_{jt} = \sum_j \lambda e_{jt} y_t = \lambda e_t y_t,$$
……………………………….(2.15)

Where $e_t = \sum_i e_{it}$ is the sum of output elasticities to input. It can be shown that e_t is a measure of returns to scale. Suppose changes in all inputs have the same scale, $\Delta x_{jt} = ax_{jt}$ Consider the changes in output Δf by taking the total derivative of $f(x_1, x_2, \ldots, x_n, t)$ and substituting

$\Delta x_{jt} = ax_{jt}$ into Δf, we have:

$$\Delta f = \sum_j \frac{\partial f}{\partial x_{jt}} \Delta x_{jt} + \frac{\partial f}{\partial t}\Delta t = f\sum_j \frac{\partial f}{\partial x_{jt}} \frac{ax_{jt}}{f} + fA_t = fa\sum_j e_{jt} + fA_t = afe_t + fA_t.$$
…… (2.16)

Without considering technical progress, the production function shows increasing (constant, decreasing) returns to scale when e_t >1 (= 1, < 1). Dividing Equation (2.14) by Equation (2.15), the cost share for input j is:

$$S_{jt} = \frac{w_{jt} x_{jt}}{C_t} = \frac{e_{jt}}{e_t} \quad \text{………………………………. (2.17)}$$

This shows that the cost share is always equal to the relative output elasticity in the case of cost minimization. For the constant returns to scale, e_t =1, the cost share is equal to output elasticity. Inserting $e_t \frac{1}{e_t}$ into Equation (2.11) and rearrange terms, we can rewrite the output growth as:

$$y_t = \sum_j \frac{e_{jt}}{e_t} x_{jt} + (e_j - 1) \sum_j \frac{e_{jt}}{e_t} x_{jt} + A_t + TE_{t\_} \quad \text{…………………………………. (2.18)}$$

Using the cost share Equation (2.17),

$$y_t = \sum_j S_{jt}\ x_{jt} + (e_j - 1) \sum_j S_{jt}\, x_{jt} + A_t + TE_{t\_} \quad \text{…………………………………. (2.19)}$$

In the above, output growth is decomposed into four sources: input growth $\emptyset = \sum_i S_{it}\ X_{it}$ adjusted scale effect (e_t - 1) $\boldsymbol{\phi}_t$, technical progress A_t, and the growth of technical efficiency TE_t. The first term represents the contribution of input growth to the output growth. The growth of aggregate input is the weighted sum of all input growth. The weight is the cost share of the input, which is also the ratio of output elasticity of an input. The second term is the adjusted scale effect. The contribution of increasing returns to scale to output growth is positive

(e – 1)> 0, and the scale effect of (e - 1) is adjusted by the growth of aggregate input. For constant returns to scale (e = 1) or zero input growth ($\boldsymbol{\phi}$ = 0), the adjusted scale effect is zero. The third term A_t is a measure of technical progress and the last term TE_t refers to the change in technical efficiency. This decomposition is different from Solow's growth decomposition (Solow, 1957) in two ways. First, this decomposition allows non-constant returns to scale. Second, it considers the change in technical efficiency.

With the decomposition of output growth as shown by equation (2.19), we can easily derive the decomposition of the growth of TFP. Define the TFP for a production function with multiple inputs at time t as:

$$\mathrm{TFP}_t = \frac{y_t}{\boldsymbol{\Phi}_t} \quad \text{…………………………… (2.20)}$$

where $\boldsymbol{\phi}$ is the aggregate input. Assuming $\emptyset = \sum_i S_{it} \ X_{it}$ the growth of TFP is:

$$TFP_t = (e - 1)\sum_i S_{it} x_{it} + \Delta\delta_t + TE_t \quad \text{.................................} (2.21)$$

The decomposition of output and productivity growth shown in Equations (2.19) and (2.21) has been applied to the data. The stochastic frontier model assumes deviations from the efficient frontier with random shock (Aigner et al., 1977). The specification of technical inefficiency in Equation (1) might also capture other random shocks that are either beyond the control of the firm or not directly attributable to the underlying technology. The random shocks can be included in the translog production frontier function by adding a two-sided error term (Greene, 1980).

2.6.6 International Productivity Comparisons and Currency Conversion

One of the major issues in doing international comparisons of productivity is that the data should be made compatible between countries. In order to accurately compare the productivity levels of international manufacturing sectors, it is necessary to use an appropriate currency conversion tool. When the nominal exchange rate is used for conversions it leads to biasedness caused by various factors like, interest rate differentials, capital flows between countries, speculation on currency and international prices of goods that are traded internationally. Consequently, it doesn't indicate the real price difference among countries. Several other methods have been suggested to adjust for differences in quantities. One method, the direct approach, divides the total revenues by the physical volumes to determine the price of each unit. Therefore, every unit produced in the country has the same price (it is called the "law of one price"). This method suffers from unreliability since the "law of one price" can most appropriately be applied in industries where the output is homogenous such as steel, petroleum, and bricks, but does not apply to industries where the output is heterogeneous. Hence, it is not considered a good method for about 75% to 80% of manufacturing industries. A second method uses the accounting data and deflates volume by the specific price index for a specific industry. But these measures do not directly reflect the change in the absolute prices, but appear to reflect basic levels of price differences among countries (Wacker and Johnson, 1998).

Consequently, there does not appear to be a satisfactory method to make between country comparisons of levels of productivity. Still many researchers believe that the best alternative is the use of Purchasing Power Parities (PPP) or the closely related Unit

Value Ratios (UVR)[12]. These ratios are computed for a group of identical products between each country. For some industries, there are individual PPPs, but in most cases, the overall PPP should be used due to the heterogeneity of manufacturing. The PPPs are generally more stable over time when compared to exchange rates, since they do not reflect the radical fluctuations caused by financial and political activity. However, PPPs have some drawbacks. The large number of product comparisons necessary to derive each country's PPP makes it difficult to get an accurate measurement for specific products that may not have a comparative product in others countries. Additionally, regulations and product information may not be fully disclosed. Even when corresponding products can be found, the level of quality or product variety may make direct price comparisons questionable. Consequently, the inability to match products among countries presents a difficult problem for the derivation of the PPP. Because of these difficulties with PPPs and UVRs, some authors suggest that rates of productivity change should be used for comparisons. There are several important difficulties. Usually, the most important difficulty is the base used for determining productivity. For example, a low income country may have a higher productivity change than the U.S. Yet, this does not imply that the low income country has or will have an economic advantage over the U.S., since the U.S. has a higher base. Additionally, although the under developed country may have a higher productivity percentage increase, in absolute terms, the U.S. may have higher increase in productivity (10% of 1,000 is greater than 15% of 100). Another important consideration is the time-phasing of investment present in all measures of productivity. Investment in equipment usually does not improve productivity in the same period as the investment. Thus, measuring the percentage change in productivity alone does not seem to have any inherent advantage for making international productivity comparison.

PPPs are now provided on a regular basis by Eurostat, the OECD and the World Bank. However, expenditure PPPs raise problems for comparisons by industry (agriculture, industry and services) as, by design, such PPPs are not available on an industry basis. This, however, introduces serious distortions especially for countries at lower levels of development for which GDP PPPs are heavily downwardly biased because of relatively cheap services due to the Balassa-Samuelson effect. This implies that the use of GDP

[12] See, Maddison and van Ark (1989), van Ark (1993), Timmer (2000), Szirmai and Ren (2000) and Erumben (2007).

PPP for manufacturing productivity comparisons can lead to a large overestimation of relative productivity levels in less advanced countries. Other issue is that data collected for PPPs tend to be from major cities, usually capitals and is not necessarily representative of a particular region (ONS, 2007). Pertaining to these issues no consensus has been reached with respect to currency conversion factor while doing international comparisons. Studies have resorted to differential tools for making absolute and relative comparisons of productivity, labour cost and unit value ratios. A list of some studies has been provided in this context.

All of the above listed studies have adopted different tools to make data compatible between two countries. In case of studies dealing with India China manufacturing sector comparison despite of varying methodologies the common conclusion drawn about the performance of two countries has been that China has outperformed India with its higher productivity level especially since early 2000s.

In present study we have followed one of the most referred studies in India China comparison, Bosworth and Collins (2008) and used PPP exchange rates from OECD to convert real value added (deflated using appropriate country and sector wise price deflators) in to US dollars for comparing level of labour productivity. Wages have been converted in to US Dollars using nominal exchange rate following Erumban, 2009.

Study	Time period	Countries	Variables Compared	Currency Converter	Remarks
Bosworth and Collins (2007)	1978-2004	India - China	Growth accounting technique to identify role played by various sectors and factors of production	PPPs from world bank are used for labour productivity comparisons. The trend analysis and TFPG comparison is based on constant prices in national currencies	Study finds similar tends by applying both PPPs and Nominal exchange rate.
Arsana and Wu (2013)	1986-2010	China - Indonesia	TE and TFP	at constant prices in national currencies only	Study compares trends in rates of technical change and technical progress calculated from series based on national currencies only.
Li et.al (2011)	2003	India - China	TFP	Nominal Exchange rate	
Ceglowski and Globe (2012)	1998-2001	China-US	Unit Labour Cost	Nominal exchange rate and PPP exchange rate.	Labour Compensation has been converted using nominal exchange rate and Value added had been converted using PPP exchange rate available from Groningen University.
Ark et al. (2008)	1995, 2004	India - China	LP, ULC and Competitiveness	PPP exchange rates of manufacturing sector.	PPPs are calculated by author.
Pandey and Dong	1998-2003	India - China	TFP	Nominal exchange rate.	

Source: Prepared by author.

This implies that when comparing labour cost levels across countries, wages converted using nominal exchange rate represent cost element of the arbitrage across countries. The production function has been run separately for each country based on constant prices in national currencies.

2.6.7 Measurement of Industrial Agglomeration

There are several measures of industrial agglomeration used in the new economic geography literature like Hoover's Index (Hoover, 1948), locational Gini coefficient (Krugman, 1991); Ellison-Glaeser (EG) index (Ellison & Glaeser, 1997); Maurel-Sedillot (M-S) index (Maurel & Sedillot, 1999), and K-density (Duranton & Overman, 2005) Most of these agglomeration measures are based on either geographical proximity or geographical concentration. Duranton & Overman (2005) and Puga (2010) list the desirable properties that an index of agglomeration should satisfy. These are:

1. It should be comparable across industries.
2. It should control for the overall concentration of economic activity
3. It should take into account distribution of firm/plant-size in an industry
4. It should be possible to test it statistically
5. It should take care of the modifiable area unit (MAU) problem. This implies that it should not be biased with respect to spatial aggregation

Kominers (2008) adds two additional properties to the above list. He argues that the agglomeration index should be based on a theoretical model and it should be possible to calculate it in closed form. It is difficult to find an index which satisfies all these properties. Kominers (2008) explains that agglomeration indices can be based on model-based or axiomatic approach. The key difference between these approaches is discreteness and continuity. The former approach assumes discrete geographic units and is dependent on political boundaries. This is the main drawback of discrete indices. In this context, Guillain & Galo (2006) state: "they are a-spatial in the sense that geographic units under study are considered to be spatially independent from each other. The spatial units are treated identically, even if they are neighbours or distant, so that the role of spatial agglomeration can be underestimated."

Various measures of industrial agglomeration used in the present study are discussed as follows.

2.6.7 (A) Measurement of M-A-R Externalities (Specialization)

There are several measures of M-A-R externalities used in the literature like location quotient, own industry employment, number of industry plants, Herfindahl index of concentration, indices based on the technological closeness, and employment in related industries. Out of all the indicators mentioned, L.Q. and own-industry employment are the most widely used measures of M-A-R externalities in the literature (Beaudry & Schiffauerova, 2009). Beaudry & Schiffauerova, (2009) have reviewed these indicators and have classifed them according to 'size', 'share' and 'diversity. Size indicators measure M-A-R externalities by looking at the absolute size of employment, value added etc. Share indicators are based on relative size of the industry and diveristy indicators are based on the extent of industrial diverisity in the region.

The most widely used measure of M-A-R externalities is the 'location quotient' (LQ). It was first introduced by Florence (1937). It is an indicator based on industrial 'share'. Mostly, it is calculated using the employment data; however, some researchers also calculate using the output data. LQ is the ratio of industry i's share in the total employment of the region r to industry i's share in the total employment of the entire national economy. It is a widely used measure of regional specialization. Glaeser et al (1992) argued that MAR externalities can be measured by studying regional industrial specialization. As stated earlier, MAR externalities measure knowledge spillovers between firms in an industry and it is believed that more is the relative concentration of an industry in a region, greater is the possibility of intra-industry knowledge spillovers. The formula is given by:

$$L.Q._i^r = \frac{\frac{E_{ir}}{\sum E_{ir}}}{\frac{E_{in}}{\sum E_{in}}}$$

Where E_{ir} is employment in industry, i in region r and E_{in} is national employment in industry I in region r. If there is regional specialization, each region's employment will be more highly concentrated in that industry in which it specializes. If LQ is substantially greater than 1, there is evidence of regional concentration. The choice of benchmark region is very important in the L.Q. formula and it affects the magnitude of the L.Q. As Wang & Hofe (2007) point out, this choice is with respect to the denominator in the LQ formula. The benchmark region can be a state or nation depending upon the objectives of the study[13].

LQ is highly sensitive to the geographical size of a region (Lall et al, 2001; Ejermo, 2005). The use of LQ may not fully reflect the location decisions of the firms as industry location is partly a random process (Duranton & Overman, 2005). Guimaraes, Figueiredo and Woodward (2008) explain this by the famous dartboard example of Ellison & Glaeser (1997). They state: "If 10 firms choose their locations by throwing darts at a map with 10 equally sized regions, the probability of ending up with a single firm in each region is very small. Most likely, in some regions by chance pockets of concentration will occur and that is perfectly compatible with the idea that firms' decisions were independent and random. The location quotient is unable to account for this problem. Because of the discrete nature of the phenomena it is possible to observe spurious concentration; that is, concentration that occurs by chance alone." However, despite these limitations, LQ remains a widely used measure of regional specialization in the regional science literature.

Another measure of M-A-R externalities widely used in the literature is own-industry employment in the region (for example, Henderson, 2003; Lall et al 2003, 2004, Rosenthal & Strange, 2010). Some scholars argue that it is a better measure of MAR externalities because such externalities are dependent on the absolute size of an industry rather than its relative size (Beaudry & Schiffauerova, 2009). However, this measure also does not take into account an industry's firm-size distribution. There are several other measures of MAR externalities used in the literature like employment in related industries, share of employment in innovation & non-innovative sectors.

Following Glaeser et al (1992) and Feldman and Audretsch (1999), we use location quotient as a measure of regional specialization and hence M-A-R externalities. This measure is most widely used to capture MAR externalities. It is very simple to calculate with the available data and provides a reasonable measure of M-A-R externalities.

[13] In the present study nation has been taken as the benchmark region.

Commonly Used Measures of M-A-R Externalities in the Literature

Variable	Authors/Papers	Measured by:
Location Quotient (L.Q.)	Glaeser et al (1992); Henderson et al (1995); Feldman and Audretsch (1999) Marccou et al (2013)	Ratio of regional share of an industry to its national share
Own-industry Employment	Henderson (2003); Lall et al (2003, 2004); Rosenthal & Strange (2010)	Total employment in that industry in a region
Employment in related industries or provider sectors		

Source: Author's Compilation

2.6.7 (B) Measurement of Jacobian Externalities (Diversity)

The most commonly used measures of Jacobs' externalities are Herfindahl-Hirschman Index (HHI), other industry employment, total urban population and total local employment among others. The early agglomeration literature measured Jacobian externalities by city size. Most of the early empirical studies measured city size by total population or total employment in the city ((for example, Sveikauskas, (1975); Segal (1976); Moomaw (1985); Mitra (2000)). It was argued that larger cities and regions can support a broad range of activities and therefore, they reflect diversity. As Lall et al (2004) explain, "It is believed that larger cities can support a wide range of manufacturing activities and provide more room for diversification as compared to the smaller cities ". Urban population, urban employment and urban population density are some of the popular diversity measures of a region's size. However, scholars argued that these size-based measures do not measure diversity as implied by Jacobs. They seem to measure "global urbanization externalities, which are related to local market size but not to the diversity implied by Jacobs externalities per se, because they derive from the specific industrial composition of the region" (Beaudry & Schiffauerova, 2009).

Since 1990s onwards, an increasing role has been assigned to measure Jacobian by constructing indices of diversity. Following Jacobs (1969) and Glaeser et al (1992), the literature began to measure Jacobian externalities by indices of diversity. Glaeser et al.

(1992), Lall & Chakarvoty (2004), Combes (2000) and Marrocu et al. (2013) have used diversity indices to measure the Jacobian externalities. HHI is the most widely used meausre of diversity in the literature (Beaudry & Schiffauerova, (2009). Henerson et al (1995) and Lall & Chakravorty (2003) have used the simple version of the HHI index to measure Jacobian externalties. In the context of dynamic externalities, De Lucio, Herce & Goicoela (2002) define it as "the sum of the square proportions of employment of all the industries that are present in the region". Higher value of this index implies lesser diversity. This index is given by:

$$D_{ij} = \sum_{i=1}^{i} \left[\frac{E_{ir}}{\sum_{i=1}^{i} E_{ir}} \right] \wedge 2$$

Here, E_{ir} is the employment in ith manufacturing industry in region r. The benchmark employment in this index could be manufacturing employment or total employment in the region r. If total manufacturing employment is used, then this index is called manufacturing diversity index. Several modified versions of HHI are used to measure diversity externalities. One minus HHI is another widely used modification to get a direct measure of the extent of diversity. The inverse of HHI with employment in sectors other than one for which diversity is calculated is widely used to measure Jacobs externalities (for example, Combes, (2000), Usai & Paci (2003), Cingano & Schivardi, (2004) and Marrocu et al (2013). It takes the following form:

$$D_{ir} = \frac{1}{\sum_{i=1}^{i*} \left(\frac{E_{i*r}}{E_r - E_{ir}} \right)} \wedge 2$$

Here, E_{i*r} indicates the employment in all other industries (except i) in region r. E_r is the total employment in the region r. E_{ir} is the employment in industry 'i in region r. Therefore, this index takes into account employment in all other industries except the industry for which the diversity externalities are measured.

The main drawback of diversity index of this kind is that it considers industrial sectors as symmetrical. As Beaudry & Schiffauerova, (2009) state, "diversity is measured symmetrically, implying that it does not consider how different or complementary the industrial sectors are, but assumes them to be equally close to one another". However, Palan (2010) argues that HHI fulfills all the criteria of a reliable index.

The Gini index is another popular measure of Jacobian externalities in the literature (for example, Paci & Usai (2000); Wen (2004); van der Panne & van Beers, (2006)). The Gini coefficient is given by area between the line of equality and Lorenz curve divided by the total area under the line of equality. This index takes the value between 0 and 1. As with HHI, diversity externalities are measured by subtracting Gini coefficient from 1 or taking its inverse. Van der Panne & Van Beers, (2006) have used the following form of Gini coefficient:

$$\text{Gini}_r = \frac{1}{2n^2 s_r} \sum_{k=1}^{n} \sum_{i=1}^{n} | s_{ir} - s_{kr} |$$

Here, n is the number of industries, s_{ir} is the share of industry i's employment in region r, s_{kr} is the share of industry k's employment in region r; and s_{ir} is the mean of the shares.

Following the literature, we measure Jacobs' diversity externalities by using modified HHI to measure diversity externalities. It takes the following form:

$$D_{is} = \sum_{j \neq i} \left(\frac{E_{js}}{E_s - E_{is}} \right) \text{ square}$$

Commonly Used Measures of Jacobian Externalities in the Literature

Variable	Authors/Papers	Measured by:
Total Urban population	Sveikauskas (1975); Segal (1976); Moomaw (1985); Nakamura (1985); Mitra (2000); Feser (2001); Baldwin et al. (2007)	Total urban population in the region
City/Region Diversity	Rosenthal & Strange (2003); Glaeser et al (1992); Henderson (2003); Lall & Chakravorty (2004); Fu & Hong (2011); Widodo et al. (2014);	Herfindahl Index; Modified Herfindahl Index; Gini Coefficient
Overall city employment	Henderson (1986); Jofre-Monseny et al. (2014)	Overall city employment outside that industry,

Source: Author's compilation

2.6.7 (C)Measurement of Porter Externalities (Competition)

Average firm size, indices of concentration based on HHI and the ratio of firm size in the local industry to nation are the widely used measures of Porter's competition externalities.) Average firm is defined as total employment divided by number of firms in the local industry. This measure is simple to calculate but is generally regarded as a weak measure of local competition (Marccou et al, 2013). This measure also fails to take into account the size-distribution of firms (Leon, 2014). However, some of the studies which use aggregate industry level data rely on this to measure the competition externalities.

The most widely used measure of Porter's competition externalities in agglomeration literature is the ratio of number of firms per worker in the local industry to this number at the national level. This measure was first used by Glaeser et al (1992) and followed by several others.

$$\text{Competition Index}_{ij} = \frac{\frac{N_{ij}}{E_{ij}}}{\frac{N_i}{E_i}}$$

In this formula, N_{ij} is the number of firms in industry 'i in region j. N_i is the number of firms in industry I at the national level. E_{ij} is the employment in industry I in region j and E_i is the employment in industry I at the national level. If the value of this index exceeds one, there are relatively more firms of the industry in this region as compared to the national level. Glaeser et al (1992) point out another interpretation of this value. The value of this index exceeding one may also mean that firms are small-sized in this region as compared to the national level. However, they agree that that because of the data constraints, it is difficult to separate competitive firms from smaller firms.

Another widely used measure of the competitive environment mainly used by antitrust departments is the HHI (Hirschman, 1964). It is defined as the sum of squares of market shares of firms in the industry. Leon (2014) argues that HHI gives greater weight to larger firms than smaller ones and provides a more accurate index of competition by taking into account each firm's information. Combes (2000) and Martin et al. (2011) have used firm level data to compute HHI and thereby estimated competition externalities. This index is expressed as:

$$\text{Competition}_{ri} = \sum \left(\frac{E_{r,i,j}}{E_{r,i}} \right)^{\wedge}2$$

Where $E_{ri,j}$ is the employment level of firm j in local industry r-i.

Following, Glaeser et al (1992); Van der Panne (2004) and Gao (2006), we measure Porter's competition externalities by the ratio of number of firms per worker in local industry to that number at the national level. Since, the present study uses state-industry data, exact indicators of the competitive environment like Herfindahl index of an industry are difficult to obtain. However, firm size index has been considered as a reliable proxy for measuring competition by several studies (for example, Paci, and Usai, 2008) that have used industry-level data.

Commonly Used Measures of Porter Externalities in the Literature

Variable	Authors/Papers	Measured by:
Average Firm Size	Paci & Usai (2008); Marrocu et al., (2013)	Total employment divided by number of firms in the local industry
Concentration	Combes (2000); Martin et al (2011)	Herfindahl index; Inverse HHI
Firm Size Index	Glaeser et al (1992); Batisse (2002); Van der Panne & Van Beers (2006); Gao (2006)	Ratio of number of firms per worker in the local industry to that ratio at the national level

Source: Author's Compilation

2.6.8 Linkage between Regional Industrial Productivity Growth and Dynamic Agglomeration Externalities:

Finally, we would examine the linkage between productivity growth and agglomeration economies in manufacturing sector by regressing TFPG of regional industry on the dynamic externalities variables- specialization, diversity and competition. The present study adopts a two-step procedure to investigate the above relationship. In the first step, we estimate the TFPG using the stochastic frontier production function method. In the second step, region-industry TFPG is regressed on agglomeration and other control variables. Our regression model follows the standard approach in the empirical literature to examine the relationship between dynamic externalities and productivity growth (Glaeser et al., (1992); Cingano & Schivardi, (2004); and Marrocu et al., (2013). Specifically, our baseline model takes the following functional form:

$$TFPG_{ri,2001-2011} = \beta_0 + \beta_1 Specialization._{ri} + \beta_2 Diversity_{ri} + \beta_3 Competition_{ri} + \ln TFP_{ri} + error_{ri}$$

Here i refers to the industry, and r refers to the geographical unit (state/province). The LHS variable is the TFP growth for an industry-state in a particular year. The independent variables are agglomeration externalities (Marshall, Jacobs, and Porter). Natural log of initial TFP and sectoral dummies are included as control variables in the above regression model.

Chapter - 3

Growth and Structure of Manufacturing in India and China

3.1 Introduction

With Britain embarking on the path of Industrial revolution in the second half of eighteenth century followed by European countries like Belgium, Switzerland and France a global race of industrialization speeded up. Each country developed its own specialization pattern varying from textiles to coal mining, engineering and luxury goods according to their respective natural resources wealth and ability to adapt advanced technology (Pollard, 1990 and Crafts, 1977). Later the race was joined by United States (USA) in nineteenth century with highly capital intensive and skill intensive production techniques (Wright, 1990). In a short span of time USA became the world leader in technology and witnessed a fast spur in productivity level. Famous latecomers to the process of industrialization were Germany and Russia (Szirmai, 2009).

During the course of time after 1950s East Asian Tigers became paragon of successful industrialization. With the structural changes taking place across the globe and wake of industrialization a lot of contemporaneous economic literature came up to embody ideas about the process of economic growth and structural change. The world economy was divided into industrial economies and agricultural economies (Lewis, 1978). Industrialization became synonymous with economic development, technological leadership and international dominance. Chenery, 1955 asserted, “Industrialization is the main hope of poorest countries trying to increase their levels of income.” Within the industrial sector the development and growth properties of manufacturing sector were identified. Nicholas Kaldor (1966) rightly asserted manufacturing as engine of growth known as Kaldor’s first law.

Recently the experience of China in post-reform era seems to support the general experience of all developed and industrialised economies. India is said to have fallen apart from China in the race of economic growth because of lack of a strong manufacturing base. The acuteness of Indian manufacturing performance as compared to Chinese manufacturing sector has been well – recognised in the literature (Li et.al, 2010, Wu et.al, 2007, Nagraj 2005, Pandey and Dong 2007 and many more). China accounted for 22.4 percent of global manufacturing in 2012, while India's share of global manufacturing stands at a little over 2 percent (Sahoo and Bhunia, 2014). These figures prove to be very humbling as well as alarming for an Indophile.

3.1.1 Empirical Literature on Growth and Structural Change in Industrial Sector

Hoffman's (1958) empirical exercise regarding the process of industrialization in which he specifically analysed the trajectory of the manufacturing sector to examine whether the pattern of growth is distinguished for the growth of the consumer goods industries followed by the capital goods industries in the process of industrialization, constitutes a formal beginning towards the issue of structural change in the process of industrial growth. Taylor and Chenery (1968) examined the pattern of growth in manufacturing sector and found that in the early stage, industrialization is characterized by simple technologies with low income elasticity of demand, which subsequently transform into sector dominated by complex technologies with high income elasticity of demand.

Chenery and Syrquin (1986) built a 'standard pattern of industrialization' (for the income interval US $140- $5040 per capita income at 1970 prices) which consisted of the structural transformation from one stage to another, based on the interaction among demand, trade and technological explanations which helped in comparing the pattern in the individual countries. A holistic view about the structural transformation of the economy was created and the basic sectoral classification was also done. Within manufacturing, the study found a shift towards the sectors that use intensive intermediate inputs and technology. This pattern was further analysed empirically by Kubo et al. (1986) for nine countries. In 1989, Syrquin and Chenery extended their study to 108 economies for the period 1950-83. This study also found that as income increases (defined by the income interval US $300- $4000 per capita GNP at 1980 prices) the composition of manufacturing shifts from light to heavy industry.

The prominent work in case of Indian manufacturing sector is that of Ahluwalia (1991) wherein she found that at the time of independence, Textile and Sugar industry dominated. With the inception of the Second Five-year Plan, the process of structural diversification of industrial sector began and by 1980, the weight of consumer's goods in Index of Industrial Production (IIP) declined by 20% and capital goods increased by 10%. In terms of value added in the total manufacturing, the share of consumer goods declined from 50% to 36%, while that of capital goods increased from 12% to 21%.

Wei and Balasubramaniam (2015) tried to analyse and compare the structure of manufacturing sector in India and China. They concluded that due to policy framework and Human resource endowments of India it has missed the chance to specialize in labour intensive manufacturing. China has slowly moved the structural change ladder and improved the structural stage of its manufacturing sector.

Not many studies have compared the structure and stage of industrialization of manufacturing sector of India and China for the recent period.

3.2 Outline of the Chapter

As discussed in the introductory section of this chapter, industry plays a significant role in the overall development of a country. The structure of industry is also important because the kind of industries a country develops, effects its growth and competitiveness. This chapter endeavours to fulfil the objective of comparing overall manufacturing sector's growth and structure in both India and China. The chapter has been divided into seven sections including the introductory section. The present section provides the outline of the study. The third section aims at providing an overview of the policies and performance of manufacturing sector in both economies at aggregate level. The fourth section compares the structure and growth of value added and employment of manufacturing sector and its component industries at two-digit level for the period 1995-96 to 2012-13. The fifth section carves out the structure of manufacturing sector to understand the technology intensity of manufacturing sector by using three-digit level data for both India and China for the period 1998-99 to 2011-12. The sixth section traces pattern of industrialization by employing Gini coefficient of value added and employment data of three-digit level to get an idea about the trends of specialization and diversification in manufacturing sector during the study period. Seventh section concludes the chapter.

3.3 Manufacturing Sector in India and China: An Overview of Policies and Performance

A comparative analysis of the performance of manufacturing sector in India and China demands a very comprehensive step by step analysis of industrial growth and the policy regime of both economies. A mere comparison of the values of output and employment will not help to pinpoint the actual trajectory of industrial growth in both economies.

The present section focuses on the period between 1978 to 2011-12 with a brief historical overview of industrial sector in India and China prior to 1978.

We first briefly look at the data used for the trend analysis carried out in the present section. For examining the overall growth of manufacturing value added in both India and China, one comes across various sources of data. The first is the UN- economic activity database, second is the World Development Indicators and third one is national accounts data of each country. In the case of China, World Bank data refer to them as manufacturing value added but when closely examined and compared with data from CSY (China Statistical Yearbook), it becomes clear that World Bank data on manufacturing value added is actually Manufacturing plus Mining and utilities. The data series utilized in the present section has been taken from the National Accounts Statistics (NAS) of both economies provided by CSO in India and Published in China Statistical Yearbook by National Bureau of Statistics (NBS) as the data for the considered time period is easily available in national accounts of both economies. In the case of India, sectoral classification is provided up to nine sectors with manufacturing as a separate category. In the case of China, the nation-wide GDP has been further classified into Primary sector, Secondary sector with details provided on Industry and Construction separately and the Tertiary sector. No separate information is provided on manufacturing sector GDP or value added until the start of publishing of sectoral value added in 2005. So the manufacturing sector values for China are actually manufacturing plus Mining and utilities. Constant GDP series at 2005 prices for both India and China have been converted into US dollar by using nominal exchange rate.

3.3 (a) Evolution of Industrial sector in India and China during 1950-1978

While going through the economic growth literature of both economies one finds some of the striking similarities in the experience of both economies in terms of role played by public sector, emphasis on self-sufficiency, autarkic regime and upheavals in the growth process of industry during the first thirty years of their independence. During initial years of planning, India and China were both very eager to attain self-sufficiency and wanted to grow by utilizing domestic resources and having least dependence on external sector. This drive of self-sufficient growth required them to develop a strong industrial base by encouraging heavy capital goods industries (HCI). If we follow economic growth theory as asserted by Chenery and Syrquin (1989), HCI does not outstrip light industry in importance until countries reach mid-income level of development. To build up their initially small` HCI, India and China committed to high levels of capital and skilled labour. But this commitment ran opposite to the comparative advantage of India and China in labour intensive production. This led to sizeable efficiency losses in India (Auty, 1991).

Both India and China recorded high growth rates of industrial output during their respective first economic plan periods. India's First Plan laid greater emphasizes on infrastructural growth and just two percent of total Plan expenditure was incurred on industrial sector. Second and Third Plan in India focused completely on building a strong industrial base, with the Third Plan period witnessing an annual growth of industrial output by 19.6 percent. On the whole, manufacturing sector in the Indian economy grew at an annual rate of 6.7 percent for the entire period of first three Plans (1951-1965) with the production structure tilting towards HCI. This period has been regarded as the true period of Indian industrialization by many researchers (Panagariya, 2009 and Bhatt 2012). Industrial growth came to a halt after mid-60s. During the years 1965-67 industry recorded a very slow growth rate of around 3 percent and manufacturing even more low at 0.8 percent. To counteract this slow growth of industrial sector, the government tried to liberalize industrial sector and delicensed eleven industries on the basis of recommendation of Swaminathan committee. At the same time, the Indian economy was going through a macro economic crisis. Indian rupee was devalued in 1966. Industrial growth geared up again during 1968-70 but due to droughts in the early years of 1970s, there was downturn in whole economy. The piecemeal liberalization process was reversed in early 1970s by introduction of MRTP in 1969 and FERA in 1973 and import controls were introduced with more force this time. Economy on the whole and industrial sector were again facing slow growth as compared to previous periods. The stifling effect of these regulations was felt and rules were relaxed a little after mid-1970s (Panagariya, 2009). Indian industry recorded a growth rate of 7.6 in 1978-79 and manufacturing sector grew at 12.5 percent. But the structure of Indian manufacturing was inclined towards HCI. Ahluwalia 1985, divided manufacturing output into two categories, input based and use based. Input based classification revealed that agro-based industries went down from 43.7 percent in 1960-61 to 33.7 percent in 1979. Use based classification revealed that share of capital goods rose from 10.7 percent in 1960 to 17.7 percent in 1979 and share of Basic goods industry rose from 21percent to 30.8 percent. The importance of Consumer non-durable goods diminished and share of Consumer durables increased from 2.5 percent in 1960 to 4.9 percent in 1979.

Similarly, during 1953-1957 Chinese industry grew at a very fast rate due to big-push of HCI. Annual growth rate recorded by Chinese industry was 17.4 percent during 1952-1957 with heavy industry growing at the rate of 30.2 percent and light industry growing at 11 percent (Wu, 2001). The disaster of "Great Leap Forward" (GLF) inflicted a massive negative shock on the economy during 1958-1961. Auty, 1992 attributes these negative spillovers to the fact that HCI big push invariably exceeded the domestic implementation capacity. Human and capital resources were diverted to HCI with corresponding withdrawal of resources from consumption oriented activities such as light manufacturing and agriculture. Riskin, 1998 indicates shortage of consumer goods and adverse effect on agricultural production due to launching of GLF. In the policy of GLF large number of small commune level HCI plants were established during 1957. Almost 45% of GDP was contributed to industry in 1958, but much of the industrial production came out to be unusable and of lower quality. The result was a heavy fall in industrial output in 1959 as the implementation capacity was breached. So the period of 1958-1962 was of slow economic growth as well as low industrial growth for Chinese economy. The industrial output did not recover to pre-leap period until mid-1960s (Bunge, 1981 and Cole, 1988). This period of slow growth was associated with a rising rate of investment in Chinese economy which was further disappointing. Chinese investment as percentage of GDP was as high as 29 percent during this period. The rate of investment in the Indian economy was much lower than that of the Chinese economy.

The period of 1969-1973 again provided a surge to the Chinese economy reflecting the results of second HCI big push and recovery form "Cultural Revolution". The second big push of HCI was mainly oriented towards defence considerations and was inclined towards interior provinces. Rothenberg 1987, stated that the decentralization of industry during Cultural Revolution aimed at making each province self-sufficient so that the military invasion would be totally ineffective. But HCI led effort to develop interior regions contributed to low productivity of Chinese industry. During 1965-1970, Chinese manufacturing sector grew at the rate of 9.8 percent and during 1970-1978 it grew at the rate of 7.91 percent with heavy industry growing at faster rate than light manufacturing (Wu, 2001). So it can be concluded that the period of 1959-1978 was a period of slow industrial growth and Chinese industry could not regain the growth rate of pre-leap periods.

The above discussion highlights that both the economies of India and China started with a big push of HCI but by late 1950s and 1960s both were facing problems in their autarkic policy regimes. Auty 1992, stated that India experienced almost stagnant structure of production whereas the structure of Chinese economy evolved during the whole period (1950-1978). But, by and large, both economies were having a production structure characterized with dominance of HCI and faced problems in downgrading HCI and spurring light industry. Policy makers in both economies have realised the problems inherited in their earlier pattern of economic planning and resource use. Both economies made conscious efforts to get out of this phase of low growth and embark on the path of industry led growth with dominance of light industry with growing consumption. This is where the difference came and paths of both economies seemed to be diverging. The policies followed thereafter and pattern of growth of manufacturing sector of both economies need to be studied thoroughly so as to trace the points of variations in the growth of both economies and draw implications about the redundancy of the path followed. It need to be noted that one of the remarkable feature of Chinese economy which differentiated it from India has been the high rate of investment and savings throughout.

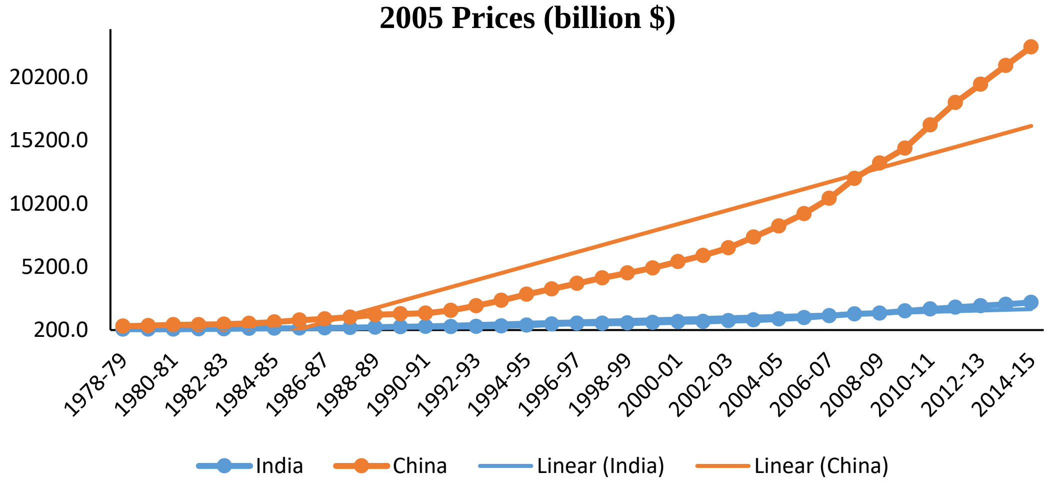
3.3 (b) Growth of Manufacturing Output and Employment in India and China during 1978- 2011

The period after mid-1970s brought major changes in the policy regime and economic structure of both India and China. Both initialized their respective liberalization processes with China following a planned path carrying a long term vision and India experimenting with its piecemeal relaxation of restrictions already imposed.

If we look at the overall performance of manufacturing sector in India and China in terms of value added of the sector we can clearly see that Chinese manufacturing has grown much bigger in size as compared to Indian manufacturing (Graph 3.1). The value added of Indian manufacturing sector has grown from $27 billion in 1978-79 to $238 billion in 2014-15, over a period of almost 35 years. On the other hand, value added of Chinese manufacturing has grown from $50 billion in 1978-79 to $2258 billion in 2014-15. So the increase in Chinese manufacturing value added has been much larger than the increase shown by value added of Indian manufacturing. In 2009-10 the value added by Chinese manufacturing has been 9.5 times more than the value added of India attain

Graph – 3.1

Manufacturing Value Added in India and China at Constant 2005 Prices (billion $)



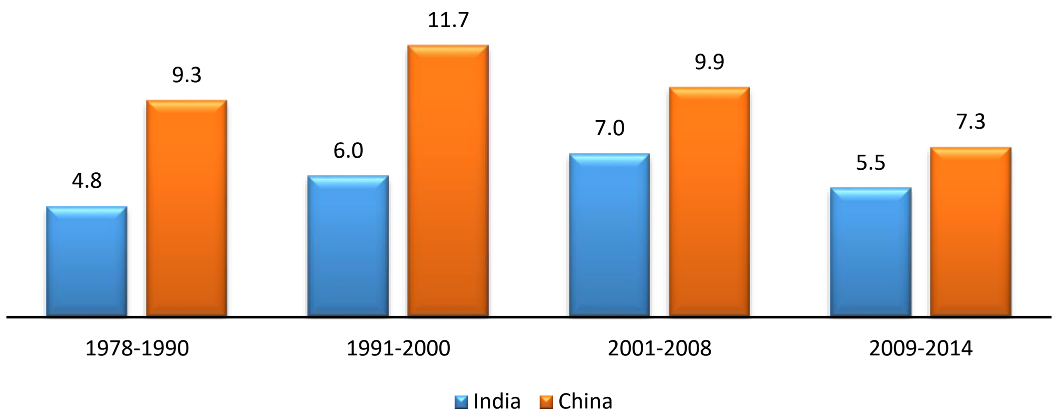
Source: NAS, CSO, India and CSY, NBS, China.

such a high growth in manufacturing sector which acted as a boon for the growth of overall economy. In the starting phase both economies seemed to be following similar growth paths but over the course of time the divergence in their pursuit of economic development and planning became visible. The core themes of the development planning in both economies were common but the tools adopted to achieve the development goals have been quite different in both economies with the biggest difference lying in the governance structure of both economies. Both of them realised the poor performance of the policies adopted by them during first 15 to 20 years of their independent states and time to time changes have been employed in the regulation systems of the industrial sectors of both economies.

In case of India the measures taken in 1970s mainly involved liberalization of licensing provisions. Poor industrial performance in the first half of 1970s and rising inflation was a cause of concern. The strictness in the restriction policies and their negative effects were being realised till late 1970s. The liberalization measures before 1990s can be divided into three phases, 1975-79, 1979-84 and 1984-89 (Panagariya, 2009). These whole set of reforms were, broad banding, capacity recognition except small scale industries and industries under MRTP and FERA, automatic capacity expansion in selected industries, delicensing of some sectors. All these measures were initiated in early 1975-79 and were expanded over the above mentioned three phases. The liberalization process was accelerated in 1980s under the prime ministership of Rajiv Gandhi. The exemption limit under the MRTP act was raised. New elements were included in the policy of broad banding whereby the firms in a number of industries

Graph – 3.2

Average Exponential Growth Rate of Manufacturing Value Added in India and China (Percent)



Source: Calculated by author using data from NAS, CSO, India and CSY, NBS, China.

could diversify in related business without licences (CMIE 1986). Kelkar and Kumar (1990) argued that as a result of these reforms, the manufacturing sector at the end of the 1980s looked significantly different from the end of the 1970s. Much of liberalization was ad hoc and arbitrary (Chaudhuri, 1998). The perspective plan for industries and prudent use of licensing for developing strategic industries was missing. These reforms were not able to unleash the growth potential of Indian manufacturing sector and it recorded the growth rate of 4.8 percent which was much lower than the rate attained by China during the same time period (Graph 3.2).

Similar to India, China was also going through the phase of liberalization of its policies after mid-1970s mainly focusing at internal autonomy of the sectors and loosening the grip of state. The disappointing trend during 1959-76 in the speed and capital efficiency of Chinese economic growth was halted by reforms led by Deng Xiaoping. Chinese reforms were mainly initiated to resolve the problem of industrial weakness. It carried twin objective, one was to expand rural industry and other was to boost industrial efficiency. Dengist reforms also aimed at downgrading self-sufficiency as an economic objective to boost efficiency. This in turn required regional and national specialization and vastly expanded role of trade. It was also realised that one of the major factor behind industrial inefficiency in China was the state control over major operations of SOEs. So steps were taken to liberalize the working of SOEs and to remove hindrances in the entry of private sector and foreign sector. During the initial period of Dengist reforms in 1979-80 industrial output decelerated sharply but negative impact of this on GNP growth was offset by rapid rural growth (Perkins, 1988). Rural reforms lifted the agricultural growth rate to 8 percent in 1979-84 and was associated with sharp increase in consumption (Auty, 1992). As food grain production became sufficient, rural investment switched from farm to industry and by the mid-1980s rural manufacturing output exceeded that of farm output (Economist, 1988). Later on the reforms were applied to industrial sector in 1984 which involved the devolution of decision making to enterprises. During 1985-87 industrial output accelerated with a growth rate of 17.8 percent. But one of the adverse effecst of these industrial reforms was in the form of rising investment in HCI sector which was a drawback for development of consumer goods industry. HCI has therefore proved no easier to reform in a command socialist economy than it has in India's command capitalist economy (Lucas, 1989). During the period of 1978-1990 Chinese manufacturing sector grew at a rate of 9.3 percent (Graph 3.2) which was far higher than that of India's during that time and the major role was played by TVEs in the industrial growth of China during this period.

The macro economic crisis of 1991 acted as a fuel and the hesitant liberalization of 1980s was geared up, which transformed the whole economy. Industrial licensing was discontinued with just as few priority expectations. The entry restrictions on MRTP firms were myriad. The public sector monopoly was ended in many sectors and a policy of automatic approval of for FDI up to 51 percent was initiated. These policy changes resulted in a 6 percent growth rate of manufacturing sector value added which was not up to the mark as expected. The Indian manufacturing sector's growth was a little less than half the rate of growth of Chinese manufacturing sector (11.7 percent). What was happening in China at the same time was the national and regional level restructuring of SOEs which involved structural adjustment, liberalization, efficiency improvement and amendments in the governance of SOEs. The policy shifted to privatization and closure of small SOEs during 1995-97 on the one hand and creation of large, dynamic and globally competitive SOES on the other hand. These adjustments proved to be beneficial and true to expectations of the policy makers in China. Chinese manufacturing sector achieved a double digit growth rate during the whole decade and maintained it for each year without fluctuations. The scale of restructuring was such that the number of SOEs fell from nearly 65,000 in 1998 to 31,750 in 2004 (Bramall, 2009).

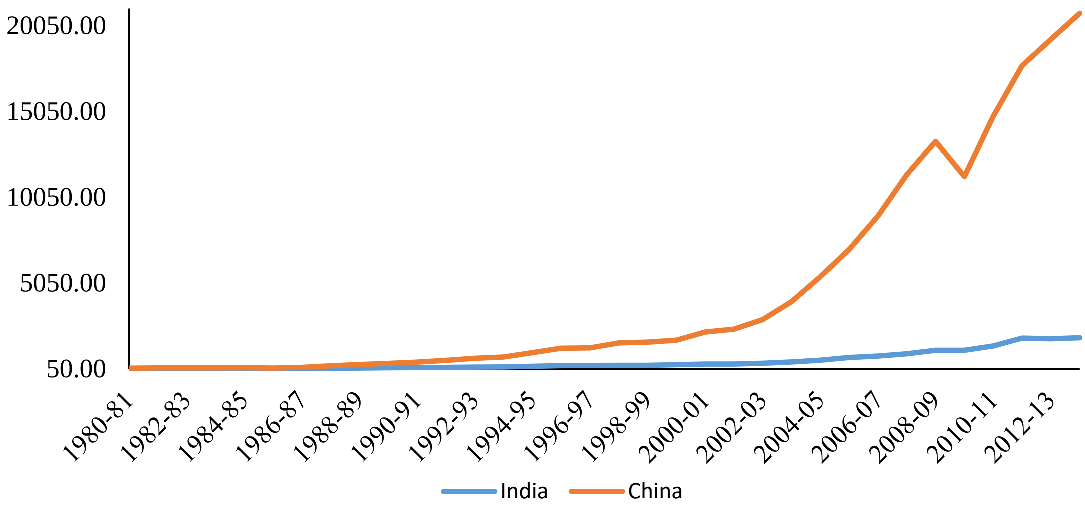
The growth rate of value added of Indian manufacturing rose to 7.7 percent during 2001-2008 which was the longest ever upswing in the growth of manufacturing since 1990s. Chinese manufacturing sector recorded a growth rate of 9.9 percent during these eight years. The growth rate of manufacturing value added in both countries was affected by the recession of 2007-08. As can be seen in the graph 3.2 the growth rate of Indian manufacturing value added came down to 5.5 percent during 2008-2014 and that of Chinese manufacturing value added came down to 7.7 percent. The growth rate of Chinese manufacturing valued added was lowest during the period of 2008-2014 whereas Indian manufacturing grew a slowest rate during 1978-90. Indian manufacturing sector still needs to do a lot a lot of hard work for winning the race with China and even more, with the growing needs of its own economy.

3.3 (c) Growth of Exports and Imports of Manufacturing Sector in India and China

The present section examines the evolution of aggregate exports and imports of manufactured products in India and China between 1980 and 2013. Both India and China had highly restrictive trade regimes until late 1970s. Both began to open to international trade in the late 1970s in modest ways but China moved faster. Liberalization in India received impetus in the second half of the 1980s especially through de-licensing of many imports, introductions and expansion of export incentives that partially offset the anti-trade bias of the regime and a significant depreciation of exchange rate. But India's liberalization became systematic only with launch of the major reform package of 1991. China focused on liberalization through decentralization of trading rights to the provincial and city administration and multiplication of the so-called "Foreign Trade Companies". It also relied heavily on the setting up of special economic zones and open cities that were allowed more liberal economic environment than available elsewhere in the country. By the time of entry of China into WTO in 2001 it already had a relatively liberal regime in the area of industrial goods and trade (Panagariya, 2010). The results of the policy changes adopted by both countries become clear by looking at the trade figures of both of them with China leading the race with a greater pace.

Graph - 3.3

Manufactured Exports of India and China during 1980-2013 (US $ 100 million)

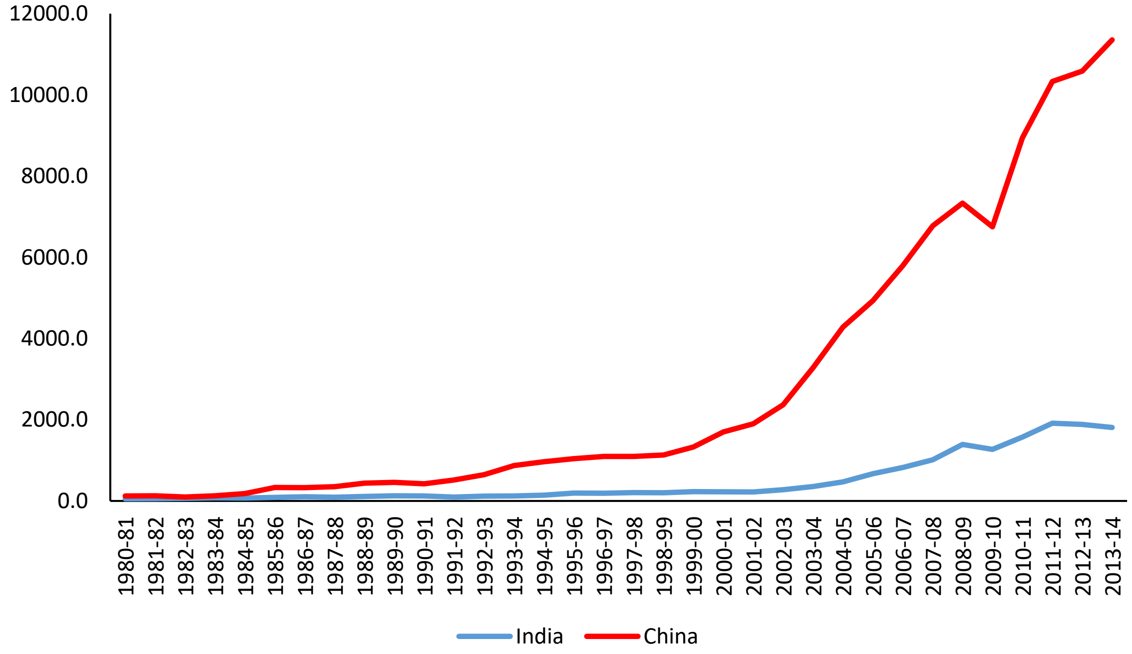


Source: UN-Comtrade, online database.

A look at the exports of manufacturing sector of India and China (Graph, 3.3) highlights the widening gap between the two. India seems to be far behind China in terms of value of manufactured exports. As stated by Panagariya, 2010, during each of the years 2002, 2003 and 2004, the increase in China's exports over the previous was more than the absolute level of India's exports. Indian exports grew from US $5 billion in 1980-81 to US $186 billion in 2013-14. Whereas Chinese manufactured exports grew from US $8.7 billion in 1980-81 to US $2077.1 billion which is a huge absolute growth. Indian manufactured exports performance fades away in the presence of Chinese manufactured exports. The growth rates of Chinese exports have remained higher than that of India during 1980-2008 except 2009-2013 when India outperformed China in terms of growth rate of manufactured exports (Table 3.1). Both India and China experienced fastest growth in their manufactured exports during 2000-2008. It was the period when China was granted an entry into WTO at the Doha Ministerial Conference in 2001. The growth in world exports was also recorded highest in the same period.

Graph – 3.4

Manufactured Imports of India and China during 1980-2013 (US $ 100 million)



Source: UN-Comtrade, online database.

Graph 3.4, presents the imports of manufactured imports in India and China. Imports of manufactured products have always been higher in China as compared to India and the gap has been widening throughout the period of analysis. Imports of Indian manufactured imports have risen form US $5.3 billion to US $180.9 billion in 2013. On the other hand, Chinese manufactured exports rose from US $12.2 billion in 1980 to US $1135.4 billion in 2013-14. One of the features of Indian and Chinese manufactured trade to be noted is that both countries experienced a trade deficit in manufactured products until the year 1989-90. The growth rates of Chinese imports have remained higher than that of India except 2000-2008 when India outperformed China in terms of growth rate of manufactured imports (Table 3.1). The period of highest growth of exports (13.7 percent) in India i.e., 2000-08 was accompanied by even larger growth in imports (20.3 percent). During this period Chinese exports and imports also grew at the fastest rate but the growth in exports was higher than the growth in imports. It was only during the period of 2009-2013 when Chinese Imports grew at a higher rate than exports. The growth rates of manufactured exports and imports of

China have always been higher than the growth recorded by total world exports and imports.

Table 3.1: Growth of Trade of India and China

Period	Exports			Imports		
	World	India	China	World	India	China
1980-89	6.6	8.0	14.3	6.8	8.7	13.2
1990-99	5.8	8.4	13.6	5.9	6.3	11.4
2000-08	8.9	13.7	20.0	8.8	20.3	16.3
2009-13	7.0	9.9	8.9	7.1	7.1	10.4
1980-2013	7.0	10.6	16.1	7.3	10.7	13.7

Source: Calculated by author using UN-Comtrade, online database.

Table 3.2: Share in World Trade of Manufactures

Period	Exports		Imports	
	India	China	India	China
1980-81	0.46	0.80	0.5	1.1
1990-91	0.52	1.85	0.5	1.7
2000-01	0.70	4.69	0.5	3.5
2013-14	1.57	17.53	1.5	9.2

Source: Calculated by author using UN-Comtrade, online database.

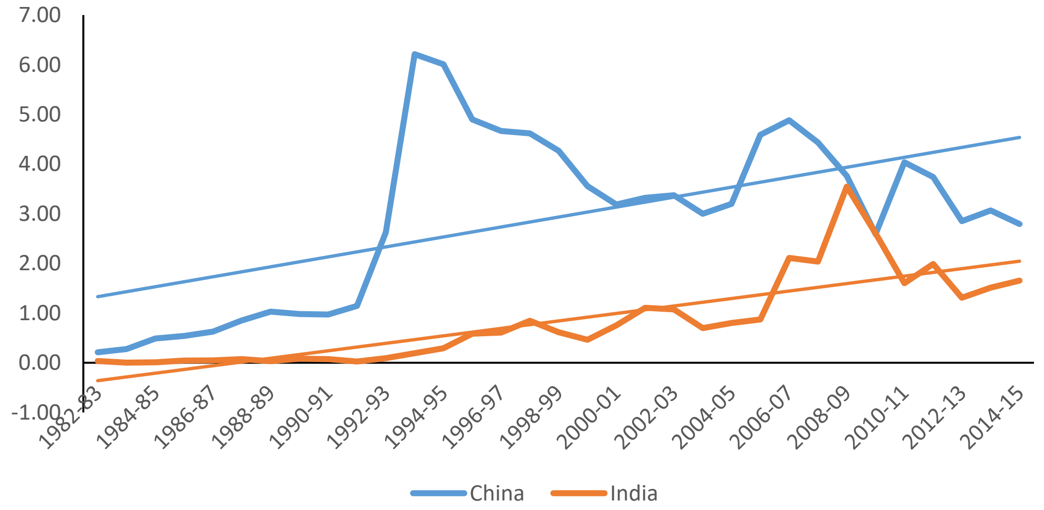
If we look at the scale of trade of manufactured exports of India and China at world level it is found that China's manufactured trade has a significant role to play in total world trade. Share of China's manufactured exports rose from 0.80 percent in 1980 to 17.5 percent in 2013-14 whereas India's manufactured export share in total world exports improved a little form 0.4 percent in 1980 to 1.57 percent in 2013-14. Following a similar trend share of manufactured imports of China in world imports rose from 1.1 percent in 1980 to 9.2 percent in 2013 while India seems to be standstill here again with a very minimal rise in share from .5 percent of world manufactured exports to 1.5 percent of total world exports in 2013. The growth rate of manufactured exports and imports of India have always been higher than the growth reported by total world trade but even then Indian manufactured exports could not grow to the level that they can make substantial contribution to world trade.

3.3 (d) FDI Inflows in the Manufacturing Sector of India and China

Table 3.3, presents FDI inflows into both Indian and Chinese economy and manufacturing sector. Share of FDI inflows into manufacturing sector out of total FDI inflows are also presented. In case of India official data available for 1991-2000 and 2001-2010 have been lumped together, so for China also annual data on FDI inflows have been lumped for the period 1997-2007 to see a comparative picture. The share of FDI inflows has been quite substantial in Chinese GDP as compared to share of FDI inflows in GDP of Indian economy. Share of FDI in GDP of Indian economy has been almost negligible before the period up to mid-1990s. Share of FDI inflows in GDP has been maximum during the period 2006-2009. This was the period which saw the highest growth in manufacturing GDP and also manufactured exports of India. In case of China FDI inflows became visible as share of total GDP during late 1980s. By 1993-94 and 1994-95 share of FDI inflows rose to more than 6 percent in Chinese GDP. Since then the share of FDI in GDP of China has been fluctuating between 2.5 percent to 4.8 percent. FDI inflows contributed 2.9 percent of Chinese GDP in 2014.

Graph – 3.5

Share of FDI inflows in GDP of India and China during 1982 to 2014 (Percent)



Source – WDI, 2015.

Table 3.3, reveals that in the year 2014-15, FDI inflows into Chinese economy were 4 times of the FDI inflows into Indian economy and FDI inflows into Chinese manufacturing sector were 3 times of the FDI inflows into manufacturing sector of India. This highlights the gap between the FDI inflows into the Indian and Chinese manufacturing sectors. According to Prasan and Wei (2006), Hong Kong, Japan, Korea, Taiwan and Singapore together accounted for 60 percent of FDI inflows into China during 2001-04. Many studies have found evidence of round tripping of FDI in China through Hong Kong and Taiwan during late 1990s till early 2000s which has been considered as a major source of high FDI in China. In both the economies a major share of FDI goes into manufacturing sector. In recent period of time share of manufacturing sector's FDI inflows in total economy FDI inflows have risen in India from 42.4 percent during 1991-2000 to 50 percent in 2014-15. This highlights the growing importance of Indian manufacturing sector for attracting FDI inflows. On the other hand, the share of FDI inflows into manufacturing sector of China has decreased from 47.6 percent during 1997-2007 to 38.7 percent in 2014-15. The reason for this is the greater emphasis on service sector growth in China these days. Here it can be asserted that it was not the case that FDI inflows towards India are not going into manufacturing sector but in fact, manufacturing sector FDI inflows were a major part

Table 3.3: FDI Inflows (US million $)

India				China			
Year	**National Total**	**Manufacturing**	**Share (%)**	**Year**	**National Total**	**Manufacturing**	**Share (%)**
1991-2000	16699.6	7080.4	42.4	1997-2007	534645.8	254548.8	47.6
2000-10	110289.3	42400	38.4	2008-09	92395.44	49894.83	54.0
2010-11	21383.1	10139.8	47.4	2009-10	90032.72	46771.46	51.9
2011-12	35120.8	18735.3	53.3	2010-11	105735.2	49590.58	46.9
2012-13	22423.6	8723.1	38.9	2011-12	116011	52100.54	44.9
2013-14	24299.3	13656.4	56.2	2012-13	111716.1	48866.49	43.7
2014-15	30930.5	15422.5	49.9	2013-14	117586.2	45554.98	38.7

Source – SIA newsletter, various years, DIPP, India and CSY, various year China.

of total FDI inflows in India. The reason that Indian manufacturing could not speed up like Chinese economy on the basis of FDI inflows is that the amount of FDI inflows in India was far below the level of FDI inflows into China.

3.4 Structure of Manufacturing Sector of India and China

As economy grows and manufacturing sector expands labour gets allocated from less productive traditional industries to more productive knowledge based high tech industries. This kind of restructuring helps to generate a spurt in for overall economic growth. Successful industrialization, thus, is a cumulative process involving movements from one 'stage' to another through the establishment of new industries with higher value added and technology contents (Akyuz, 2009). But this process is not automatic as it entails moving purposefully into more skill intensive, complex and productive technologies and of up grading technological functions (Lall, 2001). Thus, sustainable industrialization is characterized with dynamic growth prospects which in the present world of imperfect markets and uncertainty could be overcome by the country's ability to exploit economies of scale, technology acquisition and its adoption and absorption (ibid). Since every country thrives for development which is a 'path dependent' process of structural transformation from low productive sectors to high productive sectors (Rodrik, 2008). Thus, studying the structural change in itself becomes the centre of understanding the modern economic growth (Syrquin, 1988).

Although, 'structure' of an economy can be defined by the supply of productive factors like natural resources, labour, capital, technology etc. and their employment in different uses or sectors while any proximate causes of change, therein causes 'structural transformation', which in itself is an inter-related process of various demand and supply factors. Thus, the accumulation of physical and human capital and shifts in the composition of demand, trade, production and employment (Chenery et al., 1986; Syrquin 1988) along with initial conditions (Pack, 1988), government policies (Rodrik, 2008) all accompany 'structural transformation' from one stage to another. Taking the case of Japan, it entered the industrial sector with the usual entry point, that is, the textile industries and achieves the dominant position in it between the World War I and II. In 1960s it became proficient in steel and ships; in 1970s in consumer electronics; 1980s in automobiles and machine tools along with several areas of computer and semiconductor technologies (Ruttan, 2001). Thus, moving from one stage to another higher one makes the industrial structure more sustainable. Similar are the stories of the major developed countries like USA, Germany (ibid), South Korea (Singh, 2004). So it becomes really crucial to understand the structural shifts taking pace within the manufacturing sector of both India and China in terms of share in value added and share in employment.

3.4 (a) Data for Structural analysis

The time period for two-digit analysis in this study is 1995 to 2012. The data sources referred for two-digit analysis are the Annual Survey of Industries (ASI) for India and China Industrial Economy Yearbook (CIEY) for China. It is to be noted that the CIEY is published in Chinese only. So for the present analysis the yearbooks have been translated by using Google translator. There have been classification changes in both India and China during the period covered. The data available for India for the period 1995-2012 follow four different industrial classifications (1984, 1998, 2004 and 2008). On the other hand, Chinese classification has changed three times during the study period (1994, 2002 and 2011). For two-digit analysis 16 industrial groups within the manufacturing sector have been considered[14]. An attempt has been made to make the data comparable over time and inter-country[15].

For three-digit analysis the time period covered has been 1999-2011. The source of Indian data is ASI and the Chinese three-digit level data on manufacturing sector has been taken from China Data Online (CDO), compiled by China Data Centre of University of Michigan. CDO takes data from National Bureau of Statistics, China (NBS). The three-digit level data have been concorded for the various industrial classifications followed in both countries and have been made compatible with ISIC-revision 3. Finally, 54, three-digit level industries for Indian manufacturing sector and 52, three-digit level industries for Chinese manufacturing sector have been analysed.

3.4 (b) Structure of Value Added in Indian and Chinese Manufacturing

If we look at the structure of manufacturing value added in India during 1995-96 to 2012-13 it seems to be concentrated in a few sectors namely, Food, Chemical, Metal, Machinery and Textiles. These five industries contributed 68.9% to total manufactured value added in 1995-96 and 57.9% in 2011-12 indicating a slight decline in concentration of manufacturing value added. During this period share of Coke and Petroleum industry rose dramatically in total manufacturing value added, from 4.3% in 1995-96 to 11.7 % in 2012-13. Coke and Petroleum industry is highly capital intensive in nature. The other new entrant into top five was Transport industry. The share of Textile sector has remained stable at around from 8.7% in 1995-96 to 8.3% in 2012-13 but it's no more among the top five major contributors to total manufacturing value

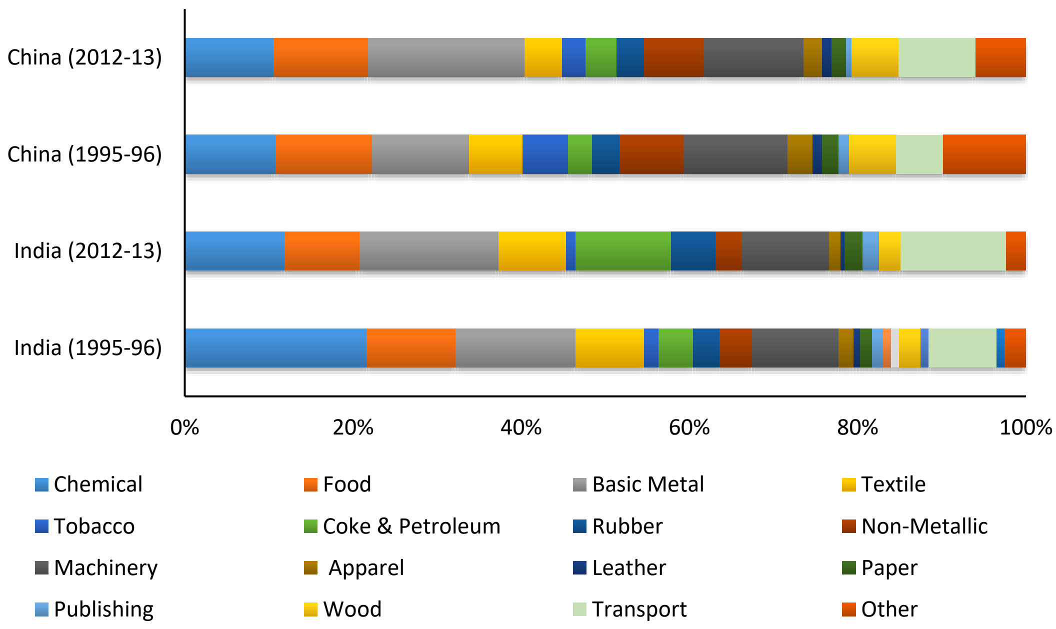
[14] See Appendix for industrial re-classification carried out in the present study.

[15] For structural analysis deflated value added in national currency has been used.

added. Share of Chemical industry showed highest absolute decline in share from 23.0% in 1995-95 to 12.3% in 2012-13 but still it is one of the highest contributors to total manufacturing value added. Except these few changes structure of value added in

Graph - 3.6

Structure of Value added in Indian and Chinese manufacturing



Source: Calculated from ASI and CIEY, various years

India has not altered much over the period of 18 years, amidst dramatic policy changes. In case of China, four industries, namely, Chemical, Food, Machinery and Metal contributed about 47.4% of the total manufactured value added in 1995-96 and in 2012-13 along with these four Transport industry contributed about 53.2% of the total value added in manufacturing indicating an increase in concentration of value added. The highest absolute rise in shares was shown by Transport industry and Metal industry both of these are capital intensive industries.

For analysing growth performance of various industries of the manufacturing sector of India and China whole period of 1995-96 to 2012-13 has been divided into three phases 1995-2001, 2002-2007 and 2008-2012 (as shown in Appendix Table A 4). The year 1995 marks India's entry into WTO, 2001 was the year when China entered into WTO and the period after 2007 witnessed the world-wide economic depression. The period of 1995-2000 seems to be a period of slow growth of manufacturing sector in India on a whole with an average exponential growth rate of 0.9 percent. All the major contributors except textile sector experienced negative growth rate during this period. During the period of 2001-2007 manufacturing sector of India grasped speed and grew at a rate of 15.6 percent with highest growth attained by Coke and Petroleum industry, followed by Metal industry and Non-Metallic Mineral industry. Textile industry showed lowest growth rate which indicates the effect of growing international competition in this industry due to opening up of the economy. During the period of 2008-2012 Indian manufacturing grew at the fastest rate with growth of 20.7 percent. All industries grew at high rates with only exception of Non-Metallic Mineral products industry (having high labour intensity) which recorded a negative growth. The growth rates achieved during 2008-2012 show a mixed picture with each sector growing fast both labour intensive and capital intensive. This is a sign of balanced growth of value added in the manufacturing sector of India. Chinese manufacturing industry has also seen increasing growth rates over the periods of time considered in the present analysis. The period of 2001-2007 recorded the highest growth in Chinese manufacturing, with growth rate of 19.2 percent and it was higher than the rate of growth of Indian manufacturing during the same period. All industries grew at a double digit growth rate with highest growth recorded by the Transport industry (38.9 percent) followed by Metal industry. During the period of 2008-2012, Chinese manufacturing industry seemed to be slowing a bit with growth rate of 13.2 percent. Highest growth rate was achieved by Non-Metallic Mineral industry, followed by Transport and Wood industry. The growth structure of Chinese manufacturing seems to be inclined towards capital intensive sector. Labour intensive industries also have shown substantial improvement but their growth has been a little bit slower than the growth of capital intensive industries such as Transport industry.

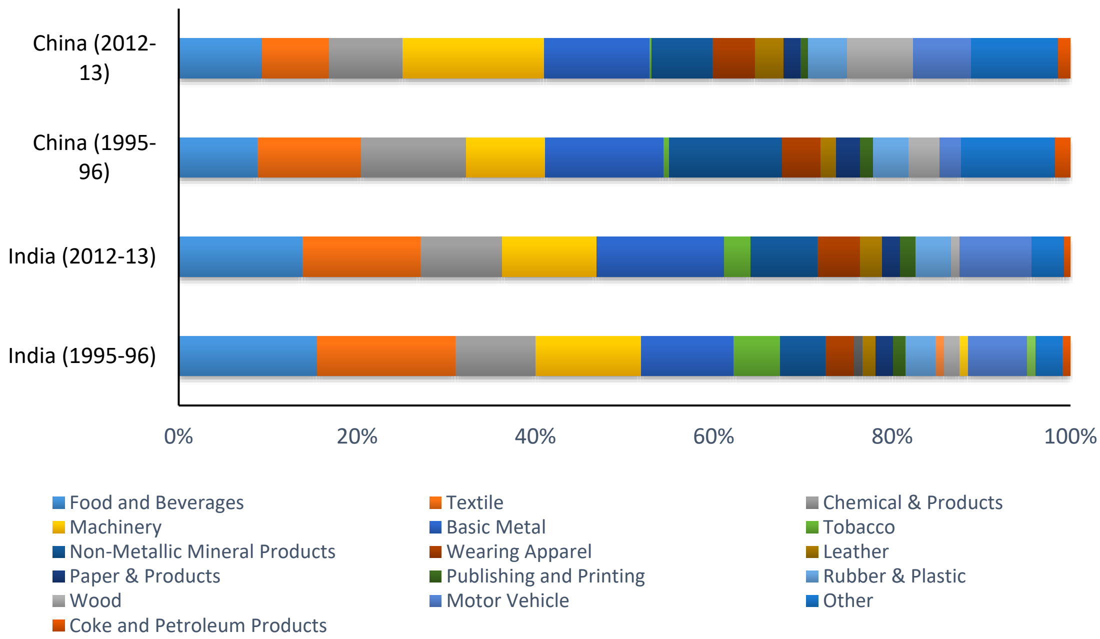
3.4 (c) Structure of Employment in Indian and Chinese Manufacturing

For structural analysis of employment in manufacturing sector of India the total number of employees has been taken as employment variable and for China total number of Persons engaged has been considered. In India, the Textile, Food, Chemical, Basic Metal and Machinery were major employment providers during 1995-96 with combined contribution of 50.8% in total employment. Same industrial groups are taking lead in both value added and employment shares. Now if we look at share in employment in 2011-12 then a different set of industrial groups dominate as compared to value added distribution. Food and Textile sectors both of which are labour intensive sectors have lost their space in the top five contributors to value added but they are still on the top with respect to employment shares. Chemical industry and Basic Metal showed a highly imbalanced picture with very low shares in employment as compared to its shares in value added indicating highly capital intensive nature of both sectors. Coke and Petroleum industry which was among the toppers in terms of value added share is having one of the least contribution towards manufacturing employment.

In China during 1995-96 highest share of workers has been in Non-Metallic Mineral industry, Chemical industry and Textiles sector. In 2012-13 again the same set of industries were highest employment providers.

Graph - 3.7

Structure of Employment in Manufcaturing of India and China



Source: Calculated from ASI, India and CIEY, China, various years.

The picture of Chinese manufacturing is quite balanced in terms of shares in value added and employment as compared to the situation of Indian manufacturing sector. If a sector in China is contributing more to value added its share in total workers is also high, which is not the case with India. This kind of sectoral distribution of value added and workers can have significant implications for employment, productivity and competitiveness of a sector.

A look at growth performance of manufacturing sector in terms of employment (Appendix Table A 5) in India reveals that period of 1995-2001 was a period of negative employment growth. Only six industries had positive growth rate of employment with significant rate of growth achieved by Metal (7.6) percent, Apparel (5.6 percent) and Leather (3.9 percent). During 2001-2007 employment growth recovered in Indian manufacturing with Apparel (9.8 percent) and Metal (9.7 percent) recording highest employment generation. All other industries recorded positive growth rates except Tobacco manufacturing. In the later period of 2008-12 capital intensive industries like Transport (10.2 percent) and Publishing (9.5 percent) recorded highest growth rates of manufacturing employment. Coke and Petroleum industry recorded negative employment growth. Apparel also showed low growth. On the whole manufacturing employment grew at a rate of 6.3 percent during 2008-12.

Now coming to employment growth in Chinese manufacturing again the period of 1995-2001 was a period of negative growth of employment and only five industries recorded a positive growth rate. As was the case of India employment growth recovered during 2001-2007 with manufacturing sector employment generation showing growth rate of 7.5 percent. Transport industry (20.7 percent) and Other manufacturing (18.3 percent) recorded highest growth rates. But again, the later period 2008-12 recorded a slowing employment generation with growth rate of 1.4 percent.

3.5 Technology Intensity and Structure of Manufacturing Sector in India and China

To reiterate, successful industrialization requires structural shift within the manufacturing sector. Various scholars have classified the manufacturing sector into different 'subgroups' to find out the structural shift from one subgroup to another, thus defining the 'pattern of industrialization'. Hoffman (1956) divided the manufacturing industries into 'use based' sectors wherein 'consumer goods' sector developed first. Chenery and Taylor (1968) divide them into three subgroups, that is, early, middle and late industries. Further, Syrquin and Chenery (1989) classified the manufacturing sector into two subsectors- light and heavy industries. But apart from the varied terminology used in the respective studies, it is found that in the initial stages low skilled and highly labour intensive industries like textiles, food products, leather and furniture comes up; followed by relatively highly skilled and technology intensive industries like metal, vehicles etc, moving up to engineering and chemical industries at the higher level in technological ladder.

On the theoretical front, going beyond the neo-classical view, in which technological progress is exogenous, the endogenous growth theories which evolves in the late 1980s regarded investment in research and development (R&D) as an important factor for growth, which makes it imperative to re-define the terminology used for the classification of industries within the manufacturing sectors by taking R&D content into its preview. Thus, based on the technological contents, the low technology intensive industries should be followed by the high technology intensive industries defining the structural shift which determines the 'pattern of industrial growth'. That is, in the initial stages the low technology and unskilled labour intensive industries dominates and subsequently the relatively high technology intensive industries should take the realm. The dominance of a particular subsector can be understood as its relative high proportion of 'value added' and /or 'employment'. Moving up the technological ladder from the initial stages to the subsequent ones' entails sustainability as it corresponds to relatively higher income elasticity of demand (Lall, 2001) along with the higher labour productivity and higher labour productivity growth (Edquist et al, 2001).

Thus, the interdependence of both the demand and supply factors works in tandem to climb the technology ladder. The process can be explained as under:

To begin with, the higher labour productivity due to the inclusion of technology might increase income and consumption. Then it would simultaneously produce the income effect on demand (ibid). This change in the demand components exerts the pressure on the supply side which again changes the technological contents. This further changes the trade pattern depending upon the comparative advantage of the countries concerned. But apart from the economic causality, the country's initial structure, natural resource endowments, and development policies (Chenery and Syrquin, 1986) plays an important role in determining the structural transformation. The transformation can take the pattern of modern industrialization, dubbed as '*the flying geese paradigm*', in which as the new and more dynamic industries emerge, the traditional ones are phased out or may even be left entirely to countries at the earlier stages of development (Akyuz, 2009). Recently, Imbs and Wacziang (2000) found a unique pattern of industrialization, regarded as the *'U-shaped pattern'* of specialization- diversification- specialization, wherein the early stages of industrialization are characterized by sectoral specialization in exploiting endowments of natural resources and unskilled labour. This is followed by diversification into a wide spectrum of more technologically advanced activities, but there exists a point, although late in the development process wherein they start to specialize again, this time in technologically advanced industries.

Economic theories associate high-technology intensive sector with the economic growth of a nation. As an economy grows, a shift from a natural resource based and low technology intensive manufacturing to high technology intensive manufacturing is bound to happen. Global value added of high-technology manufacturing was $1.5 trillion in 2012, making up 14% of the manufacturing sector. While, China, with a 23.92% global share, was the second largest producer of hi-tech products, India with a 0.93% global share was a distant laggard. The National Manufacturing Policy, 2011 and the 12th Five Year Plan (2012-17) acknowledge the urgency to attain more 'breadth' and 'depth' in manufacturing, implying not only improvement in the production of similar goods but also diversifying into more complex products and moving up the manufacturing value chain (Kathuria et.al, 2014).

In the present section, in order to analyse the technological complexion of the manufacturing sector, industries have been re-classified according to the technology based classification provided by the Organisation for Economic Cooperation and Development (OECD) (2007), into four categories, that is, High Technology industries (H-T), Medium-High Technology industries (M-H-T), Medium-Low Technology industries (M-L-T) and Low Technology (L-T).

Table 3.4 reveals that in Indian manufacturing H-T industry only constituted 4.4 percent of total GVA and 2.8 percent of total manufacturing employment in 1998-99 which change to a mere 3.2 percent contribution to GVA and employment share of H - T industry came slightly down to 2.3. The contribution of H-T manufacturing in Chinese manufacturing GVA has been 11.5 percent and 7.3 percent in employment in the year 2011-12 which increased to 12.5 percent of total GVA and 12.2 percent of total manufacturing employment in 2011-12. We can see that how minimal is the size of H-T manufacturing in India as compared to China.

Indian manufacturing GVA was dominated by M-H-T industry in 1998, and later in 2011-12, M-L-T industries took the lead in terms of manufacturing GVA. But employment side has been dominated by L-T industries during the whole period of analysis with a little decrease in employment contribution of L-T industries from 48 percent in 1998 to 45 percent in 2011-12. The share of L-T industries in total manufacturing GVA decreased from 28.7 percent in 1998-99 to 22.9 percent. So for the whole period major gainer in both GVA and employment has been M-L-T industries which showed a capital intensive nature with total increase of 12 percent in GVA contribution and 6.4 percent increase in employment contribution.

Table 3.4: Technology Intensity of Indian and Chinese Manufacturing

India												
	Value Added						Employment					
	Share		Growth Rates				Share		Growth Rates			
	1998-1999	2011-2012	1998-2001	2002-2007	2008-2011	1998-2011	1998-1999	2011-2012	1998-2001	2002-2007	2008-2011	1998-2011
HT	4.4	3.2	2.2	11.7	11.0	8.6	2.8	2.3	-5.3	4.1	1.8	-0.2
MHT	40.1	35.0	-0.4	15.5	18.8	12.2	27.9	24.5	-5.9	3.8	4.3	2.9
MLT	27.1	39.1	3.1	18.4	14.8	15.2	21.8	27.2	-2.3	6.0	3.6	4.4
LT	28.7	22.9	4.3	14.8	11.8	10.0	48.0	45.8	0.2	6.3	2.1	3.2
All	**100**	**100**	**2.3**	**15.1**	**14.7**	**11.5**	**100**	**100**	**-3.3**	**4.2**	**4.1**	**2.6**
China												
	Value Added						Employment					
	Share		Growth Rates				Share		Growth Rates			
	1999-2000	2011-2012	1999-2001	2002-2007	2008-2011	1999-2011	1998-1999	2011-2012	1999-2001	2002-2007	2008-2011	1999-2011
HT	11.5	12.5	15.7	7.9	8.3	12.8	7.3	12.2	6.7	5.4	2.6	6.6
MHT	25.5	29.2	10.1	16.3	8.9	14.5	22.2	29.6	1.4	6.9	2.1	4.9
MLT	26.9	30.2	9.4	24.0	11.9	19.4	31.6	24.8	-2.7	6.1	1.0	3.1
LT	36.0	28.0	1.5	12.4	17.2	11.3	39.0	33.5	1.7	2.2	3.9	-1.0
All	**100.0**	**100.0**	**9.2**	**15.2**	**11.6**	**14.5**	**100.0**	**100.0**	**1.8**	**5.1**	**2.4**	**3.4**

Source: Prepared by author from ASI,Various Years and CDO, China dataset.

3.6 Actual Pattern of Growth of Manufacturing Industries in India and China

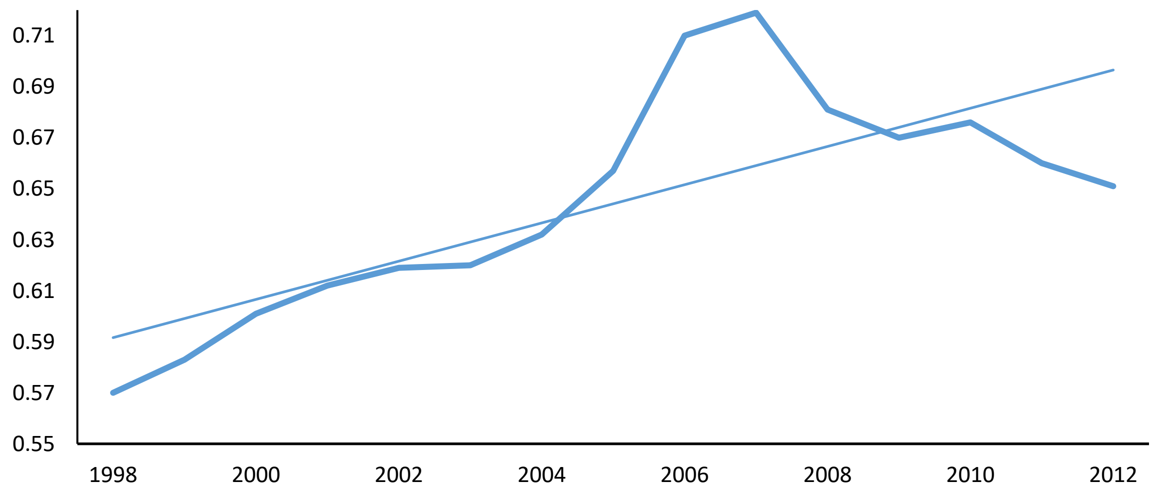
To capture the actual pattern, Gini Coefficient has been estimated for the value added and the employment at 3-digit level, which are presented in Graph 3.8, 3.9, 3.10 and 3.11, respectively. The measurement of the proportionate value added and employment are used to construct the indicator for the 'pattern of industrialization'. The Gini coefficient, thus constructed indicated the extent of diversification within the manufacturing sector. The more equal the factor shares (close to zero), the more diversified the industrial sector while the higher Gini coefficient indicates the greater concentration of value added and employment in certain industries.

3.6 (a) Pattern of Industrialization in India and China (Value added)

Graph 3.8 and 3.9 show pattern of Industrialization based on value added shares. In Indian case the trend line is moving upward which indicates rising specialization in Indian manufacturing industry. As seen in the previous section Indian manufacturing is dominated by L-T and M-L-T industries rather than the expected movements towards the H-T industries. This could point to the fact that the Indian manufacturing industries fell to be the victim of 'the flying geese paradigm' wherein the low technology intensive industries are left to the countries at early stages of industrialization (Akyuz, 2009).

Graph - 3.8

Pattern of Industrialization in India (Value Added) 1998-2012

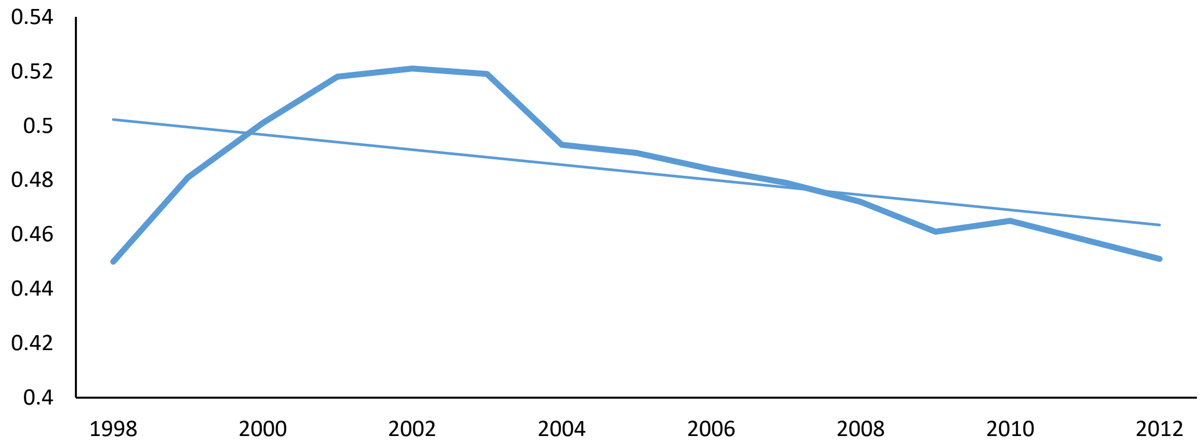


Source: Calculated from ASI, India, Various Years

In case of China, the trend line of Gini coefficient calculated for value added shares moves downwards indicating relative diversification of Chinese manufacturing industry. Chinese manufacturing value added seems to be diversifying in a number of activities with time. These kind of developments suggest the movement of Chinese economy towards a higher stage of industrialization.

Graph - 3.9

Pattern of Industrialization in China (Value Added) -1998-2012



Source: Calculated from CDO, China, Various Years

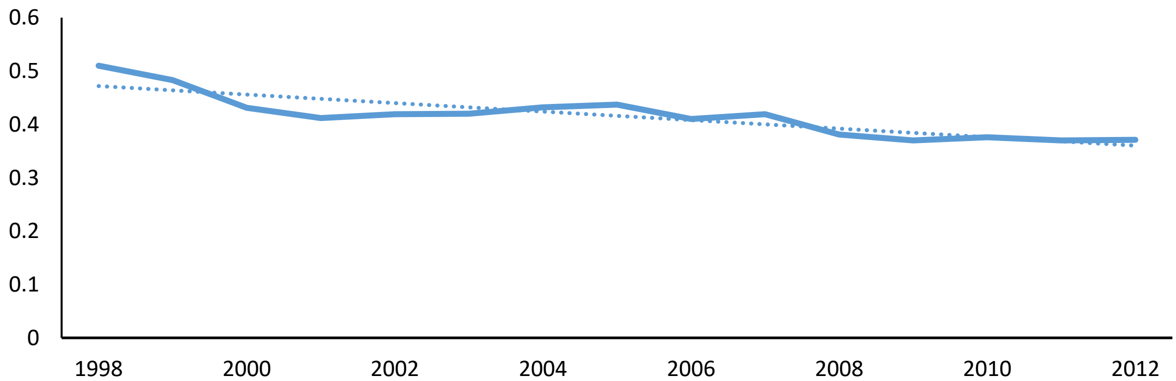
Thus, the above analyses show that the Indian manufacturing industries is engulfed with the lack of dynamism and structural transformation towards the relatively high technology intensive industries whereas China is showing the dynamism to move to the upper level.

3.6 (b) Pattern of Industrialization in India and China (Employment)

Figures 3.10 and 3.11 show pattern of Industrialization based on employment shares.

Graph - 3.10

Pattern of Industrialization in India (Employment) 1998-2012



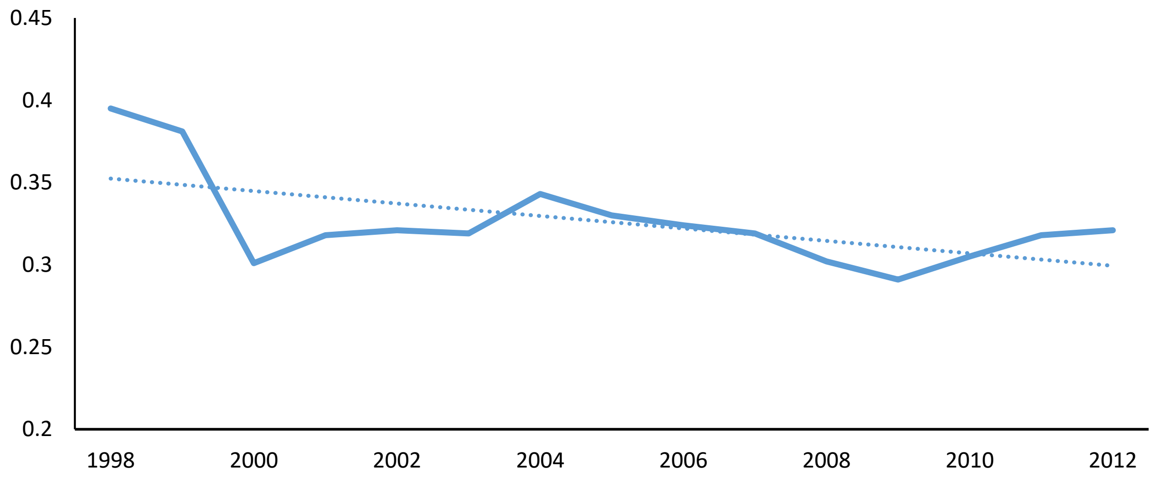
Source: Calculated from ASI, India, Various Years

In Indian case the trend line is moving upward which indicates rising specialization in Indian manufacturing industry. The trend lines of Gini coefficient of employment shares in India and China reveal that over the years' employment in both countries is getting diversified into a number of activities rather than concentrating in only a few.

The extent of movement within sectors is quite large in India (where Gini coefficient came down from .51 in 1998 to .37 in 2011-12) as compared to China (Where Gini coefficient came down from .39 in 1998 to .32 in 2011-12). But as can be seen from lower Gini coefficient, the Chinese economy is showing more dynamism than the Indian economy in terms of employment diversification towards H-T industries.

Graph - 3.11

Pattern of Industrialization in China (Employment) 1998-2012



Source: Calculated from CDO, China, Various Years

3.7 Conclusion

The findings of this chapter clearly highlight the importance of Chinese manufacturing in the overall economy of China. Indian manufacturing sector seems to have failed to achieve the remarkable level achieved by Chinese manufacturing in absolute terms. In terms of growth rates of manufacturing value added it can be seen that Indian manufacturing has shown improvement but the growth rates of value added are still well behind the growth rates of its Chinese counterpart. Contribution of manufactured exports of China has been much higher both in terms of absolute exports and their share in total exports as compared to Indian manufacturing. As has been discussed earlier that increase in Chinese manufactured exports over previous year was higher than the absolute amount of exports from India during particular years.

Now looking at the shares of different industries in total gross value added of manufacturing sector in both the economies it can be seen that both have high shares of Chemicals, Metal and Food industry. Both economies witnessed a decrease in the share of Textile industry. Both Indian and Chinese manufacturing showed an increase in share of Metal, Transport, Coke and Petroleum industry whereas in employment shares Indian manufacturing witnessed an increase in share of Apparel, Transport industry, Coke and Petroleum industry and Chinese manufacturing showed an increase share of in Machinery and Transport industry in total gross value added of manufacturing. The Metal industry which witnessed increase in value added share in Indian and Chinese manufacturing showed a declining trend in employment share. In China, industries like Rubber and Machinery which witnessed declining share in value added showed positive change in employment share. Analysis of technology intensity revealed the importance of H-T industries in Chinese manufacturing value added whereas Indian manufacturing value added showed very low share of H-T industries. Indian manufacturing value added is dominated by M-H-T industries whereas Chinese manufacturing has highest share of L-T industries. On the other hand, employment in India is still dominated by L-T industries whereas Chinses manufacturing showed a balanced share of industrial groups in both value added and employment. This hints towards the prevalence of low productivity in Indian sectors. The rise of more productive and high technology intensive industries in China could partially explain the recent debate about upward increase of overall manufacturing labour cost in China.

Chapter – 4

Labour Cost, Productivity and Efficiency in Indian and Chinese manufacturing

4.1 Introduction

As we have seen there is not much difference in the structure of value added and employment of the manufacturing sector in India and China. Some part of the high growth in China is explained by high sectoral level growth in value added and number of workers in all the industries in comparison with India. But to better understand this differential we must look into the issue of labour cost and productivity in Chinese and Indian manufacturing. Wages and productivity are supposed to be the key factors in determining whether China maintains an edge in a given set of industries. As economy goes through the phase of structural change it experiences higher productivity accompanied by higher wages. But labour surplus countries like India and China manage to keep their labour cost low during the phase of rising productivity which happens due to shifting of labour from non-productive sectors to more productive activities. So a look at sectoral level labour cost and productivity will provide us the understanding of the difference between the cost and productivity aspects of Indian and Chinese manufacturing. It will help us to identify the sectors where India can have comparative advantage over China.

4.2 Outline of the Chapter

The present chapter has been divided into ten sections including the introductory section and present section. The third section of the chapter provides empirical literature on Cost and productivity issues in Indian and Chinese manufacturing. The fourth and fifth sections fulfil the objective of analysing and comparing labour cost and labour productivity in Indian and Chinese manufacturing. The sixth section deals with the role played by capital intensity in various branches of manufacturing in India and China. The seventh section traces relationship between labour cost and labour productivity in Indian and Chinese manufacturing so as to get implications about competitiveness of manufacturing in both economies in the eighth section. The ninth section provides empirical estimation of TFP and its components in Indian and Chinese manufacturing and its various branches at differential levels of technology intensity. The tenth section concludes the chapter.

4.3 Existing Studies on Cost and Productivity of Manufacturing sector of India and China

The present section reviews empirical literature on comparison of various aspects of manufacturing sector in both India and China.

Chauduri and Panigrahi (2012) focused on comparisons of top five manufacturing industries in India and China. The top five manufacturing industries have been considered on the basis of GVA (Gross Value Added). The top five manufacturing industries considered in this paper were Basic Iron and Steel, Other Chemicals, Basic Chemicals, Basic Precious & Non-Ferrous Metal and Non-Metallic Mineral Products. Apart from GVA the paper also focussed on the differences in wage & salary, number of employees, number of enterprises and GFCF (Gross Fixed Capital Formation) with respect to the top five industries in India and China. Firstly, a comparison between India and China with respect to the four variables under study has been done. The study found that China has been much ahead of India in GVA, labour productivity, number of employees, number of enterprises. In the second half of the paper, an analysis of industry level differences in value added per employee, wage & salaries per employee and value added per enterprise for both the countries has been done. The study found that there is no significant difference observed in value added per employee, wage & salaries per employee and value added per enterprise in both the countries. An attempt has been made to look into the multivariate analysis by considering GVA as dependent variable over wage & salary, number of employee, number of enterprise and GFCF for both the countries. The study concluded that the higher wages & salary may be contributing to higher GVA in China over India.

Pandey and Dong (2007) undertook a comparative study of productivity in the manufacturing sector for China and India using data from survey of manufacturing industries for the two countries. The study found that productivity of manufacturing industries in China relative to that in India improved substantially over the 1998-2003 period. Specifically, the average total factor productivity (TFP) growth for the manufacturing sector over this period was about 12 percent higher in China than in India. Two substantial changes in government policies in China, which were not witnessed in India, have been documented. First, the late 1990s saw an enormous wave of ownership restructuring due to the formal endorsement of private property rights by the Chinese central government. Second, in 1997 a large scale labour retrenchment program was launched to address the long standing problem of labour redundancy in the public sector. The study used the data from the Chinese survey of manufacturing industries to quantify the impact of these large scale institutional changes on TFP of Chinese manufacturing industries. The findings of this study revealed that policy changes can explain about 30 percent of the growth in TFP of manufacturing industries. Hence, the study concluded that these institutional changes in China can account for a significant part of the gains in productivity of manufacturing industries in China relative to that in India over the 1998-2003 period.

Wu et al (2007) examined the comparative productivity performance and the race between India and China in 1980-2004. They compared the level of real output, capital-labour ratio and total factor productivity in individual industries between the two economies, and investigated the gap between the two, with China as the benchmark, and identified Indian industries that had experienced the fastest catch up with, or had been overtaken by, their Chinese counterparts since the early reforms. Following the ICOP PPP approach, firstly the 1995-benchmark sector-of-origin measure of India/China UVRs (Unit Value Ratio) with industrial census data in the two countries was constructed. Secondly, time series data on labour employment, net capital stock and real output was constructed for individual Indian and Chinese industries. The PPP converters were then used to convert the capital stock and output value of individual industries in the two countries into a common numeracy for the aforementioned level comparisons. The results showed that the relative price levels in India were below that of China for most of the manufacturing branches and at the sectoral level. Both labour productivity and total factor productivity levels were above the level of China for most of the period since 1980 and it is only since 2000s the study found the TFP level in China to be above that of India. A distinguishing feature of these results has been that the high levels of labour productivity were indeed driven by high levels of capital intensity which may not be sustainable in the long run. The results of this study also showed that there were significant variations to these general conclusions when focused on different manufacturing branches and the manufacturing sector in India, in real terms, was small relative to the size of China and its relative size has been decreasing.

Lee et al (2005) carried out their study with the objective of comparing real output and productivity of Chinese and Indian manufacturing from 1980 to 2002. Industry of origin approach was used to construct purchasing power parities (PPPs) by using the data from industrial census of China and India for the year 1985. Fisher’s index was used to construct PPPs. In turn PPPs were used to convert Indian manufacturing GDP into

Chinese Yuan for direct comparison. The results of the study showed that level of real value added and productivity for Chinese manufacturing was well ahead of Indian manufacturing. This study suggested that the performance of manufacturing sector in both economies was influenced by the type of reforms undertaken in both economies.

Gordon et al (2010) analysed the interplay between labour regulation, human capital and economic complexity to explain differences in the productivity performance of Chinese and Indian economy. The output variable used in this study was TFP. The source of data was World Bank's Investment Climate Survey 2003, and captured only manufacturing sector establishments. Economic complexity was proxied by share of large firms. The study argued that economic complexity and skills of labour force are complementary. So labour regulations in India adversely affected economic complexity through smaller firm size and hence affected skill level of labour. In this way labour regulations became important in explaining the productivity difference in India and Chinese manufacturing. The regression results revealed that an increase in firm size by 10 percent led to rise in productivity by 4.4 percentage point and an increase in skill level by 10 percent of a firm led to an increased productivity by 4.8 percent. But the most significant and positive effect on productivity had been posed by economic complexity. The important finding of the study had been that skill and complexity do not matter in case of Indian firms. On the basis of these findings, the study asserted that Indian manufacturing sector has not reached the threshold level of economic complexity which could have productivity enhancing effect and this could be attributed to strict labour regulations which hampered expansion of firm size. Finally, the study urged for further more detailed and micro level research on the issues discussed.

Taye et al (2011) investigated the role of the business environment in explaining China's productivity advantage using firm-level survey data. Data source for this study had again been the World Bank's "Investment Climate Survey, 2003". The median firm's TFP in the China sample exceeded that in the India sample by 1.27 or 127 log points which meant that the median Chinese firm was 156 percent more productive than the median India sample. But the difference in growth rates of TFP in both economies was found to be small and insignificant. Step by step regressions were carried out to captured the role of various factors like infrastructure, labour flexibility, human capital and business environment on the level of TFP in both countries. The results of the study revealed that China had better infrastructure, more skilled workers, and more labour-hiring flexibility than India, but a worse access to finance and higher regulatory burden.

Infrastructure appeared to be a key constraint for India. It lagged significantly behind China. Labour flexibility had also been major constraint for India, as shown by the predominance of small firms. Interestingly, regulatory uncertainty had adverse effects in India but not in China. So various factors tended to affect TFP growth in both India and China differently.

Apart from the above discussed studies numerous studied have been carried out in both economies to analyse the evolution of cost, labour productivity, TFP and its components. The literature based on individual countries has been listed in the appendix in tabular form. Studies on productivity issues of Indian manufacturing like Goldar and Kumari (2003), Das (2004), Mukererjee and Ray (2005), Rajesh and Mahapatra (2007), Banga and Goldar (2007) and Trivedi et.al (2011) hint towards deceleration of TFPG and presence of technical inefficiencies in Indian manufacturing during the post reform period.

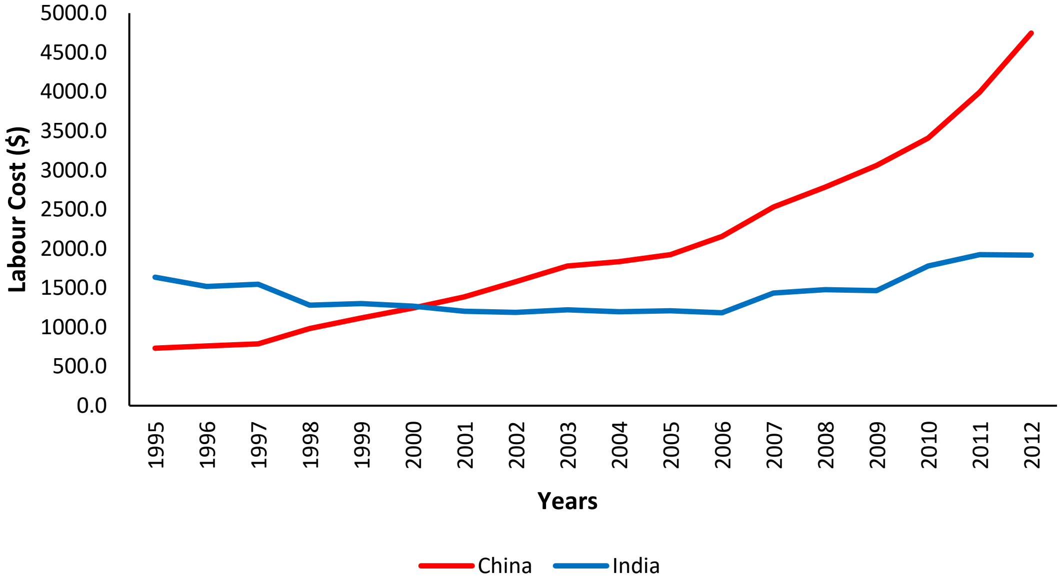
In case of China, studies like Jefferson et al (2008), Donglan (2005), Brenst (2012), Cao et al (2009) and Wu (2011) find evidences of improvement in TFPG of China's manufacturing especially since early 2000s. So the findings of these empirical studies on both countries persuade us to carry out further exploration of the trends in TFPG and its components in manufacturing sector in the recent period.

4.4 Labour Cost in Indian and Chinese Manufacturing

Graph 4.1, shows the trends of labour cost in Indian and Chinese manufacturing during 1995-96 to 2012-13. Labour cost was lower in Chinese manufacturing as compared to Indian manufacturing during 1995-96 to 1999-2000. Since 2000-01 labour cost has been higher in Chinese manufacturing as compared to Indian manufacturing. It is generally believed that Chinese manufacturing has been able to capture world markets with its lower labour cost, but this does not seem to hold as per the present analysis. It can be said that there must have been some other strong reasons that Chinese manufacturing has performed much better than Indian manufacturing. One of such reasons could be productivity performance of Indian and Chinese manufacturing. But before analysing productivity aspect of manufacturing of both economies a sectoral level analysis of labour cost will provide the picture that which sectors of manufacturing industry are more competitive in both countries in respect of labour cost.

Graph - 4.1

Labour Cost in Indian and Chinese Manufacturing



Source: ASI and CSY, Various Years.

Sectoral Analysis of Labour Cost

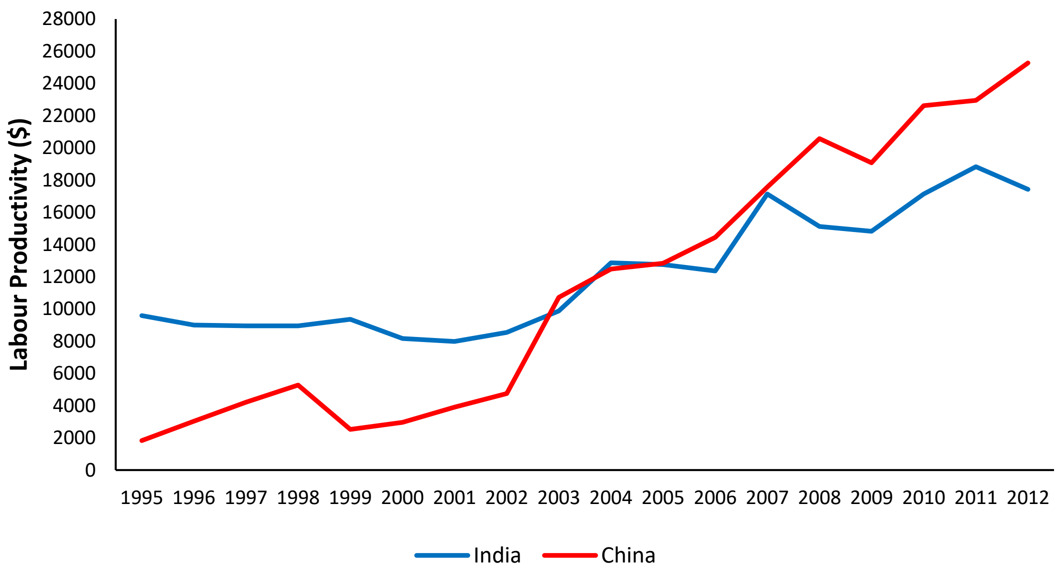
Sectoral analysis of labour cost as shown in table 4.1 reveals that in 1995-96 labour cost was higher in all the sectors of manufacturing industry of India as compared to Chinese manufacturing except Tobacco industry. In case of India lowest labour cost was shown by Tobacco industry ($1,571) and highest labour cost was shown by Coke and Petroleum industry ($11,009). In China during 1995-96 lowest labour cost was shown by Wood industry ($1,841) and highest labour cost was shown by Tobacco industry ($7,931). Now coming to the year 2012-13 we get totally reverse results. Here Indian manufacturing appears to be more competitive in terms of labour cost. All sectors of Chinese economy show higher labour cost as compared to their Indian counterparts. In terms of cost Indian Tobacco industry appears to be most competitive sectors as it shows lowest labour cost. In all the sectors labour cost in Chinese manufacturing is higher than that of labour cost in Indian manufacturing industries. So here it can be said that being cost competitive alone is not enough. To understand the better performance of Chinese manufacturing as compared to Indian manufacturing a comparative analysis of the productivity performance must be done.

4.5 Labour Productivity in Indian and Chinese Manufacturing

A comparison between labour productivity in Indian and Chinese manufacturing is shown in figure 4.2. It reveals that till 2002 productivity in Indian manufacturing was higher than that of Chinese manufacturing sector. It was from 2003 onwards that labour productivity in Chinese manufacturing began to overtake labour productivity in Indian manufacturing. There appear ups and downs in productivity in both economies but in recent times labour productivity in Indian manufacturing is showing a declining trend whereas it's rising in Chinese manufacturing. To get a better understanding of the differences in labour productivity in manufacturing sector of both economies it will be relevant to look into the sectoral level performance. This will help us to identify sectors which are contributing to higher growth of labour productivity in Chinese manufacturing and also the sectors where India lags behind.

Graph - 4.2

Labour Productivity in Indian and Chinese Manufacturing



Source: ASI and CSY, various years.

Sectoral Analysis of Labour Productivity

Table 4.1, presents the sectoral labour productivity in Indian and Chinese manufacturing. Labour productivity in Indian manufacturing was higher than its Chinese counterpart in almost all the two-digit industries in 1995-96 except Tobacco industry and the difference in both economies was quite visible in magnitude. In 1995-96, among the two-digit industries of Indian manufacturing sector highest productivity was in Coke and Petroleum industry ($180,523) followed by Chemical industry

($76,505) and Machinery industry ($45,538). The inter industry differences were also high at this point of time, as the lowest labour productivity of $ 5,495 was shown by Tobacco industry which is very low as compared to the highest value of productivity in Coke and Petroleum industry. In China during 1995-96 highest labour productivity was in Tobacco industry ($104,642) followed by Coke and Petroleum Products ($43,947). In all other industries level of productivity was below $ 15,000. This also reveals a very divergent picture in Chinese Industries also.

Now coming to 2012-13, the picture seems to has been reversed. All the industry groups in China showed higher labour productivity as compared to their Indian counterparts. In case of India, the same industries still lead the picture with highest labour productivity shown by Coke and Petroleum industry ($989,475) followed by Chemical indsutry ($110,524) and Machinery industry ($75,836). Lowest labour productivity has been achieved by Apparel industry ($14,060) and Leather industry ($15,332). Only some of the industries have been ruling the productivity performance in Indian case. In Chinese manufacturing all industries have higher labour productivity than Indian manufacturing industries in 2012-13. Highest labour productivity is again shown by Tobacco industry ($426,671) followed by Metal industry ($136,983) and Rubber industry ($199,278). Inter-industry differences have been high in productivity values of two-digit industries in both the countries at both points of time indicating a lot of inequality in productivity achievement of various industries among manufacturing sector.

The above analysis brings us to the point that one of the major reasons for higher growth of Chinese manufacturing in recent times is the higher level of productivity. As discussed in the earlier section labour cost is also seen to be higher in almost all of the two-digit industries but even this does not make Chinese manufacturing loose its competitiveness. Now one of the reasons behind this could be the gap between labour productivity and labour cost. If the gap between labour cost and labour productivity is higher it makes manufacturing sector profitable and attract more firms towards the manufacturing industry. It will be relevant here to examine the extent and growth of the labour productivity and labour cost gap in the manufacturing sector of both India and China.

Table 4.1: Labour Cost and Labour Productivity in Indian and Chinese Manufacturing (1995-2012)

	India				**China**			
	Labour Productivity (in $)		**Labour cost (in $)**		**Labour Productivity (in $)**		**Labour cost (in $)**	
	1995	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**	**2012**
Food & Beverages	17908.5	35601.4	3312.5	4816.8	13506.7	89704.3	2354.6	7456.4
Tobacco	5495.8	18354.2	1571.4	2098.3	104642.6	426671.4	7931.4	21541.6
Textile	15018.6	28092.0	5222.0	5198.2	7525.3	52085.8	1965.0	6253.2
Apparels	18047.0	14060.8	3109.4	4718.3	11186.6	32367.2	2306.2	6729.2
Leather	15022.4	15332.3	3472.4	4523.8	11471.5	44047.5	2273.6	6372.4
Wood	9968.1	26329.2	2480.0	4758.8	7342.0	81730.4	1840.8	5939.1
Paper	35807.9	33708.8	5642.1	6187.2	9847.7	80914.3	2289.5	7274.0
Printing	27593.9	53988.8	6780.8	7632.1	7157.8	42684.2	2764.8	7904.3
Coke & Petroleum	180523.4	989475.1	11008.9	18183.8	43947.2	127473.8	4780.3	12203.9
Chemical	76505.1	110524.8	6709.1	7567.6	14171.6	87264.5	2970.5	8577.2
Rubber	32420.7	42834.7	5051.3	6275.1	11014.2	199278.8	2519.3	7413.6
Non-Metallic	27818.5	43057.4	3866.3	4673.3	11935.9	84478.4	2145.1	7015.0
Basic Metal	43331.5	63343.2	7202.4	8479.8	15319.0	136983.3	3496.0	8863.6
Machinery	45538.6	75836.0	7571.0	8563.6	11546.4	82108.9	3227.5	9171.4
Transport	36994.8	67045.3	8377.6	8638.9	12266.0	88695.6	3672.5	10579.6
Other	26925.5	39558.3	5761.9	6910.4	7277.1	45262.7	**2454.4**	**6998.4**
All Industries	**31725.0**	**54555.8**	**5414.6**	**6408.0**	**12598.3**	**85874.3**	**2913.7**	**8500.1**

Source: Calculated from ASI, India and CIEY, China Various Year

4.6 Labour Cost and Labour Productivity relationship in Indian and Chinese Manufacturing Sector

It will be interesting to see that how much of gains in labour productivity get translated into increase in real wages (Labour cost) in Indian and Chinese manufacturing at sectoral level. Table 4.2 reveals that during 1995-96 to 2001-02 labour productivity in Indian manufacturing grew at the rate of 6.4 % but the rate of growth of labour cost was 0.5 percent which indicates that growth in labour productivity was not translated into growth in labour cost meaning that workers got lower wages with increasing labour productivity. In India, labour cost of most of the industries showed a very low or negative growth rate during 1995-2001, except Coke and Petroleum industry, Wood industry, Non-Metallic Mineral industry and Metal industry whose growth rate of labour cost was 17.8 percent, 8.3 percent, 4.2 percent and 5.9 percent respectively. During the same time period i.e., 1995-96 to 2001-02 labour productivity in Chinese manufacturing grew at a rate of 14.7 % which was quite high as compared to India. The growth rate of labour cost was also higher in China as compared to India. But even in China growth rate of labour cost were not aligned with the growth rate of productivity. In the later time period i.e. 2002-07 performance of Indian manufacturing in labour productivity showed a significant improvement with a growth rate of 16.8 % where labour cost grew at a rate of 5.9 %. All industrial groups showed significant improvement in productivity growth except apparel manufacturing. During 2008-12 labour productivity in Indian manufacturing grew at a rate of 4.3 % which was lower than the growth performance of previous period. Other surprising trait found in this period was the higher growth rate of labour cost (11.8 %) as compared to labour productivity. In China also growth rate of labour cost surpassed the growth rate of labour productivity during 2008-09 to 2012-13. In economic theory enhanced output per worker should, lead to higher earnings. However, if growth in earnings exceed growth in productivity, it can be detrimental to competitiveness. This trend could lead have serious implications on employment. The other interpretation of rising labour cost more rapidly as compared to productivity could be that manufacturing in India and China has not been able to move to the higher level of value chain. These countries need to stress more on innovation and advanced products to enhance the growth rate in their productivity so as to save their positions on the ground of competitiveness.

Table 4.2 : Compound Annual Growth Rates (Percent)

Industry	India								China							
	Labour Productivity				Labour Cost				Labour Productivity				Labour Cost			
	1995-2001	2002-2007	2007-2012	1995-2012	1995-2001	2002-2007	2007-2012	1995-2012	1995-2001	2002-2007	2007-2012	1995-2012	1995-2001	2002-2007	2007-2012	1995-2012
Food	8.38	27.70	17.77	8.60	3.93	3.94	20.95	2.56	24.54	28.97	3.24	23.87	7.32	11.92	21.96	16.21
Tobacco	31.26	44.03	10.62	15.13	5.37	5.12	15.28	1.08	5.55	23.15	2.22	18.05	4.01	8.61	16.48	14.06
Textile	4.47	18.78	22.06	5.80	-2.65	9.34	17.63	-2.39	27.42	33.41	1.77	23.31	6.65	11.25	24.18	15.98
Apparels	-4.64	0.95	4.44	-3.74	4.08	-1.06	14.37	4.50	13.94	3.40	9.12	4.50	7.87	12.47	18.05	15.12
Leather	-0.48	13.38	3.40	-1.15	0.27	-1.18	17.36	1.70	22.91	7.76	14.40	9.86	7.05	11.65	16.51	14.39
Wood	6.73	15.93	23.01	10.47	8.35	-0.33	20.15	6.11	35.72	36.06	5.58	28.96	6.99	11.59	33.93	17.88
Paper	5.49	16.68	3.70	3.96	2.33	8.88	15.71	-0.98	26.71	27.43	6.30	20.33	7.70	12.30	23.11	16.18
Publishing	24.73	20.16	7.25	8.79	-4.23	6.93	18.44	-1.97	20.93	27.04	6.53	21.94	6.03	10.63	17.31	15.00
Coke & Petroleum	12.29	2.18	24.91	25.66	17.81	8.92	29.79	3.99	3.84	22.69	6.53	17.59	4.79	9.39	14.95	13.45
Chemical	7.71	24.50	8.79	6.37	1.03	7.11	13.44	-0.57	11.68	36.42	12.50	22.32	6.18	10.78	18.91	14.99
Rubber	8.05	16.15	1.07	3.91	-0.56	7.03	17.37	0.76	24.63	41.77	12.50	31.47	7.44	12.04	18.12	15.52
Non-Metallic	10.64	24.05	-7.50	7.67	4.18	5.50	14.71	-0.76	6.08	37.54	23.13	32.44	8.33	12.93	23.03	16.68
Metal	-0.56	2.71	-5.74	8.55	5.87	10.79	12.03	-0.69	8.60	41.71	20.67	33.61	6.43	11.03	10.64	13.72
Machinery	7.44	13.05	2.60	8.26	-0.11	8.78	9.13	-0.69	27.09	17.29	20.67	12.19	7.94	12.54	15.78	15.13
Transport	14.83	6.95	9.12	8.62	0.59	8.31	11.62	-1.62	14.30	17.62	20.67	12.52	7.84	12.44	15.80	15.82
Other	13.78	8.80	-10.23	4.92	-2.92	2.89	15.43	1.49	-6.65	37.27	9.87	32.17	4.89	9.49	19.50	15.01
All Industries	6.40	16.77	4.32	8.49	0.60	5.93	11.81	0.09	14.68	22.69	10.98	19.59	7.41	12.01	15.11	15.53

Source: Calculated from ASI, India and CIEY, China, Various Years.

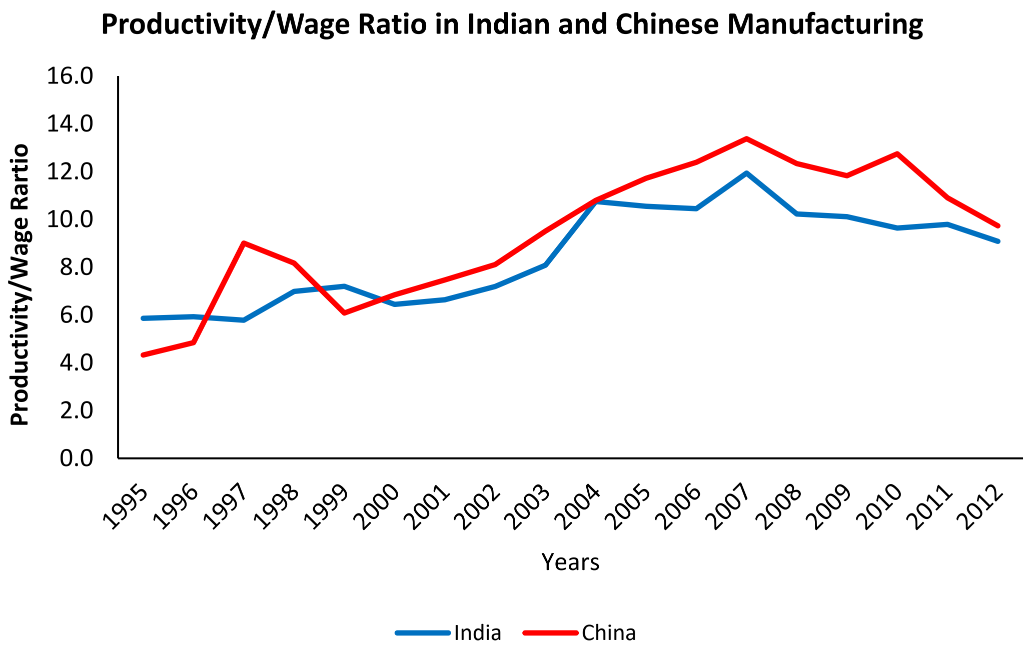
4.7 Role of Capital Intensity in higher growth rate of labour Cost as compared to Labour Productivity

Capital deepening is considered to be the driver of growth in economic growth theory. In the scenario when both capital and labour tend to change, wage rate is directly related to capital intensity. One argument in favour of this assertion is that for using more capital intensive technologies, labour with higher skills is required which would demand higher wages in return. This also leads to higher rates of productivity. Daugherty et al (2009), showed the direct relation between value added per worker and capital labour ratio. But the situation could be alarming when labour cost begins to rise more than labour productivity along with rising capital intensity. This has been the case with manufacturing sector of both India and China in the recent years. In both Indian and Chinese manufacturing capital intensity has grown at a higher rate than labour productivity in all the sub- periods taken in the present study (Appendix A6). In Indian manufacturing the difference between growth rate of labour productivity and capital intensity increased in the later period but it was very small in all sub-periods as compared to China. In case of China this difference has decreased but still it is substantial in absolute terms. So one inference about rising labour cost in China can be drawn from this relation between labour productivity and capital intensity in Indian and Chinese manufacturing.

4.8 Competitiveness of Indian and Chinese manufacturing

Discussion carried out in earlier sections points a question mark upon the competitiveness of both India and China as both are experiencing high growth rates of labour cost and comparatively low growth of labour productivity. To get a better picture a simple analysis of competitiveness of manufacturing sector as a whole has been carried out here for both India and China. Graph 4.3, shows the productivity/wage ratio (Labour productivity/ Labour Cost) for Indian and Chinese manufacturing. This index can be a good indicator of competitiveness of an economy. This ratio has been higher in Chinese manufacturing as compared to Indian manufacturing since 1996-97 with a slight change in 1999-2000 when this ratio became higher in India. Since 2001-02 onwards, Chinese manufacturing sector has been more competitive as compared to Indian manufacturing sector. Competitiveness of both India and China seems to be declining since 2007-08 but Chinese manufacturing sector is more competitive than Indian manufacturing with a higher productivity/wage ratio.

Graph - 4.3



Source: Calculated from ASI and CSY, Various Years.

4.9 TFPG and its Components in Indian and Chinese Manufacturing

It has been observed in the previous sections that both economies are facing the problem of wasteful use of capital resource. It becomes really crucial here to look into the issue of efficiency of manufacturing sector in both economies. In the present era of continuous technological advancement all over the world efficiency improvement is one of the key to remain competitive. The "knowledge gap" can only be bridged by improving productivity and being efficient. While comparing manufacturing sector of India and China we need to observe that whether the superior performance of Chinese economy has been input driven or relies upon technical progress and efficiency. So in the present section, we will examine various components of output growth (input growth, scale efficiency, technical progress and technical efficiency change) of manufacturing sector in both economies and see whether Chinese manufacturing has shown more improvement in technical progress, technical efficiency level or depends upon input growth in comparison to Indian manufacturing over the period of time.

4.9.1 Data and Variables Used for Time Varying Stochastic Production Frontier Efficiency Model

Three-digit level data on manufacturing sector of both India and China has been used covering the time period of 1998-2011 for India and 1999-2011 for China[16]. The source of Indian data is ASI and the Chinese three-digit level data on manufacturing sector has been taken from CDO, compiled by China Data Centre of University of Michigan. CDO takes data from National Bureau of Statistics, China (NBS). The three-digit level data have been concorded for the various industrial classifications followed in both countries and have been made compatible with ISIC-revision 3. Finally, fifty-four, three-digit industries for India and fifty-two, three-digit level industries for China have been analysed (Appendix A2)

We have used the two input production function where value added has been taken as a measure of output and capital and labour has been taken as two inputs.[17] The three-digit industries have been further classified into four technology intensive industrial sub-groups (Appendix A3) based upon the classification provided by Organisation for Economic Cooperation and Development (OECD, 2007).

4.9.2 Empirical Model

The stochastic frontier model with panel data is:

$$\ln Y_{it} = \beta_0 + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_{KK} (\ln K_{it})^2 + \beta_{LL} (\ln L_{it})^2 + \beta_{KL} (\ln K_{it})(\ln L_{it}) + \beta_{Lt} (\ln L_{it})t + \beta_{Kt} (\ln K_{it})t + \beta_t t + \beta_{tt} t^2 + v_{it} - u_{it}. \quad \ldots(4.1)$$

where i=1, …N industries and t=1, …T; $\ln Y_{it}$ is the log of real industrial value added for i^{th} industry at time t, $\ln K_{it}$ is the log of fixed capital stock, $\ln L_{it}$ is the log of number of employees. The random error v_{it} is symmetric and normally distributed with $v_{it} \sim N(0, \sigma_v^2)$. The technical inefficiency term u_{it} can either be time variant or time invariant (Lovell, 2000). In the case of time invariant technical inefficiency, $u_{it} = u_i \sim N^+(\mu, \sigma_u^2)$, where μ is the mode of the truncated half-normal distribution. In the case of time variant technical inefficiency, u_{it} can be expressed as a monotonic 'decay' function as $u_{it} = \eta_t u_i$, where η_t = exp (-η (t – T), and η is an unknown scalar parameter for technical inefficiency. The u_{it} can either be increasing (if η< 0), decreasing (if η> 0) or remain constant (if η= 0) (Battese and Coelli, 1992). The minimum- mean-square-error

[16] For China the accessible 3-digit level data started from the year 1999 only.

[17] The variables have been discussed in chapter- 2.

predictor of the technical efficiency of the i^{th} industry at time t is shown as (Battese and Coelli, 1988, 1992, 1995; Battese and Corra, 1977; Coelli, 1996; Kumbhakar and Lovell, 2000):

$$TE_{it} = E\ (\exp(-u_{it})\ |\varepsilon_{it})\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(4.2)$$

Where $\varepsilon_{it} = v_{it} - u_{it}$

In the present study we have taken time varying efficiency model for all industries and all sub periods based on the results of our hypothesis testing.

4.9.3 Hypothesis Testing

The correctness of the specifications of the stochastic frontier production model would directly affect the accuracy of the conclusion. Traditional TFP models mostly used Cobb-Douglas production function which is simple in its form and neither distinguishes the stochastic noise and technological improvement, nor takes technical inefficiency into consideration. So, the transcended logarithmic production function used in the present study allows for testing of various hypotheses. The model is tested specifically in four dimensions: 1) the applicability of the stochastic frontier model; 2) is technical efficiency time varying relative to the frontier; 3) whether the frontier technology change exists 4) is simple Cob-Douglas better than Translog frontier model. Four basic models using the frontier production function have been estimated based on the statistic likelihood ratio (LR). This statistical test of goodness of fit between two models has been used to test null-hypothesis. Table 4.3 presents the results of hypothesis testing carried out for manufacturing sector as a whole for the period 1998-2011 for India and for period 1999-2011 for China.[18] Based on the results of hypothesis testing we have taken Translog specification of stochastic frontier production function for all sub categories of manufacturing in India and China. Technical efficiency has been taken to be time varying for all periods for manufacturing sector as a whole.[19]

[18] Hypothesis testing was also done for all sub-groups of manufacturing sector and for all sub-periods.

[19] In case of Indian manufacturing during 1998-2001 all industrial sub-groups showed time invariant technical efficiency except M-L-T industries. For all other periods all sub groups showed time varying technical efficiency in Indian manufacturing. In case of China during 1999-2001 all sub groups showed time invariant technical efficiency except H-T manufacturing. For all other periods all sub groups had time varying technical efficiency.

Table 4.3: Test of Hypothesis for the Parameters of Distribution of Technical Efficiency

	India			China		
Null Hypothesis	LR-Test Statistics	Critical Value	Decision	LR-Test Statistics	Critical Value	Decision
1998-2011				1999-2011		
$H_0 = \Upsilon = \mu = \eta = 0$	2613.653	10.5	Reject	2613.653	10.5	Reject
$H_0 : \eta = 0$	178.341	6.63	Reject	178.341	6.63	Reject
$H_0 : \beta_t = \beta_{Kt} = \beta_{Lt} = \beta_{Kt} = 0$	345.47	13.28	Reject	345.47	13.28	Reject
$H_0 : \beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	190.33	13.28	Reject	190.33	13.28	Reject
1998-2001				1999-2001		
$H_0 = \Upsilon = \mu = \eta = 0$	1012.56	10.5	Reject	1012.56	10.5	Reject
$H_0 : \eta = 0$	1.891	6.63	Accept	0.9812	6.63	Accept
$H_0 : \beta_t = \beta_{Kt} = \beta_{Lt} = \beta_{Kt} = 0$	156.78	13.28	Reject	156.78	13.28	Reject
$H_0 : \beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	8.23	13.28	Accept	99.8	13.28	Reject
2002-2007				2002-2007		
$H_0 = \Upsilon = \mu = \eta = 0$	780.97	10.5	Reject	780.97	10.5	Reject
$H_0 : \eta = 0$	215.49	6.63	Reject	215.49	6.63	Reject
$H_0 : \beta_t = \beta_{Kt} = \beta_{Lt} = \beta_{Kt} = 0$	105.87	13.28	Reject	105.87	13.28	Reject
$H_0 : \beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	134.57	13.28	Reject	134.57	13.28	Reject
2008-2011				2008-2011		
$H_0 = \Upsilon = \mu = \eta = 0$	1044.76	10.5	Reject	1044.76	10.5	Reject
$H_0 : \eta = 0$	178.9	6.63	Reject	178.9	6.63	Reject
$H_0 : \delta_t = 0$	289.54	13.28	Reject	289.54	13.28	Reject
$H_0 : \beta_t = \beta_{Kt} = \beta_{Lt} = \beta_{Kt} = 0$	112.67	13.28	Reject	112.67	13.28	Reject

Source: Calculated by author using ASI, India and CDO, China, Various Years.
Note: These models are calculated using Frontier 4.1 computer program.

4.9.4 Estimates of Stochastic Productioin Function For India

The maximum liklihood estimates of stochatic frontier production function in translog specification with time varying inefficiency for the sub-periods , 1998-2001, 2002-2007, 2007-2011 and period as a whole 1998-2011 are prsented in table 4.4 for India. The estimated coefficient of time varying technical inefficiency has been found mostly positive for all sub periods and all sub-groups of manufacturing sector except for a negative coefficient of high-technology industries for first two sub-periods and medium high tech showing negative coefficient of inefficiency decay in the initial phase. In the latter peroids all industries showed sigificant improvement in efficiency in Indian manufactuirng. The time varying technical (in)efficiency parameter has been found to be 0.023. It implies that level of technial efficiency in Indian manufactirng has during 1998-2011 has been incraesing to the extent of 2.3 per cent. The estimates of time coefficient show significant technical progres in all sub-categories of Indian manufactuing during 1998-2011.The other two parameters γ and σ^2 are associated with the variance of the random variable V_{it} and U_{it}. Significance of parameters γ and σ^2 implies that the realised output differed from potential output significantly and the difference has been mainly due to the difference in the industry specific technical efficiency and not due to any random changes.

The coefficients of the translog production function cannot be directly interpreted economically, therefore in Table 4.4 presents the estimated values of the output elasticity with respect to the inputs of capital and labour. Returns to scale, input growth, adjusted scale effect, rate of technical progress and rate of change of technical efficiency have also been estimated. As shown in table 4.4, labour has the greater output elasticity as compared to capital. For manufacturing as whole the output elasticities for labour and capital have been .699 and .419 during 1998 to 2011 respectively. Output elasticity of capital has been decreasing over the years which hints towards low productivity of capital in Indian manufacturing whereas output elasticity of labour has shown improvement. The estimates of these elasticities show similar trends for sub-groups of manufacturing sector considered here. Input growth has been highest in M-L-T sector followed by H-T industry. H-T industries showed lowest input growth due to low growth of labour input.

Now if we look at industry wise technical efficiency change in various sub-periods it becomes clear that in the initial phase all the industries witnessed negative technical efficiency change except H-T industries. It was during 2002-07 that most of the technical efficiency improvement happened in all industries with L-T industries followed by M-L-T industries taking the lead in technical efficiency improvement. H-T industries showed lowest technical efficiency improvement during 1998-2011.

Table 4.4: Stochastic Frontier Production Function Estimates for Indian Manufacturing Industry and its Four Technological Sub- Categories (1998-2011)

Variable	Param-eter	Manufacturing Total				High Technology Industries				Medium-High Tech				Medium-Low Tech				Low Tech			
		1998-2001	2002-2007	2007-2011	1998-2011	1998-2001	2002-2007	2007-2011	1998-2011	1998-2001	2002-2007	2007-2011	1998-2011	1998-2001	2002-2007	2007-2011	1998-2011	1998-2001	2002-2007	2007-2011	1998-2011
Constant	β_0	1.06	0.44	0.97	1.09***	1.32***	-0.49	0.28	0.9***	1.52***	0.49***	0.99	0.97***	3.27***	3.12***	3.09	3.18***	1.41***	0.63***	0.73	1.21***
		(1.36)	(0.43)	1.83	(2.86)	(5.39)	(-1.1)	(2.8)	(4.5)	(5.3)	(1.98)	2.9	(4.6)	(4.51)	(6.15)	5.1	(6.9)	(10.2)	(2.4)	4.7	(8.66)
Capital	β_K	0.59	0.43	0.48	0.50***	0.82***	0.33***	0.49	0.66***	0.61***	0.52***	0.61	0.69***	4.59***	4.35***	4.09	8.71	0.80***	0.72***	0.67	0.71***
		(0.83)	(0.59)	-0.71	(8.41)	(5.02)	(4.17)	(7.61)	(14.2)	(6.12)	(9.07)	12.3	(7.3)	(2.5)	(5.5)	(0.24)	(0.12)	(11.3)	(6.7)	11.2	(17.5)
Labour	β_L	0.5	0.71*	0.83	0.68***	0.78	0.81***	0.77	0.73***	0.42***	0.55***	0.45	0.38***	0.68***	0.77***	0.52	0.61***	0.39***	0.65***	0.55	0.43***
		(1.6)	(2.02)	1.61	(7.59)	(0.2)	(8.03)	6.14	(7.64)	(4.6)	(10.8)	7.7	(8.3)	(5.8)	(11.6)	9.7	(13.8)	(4.45)	(8.2)	10.1	(11.8)
K*K	β_{KK}		0.002	-0.2	-0.5***	5.34	-0.02	-3.96	4.9	2.84	4.8*	-4.69	-2.54	-0.72	0.73***	-0.72	0.25***	-2.19	0.3*	2.19***	0.07***
			(0.002)	-2.03	(-4.07)	(1.4)	(-0.2)	-0.8	(1.5)	(0.66)	(1.8)	(-0.6)	(-0.30)	(-1.01)	(4.17)	-3.4	(2.4)	(-0.46)	(1.76)	2.8	(-2.3)
L*L	β_{LL}		0.05***	0.04	0.0001	0.79***	0.96***	0.92	0.89***	0.96***	0.84***	0.6	0.97***	0.07	0.02***	0.04***	0.00	0.89***	0.06	0.06	-0.01
			(3.7)	1.8	(1.04)	(7.1)	(6.12)	9.01	(11.1)	(10.2)	(6.18)	7.8	(9.01)	(1.5)	(3.8)	4.4	(0.5)	(7.5)	(0.88)	4.03	(-0.2)
K*L	β_{KL}		0.04	0.01	0.02***	(2.4)	1.21	1.1	0.47*	0.71	0.84**	0.7	0.66	0.13**	0.48***	0.21	0.08***	-1.1	0.06***	-1.1	0.05***
			(0.14)	0.16	(2.65)	(1.30)	(0.18)	.99	(1.8)	(0.92)	(2.06)	1.8	(0.34)	(2.17)	(4.6)	5.3	(4.8)	(-0.8)	(2.71)	3.1	(1.86)
Time	β_T	0.03	0.5**	0.06*	0.4***	0.9	1.19	2.01	0.79*	0.85	0.92**	1.02	0.66	0.53**	0.24***	0.3***	0.8***	-1.4	0.07***	-2.7	-0.01***
		(0.27)	(3.14)	2.16	(2.76)	(2.41)	(0.97)	1.03	(3.8)	(0.92)	(3.16)	3.8	(1.14)	(3.27)	(4.11)	5.2	(4.1)	(-0.41)	(2.82)	-1.1	(-3.24)
T*K	β_{TK}	0.03	0.01	o.03	-0.06***	4.34	0.02	-3.96	6.6	1.8	-4.7*	-4.69	-4.54	-1.12	-0.33***	-0.56	0.26***	-3.89	-0.5*	-2.2	0.11***
		(0.03)	(0.002)	2.03	(-4.07)	(1.4)	(0.2)	-0.7	(3.7)	(-0.66)	(-1.8)	-0.6	(-0.30)	(-1.31)	(-5.07)	-3.8	(4.4)	(-0.66)	(-1.76)	-2.8	(14.1)
T*L	β_{TL}	-0.01	-0.05	-0.03	-0.01***	-0.04	-0.07	-0.07	-0.02*	-0.06	-0.04**	-0.04	-0.01	-0.04**	-0.01***	-0.1	-0.03***	0.08	-0.03***	0.08	0.01***
		(-1.07)	(-0.43)	-1.2	(-2.4)	(-1.1)	(-0.18)	-1.08	(-1.9)	(0.91)	(-1.99)	0.54	(-0.35)	(-2.23)	(-4.64)	-0.34	(-4.1)	(0.85)	(-3.7)	1.09	(8.14)
T*T	β_{TT}	-0.02	-0.05	-0.03	-0.01***	-0.04	-0.07	-0.07	-0.02*	-0.06	-0.04**	-0.04	-0.01	-0.04**	-0.01**	-0.1	-0.03	0.08	-0.03***	0.08	0.02
		(-0.04)	(-0.13)	-1.5	(-2.3)	(-1.4)	(-0.19)	-1.18	(-1.7)	(0.81)	(-1.79)	0.44	(-0.25)	(-2.14)	(-3.04)	-0.15	(-1.1)	(0.85)	(-3.7)	1.09	(-2.01)
σ^2		0.23***	0.19***	0.2	0.22***	0.37***	2.23	2.23	0.85*	0.73	0.27***	1.365	2.00	0.5***	0.25***	0.31	0.38***	0.53	0.14***	0.53***	1.08
		(9.47)	(7.4)	10.2	13.3	(3.36)	(0.19)	1.01	(1.83)	(0.85)	(2.5)	0.5	(0.35)	(9.5)	(7.8)	8.9	(11.9)	(0.94)	(11.6)	3..3	(6.78)
γ		0.06***	0.03***	0.05	0.001	0.65***	0.55***	0.82	0.79***	0.81***	0.77***	0.61*	0.87***	0.08	0.03***	0.05**	0.001	0.79***	0.07	0.13***	0.32
		(3.2)	(2.8)	1.03	(1.04)	(4.7)	(4.12)	7.41	(10.0)	(12.1)	(8.08)	(2.1)	(11.0)	(0.53)	(3.8)	3.1	(1.1)	(4.9)	(0.54)	4.13	(-3.91)
μ		2.04	1.07	0.99	1.09***	0.02***	1.07	2.03	1.9***	-0.76	2.49***	1.99	2.97***	3.28***	3.12***	3.09	3.17***	0.69***	3.63***	2.73	2.19
		(1.36)	(0.18)	1.76	(2.16)	(4.1)	(-1.1)	(2.8)	(4.5)	(19.1)	(1.91)	2.5	(4.4)	(3.81)	(5.05)	(3.1)	(7.8)	(7.5)	(2.1)	(3.6)	(-4.06)
η			0.03***	0.4	0.023		0.006***	0.62	0.32***		0.64***	0.61	0.47***	0.7	0.3***	0.45	0.01		0.04	0.02	3.61
			(2.7)	1.8	(1.04)		(6.42)	9.21	(13.0)		(9.68)	7.8	(14.0)	(0.91)	(7.8)	3.1	(0.5)		(0.88)	4.03	(-3.02)
LLF		-388.7	-404.1	-603.8	-830.4	-36.5	-55.0	-83.0	-111	-46.9	-39.8	-64.2	-106	-135.7	-107.7	-171	-270.2	-14.5	-107.4	-61	352.7
Nobs		216	324	216	702	28	42	28	91	60	90	60	195	48	72	48	156	80	120	80	260

Source: Prepared by author using ASI, India. Note: The parameters are estimated using Frontier 4.1 computer program.*,** ,***indicates significant at 10 per cent,5 percent and 1 per levels, respectively. Figures provided in brackets are the t values.

Table 4.5: Decomposition of Output Growth and TFPG in Indian Manufacturing and its Technological Sub-Categories (1998-2011)

OUTPUT ELASTICITY/																				
Sector	**Manufacturing Total**				**High Technology Industries**				**Medium-High Tech**				**Medium-Low Tech**				**Low-Technology Industries**			
	1998-2001	**2002-2007**	**2007-2011**	**1998-2011**	**1998-2001**	**2002-2007**	**2007-2011**	**1998-2011**	**1998-2001**	**2002-2007**	**2007-2011**	**1998-2011**	**1998-2001**	**2002-2007**	**2007-2011**	**1998-2011**	**1998-2001**	**2002-2007**	**2007-2011**	**1998-2011**
ek	0.525	0.141	0.412	0.413	0.419	0.498	0.399	0.5	0.506	0.412	0.435	0.491	0.502	0.546	0.419	0.51	0.513	0.465	0.413	0.443
e_L	0.692	0.711	0.791	0.749	0.699	0.731	0.802	0.7	0.781	0.752	0.654	0.681	0.748	0.73	0.751	0.75	0.644	0.619	0.611	0.625
e	1.217	0.852	1.203	1.162	1.118	1.229	1.201	1.2	1.287	1.164	1.089	1.172	1.25	1.276	1.17	1.27	1.157	1.084	1.024	1.068
INPUT GROWTH EFFECT																				
Capital	3.7	3.88	3.54	3.41	1.01	4.01	5.14	3.08	1.98	3.15	2.88	3.01	1.98	5.06	3.55	3.81	2.44	3.29	3.13	2.03
Labour	-3.3	4.2	4.1	2.6	-5.3	4.1	1.8	-0.2	-5.9	3.8	6.3	2.9	-2.3	6	4.3	4.4	0.2	3.6	2.1	3.2
$\dot{\Phi}$	0.4	8.08	7.64	6.01	-4.29	8.11	6.94	2.88	-3.92	6.95	9.18	5.91	-0.32	11.06	7.85	8.21	2.64	6.89	5.23	5.23
SCALE EFFECT																				
e-1	0.217	-0.148	0.203	0.162	0.118	0.229	0.201	0.2	0.287	0.164	0.089	0.172	0.25	0.276	0.17	0.27	0.157	0.084	0.024	0.068
(e-1) $\dot{\Phi}$	0.09	-1.20	1.55	0.97	-0.51	1.86	1.39	0.58	-1.13	1.14	0.82	1.02	-0.08	3.05	1.33	2.18	0.41	0.58	0.13	0.36
DECOMPOSITION OF OUTPUT GROWTH																				
(1) $\dot{y}$	2.30	15.10	14.70	11.50	2.20	11.70	11.00	8.60	-0.40	15.50	18.80	12.20	3.10	18.40	14.80	15.20	4.30	14.80	11.80	10.00
(2) $\dot{\Phi}$	0.4	8.08	7.64	6.01	-4.29	8.11	6.94	2.88	-3.92	6.95	9.18	5.91	-0.32	11.06	7.85	8.21	2.64	6.89	5.23	5.23
(3) (e-1)$\dot{\Phi}$	0.22	-0.15	0.20	0.16	0.12	0.23	0.20	0.20	0.29	0.16	0.09	0.17	0.25	0.28	0.17	0.27	0.16	0.08	0.02	0.07
(4) $\Delta\delta_t$	1.07	7.01	6.28	3.53	0.04	3.03	4.38	2.12	0.09	7.04	6.80	6.11	1.29	7.16	5.51	5.77	0.15	2.82	1.99	1.14
(5) $T\dot{E}$	-0.09	1.13	1.76	1.04	0.02	0.61	0.82	0.66	-0.05	0.51	3.78	0.84	-0.03	0.33	1.98	1.85	-0.98	3.64	5.92	5.16
(6) $TF\dot{P}$	**-0.12**	**7.99**	**8.24**	**4.73**	**0.18**	**3.87**	**5.40**	**2.98**	**0.33**	**7.71**	**10.67**	**7.12**	**1.51**	**7.77**	**7.66**	**7.89**	**-0.67**	**6.54**	**7.93**	**6.37**
(7) $\dot{y}$	1.38	16.22	15.68	10.58	-4.23	11.75	12.14	5.66	-3.88	14.50	19.76	12.86	1.19	18.55	15.34	15.83	1.81	13.35	13.14	11.53
(7) - (1)	-0.92	1.12	0.98	-0.92	-2.03	0.05	1.14	-2.94	-3.48	-1.00	0.96	0.66	-1.91	0.15	0.54	0.63	-2.49	-1.45	1.34	1.53

Source: Prepared by author using ASI, India.

Technical progress has failed to surpass input growth in Indian manufacturing during 1998-2011. Only during 2007-11 technical progress contributed more towards output growth of manufacturing sector than input growth. H-T industries have shown the lowest rate of technical progress and input growth contributed more towards output growth. H-T sector of Indian manufacturing seems to lack the dynamism which could only be attained by improving research and technical efficiency in this sector. M-H-T and M-L-T industries showed quite significant technical progress which contributed towards output growth in these industries. M-H-T industry showed highest technical progress during 1998-2011.

4.9.5 Estimates of Stochastic Productioin Function For China

The maximum liklihood estimates of stochastic frontier production function in translog specification with time varying inefficiency for the sub-periods , 1999-2001, 2002-2007, 2007-2011 and period as a whole 1999-2011has been presented in table 4.6 for China's manufactuirng sector. The estimated coefficient of time varying technical inefficiency has been mostly positive for all sub periods and all sub-groups of manufacturing sector except for a negative coefficient of medium low-techn industries during 2002-07 and low-tech industries showing negative coefficient of inefficiency decay in the initial phase and during 2002-07 also. The time varying technical (in)efficiency parameter has been found to be 0.02. It implies that rate of technial efficiency in Chinese manufactirng has during 1998-2011 has been increasing to the extent of 3.0 per cent. The estimates of time coefficint show significant technical progress in all sub-categories of Chinese manufacturing during 1999-2011.The other two parameters γ and σ^2 associated with the variance of the random variable V_{it} and U_{it} show a significance difference in the realised output from potential output. The difference has been mainly due to the difference in the industry specific technical efficiency and not due to any random changes.

In Table 4.6, reports the estimated values of the output elasticity with respect to the inputs of capital and labour are reported. Returns to scale, input growth, adjusted scale effect, rate of technical progress and growth of technical efficiency have also been estimated for China's manufacturing. As shown in table 4.7, labour has the greater output elasticity as compared to capital. For manufacturing as whole the output elasticities for labour and capital have been .629 and .374 during 1999 to 2011. Output elasticity of capital has been decreasing over the years which hints towards low productivity of capital in Chinese manufacturing whereas output elasticity of labour has shown improvement.

Table 4.6: Stochastic Frontier Production Estimates for the Chinese Manufacturing Industry and its Four Technology-intensive Sub-groups

Variable	Parameter	Manufacturing Total				High Technology Industries				Medium-High Tech				Medium-Low Tech				Low-Technology Industries			
		1999-2001	2002-2007	2007-2011	1999-2011	1999-2001	2002-2007	2007-2011	1999-2011	1999-2001	2002-2007	2007-2011	1999-2011	1999-2001	2002-2007	2007-2011	1999-2011	1999-2001	2002-2007	2007-2011	1999-2011
Constant	β_0	2.04	1.07	0.99	1.09***	1.32***	1.07	0.09	1.4***	0.62***	1.04**	1.59	0.97***	1.28***	2.12***	1.07	1.17***	1.45***	2.63***	2.73	2.21***
		(1.36)	(0.43)	(2.86)	(3.41)	(5.39)	(-1.1)	(4.5)		(5.3)	(1.98)	(4.6)		(4.51)	(6.15)	(6.9)		(10.2)	(2.4)	(8.66)	
Capital	β_K	0.37	0.56	0.51	0.43***	0.02	0.71***	0.37	0.3***	0.32***	0.45***	0.35	0.28***	0.48***	0.97***	0.82	0.73***	0.19***	0.45***	0.51	0.33***
		(0.83)	(0.59)	(8.41)	(7.63)	(10.5)	(4.43)	(14.2)	(8.16)	(7.92)	(11.7)	(17.3)	(11.3)	(2.13)	(-3.5)	(-0.12)	(1.32)	(21.3)	(10.7)	(17.5)	(4.52
Labour	β_L	0.62	0.49	0.53	0.57***	0.73***	0.53***	0.47	0.56***	0.59***	0.42***	0.51	0.59***	0.59***	43.5***	-0.09	-0.09	0.75***	0.51***	0.49	0.61***
		(0.5)	(0.92)	0.81	(7.59)	(0.2)	(9.03)	5.04	(6.63)	(4.6)	(11.9)	6.7	(8.4)	(4.8)	(14.6)	13.7	(23.8)	(6.45)	(11.2)	10.2	(11.8)
K*K	β_{KK}	0.59	0.43	0.51***	0.394	0.89***	0.32***	0.66***	0.58	0.61***	0.52***	0.69***	0.43	0.29***	-0.35***	-0.09	0.4	0.75***	0.51***	0.61***	0.47
		(0.03)	(0.002)	-2.03	(-4.07)	(1.4)	(0.2)	(-0.7)	(3.7)	(-0.66)	(-1.8)	(-0.6)	(-0.30)	(-1.31)	(-5.07)	(-3.8)	(4.4)	(-0.66)	(-1.76)	(-2.8)	(-0.2)
L*L	β_{LL}	0.37***	0.14**	0.16	2.65*	1.3*	0.18*	0.99*	1.8*	0.92*	2.06*	1.8*	0.34*	2.17	4.6*	5.3**	4.8	-2.28	2.71	3.1*	1.96*
		(4.8)	(2.7)	1.8	(2.04)	(8.2)	(6.42)	9.21	(13.0)	(19.1)	(9.68)	7.8	(14.0)	(0.91)	(7.8)	3.1	(0.5)	(7.5)	(0.88)	4.03	(8.14)
K*L	β_{KL}	-0.23	0.19***	-0.22	-0.45	0.37***	2.23	0.85*	0.23	-0.73	0.27**	0.92	0.043	-0.05	0.25***	0.38***	0.67	0.53	0.14***	0.11***	0.85***
		(9.47)	(7.4)	10.2	13.3	(3.36)	(0.19)	(3.01)	(1.83)	(0.85)	(2.5)	-0.5	(0.35)	(9.5)	(7.8)	-8.9	(11.9)	(0.94)	(11.6)	-12.3	(14.1)
Time	β_T	0.04	0.06	0.05	0.04***	(54)	1.22	1.22	0.77*	0.74	0.96**	0.5	0.26	0.43**	0.23***	0.1	0.07***	-1.1	0.06***	-1.1	0.02***
		(0.37)	(0.14)	0.16	(2.65)	(1.30)	(0.18)	.99	(1.8)	(0.92)	(2.06)	1.8	(0.34)	(2.17)	(4.6)	5.3	(4.8)	(-0.84)	(2.71)	3.1	(1.96)
T*K	β_{TK}	-0.01	-0.05	-0.03	-0.01***	-0.04	-0.07	-0.07	-0.02*	-0.06	-0.04**	-0.035	-0.01	-0.04**	-0.01***	-0.1	-0.03***	0.08	-0.03***	0.08	-0.01***
		(-1.07)	(-0.43)	-1.2	(-2.4)	(-1.1)	(-0.18)	-1.08	(-1.9)	(0.91)	(-1.99)	0.54	(-0.35)	(-2.23)	(-4.64)	-0.34	(-4.1)	(0.85)	(-3.7)	1.09	(-3.24)
T*L	β_{TL}	0.02	0.002	-0.2	-0.5***	-5.34	-0.02	-3.96	-7.9	-2.84	-4.8*	-4.69	-6.54	-0.72	-0.73***	-0.72	-0.25***	-2.19	-0.3*	-2.19	-0.02
		(0.03)	(0.002)	-2.03	(-4.07)	(-1.4)	(-0.2)	-0.7	(-1.5)	(-0.66)	(-1.8)	-0.6	(-0.30)	(-1.31)	(-5.07)	-3.8	(-4.4)	(-0.66)	(-1.76)	-2.8	(-0.2)
T*T	β_{TT}	-0.01	-0.05	-0.03	-0.01***	-0.04	-0.07	-0.07	-0.02*	-0.06	-0.04**	-0.035	-0.01	-0.04**	-0.01***	-0.1	-0.03***	0.08	-0.03***	0.08	-0.01***
		(-1.07)	(-0.43)	-1.2	(-2.4)	(-1.1)	(-0.18)	-1.08	(-1.9)	(0.91)	(-1.99)	0.54	(-0.35)	(-2.23)	(-4.64)	-0.34	(-4.1)	(0.85)	(-3.7)	1.09	(-3.24)
σ^2		0.23***	0.19***	0.2	0.22***	0.37***	2.23	2.23	0.85*	0.73	0.27***	1.365	2.00	0.5***	0.25***	0.31	0.38***	0.53	0.14***	0.53	0.11***
		(9.47)	(7.4)	10.2	13.3	(3.36)	(0.19)	1.01	(1.83)	(0.85)	(2.5)	0.5	(0.35)	(9.5)	(7.8)	8.9	(11.9)	(0.94)	(11.6)	12.3	(14.1)
γ		0.07***	0.05***	0.04	0.0001	0.79***	0.96***	0.92	0.89***	0.96***	0.84***	0.6	0.97***	0.07	0.02***	0.035	0.00	0.89***	0.06	0.06***	0.02***
		(5.8)	(2.7)	1.8	(1.04)	(8.2)	(6.42)	9.21	(13.0)	(19.1)	(9.68)	7.8	(14.0)	(0.91)	(7.8)	3.1	(0.5)	(7.5)	(0.88)	4.03	(8.14)
μ		1.06	0.44	0.97	1.09**	1.32***	-0.49	0.28	0.9***	1.52***	0.49***	0.99	0.97***	3,28	3.12***	3.09	3.17***	1.41	0.63***	0.73	1.01***
		(1.36)	(0.43)	1.83	(3.86)	(5.39)	(-1.1)	(1.8)	(4.5)	(5.3)	(4.98)	2.9	(4.6)	(4.51)	(6.15)	5.1	(6.9)	(10.2)	(2.4)	4.7	(8.66)
η			0.002	0.5***	0.03	0.34	0.02	0.9	0.8		0.08*	0.54	0.03		-0.73***	0.25	0.03		0.3*	-0.02	0.003
			(0.002)	(4.07)	(5.07)	(1.4)	(0.2)	(1.5)	(3.85)		(1.8)	(0.30)	(3.87)		(-5.07)	(2.4)	(0.01)		(1.76)	(- 0.8)	(5.1
LLF		-420.8	-436.3	-635.9	-862.5	-68.6	87.1	-115.1	-143.1	-79.0	-71.9	96.3	-137.9	-167.8	-139.8	-203.3	-302.3	-46.6	-139.5	-93.1	319.9
Nobs		156	312	208	624	18	36	24	72	45	90	45	180	33	66	44	132	60	120	80	240

Source: Prepared by author using CDO,China. Note: The parameters are estimated using Frontier 4.1 computer program. *, **, *** indicates significant at 10 per cent, 5 percent and 1 per levels, respectively. Figures provided in brackets are the t values.

Table - 4.7: Decomposition of Output Growth and TFPG in Chinese Manufacturing and its Various Sub-Sectors (1999-2011)

Sector	Manufacturing Total				High Technology Industries				Medium-High Tech				Medium-Low Tech				Low-Technology Industries			
	1999-2001	**2002-2007**	**2007-2011**	**1999-2011**	**1999-2001**	**2002-2007**	**2007-2011**	**1999-2011**	**1999-2001**	**2002-2007**	**2007-2011**	**1999-2011**	**1999-2001**	**2002-2007**	**2007-2011**	**1999-2011**	**1999-2001**	**2002-2007**	**2007-2011**	**1999-2011**
OUTPUT ELASTICITY																				
e_K	0.425	0.41	0.309	0.374	0.327	0.42	0.382	0.335	0.346	0.367	0.33	0.356	0.372	0.395	0.365	0.354	0.398	0.37	0.359	0.372
e_L	0.612	0.641	0.696	0.629	0.688	0.7	0.734	0.704	0.681	0.652	0.68	0.671	0.648	0.632	0.662	0.652	0.644	0.65	0.681	0.645
e	1.037	1.051	1.005	1.003	1.015	1.12	1.116	1.039	1.027	1.019	1.01	1.027	1.02	1.027	1.027	1.006	1.042	1.02	1.04	1.017
INPUT GROWTH EFFECT																				
Capital	2.9	3.01	3.02	3.21	3.01	2.01	2.14	3.08	3.98	3.15	2.87	3.01	2.98	2.76	3.33	3.01	2.14	3.89	4.13	2.78
Labour	1.09	1.91	1.8	2.7	1.38	1.12	1.98	2.12	0.89	1.06	1.13	1.004	1.04	1.94	1.55	1.07	1.01	1.67	1.39	1.48
$\dot{\Phi}$	3.99	4.92	4.82	5.91	4.39	3.13	4.12	5.2	4.87	4.21	4	4.014	4.02	4.7	4.88	4.08	3.15	5.56	5.52	4.26
SCALE EFFECT																				
e-1	0.037	0.051	0.005	0.003	0.015	0.12	0.116	0.039	0.027	0.019	0.01	0.027	0.02	0.027	0.027	0.006	0.042	0.02	0.04	0.017
(e-1) $\dot{\Phi}$	0.15	0.25	0.02	0.02	0.07	0.38	0.48	0.20	0.13	0.08	0.05	0.11	0.08	0.13	0.13	0.02	0.13	0.09	0.22	0.07
DECOMPOSITION OF OUTPUT GROWTH																				
(1) $\dot{y}$	9.20	15.20	11.60	14.50	15.70	7.90	8.30	12.80	10.10	16.30	8.90	14.50	9.40	24.00	11.90	19.40	1.50	12.40	17.20	11.30
(2) $\dot{\Phi}$	3.99	4.92	4.82	5.91	4.39	3.13	4.12	5.20	4.87	4.21	4.00	4.01	4.02	4.70	4.88	4.08	3.15	5.56	5.52	4.26
(3)(e-1) $\dot{\Phi}$	0.15	0.25	0.03	0.02	0.07	0.38	0.48	0.16	0.13	0.08	0.05	0.11	0.08	0.10	0.13	0.02	0.13	0.09	0.21	0.07
(4) $\Delta\delta_t$	5.67	7.81	5.18	6.53	8.41	4.03	4.18	5.12	6.89	6.54	5.77	6.41	3.79	1.16	2.01	3.77	2.15	5.32	8.87	4.13
(5) $\dot{TE}$	-0.64	2.24	1.76	2.04	1.62	0.80	0.74	2.82	-1.65	5.02	-0.78	3.34	1.23	16.33	4.48	10.85	-2.98	0.12	1.82	2.76
(6)$\dot{TFP}$	**5.17**	**10.30**	**6.97**	**8.59**	**10.09**	**5.21**	**5.40**	**8.10**	**5.37**	**11.64**	**5.04**	**9.86**	**5.10**	**17.59**	**6.62**	**14.65**	**-0.70**	**5.53**	**10.69**	**6.96**
(7) $\dot{y}$	9.16	15.22	11.79	14.50	14.48	8.34	9.52	13.30	10.24	15.85	9.04	13.87	9.12	22.29	11.50	18.73	2.45	11.09	16.21	11.22
(7)-(1)	-0.04	0.02	0.19	0.00	-1.22	0.44	1.22	0.50	0.14	-0.45	0.14	-0.63	-0.28	-1.71	-0.40	-0.67	0.95	-1.31	-0.99	-0.08

Source: Prepared by author using CDO, China.

The estimates of these elasticities show similar trends for sub-groups of manufacturing sector considered here. Input growth has been highest in H-T sector in which capital made more contribution towards input growth.

Now if we look at industry wise technical efficiency change in various sub-periods it becomes clear that in the initial phase, manufacturing sector as a whole witnessed negative technical efficiency change. It was during 2002-07 that most of the technical efficiency improvement happened in all industries with M-L-T industries taking the lead in technical efficiency improvement. L-T industries showed lowest technical efficiency improvement during 1998-2011.

Technical progress has surpassed input growth in Chinese manufacturing during 1998-2011. M-H-T industries have shown the highest rate of technical progress followed by H-T industries and technical progress contributed more towards output growth. H-T sector of Chinese manufacturing seems to have acquired the dynamism which could have been the result of improvement in research and technical efficiency in this sector. M-L-T and L-T industries showed quite lower technical progress. L-T industry of Chinese manufacturing has been experiencing both low technical progress and technical efficiency as compared to other sectors of manufacturing industry of China during 1999-2011.

4.10 Conclusion

The presents chapter investigated various facets of manufacturing activity like, labour cost, labour productivity, input growth, technical progress, technical efficiency and total factor productivity growth which contributed to output growth in both economies during the study period. The empirical findings of this chapter do provide an X-ray on the performance of manufacturing sector in India and China by trying to identify the various potentials and weaknesses. Having achieved a high level of cheap labour intensive manufacturing, China should look into her next stage of industrial development, especially high-end products. Similarly, if India has to take advantage of its low-cost manufacturing it will have to work on improving productivity in its low-technology labour-intensive sector.

As have been seen in the present analysis labour cost is less in India as compared to China but it is accompanied with low productivity and wasteful use of capital. Competitiveness as measured by Productivity/Wage ratio has been higher in China, which is due to high labour productivity in China, whereas in India, wage has been low, but productivity too is low, hampering its competitiveness.

The growth decomposition method used in present analysis estimated the contribution from input growth, scale effect, technical progress and technical efficiency towards output growth. Labour input showed higher elasticity as compared to capital in both economies but its contribution towards input growth has been lower. In terms of elasticity both labour and capital showed increasing returns for both economies at all points of time. In analysing TFPG growth it has been found that technical progress has played major role in both economies and both lacking at efficiency front with India being behind China. China's manufacturing has shown higher TFPG and efficiency in H-T industries whereas L-T industries showed inefficiency effects. Whereas Indian manufacturing seemed to be backed up by high technical progress in M-L-T industries. In Indian economy technical progress failed to surpass the contribution of input growth towards output growth whereas China's manufacturing showed significantly more contribution by TFPG in output growth of the manufacturing sector.

In a nutshell, it can be said that the challenge for India lies in strengthening its L-T and labour intensive base first so as to take the advantage of low labour cost and its vast labour pool. In India L-T industries have shown improved efficiency but this has been accompanied by low technical progress. India needs a firm base in low end products in the value chain so as to embark on the path of high end product manufacturing with high rate of technical progress and higher technical efficiency. The challenge for further industrial growth in China seems to be quality and improving efficiency. China needs to implement measures to narrow down the efficiency gap and keep the technical progress emulating through leaning by doing, absorbing advanced technology and improving efficiency of manufacturing processes.

Chapter- 5

Performance of Indian and Chinese Manufacturing at Regional Level

5.1 Introduction

Achieving balanced regional growth and development forms a policy objective of all the countries in the world. The extent of such regional disparities is significantly higher in the case of less-developed countries. The problem of regional disparities in economic development is pervasive, and it differs in extent in various economies (Dholakia, 1985). The serious social and political implications of regional disparities in growth and development have forced governments to intervene and formulate economic policies (Dholakia, 1985; Papola, Maurya, and Jena, 2011). Literature on regional growth provides inconclusive answers to the question of convergence or divergence among regions. Some of the earliest works on regional development theory (Mydral 1957; Kaldor 1960) are of the view that cumulative causation leads to widening of regional imbalances if there is no state intervention. On the other hand, Hirschman (1958) and Friedman (1966), have supported the hypothesis that spatial diffusion of innovation and economic culture originating from core gradually reaches to the periphery and the so-called core-periphery gap is narrowed with passage of time. Another view on regional development came with the development of dependency theory (Baran 1957; Frank 1967; Santos 1979; Timberlake 1987). These theorists were of the view that economic gap between developed and rent seeking core and the dependent periphery continues to prevail as agents in both regions help in extracting rent from dependent periphery and inject it into the developed core. Neo-classical approach to economic development is convergence seeking. Here most regions derive long-term benefits from modernization and technical change (Borts and Stein 1964, Richardson 1973). The process of convergence in regional industrial and economic growth may result when industrial activities shift to less developed regions. As Kuznets (1958) illustrated with the help of an inverted U-shaped curve, the process of regional convergence is observed as an economy attains higher levels of growth. Williamson (1965) and Barro & Sala-i-Martin (1992) also provide support for regional convergence and support the inverted U-shaped hypothesis in their empirical studies. So we can sum up these theoretical views in two strands, one strand of literature holds the view that regional growth will follow a divergent path as summed in the terms of backwash and core-periphery effects

(Mydral,1957; Baron,1957; Kaldor, 1970). Some post-Fordist scholars have also presented the divergent pattern of regional growth where technological change, new forms of organisation and transaction costs are seen as factors leading to widening of disparities (Piore and Sebel, 1984). On the other hand, another strand of literature supports the convergent nature of regional growth (Kuznets, 1958; Williamson 1965 and Barro and Sala-i- Martin, 1992). In more recent works of Krugman (1991, 1995), it is stated that there is always a tension between centripetal forces of higher labour productivity, larger plant size, access to markets and knowledge spillovers and centrifugal forces of higher land rents, commuting cost, congestion and pollution. This tension among opposite forces lead the way for convergence among regions in long- run.

Many researchers have tried to analyse regional disparities in economic growth with respect to variations in the industrial performance of regions. The economic growth of regions and industries is highly correlated (Rosenbloom and Sundstorm, 1997). The importance of industrial activities and manufacturing, in particular, was also highlighted by Kaldor (1967) in the form of "Kaldor's growth laws." He emphasized that long-term economic growth was dependent on the growth and productivity of the manufacturing sector. Kaldor (1967, p.7) stated, "The contention that I intend to examine is that fast rates of economic growth are almost invariably associated with the fast rate of growth of the secondary sector, mainly, manufacturing, and this is an attribute of an intermediate stage of development". As theorised by development economists like Solow (1956; 1957) and Romer (1986; 1990) the process of economic growth of a region is derived by productivity increases in terms of technical change and innovation which in turn depends upon the pace of industrialization of any region. It can be said that geographical variation in industrialization is a primary cause of geographical variation in average income in developing countries (Lall and Chakravorty, 2005). Spatial spread of industrialization over an economy decides the pace of regional convergence or divergence. Barua and Chakraborty, 2010 have explained the phenomenon of inter-regional inequality in the context of Chenery – Syrquin framework provided by Chenery and Syrquin (1977). It states that the manufacturing sector plays a key role in providing momentum to economic growth and determining income level of a particular region. Thus if manufacturing gets concentrated in some particular regions it may lead to divergent pattern of economic growth among different regions. In their study Barua and Chakraborty (2006) find empirical evidence that growth of manufacturing sector is positively related to rising income inequality among Indian states.

Hereafter, we move to a discussion of the status of inter-regional inequalities and spatial spread of industrialization in India and China.

5.2 Outline of the Chapter

This chapter examines the regional level industrial performance of India and China in terms of growth of value added and employment manufacturing sector. Here we seek to understand the prevailing variations in industrial performance at regional level in both economies. This chapter aims at bringing out the contrasts in the spatial spread of manufacturing sector in both economies. Section 5.1 presents a brief introduction and main theories underlying the phenomenon of regional growth. The present section provides outline of the chapter. Section 5.3 discusses prevailing regional disparities in industrial development of India and China from a policy perspective. Section 5.4 discusses the growth and structure of manufacturing sector at regional level for India and China. Section 5.5 examines the regional variation in specialization and industrial concentration in manufacturing sector of India and China. Section 5.6 concludes and discusses the implications of regional disparities in industrial performance.

5.3 Regional Disparities in Industrial Development of India and China: A Policy Review

Despite witnessing a phase of rapid economic growth after liberalization in the form of market reforms and decreasing state intervention, the simultaneous surge in regional disparities has eluded both India and China. But the uneven development of industrial sector in India and China is not a new phenomenon. In case of India dates long back to the colonial period and in China it has been observed since Mao's era of industrial policy. In Indian economy one of the intrinsic patterns of economic development and industrialization in the colonial period has been the concentration of development in certain areas. As observed by Meher (2000), "The modernization process of the Indian economy and society, though started during the British rule, remained confined to a few pockets and enclaves of colonial interests." The base of manufacturing had been in the export-related processing of basic goods such as tea and jute at the independence and most of these industries were concentrated in and around the major ports of Bombay, Calcutta and Madras, which provided good avenue of transport for the goods being delivered and received from the interior and abroad (Mohan, 1997; Roth, 1970; Meher, 2000). Apart from the uneven distribution of industries and infrastructure among the states, the concentration of the industries in certain metropolitan regions was most glaring. Given this historical pattern of industrialization in India, as Mohan (1997) observed, "there has been a longstanding concern with the location of industries in the country". Sekhar (1983) have reviewed some policies such as industrial licensing, the location of public sector industries, location policies for metropolitan cities, small-scale industries location policies, the distribution and pricing policies for intermediate industrial inputs and other government location incentives, which were aimed at influencing inter-state distribution industries. The Industrial Development and Regulation (IDR) Act, 1951 was the principle instrument for channeling the investment in the industrial sector in socially desired directions. The act controlled not only entry to an industry and expansion of capacity, but also technology and import content (Ahluwalia, 1991). Industrial licensing has been used increasingly for attaining the objective of regional dispersal of industrialization by favouring the applications by the private sector for setting up industries in backward areas. The industrial policy 1977, decided not to issue licenses for new industries within the peripheries of metropolitan cities. Furthermore, the financial institutions were also instructed to deny finance to new industries, which do not require an industrial license and which would like to locate in these areas. The second and third plan emphasized on promoting greater integration between the large scale and small scale enterprises by providing fiscal incentives and reservations for the small-scale sector (Ahluwalia, 1991). Under the policy of backward area development program, the second and third plan have emphasized on the development of infrastructure in backward areas and the promotion of small scale industries as the main instrument for industrial development. Various incentives for encouraging industrial growth were capital investment subsidy, transport subsidy, income tax concessions, concessional finance from financial institution, state government incentives and so on. In 1988 the growth center approach was introduced with the objective of developing the infrastructure of centers that could act as magnets for attracting industries to these areas through providing basic facilities like power, water, telecommunication and banking. Another important policy has been the control of distribution and pricing of key industrial products through the operation of freight equalization scheme (Mohan, 1997). Among the other polices influencing inter-regional distribution of industries the industrial estate programme, the rural industries project etc. were important.

However, since the mid-1980s the public sector industrial policy gradually lost its momentum in growth. The establishment of a large number of major industrial projects in less developed regions has not had any significant impact on the industrial or overall economic growth of these regions (Ramadhyani, 1984). The industrial licensing and location policy resulted in fragmented and under-utilized capacity and thus, concentration of industries in few pockets. Bhargava (1995) remarked, "The licensing regime resulted in concentration of large industries in relatively few hands. Licensing and location restrictions resulted in fragmented and underutilized capacity. The objectives of balanced regional growth were also not achieved; as successful industries were concentrated in a few regions of the country." Mohan (1997) contends that the policy instruments that were used to influence industrial location may have been somewhat inadequate in greatly altering the distribution of industries across the country. Facing with such situations a series of internal de-regulation policies were taken by the government during the mid-1980s and, then in 1991, the severe financial crisis faced by the Indian economy forced the central government to take a drastic stabilization-cum-structural adjustments policy measures to set industry free of excessive regulation in tune with the pro-market reforms.[20] The large scale de-licensing of industry and changes in industrial location policies were two of the major policy changes of the stabilization-cum-structural adjustments process of the early 1990s.[21]

[20] The economic liberalization policies in India have mainly three aspects: trade liberalization, industrial liberalization and financial liberalization (Narayana and Joseph, 1993), with two main thrusts: first, to integrate India with the rest of the world through trade liberalization, and second, to give a much greater role to the private sector in industrial development of the economy through abolition of industrial licensing and other controls and permits (Balakrishnan, 2003; Subrahmanian, 2003). However, our interest in this paper is only on the later one: policy shifting relating to the industrial sector.

[21] Stabilization involves short-term demand management through monetary and fiscal policies. The specific objectives of stabilization were: first to bring inflation under control through restrictive monetary policies and secondly, to correct deficit in the balance of payments usually through devaluation of exchange rates accompanied by import liberalization and thirdly, to check fiscal deficits by curbing government spending, particularly the non-developmental expenditures. Structural adjustment, on the other hand, is combined with

Regarding the changes in the industrial policy, Mohan (2006) remarks “The obsolete system of capacity licensing of industries was discontinued, the existing legislative restrictions on the expansion of large companies were removed, phased manufacturing programs were terminated, and the reservation of many basic industries for investment only by the public sector on the import of foreign technology were withdrawn, and a new regime welcoming foreign direct investment, hitherto discouraged with limits on foreign ownership, was introduced.” Under the new policy regime there are very few location restrictions. The private enterprises can establish industries anywhere of the country they wish without facing restrictions, except a few environmental, pollution and other local land-use-related restrictions and also up to a certain distance from the metropolitan cities. The role of the central government as industrial owner and location regulator, thus, has curtailed and the role of private sector in industrialization has increased under the liberalization policy regime. In a liberalized policy regime, we could have two sets of possible situations: first, under the dominance of the private sector in industrialization it is likely that industries will be more concentrated in the already industrially developed states leading to widening of interregional divergence. This is because since each state has an equal opportunity to lure industrial investment, the developed states will take the advantage of available infrastructure to attract investment. The second view argued that although in the liberalized era the role of the central government in industrialization has curtailed, the state governments would have greater freedom and scope to attract private investment (including foreign investment) into the state by adopting pro-active industrial policies and practices offering attractive investments and conditioning the investment climate market friendly for entry and operation of industries in the state, which will provide advantage to the industrially backward states to accelerate industrial growth through its own policies and thus, reduce inter-regional variation in industrial disparities (Subrahmanian, 2003). With such conflicting views it is not clear what has happened to the regional spread of industries in India in the post liberalization period.

Similarly, in case of China, the national government has played an important role in China’s economy through its direct investments, regulation of resource allocation, fiscal

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the supply side of the economy or raising the long-term growth through improving efficiency, productivity and competitiveness (Joseph, 1987 and 1997).

transfers, and policies. There have been several distinct policy regimes since the beginning of the communist regime in 1949. Originally, Mao Zedong adopted a policy inspired both by the Soviet experience and by military security concerns. China followed the Soviet principle of central planning for resource allocation; priority was given to the development of heavy industries, and trade and financial linkages with the western economies were limited. Mao's strategy was to implement balanced regional development and to encourage relative regional autonomy. Therefore, regional economic self-sufficiency was incorporated into China's economic policy as a new principle of Maoism. A region should be self-sufficient not only in food production but also in industrial goods. The aim was primarily to achieve military security rather than to encourage economic growth. At the beginning of the 1960s, the growing military presence of the US in Vietnam and the worsening Sino–Soviet relationship led Mao to reinforce regional economic self-sufficiency, seen as a key to China's protracted defense. Mao envisaged three lines of defense (coastal, western, and central), and ordered military–industrial complexes constructed in western China, popularly called the ''Third Front.'' This Third Front industrial policy involved heavy state investment in the interior and northwest provinces, with the bulk of it in Sichuan, Shaanxi, Hubei, Gansu, Henan, and Guizhou (De´murger, Sachs, Woo, and Bao, 2001). Thus, the core of Chinese industrialization was the development of heavy industry (Naughton, 1988). The authorities played a crucial role in the process of heavy industrialization by adopting numerous policy measures (low interest rates, low wages, and prices for intermediate goods, etc.). These policy measures had important consequences. For the period 1953–1979, heavy industry grew at an average rate that is 1.47 times higher than that of light industry (Lin, Cai, and Li, 1996). This system resulted in significant inefficiencies, in terms of both resource allocation and productivity. As production, employment, investment, and product prices were planned by the central government, enterprises faced no competition, workers and managers lacked incentives, and industrial efficiency was low. Moreover, this policy resulted in a spatial dispersion of industry. In a sense, the economic geography was reshaped. Indeed, many industrial enclaves were established in the remote, interior regions, whereas coastal provinces with economic potential were left behind.

With the implementation of reforms introducing market economy elements in the 1980s, more state capital was invested in the coastal provinces. The authorities indeed stipulated the importance of the priority development of these provinces, which were seen as growth centres that could diffuse positive externalities to the interior provinces. The fundamental element of the regional policy was the exploitation of comparative advantages. The task was to develop in the coastal provinces consumer goods industries with high value added, to improve the technological content of traditional industries, and to transfer activities with high energy consumption levels to less industrialized provinces. The interior provinces were to produce energy, raw materials, and transformation industries, and to continue activities in the agricultural sector (Brun and Renard, 2001; Yang, 1997). The aim was more regional production complementarity and less self-sufficiency. This new policy was implemented through an open-door policy, which consisted of attracting foreign direct investment and promoting foreign trade in targeted zones where local governments had considerable latitude to provide investors with special privileges. The establishment of regional preferential policies led to the institution of five Special Economic Zones (SEZ), fourteen Coastal Open Cities, six entitled to establish their own Economic and Technological Development Zones (ETDZ), the establishment of Coastal Open Economic Zones and of an Open Coastal Belt. The Deng Xiaoping southern tour in 1992 was followed by further extension of these economic zones throughout China.

The important role of this open-door policy in regional growth has been emphasized in several studies (De´murger, 2000; Mody and Wang, 1997). Ma (1995), Ma and Norregaard (1998) and Chen and Feng (2000) argue that the central government policies should not be biased in favour of the Coastal regions. The central government led by Premier Zhu Rongji launched the “Western Development Strategy” in 1999 to boost the lagging Interior and West regions. The main components of the strategies include the development of infrastructure, enticement of foreign investment, increased efforts on ecological protection (such as reforestation), as well as human capital formation such as promotion of education and retention of talent flowing to richer provinces. As of 2006, a total of one trillion Yuan was spent on building infrastructure in western China (Goodman, 2004). Moreover, the Northeast was one of the earlier regions to industrialize in China, focusing mainly on equipment manufacturing including the steel, automobile, shipbuilding, aircraft manufacturing, and petroleum refining industries. Recent years, however, have seen the stagnation of the Northeast's heavy-industry-based economy, as economy continues to liberalize and privatize. Hence, the central government led by Premier Wen Jia Bao has initialized the "Revitalize the Northeast" campaign in 2003. These policy factors played important role differential patterns of industrial development of the four regions in China.

In the nutshell, it can be said that the Dengist reforms in China in late 1980s were tilted towards developing a few regions first and hence the launch of open door policy was the first step in this intentional uneven development trajectory. In India also the process of globalization and liberalization was enforced with the view that wealth coming from developed countries and domestic business capital gains will translate gradually into welfare and improvement of standard of living of the deprived. So both countries believed in the working of trickle-down theory. In China it was the state which deliberately augmented such a policy and in India such a policy was enforced by advocates of globalization and became a sudden need for country during the depression of 1991.

But disappointingly, trickle down does not seem to have materialized in India and China as both countries have high Gini-coefficients of income inequality and both have not performed very well on the front of Human Development Index prepared by UNDP (China ranks 93rd and India placed at 119th place).

According to the prevailing growth theory of convergence, differences in growth across regions should decrease over time as the rates of return on capital and labour equalize across regions and sectors. But India and China seem to follow a different path especially in the post-reform era. A number of studies (Ahluwalia, 2000 and 2002; Nagaraj, Varoudakis and Veganzous, 1998; Rao, Shand and Kalirajan, 1999; and Shand and Bhide, 2000) have observed that the regional disparity in India has widened, especially during the 1990s. A recent study (Barua and Chakraborty, 2010) observed that high income states have gained in terms of manufacturing sector and trade with liberalization, and hence regional inequality has increased further. Similarly, one of the key dimension of regional inequality in China during the post-reform period has been the inland-coastal divide (Chen and Fleisher, 1996; and Zhang and Kanbur, 2001; Fan and Kanbur, 2009). With openness, the rates of returns to labour - in particular skilled labour in the coastal areas - change, as well as for land. Consequently, the coastal regions enjoy a comparative advantage in proximity to the international market and in access to a large pool of well-educated labour. Coupled with the institutional barriers to labour mobility, which, however been abated recently, China's open door policy has been strongly associated with a widening inland-coastal disparity (Gajwani and Kanbur, 2006).

The manufacturing sector provides base for international competitiveness and inter-regional growth within a country. It can help regions come out of underdevelopment and push them on the path of prosperity. But at the same time, rapid growth does not guarantee that the poor can share the bigger pie if the distribution becomes more skewed (Ravallion and Chen, 2004). In the Indian context, many studies (Das and Barua, 1996 Rao, et al., 1999; Kar and Sakthivel, 2006) have shown that the prominent sector contributing towards divergence among Indian states has been the manufacturing sector. Internationally also Indian manufacturing sector has lagged behind its neighbouring and equally labour abundant country China. One of the similarities that can be observed between the manufacturing sectors of both economies is the inter-regional variation as highlighted by the literature. With opening up of economy this sector is expected to contribute towards overall development of an economy but it may be partial towards regions within a country. The phenomenon that has been observed is that industry goes where industry is, so as to take advantage of agglomeration, linkages and better infrastructure (Chakraborty, 2000). This will make the process of cumulative causation (concept developed by Mydral, 1957) to set-in and further leading to divergence among regions causing backward regions to lag behind. The economic opportunities available to workers in a backward region remain circumscribed in such a scenario. The whole process can lead to widening gaps between the productivity and earnings of the labour across regions. So along with marching towards development of manufacturing sector polices should be formulated in a way which help backwards regions gain more in terms of output, employment and productivity.

Keeping in view the above discussion, the coming sections below will explore the prevalent extent of industrialization at regional level, regional industrial structure and directions of regional specialization and industrial concentration.

5.3.1 Extent of Industrialization of Indian and Chinese Regional Economies: The Present Scenario

This section provides an overview of state-level and province-level performance of the whole manufacturing (including both registered and unregistered) sector in both India and China respectively. Firstly, the contribution of manufacturing in regional GDP has been examined at two points of times 2004-05 and 2012-13 which covers nine years (almost a decade), just to have an idea of the extent of industrialization of regional economies in recent period. Here annual growth rate of regional manufacturing GDP in both India and China have been studied.

Table 5.1 presents the share of manufacturing GDP in total GSDP of major Indian states along with annual growth rate of manufacturing GSDP. One of the most glaring fact that emerges here is the wide variation in the extent of industrialization among Indian states. Most industrialized state is Gujarat with manufacturing contributing 26.5 percent to its GSDP whereas the least industrialized state of Kerala just has 7.5 percent of its GSDP coming from manufacturing sector. A glance at changing share of manufacturing in total GSDP reveals that 14 out of 19 states taken here have experienced declining share of manufacturing in their economy. In only three states namely Gujarat, Maharashtra and Uttarakhand, manufacturing contributed more than 20 percent of their GDSP. The most rapid industrialization has been experienced by Uttarakhand where manufacturing as percentage of GSDP rose from 12.7 percent in 2004-05 to 27.8 percent in 2012-13. On the other hand, the state of Jharkhand experienced steepest decline in the share of manufacturing in GSDP from 33.7 percent in 2004-05 to 17.7 percent in 2012-13 hinting severe de-industrialization of the state. All These figures seem to be contrary to the ongoing efforts of Indian governments during last decade which proclaimed the importance of speeding up manufacturing sector’s growth all over India.

Economy has a whole seem to have stagnated on the path of industrialization as contribution of manufacturing has remained unaltered at around 15.5 during all the years since 2004-05.

Table 5.1: Regional Structure and Growth of Indian Manufacturing GSDP

State	Share of Manufacturing in GSDP		Annual Growth rate of Manufacturing GSDP (at Constant 2004-05 Prices)								
	2004-05	2012-13	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Average
Andhra Pradesh	11.48	11.06	-0.4	6.8	13.7	2.8	5.3	4.2	20.7	-7.5	5.7
Assam	10.5	7.9	-7.3	-1.9	-7.0	-4.5	18.1	5.3	3.9	3.3	1.3
Bihar	5.6	4.5	-6.7	6.0	19.8	16.7	-4.2	18.5	-10.1	1.8	5.2
Chhattisgarh	21.9	14.5	-22.5	33.7	11.2	2.4	-12.2	-5.4	-8.3	11.3	1.3
Gujarat	27.3	26.5	15.6	9.4	7.3	4.1	20.4	0.7	1.7	4.8	8.0
Haryana	21.4	18.4	7.1	8.3	7.8	2.6	9.6	7.4	2.6	4.3	6.2
Himachal Pradesh	11.5	17.1	6.4	11.7	6.7	21.3	26.2	10.3	6.7	3.1	11.5
Jharkhand	33.7	17.7	-29.1	-14.2	37.9	-46.6	4.9	18.2	-15.6	6.3	-4.8
Karnataka	18.4	16.4	3.5	19.4	6.1	11.1	-6.3	5.9	3.7	0.9	5.5
Kerala	8.6	7.5	2.0	6.7	15.1	2.1	0.3	10.6	4.3	1.7	5.3
MP	11.1	10.4	6.7	22.1	4.3	15.4	6.3	-0.3	3.7	1.8	7.5
Maharashtra	20.6	20.4	19.9	15.8	8.0	-4.5	6.6	12.1	-4.4	9.8	7.9
Odisha	12.1	13.0	2.5	21.0	24.8	11.8	-7.2	5.0	0.9	-3.6	6.9
Punjab	15.1	19.4	9.2	19.6	16.8	3.1	10.7	8.3	3.0	2.0	9.1
Rajasthan	12.5	16.3	9.2	19.1	2.8	10.5	11.7	-5.2	32.2	0.9	10.2
Tamil Nadu	19.8	19.6	13.1	15.8	0.6	-1.3	22.6	11.0	1.4	1.1	8.0
Uttarakhand	12.7	27.8	31.8	21.0	31.5	17.3	19.6	12.2	9.6	10.7	19.2
Uttar Pradesh	13.5	12.7	5.1	16.6	8.5	-8.5	13.3	7.7	-1.0	1.4	5.4
W.B	11.1	9.9	-2.4	10.7	11.5	0.9	10.6	6.0	-3.3	3.3	4.6
All India	**15.3**	**15.8**	**10.1**	**14.3**	**10.3**	**4.3**	**11.3**	**8.9**	**7.4**	**1.1**	**8.5**

Source: Calculated by author using National Accounts data from CSO, India.

Next the growth rate of state domestic product (GSDP) of manufacturing in different states has been presented in Table 5.1. The figures show growth rate over the previous year. The average rate of growth of GSDP in manufacturing was highest in case of Uttarakhand at 19.2 per cent and lowest in case of Assam at 1.3 percent. The main observations that emerge from this table are: (a) Uttarakhand, Himachal Pradesh, Rajasthan and Punjab have witnessed growth rates which are above the national average (b) Gujarat, Maharashtra, Karnataka, Haryana, Madhya Pradesh, Odisha and Tamil Nadu have shown close to average performance in terms of growth rates of domestic product in manufacturing (c) Bihar and West Bengal have witnessed slow growth of domestic product in manufacturing sector; (d) States of Assam and Chhattisgarh have shown below 2 percent growth rates whereas most strikingly Jharkhand reported negative growth in manufacturing GSDP.

Table 5.2, which shows the pattern of Chinese regional industrialization points towards the high levels of industrialization attained by Chinese provinces. Most of the provinces had more than 40 percent of their GDP coming from manufacturing sector in 2012-13. Only 5 provinces namely, Beijing, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Shandong and Guangdong have shown decreasing share of manufacturing over the period of 2004-05 to 2012-13. All of these are coastal regions except Heilongjiang. Shanghai one of the leading industrialized provinces of China has experienced highest de-industrialization as manufacturing lost 9.3 percent of its share in GSDP over the period of 2004-05 to 2012-13. Except Beijing and Shanghai all other provinces had more than 40 percent of their GSDP coming from manufacturing sector which indicates high level of industrialization of Chinese provinces. Shanxi and Henan have more than half of their GDP coming from manufacturing sector in 2012-13. These findings reveal the importance that manufacturing sector has been playing in the regional economies of China.

The growth of regional manufacturing GDP in China is also presented in table 5.2. The table provides growth rate over the previous year along with average growth rates for the whole period. Shaanxi has been the top ranker in terms of GDP growth for the period of 2005-06 to 2012-13.

Table 5.2 Regional Structure and Growth of Chinese Manufacturing GSDP

Provinces	Share of Manufacturing in GDP		Annual Growth rate of Manufacturing GDP (at Constant 2004-05 Prices)								
	2004-05	**2012-13**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**Average**
Beijing	39.6	33.4	20.0	16.6	13.2	15.0	3.5	17.3	14.1	15.7	14.4
Hebei	46.6	48.0	14.7	12.8	16.2	17.7	0.2	16.4	18.8	17.6	14.3
Shanxi	51.6	53.0	22.6	18.4	20.9	19.8	-11.4	24.5	21.8	23.2	17.5
Liaoning	41.2	48.1	19.2	16.1	19.7	22.8	2.7	21.2	17.8	19.5	17.4
Jilin	38.6	46.5	18.5	15.6	23.6	19.2	12.0	22.3	20.1	21.2	19.1
Heilongjiang	53.1	44.5	4.0	3.8	8.4	15.3	-10.6	23.0	17.8	20.4	10.2
Shanghai	46.9	37.6	14.4	12.6	11.9	8.4	-7.0	17.2	9.3	13.3	10.0
Jiangsu	50.1	45.4	18.0	15.3	14.6	13.6	8.5	14.6	13.5	14.0	14.0
Zhejiang	47.9	45.4	17.0	14.6	16.5	12.2	1.5	16.9	13.8	15.3	13.5
Anhui	36.1	46.2	11.6	10.4	20.4	21.1	14.2	24.8	23.4	24.1	18.8
Fujian	41.8	43.7	13.3	11.8	17.6	15.5	6.9	20.2	16.6	18.4	15.0
Jiangxi	31.8	46.2	23.8	19.3	20.7	17.7	13.4	25.4	20.8	23.1	20.5
Shandong	50.3	46.9	19.4	16.3	13.8	16.7	4.7	10.4	11.3	10.9	12.9
Henan	43.8	51.8	21.9	18.0	19.7	21.3	3.6	17.2	14.3	15.7	16.5
Hubei	41.1	43.5	6.1	5.7	15.1	20.3	16.5	22.9	21.2	22.1	16.2
Hunan	31.7	41.3	20.4	16.9	20.2	21.1	11.2	23.6	22.4	23.0	19.8
Guangdong	49.9	46.3	21.9	18.0	16.2	13.6	4.6	15.7	12.9	14.3	14.6
Guangxi	31.5	41.4	20.8	17.2	23.8	20.4	8.3	25.8	20.4	23.1	20.0
Sichuan	33.0	45.1	18.4	15.6	19.7	20.5	13.3	23.6	21.7	22.6	19.4
Shaanxi	36.9	46.8	32.6	24.6	17.7	22.8	5.9	23.2	22.2	22.7	21.4
China	**43.4**	**44.5**	**18.3**	**15.5**	**16.8**	**17.2**	**5.4**	**18.5**	**16.6**	**17.6**	**15.7**

Source: Calculated by author using National Accounts data from CSY, China.

The main observations that emerge from this table are: (a) All provinces have experienced double digit growth rates of manufacturing sector's GDP, (b) Heilongjiang, and Shanghai seem to be lagging behind in terms of growth rates of manufacturing GDP with average growth rates of 10.2 and 10 percent respectively for the period of 2005-06 to 2012-13, (c) All coastal provinces namely, Beijing, Hebei, Jiangsu, Zhejiang, Shandong, Fujian and Guangdong have shown below average growth rates, (D) All non-coastal provinces except Heilongjiang have reported above average growth rates of manufacturing GDP. Level of regional industrialization and growth rates of manufacturing GDP in Chinese provinces hints towards positive developments taking place in inner parts of China which could lead to declining inter-regional inequality in the industrial sector.

5.4 Regional level Performance and Structure of Manufacturing sector in India and China

This section provides us with the regional distribution of manufacturing GVA and employment in both India and China. The analysis presented here will help to develop the understanding of the present context of spatial spread of manufacturing activity in both economies.

5.4.1 Structure and Growth of Registered Manufacturing GVA and Employment in India

Table 5.3 and 5.4 present the structure and growth of GVA and employment of manufacturing sector respectively, at state-level in India for the period 1998-99 to 2011-12. Maharashtra accounted for the largest share in manufacturing value added and employment at all points of time except for employment share in 2011-12 where Tamil Nadu took over the lead. Other major contributors to the manufacturing sector GVA and employment in India has been Gujarat and Tamil Nadu. Among these three Maharashtra and Gujarat have experienced a slight decline in their total share in manufacturing sector of India whereas Tamil Nadu has shown a slight improvement with its share in GVA increasing from 9.5 to 10.2 percent and its share in employment increasing from 13.1 percent to 14.5 percent during 1998-99 to 2011-12. The combined share of these three states has been showing decreasing contribution in GVA but still their share is large as compared to other states. The combined share these three states was 43.9 percent of total manufacturing GVA of India in 1998-99 and fell to 42.2 percent in 2011-12. These three states contributed 35.8 percent of total manufacturing employment in 1998 which increased to 38.8 percent in 2011-12. But one thing to be noted here is that the contribution made to employment by these three states has been less as compared to their share in total GVA. This hints towards the highly capital intensive nature of manufacturing sector of India. India uses more capital intensive techniques of production in manufacturing than countries at similar level of development and similar factor endowments (Hasan et al, 2013).

Table:5.3 Structure of Manufacturing GVA and Employment in India (1998-2011)

State	Share in Total Manufacturing GVA				Share in Total Manufacturing Employment			
	1998-1999	2002-2003	2007-2008	2011-2012	1998-1999	2002-2003	2007-2008	2011-2012
Andhra Pradesh	5.7	6.7	6.5	8.8	10.1	12.7	10.0	10.1
Assam	1.0	1.6	0.7	0.9	1.3	1.4	1.3	1.3
Bihar	0.5	0.5	0.3	0.7	0.7	0.7	0.7	0.9
Chhattisgarh	2.1	1.9	3.0	1.7	1.1	1.2	1.5	1.4
Gujarat	13.5	14.5	13.6	12.2	9.5	9.0	10.0	10.3
Haryana	3.7	4.4	3.9	3.9	4.4	3.8	4.9	4.3
Himachal Pradesh	0.6	0.8	2.2	2.7	0.4	0.4	0.9	1.2
Jharkhand	5.1	3.8	4.1	2.2	2.4	2.0	1.5	1.5
Karnataka	6.5	6.8	7.2	6.1	6.5	6.1	6.9	6.7
Kerala	2.7	2.0	1.2	1.2	3.3	3.4	3.4	2.9
Madhya Pradesh	3.3	3.1	2.9	2.5	3.5	2.6	2.4	2.3
Maharashtra	20.9	19.6	22.2	19.8	16.2	14.7	13.0	14.0
Odisha	1.6	1.6	2.8	2.7	1.7	1.5	1.8	2.1
Punjab	3.4	3.1	2.9	2.3	3.8	4.4	5.3	4.5
Rajasthan	2.6	2.8	2.6	4.9	2.8	3.1	3.5	3.5
Tamil Nadu	9.5	9.0	8.5	10.2	13.1	14.2	14.8	14.5
Uttarakhand	0.4	0.7	5.6	4.9	0.5	0.5	1.2	2.5
Uttar Pradesh	7.5	6.6	1.7	3.8	7.2	6.8	7.2	6.4
West Bengal	4.4	4.3	3.0	2.9	8.0	6.8	4.9	4.9
Others	3.5	4.7	4.5	4.8	2.0	3.0	3.6	3.5
All India	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Calculated by author using data from ASI, India.

Now if we consider other way round the states with lowest shares in GVA and employment are Assam, Bihar, Chhattisgarh, Delhi and Kerala. The combined share of these five states in GVA was 7.7 percent in 1998-99 which came down to mere 5.2

percent in 2011-12 and their share in employment was 8 percent which came down to 7.5 percent in 2011-12. This indicates dominance of a few states in manufacturing GVA and employment in India leading to the highly concentrated nature of manufacturing activities among Indian states. States like Andhra Pradesh, Uttarakhand, Himachal Pradesh, Haryana, Odisha and Rajasthan have shown an improvement in their share in total manufacturing GVA and employment of India. Decreasing share in GVA and employment has been reported by Delhi, Jharkhand, Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal. Four out of six of these states had very low contribution in GVA and employment. Only Maharashtra is an exception in terms of share in total manufacturing GVA and employment as it has been the biggest contributor but is now losing its share and leaving room for other states to fill. The remaining states present a mixed picture with some losing in terms of share in employment but gaining in GVA and some losing in GVA and gaining in employment. This is a reflection of large variations of the industrial structure and productivity among Indian states (Papola et al., 2011).

Now looking at growth rates of manufacturing GVA and employment of major Indian states, the first thing worth noting is the disconnection between the growth rates of GVA and employment as GVA grew at a far greater pace compared to employment growth. It is observed that the states like Uttarakhand and Himachal have recorded very high growth at all points of time considered in the present analysis in terms of both GVA and employment with GVA recording more growth and both of them possess capital intensive nature of manufacturing. So the other point worth noting here is that if we look at the employment growth alone then 7 out of first 8 ranks in terms of employment growth have been occupied by states which have already lower share in employment as compared to their share in GVA. This hints at a disconnection between labour intensity and employment growth. Such a phenomenon has been tested earlier in the Indian case by several researchers and questions have been posed on the employment generation capacity of the labour intensive sector of Indian manufacturing (For e.g. Das et al, 2009 and Kapoor, 2016).

Table 5.4: Growth of Manufacturing GVA and Employment in India (1998-2011)

States	Growth in Manufacturing GVA				Growth in Manufacturing Employment			
	1998-2001	**2002-2007**	**2009-2011**	**1998-2011**	**1998-2001**	**2002-2007**	**2009-2011**	**1998-2011**
Andhra Pradesh	4.5	12.4	8.6	9.9	0.4	0.3	5.6	2.9
Assam	-10.6	-0.2	16.2	7.0	-0.4	3.0	5.2	3.4
Bihar	-2.4	0.9	0.6	7.4	0.1	5.3	14.3	5.1
Chhattisgarh	-7.5	21.0	-6.8	6.4	-1.3	7.9	2.4	4.3
Gujarat	-0.4	11.5	5.2	6.9	-3.0	6.7	3.3	4.1
Haryana	3.7	8.8	7.0	8.3	-9.4	8.7	-1.0	2.5
Himachal Pradesh	9.0	29.5	9.4	18.9	2.1	18.4	10.3	11.7
Jharkhand	-17.8	14.3	0.1	1.2	-6.6	-0.5	3.2	-0.8
Karnataka	-1.0	13.1	21.8	13.2	-3.3	6.6	4.0	3.4
Kerala	-5.5	2.9	2.8	1.8	-5.0	1.6	1.2	-0.6
Madhya Pradesh	-1.1	15.9	-1.3	6.1	-7.1	5.0	4.0	1.8
Maharashtra	-2.1	14.7	4.0	7.4	-4.9	2.3	5.9	1.9
Odisha	-2.7	23.3	0.9	11.4	-4.9	7.4	7.3	4.8
Punjab	0.6	10.9	28.8	9.1	2.4	7.5	2.7	3.8
Rajasthan	5.5	11.6	15.3	11.8	0.1	6.8	6.2	4.8
Tamil Nadu	0.4	11.5	13.2	8.6	-0.9	5.4	2.0	3.5
Uttarakhand	10.1	27.4	-1.7	27.2	-2.8	20.6	10.2	15.4
Uttar Pradesh	-3.4	9.9	6.4	4.7	-4.9	5.6	4.0	2.3
West Bengal	-0.8	6.4	3.3	4.6	-5.9	-0.6	3.8	-0.8
Others	5.4	8.8	5.1	9.6	3.6	5.3	0.7	5.3
All India	**-1.0**	**12.4**	**7.0**	**8.1**	**-3.1**	**4.6**	**3.9**	**3.0**

Source: Calculated by author using data from ASI, India

Other striking disconnect that can be observed here is between the ranks that states holds in terms of GVA growth and employment growth. Not only does the rates of growth of GVA and employment vary among states but some of the states have performed well in terms of GVA growth but lagged in employment growth and vice versa. States of Karnataka, Rajasthan and Andhra Pradesh are among the top rankers in terms of GVA growth but have a lower rank in terms of employment growth. Similarly, the state of Bihar which ranks far below in terms of GVA growth is among the top rankers in terms of employment growth. These kind of trends pose severe impediments in the way of productivity growth in manufacturing sector of a state as well as for the economy as a whole. The other surprising observation which can be made here is that the highly industrialised state of Maharashtra has displayed below average growth rates during 1998-2011 in both GVA and employment and the other pace maker state of Gujarat has depicted below average growth in GVA but above average growth in employment paving the way for other states like Andhra Pradesh, Karnataka and Rajasthan to converge with them on the path of industrialization. The states of Uttar Pradesh, Jharkhand and West Bengal are the least performers in terms of growth of both GVA and employment growth in manufacturing sector which does not provide an encouraging picture of the industrial growth in these states.

Now observing the temporal dimensions in terms of manufacturing GVA and employment growth it can be noted that during the initial phase of 1998-99 to 2001-02 manufacturing sector's GVA and employment witnessed a setback in terms of negative growth rate at the all India level. The growth of both GVA and employment recovered during the second phase of 2002-07 with a growth rate of 12.4 and 4.6 percent respectively at the all India level and the states of Himachal Pradesh and Uttarakhand manifested double digit growth rates. The latest period of 2008-11 brought a slight slowdown in growth rates of both GVA and employment. This could be due the fact that the effects of recession were visible in the later period. If we consider the whole period of 1998-2011 it can be noticed that Indian manufacturing GVA grew at a rate of 8.1 percent which is substantial, but employment grew at a rate of 3.2 percent which is quite low for a labour surplus economy like India.

5.4.2 Structure and Growth of Registered Manufacturing GVA and Employment in China

Table 5.5 and table 5.6 present the share and annual growth rates of manufacturing GVA and employment across major Chinese provinces. Jiangsu, Shandong and Guangdong have been the key players in terms of contribution towards manufacturing GVA and employment during 1999-2011. These three provinces contributed 32 percent of manufacturing GVA and 33.1 percent of manufacturing employment in 1998-99 and their share rose to 35.1 percent of manufacturing GVA and 41 percent of manufacturing employment in 2011. Here one thing to be noted is that Guangdong which reported a decline in its contribution to total manufacturing in terms of GVA has reported highest increase in employment share over the period 1999-2000 to 2011-12. Beijing and Shanghai lost substantial share in manufacturing GVA during 1999-2011. No other major change has been observed in the regional structure of Chinese manufacturing GVA during the period of 1998-99 to 2011-12. If we divide Chinese provinces into coastal and inner provinces than we observe that share of coastal provinces has reported an increasing trend from 1999 to 2011. 56 percent of GVA and 64 percent of employment still comes from 7 coastal provinces of China. The picture of China seems to be balanced as compared to India in terms of simultaneous contribution made to GVA and employment by various provinces.

Table 5.5: Structure of Manufacturing GVA and Employment in China (1999- 2011)

Provinces	Share in Total Manufacturing GVA				Share in Total Manufacturing Employment			
	1999-2000	2002-2003	2007-2008	2011-2012	1999-2000	2002-2003	2007-2008	2011-2012
Beijing	7.1	7.0	5.2	3.6	5.0	4.6	3.2	3.0
Hebei	3.7	3.8	4.1	4.9	4.5	4.3	3.6	3.7
Shanxi	1.5	1.6	2.4	2.0	2.0	1.9	1.6	1.2
Liaoning	6.6	6.2	5.9	5.2	4.7	3.8	3.9	3.9
Jilin4	2.9	2.7	2.0	2.8	2.2	1.7	1.2	1.3
Heilongjiang	2.5	2.3	1.6	1.1	2.4	1.7	1.2	1.0
Shanghai	7.9	8.5	7.6	4.8	4.8	4.8	4.1	3.3
Jiangsu	11.1	11.5	12.6	13.7	11.6	11.5	12.2	13.4
Zhejiang	6.2	7.5	8.0	6.3	6.7	9.4	11.1	8.8
Anhui	2.2	2.1	2.3	2.6	2.7	2.4	2.1	2.8
Fujian	2.6	3.0	2.8	2.5	2.7	3.5	4.9	5.0
Jiangxi	1.5	1.3	1.5	2.0	1.8	1.5	1.8	2.2
Shandong	7.9	7.9	10.8	12.4	9.5	10.4	10.7	9.6
Henan	3.8	3.5	3.6	4.8	5.6	5.0	4.2	5.6
Hubei	4.0	3.4	3.2	4.7	4.8	4.0	2.6	3.1
Hunan	2.3	2.3	2.2	2.6	2.8	2.4	2.8	3.0
Guangdong	13.0	13.2	11.1	9.0	12.0	14.5	18.2	17.8
Guangxi	1.3	1.0	1.2	1.5	1.6	1.4	1.2	1.6
Sichuan	2.7	2.5	2.8	3.8	3.4	3.1	2.9	3.8
Shaanxi	1.9	1.9	1.6	1.6	2.1	1.9	1.2	1.2
Other Small	7.1	6.9	7.6	8.1	7.3	6.3	5.5	5.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Calculated by author by using data from CDO, China.

While looking at growth figure of GVA and employment in table 6.4, the mismatch between growth rate of GVA and employment can be observed. Chinese GVA grew at the rate of 17.3 percent while employment grew at just 5.2 percent for the period 1999-2011. Now coming to provincial growth in GVA it can be seen that here top rankers seem to be different provinces rather than the highly industrialised provinces. The average growth rate figures in table 5.4 shows that 13 out of 21 provinces considered here have recorded above average growth rate and all provinces reported double digit growth rates of GVA for the period 19980-99 to 2011-12. Highest growth has been reported by Jiangxi followed by Hunan and Sichuan. First five ranks in GVA growth have been occupied by those provinces which contributed more towards employment as compared to their contribution towards GVA.

Table 5.6 Growth of Manufacturing GVA and Employment in China (1998-2011)

Province	Growth in Manufacturing GVA				Growth in Manufacturing Employment			
	1999-2001	2002-2007	2008-2011	1999-2011	1999-2001	2002-2007	2009-2011	1999-2011
Beijing	7.2	16.1	6.3	13.2	-4.1	2.5	0.9	1.0
Hebei	4.2	23.1	10.9	19.0	-0.7	5.4	3.8	3.5
Shanxi	-1.2	31.4	5.1	18.7	-3.8	5.8	-2.1	1.2
Liaoning	6.9	27.8	10.8	20.2	-6.6	8.6	1.2	3.4
Jilin	12.2	15.5	15.3	17.9	-6.6	2.8	3.1	1.3
Heilongjiang	5.3	14.0	11.1	12.9	-8.5	1.6	-2.1	-1.9
Shanghai	7.7	15.1	4.2	11.1	-1.8	6.3	-2.5	2.3
Jiangsu	7.0	21.1	9.0	17.4	-2.4	9.7	0.3	6.3
Zhejiang	11.4	16.4	5.3	15.4	6.1	11.8	-2.9	7.3
Anhui	1.5	21.4	20.8	20.4	-5.7	6.4	8.2	5.4
Fujian	6.7	18.6	12.8	18.7	1.9	15.2	2.9	10.1
Jiangxi	3.5	31.6	18.0	24.2	-8.2	12.0	4.4	6.6
Shandong	8.0	24.9	8.9	19.3	-0.9	9.2	-0.7	5.2
Henan	4.3	30.3	13.1	20.9	-3.8	5.4	8.9	5.1
Hubei	3.7	15.0	16.4	15.5	-6.4	1.1	4.8	1.6
Hunan	5.6	26.5	18.7	21.8	-6.3	11.6	7.7	5.8
Guangdong	8.5	17.0	7.4	14.9	1.6	12.9	-0.3	8.3
Guangxi	3.6	24.8	17.5	20.2	-4.6	7.0	8.0	5.2
Sichuan	0.7	23.3	16.2	21.1	-5.2	7.5	7.6	6.1
Shaanxi	7.4	25.4	11.0	18.4	-4.2	1.1	2.8	0.7
Other Small	5.4	20.4	12.3	17.0	-5.8	6.4	2.8	3.0
Total	**6.9**	**20.7**	**10.4**	**17.3**	**-2.3**	**8.7**	**1.4**	**5.2**

Source: Calculated by author using data from CDO, China.

Jiangsu and Guangdong have reported below average growth rates for the period 1998-99 to 2012-13 and Shanghai reported the lowest growth rate during 1999-2011. The latest period of 2009-2011 depicts the slowing down of growth rate of manufacturing GVA as overall manufacturing GVA grew at 10.4 percent, quite low as compared to the previous period of 2002-07 when it grew at the rate of 20.7 percent. It can be said that coastal regions have seemingly lost their lead and other inner provinces are coming forward to take the lead in terms of growth of GVA. Now the employment growth figures present a different story. Provinces showing high GVA growth do not necessarily occupy a top position in terms of employment growth. The highest growth in employment has been depicted by Fujian (10.1 percent) followed by Guangdong (8.3 percent) and Zhejiang (7.3 percent).

Now looking at employment growth in table 5.6, it can be noticed that the first phase 1999-2001 witnessed negative employment growth in Chinese manufacturing. The period of 2002-2007 showed a significant growth of 8.7 percent at the country level in manufacturing employment of China. Five provinces namely Zhejiang, Fujian, Jiangxi, Hunan and Guangdong showed double digit growth rate during this period. Even during the years of recession employment growth was significant in Chinese manufacturing. But the later period of 2009-2011 shows the signs of declining employment growth and the overall growth of Chinese manufacturing employment has fallen to just 1.6 percent recently. For the whole period considered for analysis i.e. 1999-2011 Chinese manufacturing employment grew at the rate of 5.1 percent with the highest growth depicted by Fujian (10.1 percent) followed by Guangdong (8.3 percent). All of these three provinces have labour intensive manufacturing and Fujian and Guangdong had almost double contribution towards employment as compared to their share in value added. But the mismatch between values of growth rates of GVA and employment and differing performance by provinces in GVA and employment growth can have serious implications for productivity and employment growth of regions.

5.4.3 Review of Structure and of Manufacturing GVA and Employment in India and China from a Comparative Lens

It can be observed from the above analysis that Chinese manufacturing has shown faster growth as compared to its Indian counterpart both in terms of GVA and employment. Chinese manufacturing GVA has grown at a double rate as compared to growth of Indian GVA. In terms of employment also China has outpaced India during all sub-periods considered here except for the latest period 2008-2011 where Indian employment grew at faster rate.

One common pattern observed in the structure of GVA and employment in India and China has been that both economies show variations in the contribution made by regions towards GVA and employment. In the Indian case ten out of nineteen states had more contribution towards GVA as compared to their share in employment. Highest variation has been found in Maharashtra and Tamil Nadu. In 2011-12, contribution towards national manufacturing GVA has been 5.8 percent higher than the contribution towards employment in Maharashtra and in Tamil Nadu contribution towards national employment pool has been 4.3 percent higher than the contribution towards national manufacturing GVA. In China, twelve out of twenty one provinces showed higher contribution towards GVA as compared to employment. Guangdong has shown stark variations as its contribution towards employment has been almost 9 percent higher than its contribution towards manufacturing GVA. These patterns in both economies hint towards the presence of not only variations in the role played by various regions in total manufacturing activity of the nation but also unravel the differences underlying the nature of manufacturing activity among regions. Some regions seem to be relying more on capital intensive activity whereas some are beckoning upon labour intensive activities. These developments in the nature of manufacturing activity across regions of an economy can lead to high variations in productivity performance and employment growth among regions.

5.5 Inter-Regional Differences in Structure and Specialization in manufacturing sector in India and China

The patterns of specialization can play significant role in working of spill over effects and spatial distribution of industrial activity. If regions specialize in a few industries, they induce corresponding firms to locate in a few regions leading to increasing concentration of manufacturing activity in a few regions. Decreasing specialization indicates overall pattern of convergence in regional industrial structure. The continuous evolution of policy regimes of both India and China had profound impact on the industrial landscape and regional development.

Alagh et al. (1971a, 1971b) study fifteen major Indian states for the period 1956 to 1965 and found that the traditional primary-resource oriented industrial base was the basic characteristics of the regional economies in India, except for the states like Maharashtra, Tamil Nadu, West Bengal and to some extent Punjab. Further, their studies have shown that, Maharashtra, Tamil Nadu and West Bengal were the most diversified states, while states like Punjab, Gujarat, Madhya Pradesh, Uttar Pradesh etc, were the middle diversified states and other states like Rajasthan, Bihar, Assam, Jammu & Kashmir, Odisha, Kerala have least diversification. Their conclusion was that, the least and middle diversified states, in general, specialized in resource-based industries, while the diversified states apart from resource based industries specialized in capital and demand oriented consumer goods industries. Another study by Subrahmanian and Pillai (1986) in the context of Kerala for the period 1960 to 1980-81 has drawn the same conclusion about the concentration and diversification of industries in the Indian states. Shetty (1982) observed that the four major industrialized states namely, Maharashtra, West Bengal, Gujarat and Tamil Nadu together accounted for 44.7% of factories, 37.9% of the fixed capital and 40.8% of productive capital, while Bihar had only 5-6% share of all attributes whether relating to employment or output. Further, these five above mentioned states and Uttar Pradesh, Madhya Pradesh, Andhra Pradesh and Karnataka accounted for 78.4% of total number of factories, 79.0% of fixed capital and productive capital, 82.4% of factory employment, which indicated the concentration of industries in few states and this concentration has continued rising over the years.

A recent study by Chakravorty (2003a) on the location of industrial investment in India has found more concentration of industry on the west and east coasts, and the sparseness of industry in Bihar, eastern Uttar Pradesh, and central Madhya Pradesh in the post liberalization period. States like Andhra Pradesh, Bihar, Maharashtra, Uttar Pradesh, Kerala and West Bengal have lost their share in investment in the post reform period as compared to the pre reform period, while states like Assam, Gujarat, Karnataka, Madhya Pradesh, Odisha etc. have gained share in investment. The district wise desegregation shows that the metropolitan districts have lost their share of investment in the post reform period, whereas some sub-urban districts and even non-urban districts have gained (Chakravorty, 2003a). However, Deichmann et al. (2008), in their comparative study of industrial location in the developing countries have found that in India although the largest increase in the manufacturing activities during the period 1989 to 1996 have taken place in the secondary and periphery areas (which indicate some de-concentration of activities), metropolitan areas retained their dominance in rapidly growing industrial sectors. Both the empirical studies concluded that there is inter-regional divergence and intraregional convergence of the location of industrial investment in India in the post liberalization period.

Many studies have tested working of agglomeration economies and spill over effects on Chinese economic development. Fan and Scott (2003) noted that industrial employment is more concentrated than number of establishments and labour intensive industries are more spatially concentrated. Batisse and Poncet (2003) used 1992-1997 provincial input-output tables and found greater geographic concentration in industries with significant comparative advantages, strong supply linkages and high market potential. They also found larger location quotients for industries enjoying high protection from inter-regional competition. Using a panel dataset for 1985-1997 Bai et al. (2004) showed that Hoover coefficient of China's industries reversed in mid 19990s and rose significantly in the following years. The study also observed less geographical concentration in industries with high tax profit margins and shares of state ownership indicating that local protectionism may disperse industry. Wen (2004) calculated the Gini coefficients of 25 two-digit manufacturing industries in 1980, 1985 and 1995, and demonstrated that most manufacturing industries are highly concentrated while chemical fibre, ferrous metal and non-ferrous metal smelting and pressing tend to disperse. The study also found that resource based industries are the most concentrated in coastal regions while most of the industries producing goods with higher transport costs are geographically dispersed.

One argument always presented for better performance of Chinese industry over Indian industry has been the higher level of concentration and specialization attained by Chinese industries and provinces respectively. So in the present section an attempt will be made to investigate the debate over whether Chinese provinces have become more specialized and Chinese industries are more concentrated as compared to their Indian counterparts. This section carries twofold objective, firstly it will shed more light on the already observed regional inequality in industrial development in both economies and secondly it will compare the level and nature of agglomeration economies present in industrial sector of both economies by examining regional specialization and industrial concentration. But before proceeding further, it will be prudent to discuss the way in which concepts of specialization and concentration have been used in the present analysis.

Regional Specialization: Specialization is defined as the distribution of weight of a particular industrial sector in a specific region. Here we focus on the industrial structure of a region. A region in which only a small number of industries are represented is said to be highly specialised. In contrast, a region in which a large number of industries are represented is said to be diversified.

Industrial Concentration: Concentration is defined as the distribution of weight of a particular region in a specific industrial sector. Here the focus is on geographical distribution of a particular sector among various regions. If the high share is contributed by only a few regions, then the industry is said to be concentrated on the other hand if a particular industrial sector is spread evenly among regions then it is said to be dispersed.

For measuring both these indicators of degree of localization of industrial sector in both India and China Isard's index of localization has been used:

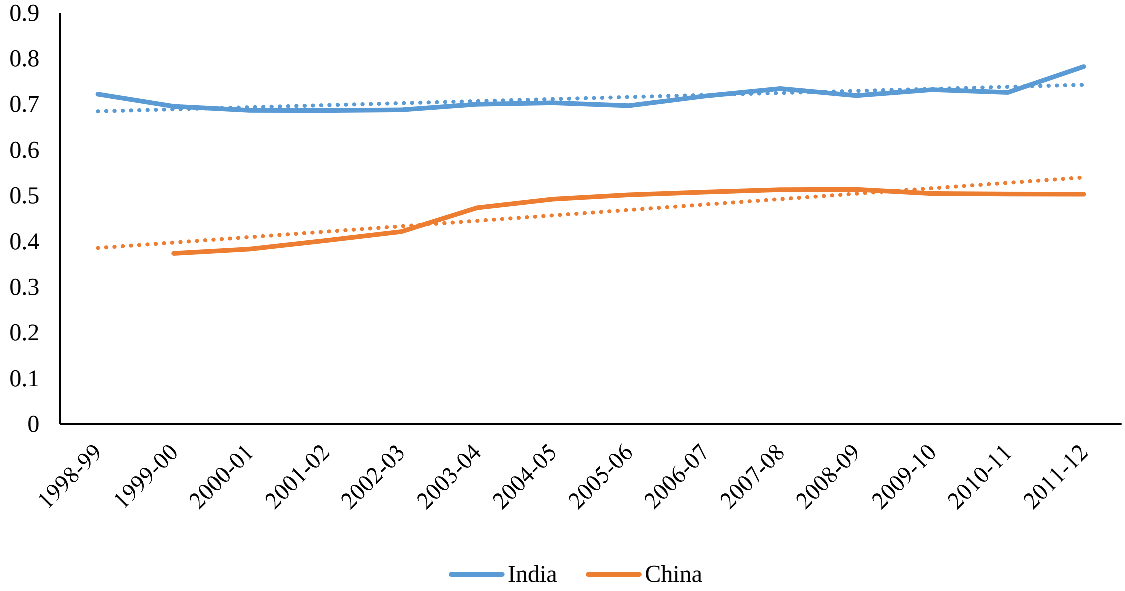
$L_{sp} = \sum|E_{sr}/E_{sn} - E_r/E_n|$

Where E represents employment, s represents industrial sector, r represents region and n represents national value. L_{sp} gives us the level of concentration of a particular industrial sector. While calculating both indices we have made use of employment as the variable to represent industrial activity. This choice has been made due to the fact that the primary objective of inducing industrial activity in the lagging regions is to generate local employment opportunities (Paranjape, 1988) and employment generation is the key objective for the labour surplus economies of India and China.

If we exchange region with sector in (5.1) we get coefficient of specialization. Graph 5.1, summarizes the average evolution of index of specialization for states and provinces of India and China respectively. The aggregate index of specialization shows a general increasing trend for China and relatively stagnant position of Indian states. Indian regional specialization is quite high as compared to China indicating high and increasing specialization taking place among Indian states. On the other hand, specialization of Chinese provinces is lower than Indian states and also the index showed an increasing trend till 2005 and seem to have stabilised thereafter.

Graph - 5.1

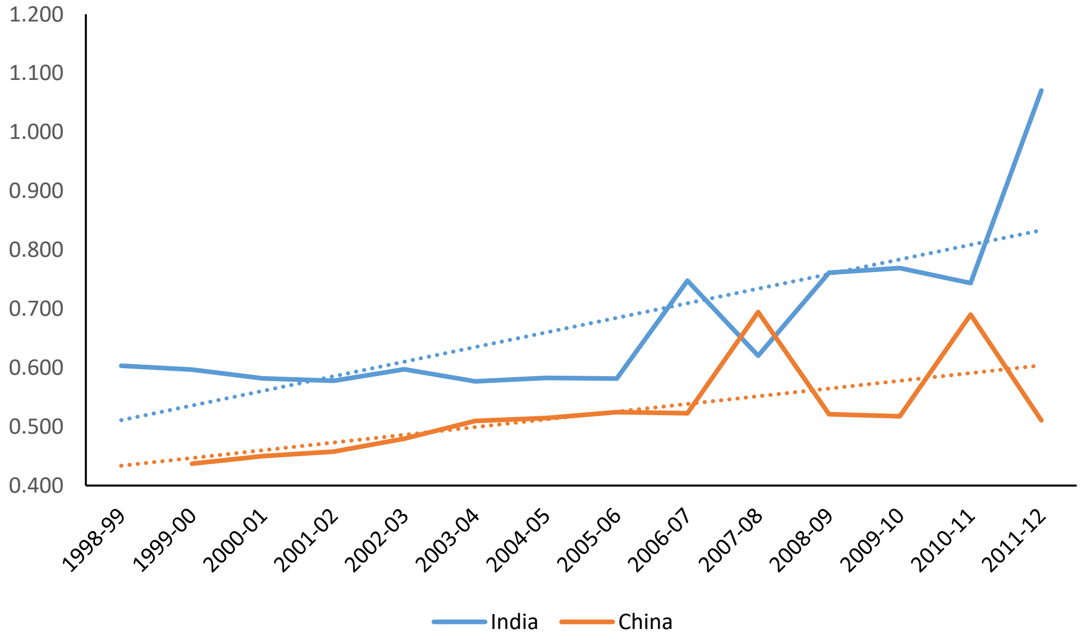
Average Evolution of Regional Specilization in India and China (1998-2011)



Source: Calculated by author using data from ASI, India and CDO, China.

Graph - 5.2

Average Evolution of Concentration of Industrial Sectors in India and China (1998-2011)



Source: Calculated by author using data from ASI, India and CDO, China.

Graph 5.2 summarizes the average evolution of the index of localization for 19 industrial sectors considered in our analysis. The index of concentration shows an increasing trend in concentration of industrial sectors in both economies with Indian industrial sectors experiencing higher concentration as compared to Chinese industrial sectors.

The above results seem to be contrary to the assumed degree of agglomeration in India and China. Here both regional specialization and industrial concentration have been higher in India as compared to China. The process of agglomeration economies does not seem to have worked well in Indian case as India has experienced far less industrial growth in comparison with China. To gauge the spatial pattern and level of specialization and concentration a regional level analysis has been carried out for both India and China in the following section.

5.5.1 Industrial Specialization across Indian States (Top Five Product Groups in a State)

Here we make an attempt to analyse the regional level differences in structure and specialization of Indian states. We consider top five product groups in terms of their contribution to employment in manufacturing sector in a state to see to what extent the product groups featuring in this bunch differ from state to state. This exercise will enable us to see the degree of specialization or diversification of the manufacturing sector in a state, as shown by the percentage of employment claimed by top five industries.

Among all the states considered here food products feature in 19 out of 21 states among the top five industries in 2011. The next most ubiquitous groups among top five have been Textiles, Chemical industry, Non-metallic Mineral products and Transport manufacturing in 2011. Transport manufacturing has taken the place of machinery manufacturing over the period of time as in 1998 machinery industry was featured among top five industries in 9 out of 21 states and now Transport industry has taken the toll. Different states, however, show diverse patterns insofar as the largest product group is concerned at both points of time. Now if we look at 2011 figures, textile group and food products are the largest in each of 5 states. A single product group accounts for more than 50 percent of employment in 5 less industrialized states in 2011. In Bihar non-metallic mineral products dominated with 59 percent of total manufacturing employment. Odisha and Chhattisgarh had 62.2 percent and 63 percent respectively, of manufacturing employment in basic metal industries. Food and Beverage industry contributed to almost half of the manufacturing employment in Kerala. Jharkhand too have high share of employment (46 percent) coming from basic metal. Food and Beverage industry is the largest in Assam with 50.2 percent of employment. Industries with significant domination though smaller proportion are Tobacco industry in Andhra Pradesh (22 percent), Transport industry in Haryana (31.7 percent), Chemical Industry in Himachal Pradesh (31.6 percent), Apparel industry in Karnataka (33.1 percent), Textile industry in West Bengal (27.4 percent), Transport industry in Uttar Pradesh (36.2 percent). The above features suggest a high degree of specialization in the industrial structure of various states. That is also reflected by the high proportion of total employment accounted for by the largest five industry groups in each states. Assam, Bihar, Kerala, Odisha, Chhattisgarh, Jharkhand and Uttarakhand had over 75 percent of their respective manufacturing employment concentrated in top five industries in the year 2011.

Table 5.7 : Specialization of Indian States (1998-2011)

States	Share of top 5 Industries 1998	Top five contributing Industries in 1998	Share of top 5 Industries 2011	Top five contributing Industries in 2011
Andhra Pradesh	74.7	A,TO,TX,CH,NM	69.6	A,TO,TX,CH,NM
Assam	91.2	A,TX,PA,CK,NM	88.7	A,PA,CK,CH,NM
Bihar	75.8	A,TX,CK,CH,NM	90.2	A,TX,CK,NM,MA
Gujarat	71.0	A,TX,CH,NM,MA	63.3	TX,CH,NM,BM,MA
Haryana	74.9	A,TX,NM,MA,TR	68.5	A,TX,AP,MA,TR
Himachal Pradesh	71.1	A,TX,NM,MA,IN	66.2	A,TX,CH,EL,IN
Karnataka	56.3	A,TX,AP,MA,IN	65.2	A,AP,CH,MA,TR
Kerala	76.9	A,TX,CH,RB,NM	76.6	A,TB,TX,RB,NM
Madhya Pradesh	73.2	A,TX,CH,NM,EL	57.8	A,TX,CH,EL,TR
Maharashtra	67.0	A,TX,CH,MA,TR	55.6	A,CH,FM,MA,TR
Odisha	77.9	A,TX,CH,NM,BM	88.1	A,TB,CH,NM,BM
Punjab	75.1	A,TX,FM,MA,TR	69.9	A,TX,AP,NM,TR
Rajasthan	71.4	A,TX,CH,NM,BM	62.3	A,TX,CH,NM,BM
Tamil Nadu	66.5	A,TX,AP,CH,TR	61.4	A,TX,AP,CH,IN
Uttar Pradesh	59.2	A,TX,CH,MA,TR	52.6	A,AP,LE,NM,FM
West Bengal	73.1	A,TX,BM,MA,TR	69.1	A,TX,LE,BM,FM
Jharkhand	85.4	CK,CH,NM,BM,TR	88.5	CK,NM,BM,MA,TR
Chhattisgarh	92.5	A,TX,CH,NM,BM	93.8	A,NM,BM,FM,MA
Uttarakhand	84.1	A,PA,NM,EL,IN	77.3	A,CH,RB,EL,TR
Others	48.5	A,TX,AP,CH,RB	50.4	A,TX,CH,RB,O
India	58.5	A,TX,CH,BM,MA	51.3	A,TX,CH,BM,TR

Source: Calculated by author using data from ASI, India.

Punjab, West Bengal and Haryana had also close to 70 percent of their total manufacturing employment coming from top five industries. On the other hand, Uttar Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu, Rajasthan and Gujarat had relatively diversified industrial structure. Uttar Pradesh had most diversified industrial structure with only 52 percent of manufacturing employment coming from top five groups. Second most diversified state has been Maharashtra with 55 percent employment contribution made by top five products and the largest industry in Maharashtra Food and Beverages contributed only 12.4 percent to total manufacturing employment of the state.

Comparing the overall level of specialization at both points of times it can be said that level of specialization has come down in 2011 as compared to 1998 in most of the states except for Bihar, Karnataka, Odisha, Jharkhand, Chhattisgarh and other small states which have witnessed increasing concentration of manufacturing employment in the top five industries over the period of time.

5.5.2 Locational Diversification or Industrial Concentration in Indian Industries (Top Five States in an Industrial Group)

Here we try to analyse the extent to which industries have been dispersed or concentrated among Indian states.

Among all the industry groups considered here Maharashtra appears in 16 out of 19 industries revealing the dominance of this state across manufacturing sector of India in 2011. Other most appeared states are Tamil Nadu, Gujarat, Andhra Pradesh and Uttar Pradesh. These states are also among the most diverse states in Indian manufacturing. Now coming to the concentration of industries it has been found that Tobacco industry has been the most concentred industry with five largest contributing states accounting for 86.8 percent of the total employment in that industry with Andhra Pradesh alone contributing 63.2 percent of the total employment in Tobacco industry in India in 2011. Next comes the Apparel industry with five largest contributing states accounting for 83.7 percent of the total employment in that industry and Tamil Nadu alone contributing 38.9 percent of the total employment in the Apparel industry of India in 2011.

Other highly concentrated industry is the Leather industry with top five states contributing 83.2 percent of total employment. Most other industries are reasonably dispersed in their location though the top five states contribute more than half of total employment in all cases except the most diversified industry of timber products in which top five states contributed a little less than half of the total employment with figure of 49.3 percent.

Table 5.8 : Concentration of Industries India (1998-2011)

ISIC 3.1	Share of top 5 States in 1998	Top five contributing states in 1998	Share of top 5 States 2011	Top five contributing states in 2011
15	58.1	AP,KE,Mah,TN,UP	57.7	AP,KE,Mah,TN,UP
16	94.5	AP,KA,MP,Mah,UP	86.8	AP,KE,Mah,O,UP
17	69.2	GU,MP,MA,TN,WB	68.6	GU,PU,MA,TN,WB
18	88.2	KA,MA,TN,UP,O	83.2	H,KA,PU,TN,UP
19	79.4	H,TN,UP,WB,O	83.7	AP,H,TN,UP,WB
20	59.9	KA,KE,TN,Wb,O	49.3	GU,,KE,MAH,TN,WB
21	56.2	AP,KA,MA,TN,UP	55.1	AP,GU,MA,TN,UP
22	68.8	KA,Ma,TN,UP,O	69.7	AP,Ma,TN,UP,O
23	66.1	GU,MA,UP,WB,JH	58.9	AS,GU,MA,WB,JH
24	74.1	AP,GU,MA,UP,O	68.1	AP,GU,MA,TN,O
25	56.2	AP,GU,MA,UP,UT	57.5	AP,GU,MA,TN,O
26	46.8	AP,GU,MA,RA,TN	53.5	AP,BH,GU,PU,RA
27	57.4	MA,OR,UP,WB,JH	58.1	GU,MA,Or,WB,CH
28	61.3	GU,MA,TN,KA,Wb	67.7	GU,KA,MA,TN,UP
29+30	75.6	GU,MA,TN,KA,Wb	69.7	GU,H,MA,TN,KA
31	65.2	GU,KA,Mah,UP,WB	54.7	AP,KA,Mah,TN,O
32+33	61.0	KA,MA,TN,UP,WB	66.6	AP,KA,MA,TN,UP
34+35	68.2	H,MA,PU,TN,WB	77.8	H,MA,PU,TN,UT
36	79.6	GU,MA,TN,UP,Utt	76.5	GU,MA,RA,TN,O

Source: Calculated by author using data from ASI, India.

5.5.3 Industrial Specialization across Chinese Provinces (Top Five Product Groups in a Province)

Here we make an attempt to analyse the regional level differences in structure and specialization of Chinese Provinces by calculating contributions made by top five provinces in a particular product group.

Among all the Provinces considered here Chemical Products features in seventeen out of twenty provinces and Food Products feature in fifteen out of twenty provinces among the top five industries in 2011. The next most ubiquitous groups among top five have been Non-Metallic Mineral Products, Machinery and Transport Manufacturing in 2011. Various provinces however, show diverse pattern insofar as the largest industry is concerned. Food Products has been largest industry in only four out of twenty provinces namely, Heilonong, Shandong, Henan, Guanxi and Sichuan. Machinery appeared as largest industry only in 3 provinces namely, Beijing, Lionizing and Anhui. Basic metal has been largest industry in 3 provinces namely, Henan, Shanxi and other small provinces. Zhejiang had Textile industry as the largest and Fujian had Leather industry as the largest industry with 13.9 percent of total manufacturing employment in both provinces in 2011. Transport industry has been largest in three provinces namely Jilin, Hubei and Shaanxi. Chemical industry has been largest in Hunan with 15 percent of total manufacturing employment in that province in 2011.

Table 5.9: Specialization of Chinese Provinces (1998-2011)

Provinces	Share of top 5 Industries 1998	Top five contributing Industries in 1998	Share of top 5 Industries 2011	Top five contributing Industries in 2011
Beijing	48.8	A,CH,MA,IN,TR	57.0	A,CH,MA,IN,TR
Hebei	62.5	A,TX,CH,NM,MA	54.5	A,CH,NM,BM,MA
Shanxi	65.0	CK,CH,NM,FM,MA	73.4	CK,CH,BM,MA,IN
Liaoning	57.8	TX,CH,NM,MA,TR	59.6	A,TI,CH,NM,TR
Jilin	72.1	A,CH,NMMA,TR	73.8	A,TI,CH,NM,TR
Heilongjiang	58.6	A,CH,MA,NM,TR	65.9	A,CK,CH,MA,TR
Shanghai	48.7	TX,AP,CH,MA,TR	60.9	CH,MA,EL,IN,TR
Jiangsu	57.3	TX,AP,CH,NM,MA	59.3	TX,CH,,MA,EL,IN
Zhejiang	53.2	TX,AP,CH,MA,EL	53.6	TX,MA,EL,TR,O
Anhui	66.6	A,TX,CH,NM,MA	48.2	A,CH,MA,EL,TR
Fujian	49.4	A,AP,LE,NM,IN	52.2	A,AP,LE,NM,O
Jiangxi	61.8	TX,CH,NM,MA,TR	47.4	CH,NM,BN,EL,IN
Shandong	60.5	TX,CH,NM,MA,TR	56.2	A,TX,CH,NM,MA
Henan	70.6	A,TX,CH,NM,MA	55.6	A,TX,CH,NM,MA
Hubei	63.3	TX,CH,NM,MA,TR	56.0	A,TX,CH,BM,TR
Hunan	63.5	TX,CH,NM,MA,TR	60.3	A,CH,NM,BM,MA
Guangdong	47.1	AP,NM,EL,IN,O	62.3	AP,RU,EL,IN,O
Guangxi	68.1	A,CH,NM,MA,TR	58.3	A,CH,NM,BM,TR
Sichuan	51.5	A,CH,NM,MA,TR	58.4	A,CH,NM,MA,IN
Shaanxi	65.4	TX,CH,NM,MA,TR	64.9	A,CH,NM,BM,TR
Other	62.8	A,TX,CH,NM,MA	64.3	A,CH,NM,BM,TR
China	53.3	A,TX,CH,NM,MA	44.9	A,CH,MA,EL,IN

Source: Calculated by author using data from CDO, China.

Now coming to proportion of total employment accounted for by the largest five industry groups in each province, one observation has been made that the level of specialisation of Chinese provinces is quite low as compared to Indian states. In India, the largest five industries contributed share as large as 93.8 percent (Chattisgarh) whereas in China largest contribution towards total manufacturing of a province has been 73.8 percent (Jilin) in 2011. Only three provinces in China reported more than 65 percent share in total manufacturing employment by top five industries. Most diversified province has been Anhui with 48 percent contribution made by top five industrial groups in 2011. One more thing to be observed here is that coastal provinces namely Beijing, Shanghai, Zhejiang, Jiangsu, Fujian, Shandong and Guangdong collectively show more specialization as compared to non-coastal provinces. If we compare specialization level at both points of time it becomes clear that overall level of specialization in China has come down and regions are moving towards a more diversified industrial structure. But the level of diversification is increasing more in non-coastal regions. Coastal provinces namely Shanghai, Guangdong and Beijing have shown increasing specialization.

5.5.4 Locational Diversification or Industrial Concentration in Chinese Industries (Top Five Provinces in an Industrial Group)

Here we try to analyse the extent to which industries have been dispersed or concentrated among Chinese provinces at two points of time, 1998-99 and 2011-12. Among all the industry groups considered here Jiangsu, Shandong and Guangdong appear in 16 out of 19 industries revealing the dominance of these coastal provinces across manufacturing sector of China in 2011. Zhejiang dominated in 13 out of 19 industries. Now coming to the concentration of industries it has been found that Instrument Manufacturing, Electrical Machinery, Leather and Apparel are most concentrated industries and major contribution towards employment of these industries has been made by Guangdong.

Most other industries are reasonably dispersed in their location though the top five provinces contribute more than half of total employment in all cases except the four most dispersed industries namely Transport, Non-Metallic Mineral Products, Basic Metal and Food products in which top five states contributed a little less than half of the total employment with figures above 46 percent in each case.

Table 5.10: Concentration of Industries China (1998-2011)

ISIC 3.1	Share of top 5 Provinces in 1998	Top five contributing Provinces in 1998	Share of top 5 Provinces 2011	Top five contributing Provinces in 2011
15	47.8	JI,SHA,HE,GU,O	48.2	SH,HE,GU,SI,O
16	60.7	AN,HE,HU,HUB,O	65.1	HE,HUB,HU,SXI,O
17	53.8	JI,ZHE,SHA,HU,O	69.3	SH,HE,GU,JI,ZHE
18	68.5	SG,JI,ZHE,BE,GU	70.0	JI,ZHE,FU,SH,GU
19	79.2	JI,ZHE,FU,SHA,GU	77.4	HEB,JI,ZHE,FU,GU
20	43.1	HEI,JI,FU,GU,O	50.4	JI,FU,SH,HE,GU
21	54.5	JI,ZHE,SHA,HE,GU	56.0	JI,ZHE,SH,HE,GU
22	47.4	BEI,JI,SHA,GU,O	58.0	BE,JI,ZHE,SH,GU
23	53.5	BE,SHX,LOI,SHA,O	60.3	HEB,SHX,LOI,SH,O
24	42.4	HEB,JI,SHA,HE,O	49.0	JI,ZHE,SH,GU,O
25	55.4	SG,JI,ZHE,SHA,GU	65.0	JI,ZHE,FU,SH,GU
26	45.1	JI,SHA,HE,GU,O	47.7	JI,SH,HE,GU,O
27	53.5	BE,JI,ZHE,SHA,GU	48.3	HEB,LOI,JI,SH,O
28	51.0	SG,JI,ZHE,SHAGU	62.2	LIO,JI,ZHE,SH,GU
29+30	45.2	JI,ZHE,SHA,HE,GU	53.9	JI,ZHE,SH,GU,LIO
31	55.0	SG,JI,ZHE,SHA,GU	71.2	SG,JI,ZH,SH,GU
32+33	63.4	BE,JI,ZHE,FU,GU	75.7	BE,SG,JI,ZH,GU
34+35	41.0	BE,LOI,JI,HU,O	46.4	JI,ZH,SH,GU,O
36	74.6	SG,JI,ZHE,SHA,GU	73.7	JI,ZH,FU,SH,GU

Source: Calculated by author using data from CDO, China.

5.6 Conclusion

The analysis carried out in this chapter sheds light on the various aspects of regional spread of manufacturing activity in India and China. Many states in the Indian economy witnessed declining share of manufacturing in their GDPs. On a whole Indian regional economies seemed stagnated on the path of industrialization. States like Bihar, West Bengal, Assam and Chhattisgarh have shown very low level of industrialization in terms of growth in manufacturing GDP. On the other hand, the Chinese regional economies are significantly industrialized with most of the regions having more than 40 percent of their GDP coming from Manufacturing shows a very different picture. All coastal regions showed decreasing share of manufacturing in their GDP including non-coastal regions Heilongjiang. All other regions showed increasing share of manufacturing in their GDPs. This hints towards positive developments taking place in inner parts of China which could lead to declining inter-regional inequality in the industrial sector. Further, looking at the regional structure of manufacturing sector is has been observed that a few states dominated in GVA and employment in India reflecting large variations in the industrial structure. In China also manufacturing GVA and employment have dominance a few coastal regions. In terms of growth rates some of the states with low level of industrialization have shown improvement in India and non-coastal provinces in China have outpaced coastal regions in terms of growth of GVA. Other striking feature of manufacturing sector growth in both economies has been the mismatch between the rate of growth of GVA and rate of growth of employment.

Other important issues related to the pattern of industrialization examined in this chapter have been regional specialization and industrial concentration. In Indian context it has been observed that both regional specialization and industrial concentration have come down over the period of time. But still the level of specialization is very high as compared to Chinese manufacturing. In case of China most of the industries have shown increasing concentration and regions have depicted declining specialization except coastal regions which have shown increased specialization. This hints that the relocation policies in China have worked well but still some industries which have comparative advantage in coastal regions remain located there. An argument developed in this context is that rising labour cost alone may not be a sufficient condition for industries to re-locate from coastal to central China. Some industries are still becoming more concentrated only in coastal regions leading to increased specialization in these regions. The newly developing industrial bases in inner China are getting more diversified with time and are showing better growth performance.

Chapter – 6

Regional Productivity and its Growth in Manufacturing Industries of India and China

6.1 Introduction

While comparing shares of gross value added and employment of various regions in Indian and Chinese manufacturing respectively, the existence of variations in labour productivity level has become quite apparent. The divergence in performance of various regions of both economies make it important to appraise performance of regional manufacturing industry in terms of productivity level and growth. Hence the present chapter carries out analysis to fulfil the objective of measuring productivity level in terms of labour productivity and productivity growth in terms of both partial (labour) productivity and total factor productivity.

6.2 Outline of the Chapter

This chapter consists of eight sections including the introductory and present section. The third section reviews empirical literature on regional productivity differences in regional manufacturing of India and China. The fourth section sheds light on the inter-regional differences in the labour productivity of manufacturing sector of India and China. The fifth section provides estimates of regional level TFPG in Indian and Chinese manufacturing. The sixth section carries a theoretical debate on role of specialization and diversity in industrial sector. The seventh section tries to trace relationship between various agglomeration economies and TFPG in the manufacturing sector of India and China. The eighth section concludes.

6.3 Inter-Regional Differences in Productivity Performance of Regional Manufacturing in India and China: A Literature Survey

Many researchers have tried to evaluate regional differences in performance of manufacturing sector in both economies. Here a review of a few major studies have been presented which primarily focused on the aspect of regional disparity in terms of varying productivity performance of manufacturing sector in the two countries.

Ray (1997) estimated productivity of manufacturing sector in Indian states for the period 1969-84 using DEA based MPI. The decomposition of TFP was done into three components namely, technical change, technical efficiency change and scale efficiency change. The results of the study revealed that the productivity of manufacturing sector of Indian states declined due to decline in technical change. Further, while examining factors affecting TFPG among Indian states it was found that higher capital labour ratio and urbanization had positive effect on TFPG and industrial disputes and preponderance of non-production workers led to decline in the TFPG of manufacturing sector among Indian states.

Trivedi (2004) measured inter-state differences in productivity in organized manufacturing sector of ten major States in India during 1980-1981 to 2000-2001. The study focused on employment and output trends. The outcomes empirically confirmed the existence of inter-state differences in productivity levels and growth rates. It was also pointed out that States, such as Bihar and West Bengal, were diverging, rather than converging, from the output growth rates of organized manufacturing sector at national level.

Kumar (2004) had estimated TFPG in manufacturing sector of 15 major States in India during the period from 1982-83 to 2000-01. The author used non-parametric linear programming approach. The study also identified the sources of TFPG and measured the biasness level of technical change. The results indicated significant improvement in TFP over time. It was found that regional differences in TFP persisted in India, although the magnitude of variation had declined during the post- reform period. The study confirmed the tendency of convergence in TFPG among Indian States during the post-reform period and only technically efficient States at the beginning of the reforms remained innovative.

Veeramani and Goldar (2005) examined the effect of investment climate on state level productivity level of manufacturing sector. The findings of the study revealed that state-level investment climate is a major determinant of productivity performance during 1980-2000 period. The states with pro-worker legislation experience lower productivity growth during the same period. The study hinted towards the prevailing inter-states differences on productivity performance of manufacturing sector of India.

Trivedi et al. (2011) noted significant variations in TFPG of manufacturing sector across Indian states. The study also found that there has been deceleration in TFPG during the post-reform period in the Indian economy. The findings of the study revealed that supply side constraints like technical upgradation and organizational and institutional factors seem to be a major barrier in the growth of manufacturing sector across Indian states.

Tian and Yu (2012), based on a meta-analysis of 150 primary productivity studies, conclude that regional disparities in TFP growth are still significant in China as the TFP growth in east China is higher than that in central and west China. However, majority of the studies included in the meta-analysis do not have regional focus, use aggregate (macro) data, are conducted at industry or national level, and use conventional growth accounting or efficiency frontier approaches. Furthermore, China is a huge country with pronounced regional heterogeneity, however, existing studies on regional disparities, at best, have considered a crude three category regional classification (east, central and west provinces).

Deng and Jefferson (2011) using aggregate firm and industry data to calculate labour productivity to analyse regional disparities and find strong evidence of convergence in growth rates between inland and coastal regions over the period 1995-2004. Zhang et al. (2011) find similar regional differences and evidence of convergence analysing the impact of R&D investment and technological progress using unique province level data over the period 2000-2007.

Rizov and Zhang (2013) characterize regional disparities in China by computing aggregate productivity across the three regional typologies, based on population density, coastal-inland, and rural-urban criteria. The study analysed the productivity differentials across the categories of the typologies by decomposing regional productivity level and growth into productivity effect and industry composition effect. The findings of the study provide an evidence of regional convergence. Density of economic activity, recent policy and structural factors have been considered as factors affecting regional productivity level and growth differentials in manufacturing sector among Chinese provinces.

Wang and Szirmai (2007) analysed regional productivity trends and trends in regional convergence and divergence. A wide range of indicators including GDP per capita, labour productivity and comparative efficiency scores have been used in the study. The empirical results show that there is no long-run divergence trend between Chinese regions since 1978. On the contrary, there has been substantial regional convergence from 1978 to around 1990. This has been followed by a period of modest divergence up till around 2001. After 2001, convergence trends resumed. Whatever indicator has been used, the degree of regional inequality was substantially lower than at the beginning of the reform period. An analysis of the relative importance of technological change and efficiency revealed that in the early stages of the Chinese reform process efficiency changes predominated. Once efficiency differentials between regions reduced in the process of efficiency convergence, technological change at the frontier became more important as a driver of growth in Chinese industry.

Lei (2008) applied the Jorgenson approach, for each major industry across regions to construct an alternative investment series to calculate its net capital stocks so as to calculate industry-wise capital services. By utilizing the newly constructed capital input data in production function, the effects of the reform on regional productivity disparities have been examined in this study. Results of this study showed that, first, shares of industrial sectors in most regions became more diversified after 1993. Second, economic growth of China's industry was mainly investment-driven. Third, in 1985, there were large gaps of labour productivity between rich regions and poor regions. Remarkable catch-up effect happened in less-developed regions. Fourth, most regions experienced positive TFP growth during 1985-2005 and achieved significant productivity improvement since 1993.

Keeping in view the earlier work done by researchers on the productivity performance of manufacturing sector at regional level in both economies the present chapter tries to trace the extent of inter-state differences in productivity in terms of both labour productivity and TFPG across regions of India and China during 1998-2011.

6.4 Regional Labour Productivity in Indian and Chinese Manufacturing

The present section analyses regional productivity differentials in Indian and Chinese manufacturing. Labour productivity is a good indicator of comparative advantage of a particular sector over other sectors or a region in a particular sector. It also indicates the welfare of people in a region. The most acceptable interpretation of labour productivity is that it is a measure of potential consumption (Balakrishnan, 2004). So comparison of regional labour productivity of manufacturing sector of India and China will provide us, on the one hand, indicator of relative competitiveness of this sector in various regions of both the economies, and on the other hand, it will also serve as an indicator of relative capability of this sector to raise the overall welfare of regional economies in both the countries.

6.4.1 Extent of Differences in Interstate Productivity in India

Table 6.1 depicts per worker productivity and its growth in various states of India. Per worker productivity in Indian manufacturing varied from $ 3,341 in West Bengal to $ 13001 in Jharkhand in the year 1998. Chhattisgarh with figure of $ 11,453.3, other small states ($ 10,432), Himachal Pradesh ($9,438), Gujarat ($ 8,693.6) and Maharashtra ($ 7,857.6) were the other high productivity states in 1998. Among the low productivity states were Andhra Pradesh ($ 3,452.9), Assam ($4,615.4) and Uttarakhand ($4,201).

These figures indicate the extent of differences in the level of labour productivity achieved by various states of India. The ranking of states did not alter much during 2002 and 2007.

Now coming to 2011 we see that Kerala had the lowest level of labour productivity with a figure of $ 4,214.1 and Himachal Pradesh achieved the highest labour productivity with figure of $ 23,325.4, which means the gap between lowest and highest value of labour productivity has increased over the period of time.

Table 6.1: Regional Labour Productivity in Indian Manufacturing (1998-2011)

States	labour Productivity (in $)				Growth in Labour Productivity			
	1999	2002	2007	2011	1998-2001	2002-2007	2008-2011	1998-2011
Andhra Pradesh	18300.37	14732.55	31127.46	47409.56	3.8	11.5	5.3	8
Assam	24461.62	31945.5	26619.6	34746.8	-9.6	-4.5	-1	3.4
Bihar	19846.91	20320.2	17436.3	39887.8	-2	-4	11.8	6
Chhattisgarh	60702.49	45528.75	95113.2	67921.62	-6.3	11.3	-9.8	1.7
Gujarat	46076.08	45135.45	64456.14	64994.43	2.6	4.5	-9	3.4
Haryana	27540.92	32653.8	37507.68	49900.03	11.3	0.8	-0.8	5.3
Himachal	50024.05	54518.4	115989.3	123624.6	6.9	11.7	3.5	7.6
Jharkhand	68905.83	53797.95	131514.6	83544.43	-11	14.3	-9.5	2.3
Karnataka	32406.32	31153.95	48914.88	49879.89	3.6	6.2	3.3	4
Kerala	26029.36	16483.05	17160.36	22338.97	-6.9	-0.9	2.2	-0.2
Madhya	30194.1	32947.2	55900.32	58738.31	14.6	7.5	0.2	5.8
Maharashtra	41645.28	37394.55	81057.9	77575.04	2.5	12	-1.9	5.5
Odisha	32263.75	30161.25	75144.72	69227.54	2.6	14.6	-1.7	6.5
Punjab	28924.75	19793.25	26081.58	28618.41	-1.5	3.1	0.8	0.8
Rajasthan	30432.6	25922.7	35290.08	75382.43	6.6	3.7	10.7	7.6
Tamil Nadu	23572.28	17863.2	27088.32	38619.51	1.1	5.5	3.2	4.5
Uttarakhand	22265.83	39033.45	63458.22	82008.49	13.4	6.8	2.5	10.7
Uttar Pradesh	33673.55	27234	36627.78	41997.73	2.1	3.5	-2.2	2.5
West Bengal	17708.36	17625.6	29175.72	32402.08	5.4	7.1	-4.2	5.3
Others	55290.13	44494.65	59207.4	75042.7	2	3.3	4.8	3.1
All India	**32343.25**	**28080**	**47372.64**	**54864.01**	**2**	**7.4**	**0.2**	**4.8**
CV	**41.3**	**38.4**	**61.2**	**41.5**				

Source: Calculated by author using data from ASI, India.

Jharkhand, Chhattisgarh, Gujarat, Uttarakhand, Maharashtra and Rajasthan were other high productivity states. On the other hand, West Bengal ($ 6,113.6), Assam ($ 6,556) and Punjab ($ 5,399.7) were at the bottom.

Growth rates of labour productivity reveal that labour productivity of Indian states grew at the highest rate of 7.4 percent during the period 2002-07 and was lowest during the latest period of 2008-11. For the period as a whole i.e., 1998-11 labour productivity in Indian manufacturing grew at a rate of 4.8 percent with highest growth shown by Uttarakhand (10.7 percent), Andhra Pradesh (8 percent), Himachal and Rajasthan (7.6 percent). Kerala even showed negative rate of growth for the period (1998-2011). Bihar, Haryana, Madhya Pradesh, Maharashtra, Odisha and West Bengal showed above average growth rates whereas Assam, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Punjab, Tamil Nadu, Uttar Pradesh and Other small states reported below average growth rates pf labour productivity during 1998-2011.

Table 6.2: Average Share of Five Highest Productivity Industries at all India Level in the Gross Value Added in Manufacturing Sector (2011-12)

States	24	27	29+30	32+33	34+35	Total
Andhra Pradesh	25.2	14.3	2.3	2.5	1.7	46.0
Assam	16.3	2.3	0.2	0.1	0.1	18.9
Bihar	1.1	0.9	11.3	0.0	0.0	13.3
Gujarat	31.3	5.7	7.1	0.9	1.7	46.5
Haryana	3.9	5.2	11.5	1.2	37.9	59.8
Himachal Pradesh	62.1	1.9	1.4	4.5	3.9	73.8
Karnataka	4.1	60.6	5.0	1.5	3.2	22.2
Kerala	19.5	1.7	1.2	4.8	3.2	30.4
Madhya Pradesh	14.9	4.0	4.2	0.2	7.8	31.1
Maharashtra	19.4	7.1	12.6	2.7	7.3	49.0
Odisha	3.9	72.6	0.2	0.0	0.1	76.8
Punjab	48.2	3.3	6.6	0.2	5.9	64.2
Rajasthan	13.6	6.1	2.6	1.7	25.0	49.0
Tamil Nadu	7.6	7.6	9.2	3.7	22.3	50.5
Uttar Pradesh	14.9	8.7	4.9	6.4	9.9	44.8
West Bengal	8.3	31.7	3.2	1.5	2.8	47.4
Jharkhand	3.8	42.8	4.3	0.2	21.5	72.6
Chhattisgarh	0.4	81.5	1.5	0.0	0.2	83.6
Uttarakhand	17.4	6.9	9.1	4.0	29.4	66.8
Others	26.3	14.0	2.9	2.0	1.1	46.2
India	**18.0**	**18.0**	**6.7**	**2.2**	**9.3**	**54.2**

Source: Calculated by author using data from ASI, India.

Overall productivity differences among the states may partly be due to varying composition of the manufacturing sector and partly due to differences in productivity within the same industrial groups. So to understand the prevailing differences in the labour productivity of various states composition effect as well as individual industry differences have been examined.

6.4.1 (A) Composition Effect

We can say that states with larger share of high productivity industries in their industrial structure would have higher aggregate productivity and vice-versa. So to test this, the share of five industries with highest labour productivity at all-India level for the year 2011 (viz. Chemical products, Basic Metal, Machinery, Communication Equipment and Transport Equipment) have been presented in table 6.2.

The share of the five highest productivity industries has been highest in Chhattisgarh (83.6 percent) followed by Karnataka (74.4 percent), Odisha (76.8 percent), Himachal Pradesh (73.8 percent) and Jharkhand (72.6 percent). Among these states, Chhattisgarh, Jharkhand and Himachal Pradesh fall in the category of high productivity states. Odisha also showed above average rate of labour productivity at all points of time. Other high productivity states namely Maharashtra, Uttarakhand and Gujarat also had substantial share of GVA coming from highest productivity industries. On the other hand, states namely, Punjab, Tamil Nadu and Haryana also had substantial shares coming from high productivity industries in 2011 but still their productivity level was below average. Low productivity states namely, Assam, Bihar and Kerala also had very low share of their manufacturing GVA coming form highest productivity industries.

6.4.1 (B) Differential State-Wise Performance of Individual Industries

Some part of the interstate productivity differentials in manufacturing sector could be attributed to the differences in the structure of industries but a part of it also exists, due to presence of interstate differences in productivity even in same industrial group. In basic metal the industry with highest labour productivity ($ 23,203.6) on all India basis generated a value added of $ 48,320 per worker in Uttarakhand and $ 2,938.9 in Bihar in 2011. Similarly, Chemical Products industry with next highest labour productivity level ($ 20,750) has a figure as high as $ 137,365.1 in Punjab followed by Himachal Pradesh with labour productivity in chemical industry at $ 39,272 but only $ 5,126 in Chhattisgarh and $ 5,265.7 in Bihar.

The highest productivity in any industry in any state has been in Coke and Petroleum Products in Maharashtra ($ 343,187.2), but is as low as $ 3,823 in Punjab. The group with lowest productivity at all India level has been Manufacturing of Wearing Apparels with a figure of $ 2,830. This showed a variation of labour productivity between $ 1,747.3 in Andhra Pradesh to $ 7,892 in Himachal Pradesh. Thus, we can say that besides the differential composition of industries, there have been large variations across states in their social, economic, technological and labour market characteristics which induce wide variations in regional productivity level of an industry.

6.4.2 Extent of Differences in Inter-Province Productivity in China

As shown in table 6.3, per worker productivity in China varied from $ 9,937 in Shanxi to $ 28,595 in Fujian in the year 2011-12. Shanghai, Guangdong, Beijing, Jiangsu, Zhejiang and Shandong were the other provinces reporting above average level of labour productivity ranging from $26,732 to $16,629. Shaanxi, Liaoning, Heilongjiang, Jiangxi, Henan, Hunan and Guangxi were at the bottom reporting labour productivity level below $12,000. One should note that all the high productivity provinces are coastal provinces and all the provinces in low productivity category are non-coastal provinces.

Table 6.3: Regional Labour Productivity in Chinese Manufacturing (1999-2011)

Province	Labour Productivity (in $)				Growth in Labour Productivity			
	1999	2002	2007	2011	1999-2001	2002-2007	2008-2011	1999-2011
Beijing	16629.9	29472.64	71016.82	112391.4	11.7	13	5.6	12
Hebei	13144.5	20238.4	59299.06	115105.4	4.9	16.8	7.8	15
Shanxi	8056.8	11745.28	49825.3	92341.69	2.8	24.2	16.6	17.4
Liaoning	11523.6	22016.64	66902.48	111598.1	14.3	17.5	10.1	15.9
Jilin	13675.5	31900.8	74419.54	143813.7	20.1	12.4	13	16.6
Heilongjiang	10516.2	19916.16	45938.42	91400.59	15.1	12.2	10.3	14.9
Shanghai	26732.1	39505.6	73543.7	110236.2	9.7	8.3	7.3	8.5
Jiangsu	17004.3	27258.56	56969.04	95642.35	9.7	10.4	6	7.2
Zhejiang	16680.6	23850.24	35212.78	60641.33	5	4.2	9.9	7.5
Anhui	13592.1	21966.4	55866.76	112508.2	7.6	14	13	14.5
Fujian	28595.7	35006.08	45907.48	79427.65	6.3	2.1	5.7	5.3
Jiangxi	9683.1	17297.6	52613.3	100705.7	12.8	17.5	11.4	16.5
Shandong	16683.9	26224.32	67901.06	121151.8	9	14.4	8.8	13.4
Henan	11133.6	17100.16	70662.54	99254.27	8.4	23.7	5.3	15.2
Hubei	15676.8	24246.4	57960.14	118168.8	8.5	12.9	15.8	13.7
Hunan	11974.2	22366.4	54846.42	114564.5	12.6	13.4	11.3	15.8
Guangdong	19185.9	26445.12	37845.74	56673.55	6.7	3.6	5.7	5.8
Guangxi	11639.4	19493.12	56752.46	95043.47	8.6	16.6	9.9	14.4
Sichuan	12279.6	21908.48	57756.48	99949.03	6.2	14.7	5.1	14.4
Shaanxi	9937.8	17438.72	58435.46	101908.8	12.4	19.4	18.6	16.8
Other Small	14565.9	25284.48	62347.84	125692.9	11.9	13.5	9.3	14.9
Total	**15814.8**	**25215.04**	**54055.92**	**84906.12**	**9.4**	**10.8**	**9**	**10.8**
CV	**35.2**	**27**	**18.9**	**19.7**				

Source: Calculated by author using data from CDO, China.

Now coming to 2011, it can be noted that Chinese provinces have shown huge improvement as 15 out of 21 provinces considered here have shown above average level of labour productivity ranging from $ 143,813 in Jilin to $ 101,908 in Shanxi. The lowest labour productivity has been reported by Guangdong ($ 56,673). So the difference between the highest value and lowest value of labour productivity has increased in China as was the case of India.

All the provinces except Fujian, Jiangsu, Zhejiang and Guangdong have shown double digit growth rate of labour productivity during 1999-2011. Overall labour productivity growth in Chinese manufacturing was 10.8 for the period 1999-2011 which is quite high as compared to Indian growth rate of mere 4.8 percent during 1998-2011.

Comparing India and China we see that in the initial year of the analysis, India ($ 6,102.5) reported higher labour productivity than China ($ 5,271.6), but in year 2011 Chinese labour productivity ($ 25,505.3) was more than double the level of Indian manufacturing labour productivity ($ 10,351.7). The extent of variation in regional labour productivity measured by coefficient of variation has been higher in Indian manufacturing as compared to Chinese manufacturing at all points of time considered here. The value of CV in Chinese regional labour productivity came down to 19.7 in 2001-12 from 35.2 in 1999-2000, whereas variation in Indian regional labour productivity has shown an increasing trend from 1998 to 2011.

Next we analyse the regional variation in labour productivity of Chinese manufacturing in terms of composition effect and individual industry differences.

6.4.2 (A) Composition Effect

As have been analysed above Zhejiang and Guangdong have been two provinces with least value of labour productivity. But the share of top five industries in terms of labour productivity in national manufacturing does not differ much in these provinces from other high productivity provinces namely Hubei and Hunan (table 6.4). Even the province with highest share of top five industries viz. Shanxi (62.2 percent) has been among the lowest performers in terms of labour productivity and Jilin had the highest labour productivity in the year 2011-12, but top five industries with highest labour productivity contribute only 10.9 percent to its GVA. So the composition effect does not hold a good explanation for the variance in the regional labour productivity.

Table 6.4: Average Share of Five Highest Productivity Industries at National Level in Gross Value Added in Manufacturing Sector of China (2011-12)

Provinces	16	23	27	31	36	Total
Beijing	0.8	3.8	16.0	5.1	2.5	28.1
Hebei	0.7	2.8	26.3	3.5	1.1	34.4
Shanxi	0.9	23.1	36.3	1.4	0.6	62.2
Liaoning	0.3	6.0	14.9	4.3	7.5	33.0
Jilin	1.6	0.8	6.4	1.4	0.6	10.9
Heilongjiang	2.4	13.4	4.3	2.5	1.8	24.3
Shanghai	6.5	2.5	7.2	6.3	3.5	26.0
Jiangsu	1.2	1.0	9.0	10.5	2.0	23.7
Zhejiang	2.0	2.1	6.1	9.0	5.0	24.1
Anhui	2.3	0.7	12.6	12.8	2.3	30.7
Fujian	2.0	1.2	6.4	4.9	7.6	22.0
Jiangxi	1.3	1.4	22.6	7.0	3.4	35.7
Shandong	0.7	5.2	9.3	4.6	3.3	23.1
Henan	1.6	1.8	14.8	3.8	3.3	25.3
Hubei	3.3	1.0	14.8	3.5	1.6	24.1
Hunan	6.6	2.5	15.6	3.5	2.2	30.3
Guangdong	0.9	3.9	3.5	19.1	0.0	27.4
Guangxi	2.8	5.0	18.8	3.7	2.0	32.2
Sichuan	1.8	1.9	12.9	3.8	3.0	23.4
Shaanxi	3.3	14.0	20.5	4.5	1.1	43.3
Other	11.4	5.7	25.2	3.6	1.6	47.4
China	**2.3**	**3.4**	**12.3**	**7.5**	**2.6**	**28.1**

Source: Calculated by author using data from CDO, China.

6.4.2 (B) Differential Province-Wise Performance of Individual Industries

As composition effect does not provide any satisfactory answer to the prevailing variance in Chinese manufacturing labour productivity, here we look at the differential performance of individual industries in various provinces of China. The industry with highest labour productivity at national level viz. Tobacco manufacturing ($ 264,922.5) has as low as labour productivity as $ 91,558.9 in Heilongjiang and as high as $ 828,436 in Guangxi in 2011-12. Leather industry has shown lowest labour productivity ($ 9,742.7) but it also showed highest labour productivity of $ 143,614.2 in Heilongjiang with its lowest value in Guangdong ($ 2,225). Now if we consider top rankers in each industrial group we find that Jilin and Shandong top in 4 out of 19 groups and both of them hold first and second position respectively in terms of level of labour productivity in 2011-12. No other clear winners or losers have come forth.

The only conclusion that follows is that in China non-coastal regions are rubbing shoulders with already developed coastal regions and provinces of Guangdong and Zhejiang which reported lowest labour productivity were also the one with high employment growth which certainly diminished there labour productivity value.

One needs to look beyond the concept of labour productivity to truly understand the process of manufacturing sector growth and spread in both economies.

6.5 Regional Total Factor Productivity in Indian and Chinese Manufacturing

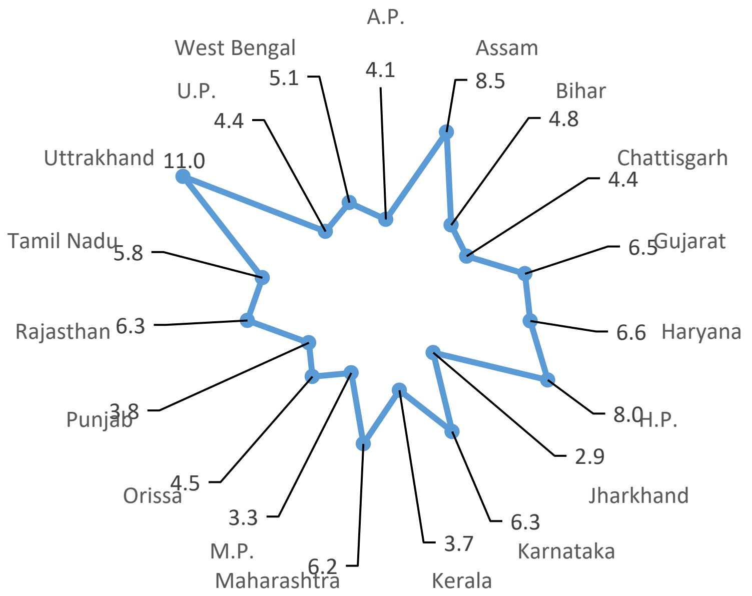
As we have seen in the earlier section that labour productivity in various regions of India and China has grown at differential rates. A particular industry performs very well in one region but the same industry performs poorly in another region at the same point of time. This indicates the prevalence of varied regional level characteristics which affect the performance of manufacturing sector of a particular region. One such factor is technology variation. Total factor productivity growth will help us to examine technology differential among regions in both economies.

6.5.1 State- Wise TFP Growth in Indian Manufacturing

The state-wise TFP growth in Indian manufacturing has been shown in figure 6.1. The state-wise TFP growth in Indian manufacturing ranged between 2.9 percent in Jharkhand to 11 percent in Uttarakhand. Madhya Pradesh (3.3), Kerala (3.7) and Punjab (3.8) were at bottom in TFP growth. For the states of Bihar (4.8), Chhattisgarh (4.4), Andhra Pradesh (4.1) and Odisha (4.5) TFP growth was below 5 percent. Medium growth in TFP was reported by Maharashtra (6.2), Rajasthan (6.3), Gujarat (6.5) and Haryana (6.6). Assam and Himachal were among the high TFP growth state with 8 percent TFP growth during 1998-2011. Therefore, wide inter-state variations in the rate of manufacturing TFP growth are clearly evident from the data.

New states like Uttarakhand and Himachal Pradesh are coming forward and already highly industrialised states of Maharashtra and Gujarat are showing signs of stagnation in TFP growth. States like Andhra Pradesh and Tamil Nadu who came a long way to join the lead of industrialised states already seemed to be struck with slow TFP growth which might impede their way to higher industrialization. Less industrialised states like Madhya Pradesh, Bihar and Kerala are still lagging behind with no sign of recovering.

Figure 6.1: State-Wise TFP Growth in Indian Manufacturing (1998-2011)

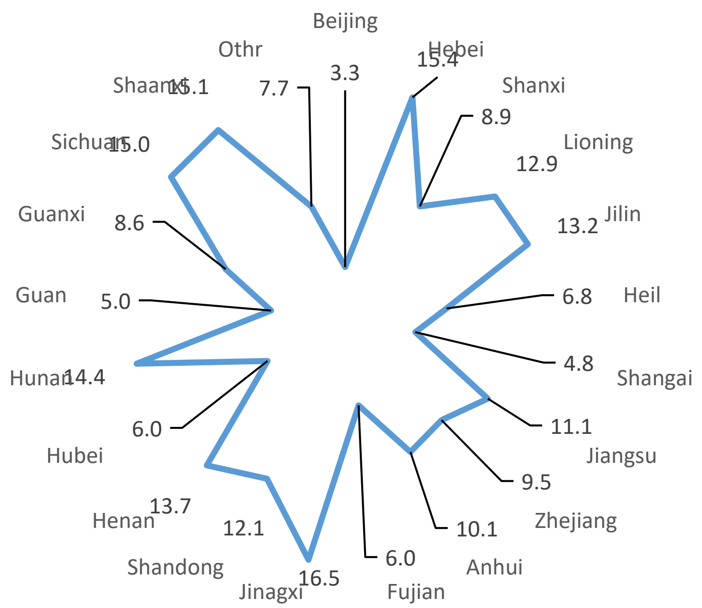


Source: Prepared by author using data from ASI, India.

6.5.2 Province- Wise TFP Growth in Chinese Manufacturing

The province-wise TFP growth in Chinese manufacturing has been shown in figure 6.2. The province-wise TFP growth in Indian manufacturing ranged between 3.3 percent in Beijing to 16.5 percent in Jiangxi. Provinces of Shanghai, Fujian and Guangdong were among the lowest performers whereas provinces namely Sichuan, Shaanxi, Hunan and Hebei were among the top performers. Here again we see that non-coastal provinces have shown better TFP growth in Chinese manufacturing sector.

Figure 6.2: Province-Wise TFP Growth in Chinese Manufacturing



Source: Prepared by author using data from CDO, China.

6.6 Spatial Spread of Industry and Total Factor Productivity Growth at Regional Level

The present section aims at determining how the productivity growth of a particular sector in a given region is affected by local specialization, competition, and industrial diversity.

6.6.1 Specialization versus Diversity Debate

A debate has emerged in the recent literature on how underlying economic structure within a geographic unit may influence the diffusion of knowledge spillovers and promote industrial development and growth over time (Audretsch, 1998). This debate revolves around two key structural elements: the degree of specialization versus diversity, and the degree of local competition versus monopoly (market structure). The specialization thesis suggests that increased concentration of a particular sector within a specific geographic region facilitates knowledge diffusion among firms within the same sector, enhancing research, development, and innovative activities. When firms in the same sector locate near each other, they benefit from externalities that are external to the firm but internal to the sector. Benefits include the sharing of a specific labour market, and of coded and implicit information as well as links within the sector. It asserts that concentration will also increase within-sector competition in the specific geographic unit of observation. Following Glaeser et al. (1992), we call this effect the MAR externality: accumulation of knowledge, development of an information network, and promotion of innovations among firms within the same sector are facilitated. These interactions affect local firms' productivity and might favour growth. In contrast, Jacobs (1969) argues that the most important source of knowledge spillovers is external to the sector in which firms operate. She develops a theory according to which the diversity and variety of industries within a geographic region promote a greater return on the exchange of economic knowledge across firms. Indeed, a diversified industrial environment facilitates the transmission of technological or knowledge externalities and innovative activities, thereby promoting local economic growth. Insofar as some ideas diffuse and can be used by noncompeting enterprises, local industrial heterogeneity can promote a more rapid diffusion of ideas. Combes (2000b) points out, however, that the beneficial effects of industrial heterogeneity require that innovations of one sector can be used in another sector. In other words, a ''Jacobs effect'' is synonymous to urbanization economies. These two theories are not necessarily mutually exclusive, as analysed by Porter (1990), who suggests that local competition is more growth-conductive than is local monopoly, but who also agrees with MAR's assertion that intra-industry specialization is a source of growth. The magnitude of these externalities and their impact on economic activity are not directly observable and are thus very difficult to assess empirically. However, in the last few years, there has been a burst of academic research in this area.

Some empirical research on agglomeration economies has attempted to assess the effects of different economic structures in explaining the location of activity and the process of local economic development. These studies are based on the idea that geographical proximity facilitates and intensifies transmission of information. Research examines the specialization and growth patterns of the studied area and focus on employment or production growth between two periods. Glaeser et al. (1992) measure economic performance in terms of employment growth. Their data set is composed of the six largest sectors in 170 US cities between 1956 and 1987. They assess the nature of local externalities through a specialization index (MAR externality), an industrial diversity index (Jacobs' externality), and a local competition index (market structure). They also include a convergence effect (catch-up) with the level of sectoral employment. All explanatory variables are measured at the initial date. Their results suggest that local competition and urban diversity are more important than specialization in generating employment growth, which is consistent with Jacobs' theory. These results suggest that important knowledge spillovers may occur between industries rather than within. Henderson et al. (1995) question the magnitude and the nature of these externalities. They study the period 1970–1987 and use data on eight specific manufacturing industries in 224 US metropolitan areas. They run their regressions for each sector separately and find evidence of MAR externalities for traditional industries and of both Jacobs and MAR externalities for new high-technology industries. The papers by Glaeser et al. (1992) and Henderson et al. (1995) provide several criticisms and extensions. They also encouraged the application of the two methodologies to other countries.

While studies that investigate the relationship between industrial structure and sectoral growth in developing countries are relatively scarce, we might mention papers by Henderson et al. (2001) on the Korean industry and Mody and Wang (1997) on coastal Chinese provinces. Exploiting a sample of 23 industrial sectors in seven coastal provinces over the 1985–1989 period, Mody and Wang found a negative impact of specialization and a positive effect of competition on local growth, as well as the existence of a quadratic relationship between the explained variable and each of these two explanatory variables.

6.7 A Regression Analysis with Agglomeration Externalities

6.7.1 Model Specification

This section aims at specifying a model which helps to determine various factors leading to Total Factor Productivity Growth (TFPG) in a particular region. Specifically, our baseline model takes the following functional form:

$$TFPG_{ir,1998-2011} = \beta_0 + \beta_1 Specialization._{ir} + \beta_2 Diversity_{ir} + \beta_3 Competition_{ir} + \beta_4 \ln TFP_{ir} + \beta_5 Xir + error_{ir} \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(6.1)$$

Here i refers to the industry, and r refers to the geographical unit (state). Our dependent variable is TFPG rate during 1998-2011. The independent variables are agglomeration externalities (Marshall, Jacobs, and Porter), intial TFP and X represents other region specific factors which have been included in the model drawing from literature for both India and China and are as follow:

1) **Exports:** It is very often hypothesised that increasing compulsions to compete in the global market could provide an impetus to improvement in productivity. Many studies (Trivedi et.at, 2011 , Ray,2014 and Blalock and Gertler, 2004) mention that exports lead to better productivity performance. More specifically it could a major reason for better performance of Chinese manufacturing than Indian manufacturing. In the present study, state wise export data of India has been taken from Ministry of Commerce and Chinese provincial level export data has been taken from China Statistical Yearbook (CSY).
2) **FDI:** Many studies **(**Bitzer & Gorg, 2009; Liu et al., 2000; Woo, 2009) have shown positive effect of FDI on growth. So in the present study we have taken regional level FDI as an independent variable affecting TFPG. State wise data for FDI has been taken from DIPP newsletters in case of India and Province level FDI data for China has been taken from CSY.
3) **Electricity per capita:** Inadequate growth of infrastructure is often viewed as one of the main constraints on productivity growth. Lucas (1988) and Romer (1990) emphasize the importance of infrastructural factors in providing a better environment for economic growth. In view of this, the rate of per capita availability of electricity has been used as the proxy for availability of

infrastructure. State-wise per capita availably of electricity has been taken form RBI for Indian economy and Chinese figures have been derived from CSY.

Apart from this, the Indian model includes two other specific variables

1) **Competitiveness Score**[22] : Competitiveness score considered in the present study has been calculated by considereing the various characteristics, such as, factor conditions (FC), demand conditions (DC), strategic context (SC), supporting conditions (SP) and their components.
2) **Labour regime :** For classifying Indian states into rigid or flexible in terms of labour regime the present study relies on the classification provided by Gupta et.al (2009). To derive the classification, Gupta et al. (2009) drew on Bhattacharjea (2006), which criticizes the methodology followed by Besley and Burgess (2004) to construct the Index. States have been classified as flexible or rigid based on the status of the rules relating to layoff, retrenchment and closure and giving workers or employers greater power in the procedures for resolving industrial disputes. Present analysis takes state-wise dummy as 1 for flexible labour regime and 0 for rigid labur regime.

Further the model for China includes dummies for coastal provinces (1 for coastal and 0 for non-coastal) and SEZs (1 for region with SEZ and 0 for region with no SEZ).

Our model is based on couples ‘‘region–sector,’’ by analogy, to couples ‘‘city–industry’’ of Glaeser et al. (1992). Regressions are estimated on pooled data for all manufacturing sectors, as in Glaeser et al. The estimation of unbalanced panel is based on fixed effect by sector model. Hausman test[23] statistics has been used to choose between fixed effect and random effect model. The modified Wald test showed presence of heteroscedasticity which has been corrected using White (robust) standard errors.

All explanatory variables are measured at the initial date, 1998 for India and 1999 for China. This is consistent with the idea that there is a lag between the emergence of agglomeration economies and their impact on firms’ location and regional growth; the stock of local specific knowledge accumulates over time. All variables are measured in logarithms, so the estimated parameters can be interpreted in terms of elasticity.

[22] Competiveness Score of Indian states has been taken from Trivedi et.al (2011).

[23] Hausman (1978) proposed a test to choose between random effects and fixed effects model. This test is based on the null hypothesis that random effects is the appropriate model. It checks whether the random effects and the repressors are orthogonal (Greene, 2008).

6.7.2 Empirical Findings

6.7.2. (A) Case of India

Estimation results reported in Table 6.7 provides evidence of the role played by industrial structure and region-specific variables in the economic performance of industrial sectors in Indian States. The analysis has been carried out for all industries first and then all industries have been categorized as labour intensive and capital intensive industries[24].

Regression on All Sectors

The initial level of TFPG in a state has a significant and negative effects on the TFPG of an industry. This indicates that productivity of backward states tend to grow faster as compared to productivity in advanced states. The initial level of specialization tends to have significant negative effect on the TFPG growth of an industry in a state. This means that industries which are more heavily concentrated initially in a state tend to report a slow growth in TFP. This finding contradicts MAR model. The initial level of the competition index has a positive estimated impact on sector-based growth. The positive sign implies that, in concordance with the implications of Jacobs and Porter, the presence of many small firms is a trigger of dynamic spillovers, and hence of growth. It is generally recognized that young establishments have greater flexibility and capacity to adapt to new conditions. Sectoral diversity positively affects growth. The positive influence of this variable supports the hypotheses that stress the importance of inter-industry externalities. Firms benefit from operating in an environment with a great variety of industries. However, as we are working at a relatively high level of aggregation a positive effect of the diversity might reflect the existence of commercial relationships between sectors, rather than the sharing and exploitation of technological complementarities between sectors.

The significant and positive coefficient of exports support the hypothesis of export led growth. Industries in the export oriented states witness higher growth of TFP. The volume of FDI in a states also affects the TFPG of industries in a positive way as shown

[24] Step wise regressions have been carried out where each externality variable was run for the manufacturing sector as whole first for both India and China. Based on the results of the separate regressions (presented in appendix) a combined regression model was run for the manufacturing sector as a whole.

Table 6.7: Determinants of TFPG at the Regional Level in India: The Regression Results

Dependant Variable: Total Factor Productivity Growth (1998-2011)

India	Total Sample	LI Industries	CI Industries
TFPG 1998	-1.034* (-14.671)	-0.321** (-2.004)	-1.267* (-3.761)
Specialization	-0.2271* (-3.363)	-0.122* (-3.090)	0.1488* (4.11)
Competition	0.0401** (2.183)	0.1107* (8.024)	0.0401* (5.183)
Diversity	0.368* (5.001)	0.241** (2.120)	0.482* (3.804)
Electricity Per Capita	0.843** (2.056)	0.652* (13.235)	0.892** (2.008)
Exports	2.091** (1.902)	3.012** (2.740)	2.671** (2.814)
FDI	1.082* (6.572)	0.178** (2.011)	1.472 (1.015)
Competitiveness Score	0.352* (4.519)	0.398* (4.519)	0.298* (5.400)
labour Regime	0.2980 (0.134)	0.0829 (1.004)	0.160 (0.046)
Number of Observations	380	185	195
R^2	0.62	0.67	0.59

Source: Prepared by author. Note: *,** indicates significant at 1 per cent and 10 per levels, respectively. Figures provided in brackets are the t values. All regressions include industry dummies.

by the positive and significant coefficient of FDI variable. The other main variable imposing a positive and significant effect on TFPG is found to be availability of electricity per capita which stresses the importance of infrastructure for better TFP performance of industries in a given state.

Regression on Labour Intensive Industries

Here again the initial level of TFPG in a state has a significant and negative effect on the TFPG of an industry. The initial level of specialization tends to have significant negative effect on the TFPG growth of labour intensive industries in a state. So we can say that MAR model does not hold good for TFP growth of labour intensive industries in India. The initial level of the competition index has a positive estimated impact on sector-based growth in labour intensive industries. Sectoral diversity positively affects growth of labour intensive industries but the coefficient is not significant. This result diminishes the importance of inter-industry externalities in labour intensive manufacturing across states of India. The significant and positive coefficient of exports support the hypothesis of export led growth in labour intensive industries. Even the extent of positive effect of exports on TFPG is higher in labour intensive industries. The volume of FDI in a state affects the TFPG of industries in labour intensive sector in a positive way as shown by the positive and significant coefficient of FDI variable but the extent of this effect is quite small. This indicates the small role played by foreign capital in labour intensive sector of Indian manufacturing. Availability of electricity per capita poses a significant and positive effect on TFPG of Indian labour intensive industries across various states. The positive and significant coefficient of competition score reflects that sectors benefit from their location in a more competitive state. State-wise labour regime does not affect TFPG significantly in Indian Industries.

Regression on Capital Intensive Industries

Here again the initial level of TFPG in a state has a significant and negative effect on the TFPG of an industry. The initial level of specialization tends to have significant positive effect on the TFPG growth of capital intensive industries in a state. So we can say that MAR model holds good for TFP growth of capital intensive industries in India. The initial level of the competition index has a positive estimated impact on sector-based growth in capital intensive industries. Sectoral diversity affects TFP growth of labour intensive industries in a significant and positive way. This result highlights the importance of inter-industry externalities in labour intensive manufacturing across states of India. Growth experience of capital intensive industries in India lends support to Jacob's hypothesis. The significant and positive coefficient of exports supports the hypothesis of export led growth in capital intensive industries. The volume of FDI in a state affects the TFPG of industries in capital intensive sector in a positive way as shown by the positive and significant coefficient of FDI variable. This highlights the important role played by foreign capital in capital intensive sector of Indian manufacturing across states of India. Availability of electricity per capita poses a significant and positive effect on TFPG of Indian capital intensive industries across various states.

6.7.2. (B) Case of China

Estimation results reported in Table 6.8 provide evidence of the role played by industrial structure and region-specific variables in the economic performance of industrial sectors in Chinese Provinces.

Regression on All Sectors

The initial level of TFPG in a province has a significant and negative effect on the TFPG of an industry. Hence we can say that productivity of backward provinces tends to grow faster as compared to productivity in advanced provinces of China. The initial level of specialization tends to have significant negative effect on the TFPG growth of an industry in a Province. This means that industries which are more heavily concentrated initially in a province tend to report a slow growth in TFP. This finding contradicts MAR model as the case was for India. The initial level of the competition index has a positive estimated impact on sector-based growth among Chinese provinces. The positive sign is in concordance with the implications of Jacobs and Porter's hypothesis i.e., the presence of many small firms is a trigger of dynamic spillovers, and hence of growth. Sectoral diversity positively affects productivity growth. The positive influence of this variable supports the importance of inter-industry externalities in Chinese sectors. The significant and positive coefficient of exports support the hypothesis of export led growth. Industries in the export oriented provinces witness higher growth of TFP.

Table 6.8: Determinants of TFPG at the Regional Level in China: The Regression Results

Dependant Variable: Total Factor Productivity Growth

China	Total Sample	LI Industries	CI Industries
TFPG 1999	-2.033* (-3.607)	-0.421* (-12.489)	-1.315* (-3.771)
Specialization index	-0.2271* (-4.143)	-0.122** (-2.010)	-0.1488* (-4.251)
Competition index	0.401* (5.183)	0.237* (5.024)	0.561* (4.183)
Diversity index	0.468* (4.001)	0.441** (2.020)	0.582* (3.413)
Electricity Per Capita	0.443** (2.016)	0.342* (6.115)	0.485* (5.363)
Exports	3.141** (2.948)	4.630* (7.564)	3.671* (5.114)
FDI	2.971** (2.051)	3.761** (2.113)	4.765* (4.327)
SEZ dummy	0.321 (1.019)	0.198** (2.219)	0.319** (2.100)
Coastal Dummy	0.2980* (3.832)	0.0829* (3.684)	0.160* (4.045)
Number of Observations	399	198	201
R^2	0.70	0.68	0.68

Source: Prepared by author. Note: *, ** indicates significant at 1 per cent and 10 per levels, respectively. Figures provided in brackets are the t values. All regressions include industry dummies.

The volume of FDI in a province also affects the TFPG of industries in a positive way as shown by the positive and significant coefficient of FDI variable. The other main variable imposing a positive and significant effect on TFPG is found to be availability of electricity per capita which stresses the importance of infrastructure for better TFP performance of industries on a given province. The significant and positive estimated coefficient of dummy variables coastal and SEZ reflects faster growth for sectors located in coastal provinces, other things equal. These results seem to confirm that the implementation of reforms openness to foreign investments, human and infrastructure endowments, development of the non-state sector, etc. has especially played an important role in the industrial growth process of coastal provinces in China

Regression on Labour Intensive Industries

The initial level of TFPG in a province has a significant and negative effect on the TFPG of labour intensive industries. The initial level of specialization tends to have significant negative effect on the TFPG growth of a labour intensive industry in a Province. The initial level of the competition index has a positive estimated impact on sector-based growth among Chinese provinces. Sectoral diversity positively affects productivity growth among labour intensive industries. Labour intensive Industries in the export oriented provinces witness higher growth of TFP as shown by positive and significant coefficient. The volume of FDI in a province also affects the TFPG of labour intensive industries in a positive way as shown by the positive and significant coefficient of FDI variable. Other main variable imposing a positive and significant effect on TFPG is found to be availability of electricity per capita which stresses the importance of infrastructure for better TFP performance of industries on a given province. The significant and positive estimated coefficient of dummy variables coastal and SEZ reflects faster growth for sectors located in coastal provinces, other things equal.

Regression on Capital Intensive Industries

The initial level of TFPG in a state has a significant and negative effect on the TFPG of a capital intensive industry. The initial level of specialization tends to have significant negative effect on the TFPG growth of an industry in a province. This means that industries which are more heavily concentrated initially in a province tend to report a slow growth in TFP. The initial level of the competition index has a positive estimated impact on sector-based growth among Chinese provinces. The significant and positive coefficient of exports support the hypothesis of export led growth. Industries in the export oriented provinces witness higher growth of TFP. The volume of FDI in a province also affects the TFPG of industries in a positive way as shown by the positive and significant coefficient of FDI variable. The other main variable imposing a positive and significant effect on TFPG is found to be availability of electricity per capita which stresses the importance of infrastructure for better TFP performance of industries on a given province. The significant and positive estimated coefficient of dummy variables coastal and SEZ reflects faster growth for capital intensive sectors located in coastal provinces, other things being equal.

The above regression analysis hints at the importance of role played by dynamic externalities in TFPG of manufacturing sector and its sub – sectors (namely labour intensive and capital intensive) in both economies. In the case of India all the variables hold good explanation of TFPG of manufacturing as a whole, labour intensive manufacturing and capital intensive manufacturing except for the case of specialization exerting negative impact on TFPG of labour intensive sector and the small role played by FDI in TFPG of labour intensive manufacturing as compared to capital intensive industries. On the other hand, in China MAR externalities did not hold good explanation for any category of manufacturing industries. Only competition externalities and diversity externalities exerted positive effect on TFPG of manufacturing industries. The major factor behind faster growth of China's manufacturing sector is the diverse environment available especially in the coastal areas and SEZs which triggered the TFPG of manufacturing sector and led to higher growth of manufacturing sector in China. So more diverse the industrial sector of a region, higher will be the TFPG of manufacturing sector.

6.8 Conclusion

In this chapter productivity level has been estimated in terms of labour productivity and productivity growth has been estimated in terms of both labour productivity and total factor productivity for the manufacturing sector of both India and China at regional level. In the case of India, the gap between lowest value and highest value has increased overtime. An analysis of composition effect and a look at state-wise performance of individual industries reveal that besides the differential composition of industries, there have been larger variations across states in their social, economic, technological and labour market characteristics which induce wide variations in regional productivity level of an industry. In the case of China, one should note that all the high productivity provinces are coastal provinces and all the provinces in low productivity category are non-coastal provinces. The extent of variation in regional labour productivity measured by coefficient of variation has been higher in Indian manufacturing as compared to Chinese manufacturing at all points of time considered here. The analysis of composition effect does not hold a good explanation for the variance in the regional labour productivity in China. The only conclusion that follows is that, in China, non-coastal regions are rubbing shoulders with already developed coastal regions and provinces of Guangdong and Zhejiang which reported least labour productivity were also the one with high employment growth which certainly diminished their labour productivity value. TFP performance of Chinese provinces has been much better than Indian states.

Further the results of the regression analysis carried out in this chapter highlight that the importance of dynamic externalities should not be examined by pooling all industries. The dynamic externalities may have a differential impact according to the nature of an industry. Specifically, it has been found out in the case of India that labour intensive industries benefit from diversity externalities whereas capital-intensive industries gain more from specialization. Competition externalities have a benign effect on productivity growth in both types of industries. These findings imply that the policies of specialization and diversification should be formulated according to the nature of an industry. In China diversity externalities and completion externalities hold better prospectus for productivity growth in both labour intensive and capital intensive manufacturing industries. Other important variables explaining regional level productivity growth in both India and China have been availability of infrastructure, level of competitiveness, FDI, exports and geographical location of the region (especially in China).

Chapter – 7

Summary and Conclusion

The Manufacturing sector has been regarded as the engine of economic growth. A sparkling example of manufacturing led economic growth model has been presented by China in last few decades. China's impressive performance in the manufacturing sector has stunned the world even as it increased its cheaply produced exports across the world. Indian economy on the other hand could not replicate the growth experience of the developed economies who followed traditional growth path. It stepped on an exceptional growth path with the service sector taking the lead. The manufacturing sector of India still contributes very little towards the national GDP, compared with the other developed and developing economies especially China. Many studies have been discussing one issue or another in the comparison of the growth experience of India and China. But few have undertaken a direct comparison of the performance of the manufacturing sector in both the economies.

In the present dissertation, an attempt has been made to compare the overall performance, structure, efficiency, cost and productivity of manufacturing sector of both the economies. The present study made a modest contribution to the literature on transitional economies, development economics and structural change. The analysis has been done at both two-digit industry and three-digit industry level. The study also attempted to understand the spatial phenomenon underlying the growth and productivity pattern of both economies by doing a regional analysis using disaggregated data at two-digit level. The study covered a period of 13 years from 1998-99 to 2011-12 for which comparable data was available and which has also been considered as the period witnessing fastest growth in both India and China. Data for various variables like gross value added, number of employees, net fixed capital and wages to workers has been taken from China Statistical Yearbook of various years, China Data Online (University of Michigan) and China Industrial Economy Yearbook of various years for China and Annual Survey of Industries has served as a source of industrial data for India. All the variables have been converted to 2005 constant prices.

7.1 Major Findings of the Study

While attempting to fulfill the outlined objectives, the present study has come up with following findings:

i) Structural Analysis of Manufacturing Sector of India and China at two-digit industry level

Structural analysis carried out in the present study revealed that there is not much difference in the structure of Indian and Chinese manufacturing value added and employment when looked at two-digit industry level. Chemical industry, Metal industry, Food industry and Machinery have been major contributing groups in value added of manufacturing sector of both India and China for the period 1995-96 to 2012-13. The major change taking place in Indian manufacturing has been that the share of Coke and Petroleum products rose dramatically in total manufacturing value added from 4.3% in 1995-96 to 11.7 % in 2012-13. The other new entrant into top five industrial groups contributing towards Indian manufacturing value added has been Transport industry. In case of China's manufacturing value added, the observation made in the study has been that the highest absolute rise in shares was shown by motor vehicle industry and metal and products. The growth structure of Indian and Chinese manufacturing seems to be inclined towards capital intensive sector. Labour intensive industries also have shown substantial improvement but their growth has been a little bit slower than the growth of capital intensive industries such as motor vehicle industry. The value added of manufacturing sector of China has shown higher growth rate than Indian manufacturing whereas employment growth has been higher in Indian manufacturing as compared to China's manufacturing over the period of present study.

ii) Technology Intensity of Manufacturing Sector of India and China

Analysis of technology intensity revealed the importance of high technology intensive industries in Chinese manufacturing value added whereas Indian manufacturing value added showed very low share of high technology intensive industries. Indian manufacturing value added is dominated by medium high technology intensive industries whereas Chinese manufacturing value added has highest share of low technology intensive industries. On the other hand, employment in India is still dominated by low technology intensive industries whereas Chinses manufacturing showed a balanced share of an industrial group in both value added and employment. This hints towards the prevalence of low productivity in Indian sectors.

iii) Labour Cost and Labour Productivity Performance of Indian and Chinese Manufacturing

Findings of the study revealed that till 2002 productivity in Indian manufacturing was higher than that of Chinese manufacturing sector. It was from 2003 onwards that labour productivity in Chinese manufacturing began to overtake labour productivity in Indian manufacturing. Inter-industry differences have been high in productivity values of two-digit industries in both the countries at both points of time (1995-96 and 2012-13) indicating a lot of inequality in productivity achievement of various industries within the manufacturing sector.

Further, the analysis carried out in the present research work showed that labour cost is less in India as compared to China but it is accompanied with low productivity and wasteful use of capital. Competitiveness as measured by Productivity/Wage ratio has been higher in China which is due to high labour productivity in China whereas in India wage has been low but productivity too is low hampering its competitiveness. Other notable feature of the labour cost and labour productivity analysis of manufacturing sector of both economies is that the growth rate of labour cost surpassed the growth rate of labour productivity during 2008-09 to 2012-13.

iv) Estimates of Stochastic Frontier Production Function on Manufacturing Sector of India and China (at three-digit industry level)

The time varying technical (in)efficiency parameter has been found to be 0.023 in case of India and 0.03 in case of China. It implies that level of technial efficiency in Indian manufactirng during 1998-99 to 2011-12 has been increasing to the extent of 2.3 per cent whereas in Chinese manufactirng during 1998-2011 technical efficency has been increasing to the extent of 3.0 per cent. So the rate of technical efficiency improvement in manufacturing sector has been higher in Chinese manufactuirng as comared to Indian manufactuirng.

The estimates of time coefficicnts of SFP of both economies show significant technical progres in all sub-categories (Technological categories) of Indian and Chinese manufactuing during 1998-2011 with Chinese coefficients having higher value. Findings of the study reveal that technical progress has played major role in growth of value added of the manufacturing sector in both economies. Both Indian and Chinese manufacturing sector lacked at technical efficiency front with India being behind China. China's manufacturing has shown higher TFPG and efficiency in high-tech industries whereas low-tech industries showed inefficiency effects. Whereas Indian manufacturing seemed to be backed up by high technical progress in medium low-tech industries. One of the most striking finding has been that in Indian manufacturing sector, technical progress failed to surpass the contribution of input growth towards output growth whereas China's manufacturing showed significantly more contribution of technical progress in output growth of the manufacturing sector as compared to the contribution made by input growth.

v) Pace of Industrialization among Indian States in Comparison with Chinese Provinces

The present study found that in the Indian economy many states witnessed declining share of manufacturing in their GDPs. On a whole may Indian regions seemed stagnated on the path of industrialization. States like Bihar, West Bengal, Assam and Chhattisgarh have shown very low level of industrialization in terms of growth in manufacturing GDP. On the other hand, in Chinese regional economy most of the provinces have had more than 40 percent of their GDP coming from the manufacturing sector. All coastal regions showed decreasing share of manufacturing in their GDP during the study period, including non-coastal province of Heilongjiang. All other regions showed increasing share of manufacturing in their GDPs. On whole level of industrialization of Chinese provinces has been higher than the level achieved by Indian states.

vi) Pattern of Regional Specialization and Industrial Concentration of Manufacturing Sector in India and China

In context of the proportion of total employment accounted for by the largest five industry groups in each province, this study found that the level of specialization of Chinese provinces has been quite low as compared to Indian states. In India largest five industries contributed share as large as 93.8 percent (Chhattisgarh) whereas in China largest contribution towards total manufacturing of a province has been 73.8 percent (Jilin) in 2011. Both economies have shown decreasing level of specialization over the period of time but still the level of specialization is very high in Indian regional manufacturing as compared to Chinese manufacturing. In case of China most of the industries have shown increasing concentration and regions have depicted declining specialization except coastal regions which have shown increased specialization.

vii) Regional Labour Productivity of Manufacturing Sector of India and China

Comparing India and China we see that in the initial year of the analysis India reported higher labour productivity than China but in year 2011 Chinese labour productivity was more than double the level of Indian manufacturing labour productivity. It has been observed that the labour productivity in various regions of India and China has grown at differential rates. A particular industry performs very well in one region but the same industry performs poorly in another region at same point of time. The composition analysis (by taking share of top five high productivity industries in a region) indicated the prevalence of varied regional level characteristics (social, economic, technological and labour market characteristics) which might have affected the performance of manufacturing sector of a particular region.

viii) Extent of Inter-Regional Variation in Labour Productivity of Indian and Chinese Manufacturing

Another finding of the study is that the extent of variation in regional labour productivity measured by coefficient of variation has been higher in Indian manufacturing as compared to Chinese manufacturing at all points if time considered here. The value of CV of Chinese regional labour productivity has decreased whereas variation in Indian regional labour productivity has shown an increasing trend.

ix) TFPG Performance of Regional Manufacturing in India and China

TFPG performance of Chinese provinces has been much better than Indian states. Even at technical efficiency front most of the Chinese provinces have performed better than their Indian counterparts. In India less industrialized states like Bihar, Madhya Pradesh, Kerala and Punjab have shown poor performance at TFPG front whereas Chinese provinces seem to follow convergent path as non-coastal provinces like Sichuan, Shaanxi, Hunan and Hebei have shown relatively high TFPG.

x) Dynamic Externalities and Regional Productivity Growth in Indian and Chinese Manufacturing

The regression analysis carried out in the present study, highlights the importance of dynamic externalities (Specialization, Competition and Diversity) in TFPG of manufacturing sector in India and China. It further contends that role of dynamic externalities in TFPG of a region should not be examined by pooling all industries. The dynamic externalities may have a differential impact according to the nature of an industry. Specifically, it has been found out in case of India that labour intensive industries benefit from diversity externalities whereas capital-intensive industries gain more from specialization. Competition externalities have a benign effect on productivity growth in both types of industries. In China diversity externalities and competition externalities hold better prospects for productivity growth in both labour intensive and capital intensive manufacturing industries. Regions with more competitive and diverse industrial environment tend to gain more in terms of TFPG.

xi) Region Specific Factors Affecting TFPG of Manufacturing sector in India and China

Along with dynamic externalities study also considered many other important variables explaining the growth in productivity of manufacturing sector. Infrastructure posed positive effect on TFPG of manufacturing in both economies. Similarly, FDI and exports of a region laid positive impact on TFPG of that region. Results of the regression analysis revealed that Indian states with higher competitiveness index record higher growth whereas the coefficient of labour regime turned up to be positive but insignificant in explaining TFPG of an Indian state. In case of China geographic location turns out to be an important variable in explaining TFPG of a region which means that regions located in coastal areas and SEZs have clear TFPG benefit than non-coastal and non-SEZ areas respectively.

7.2 Contrasts in Growth and Productivity Performance of Manufacturing Sector of India and China

All of the above summary findings highlight various aspects of manufacturing sector where India and China stand in contrast with each other. It has been observed that Indian manufacturing sector has not been able to match the remarkable growth achieved by Chinese manufacturing in absolute terms. This study has looked into various aspects of growth and productivity of manufacturing sector of both economies in detail on specified various parameters such as growth of manufacturing sector, labour productivity, TFPG, regional growth, spread of manufacturing and generation of dynamic externalities, where India's manufacturing sector lags behind Chinese manufacturing.

Clearly a prominent contrast lies in the absolute size of manufacturing sector of both economies. India’s manufacturing contributes merely 1.3 percent in world manufacturing whereas China’s manufacturing contributes 13.7 percent in world manufacturing (Bhatt, 2014). The results of the present study depicted that even the growth rate of Chinese manufacturing GVA has been higher than the growth rate of GVA of Indian manufacturing during 1995-96 to 2011-12. This hints towards the slow catch up by Indian manufacturing sector.

Here it must be noted that one of the reason for small size of manufacturing sector of India has been the dominance of the service sector. Even in the service sector business services, software, and financial services are the main components (Eichengreen and Gupta, 2011). The factors which promoted the growth of the service sector in Indian economy have roots back in history. Trade and finance have always played a significant role in India’s economic history through the ages, especially so from the British colonial days. The other factor leading to growth of the service industry in India has been the education system of the country that is to this day somewhat elitist and, in the past, caste based. Indeed, India’s software industry of the present day reflects the sort of caste oriented education which promoted services in the past (Teabe, 2003; Upadhay, 2004). On the other hand, the development of China’s manufacturing is the result of a combination of factors including broad based education, skill development, labour reallocation from agriculture to manufacturing, TVEs, privatisation, FDI, Chinese diaspora and the re-organisation of Asian production networks (Wei and Balasubramanyam, 2015). As rightly pointed out by Wei and Balsubramanyam (2015), India's managerial endowments and nature of education of its citizens are broadly different from that of China's managers and education patterns. These are the factors that explain the services orientation of Indian economy and manufacturing sector growth in Chinese economy.

Other prominent contrast in Indian and Chinese manufacturing lies in the level and growth of labour productivity. It has been found to be low in Indian manufacturing as compared to Chinese manufacturing. According to an article published by McKinsey & Company (2012), "Indian manufacturers lag behind their global peers in production planning, supply chain management, quality, and maintenance—areas that contribute to their lower productivity." The article also noted that the average worker in India's manufacturing sector is nearly five times less productive than a worker in Chinese manufacturing. The results of the present study have also confirmed the weak productivity performance of Indian manufacturing labour force as compared to Chinese manufacturing labour during 1995-96 to 2012-13.

The low level of labour productivity of Indian manufacturing sector could be attributed to the lack of well-planned policies especially relating to resource shift among sectors. As was the case of China where government deliberately emphasized the growth of agriculture sector in the earlier years. Once the output and productivity of agricultural sector reached a threshold level, it was able to release abundant labour into manufacturing sector of the economy. Agricultural employment as a share of labour force fell from more than 70% in 1978 (Sachs and Woo, 2001) to 60% in 1990. Fast forward to 2011, the figure stood at only 35% (Wei and Subhramanayam, 2015). The release of such a large number of economically active population from land hugely helped China's development of the labour-intensive, low- skilled manufacturing sector. According to a national survey by the All-China Federation of Trade Unions in 2007, the migrant workforce, with an average age of 32 and formal schooling of 10.4 years, was estimated to be 120 million, accounting for 64.4% of all workers in industry (Friedman and Lee, 2010). This highly flexible labour force with the required level of schooling offered manufacturers the much needed labour for industrial growth. On the other hand, such traits were missing in Indian economy. As Daugherty et al. (2009)

points out the resource shifts among Indian sectors have not been able to provide much needed impetus to labour productivity. Indian economy has been dealing with the problem of missing middle. On the hand, there are highly skilled well-educated workers and on the other hand there untrained less educated labourers straight out from the agricultural sector. These characteristics of Indian labour force have hampered Indian manufacturing sector from boosting the growth and productivity of labour intensive mass manufacturing. Even a marginally educated worker would try to seek a job in service sector rather than opting for working in manufacturing sector.

While looking at structure and technological intensity of manufacturing sector in India and China, the growth of capital intensive industries like Coke and Petroleum products in recent years in Indian manufacturing indicate that India seems to be in a hurry to rush to high end manufacturing by skipping proper development of labour intensive low end manufacturing. But still the share of high technology intensive manufacturing is quite low in Indian manufacturing as compared to Chinese manufacturing. Wei and Balasubramaniyam (2015), asserted that the comparison between China and India reveals that, though China has potential in all industries, India performs better than China in high-technology intensive industries. But findings of the present study reveal that at technical efficiency front medium low technology intensive and low technology intensive industries have performed better in India and compared to high-technology intensive industries during 1998-2011. High technology intensive industries in China have performed better than their Indian counterparts.

The Chinese manufacturing success in some high-tech products including cell phones, laptops, liquid crystal displays (LCDs), among others, can also be sourced to its industrial and export policies like setting up 'science parks' that encouraged quality FDI engaged in high-tech production (Berger and Martin 2011). Since the mid-1990s, FDI inflows into China has concentrated on advanced and high technology oriented industries such as electronics, bioengineering, aviation, aerospace, and IT (Sahoo and Bhunia, 2014). Thus the sophistication of Chinese manufacturing from low – technology intensive to high-technology intensive production is backed up by proper channelling of FDI into high-tech sector, particularly since the early 1990s. Shift in structure of Chinese manufacturing has been gradual form low – end manufacturing to high end manufacturing. Much of this value addition can be sourced to quality vertical

FDI, which has been lacking in India, because of its inability to position itself as a good production site (Sahoo and Bhunia 2014).

Other striking contrast has been found in the case of contribution of technical progress and input growth towards output growth of manufacturing sector in India and China. Indian manufacturing sector has been going through the phase of input driven output growth whereas China's manufacturing has sharpened the edge of technical progress. As pointed by Das et.al (2010), in Indian economy major source of growth has been factor accumulation and not productivity growth. Therefore, manufacturing sector showing an input driven output growth sector of India, does not remain outside the purview of the sustainability issue raised by Krugman (1994). As the analysis done in the present study reveals, Chinese manufacturing has shown the dynamism of productivity led growth during 1998-2011 which makes it a clear winner over Indian manufacturing.

Daugherty et al. (2009) holds extremely small scale of production in Indian manufacturing as one of the major causes of slow TFPG. The small scale of Indian industry arose in part by design i.e. the pre-reform licensing system meant that only one major company was allowed to operate in many industries, while other industries were reserved (as "small-scale industries"). While these market entry restrictions have been largely dismantled, their legacy continues to reduce competition, scale and productivity in many sectors. In addition, other regulations persist, notably those related to labour and administrative approvals, which also constrain firms' growth (Conway and Herd, 2008). Larger establishments often use newer technologies and thus achieve higher productivity, while smaller establishments are much less productive.

While carrying out the regression analysis to understand various factors leading to TFPG growth the present study found that infrastructure indicator laid positive and significant impact on regional TFPG of manufacturing sector in both India and China. According to Chuan (2008), China's success in export-orientated manufacturing is largely supported by infrastructure development, and contributes to the economic growth. From 2000 to 2005, China's road length increased from 250,700 km to 1,930,500 km. The length of running railway network increased at a rate of 9.9 per cent from 2000 to 2005. During the same period, electricity power generation capacity grew at an annual rate of 12.8 per cent (ibid). In fact, starting way back in the 1980s, China started building new coal mines to supply its power plants while developing modern power grids, and as a result power generation capacity in China went up by 400 per cent between 1990 and 2003 (Meredith 2008). With the growth in infrastructure spending grew the inflow of FDI and export volumes. Studies show that FDI in China was more concentrated in areas which boasted superior physical infrastructure and connectivity. In contrast, India's physical infrastructure is grossly undersupplied, thus deterring investments in manufacturing. The magnitude of the deficit in infrastructure can be gauged from the fact that according to the document of 12th five year plan an estimated $1 trillion of investments would be required in India's infrastructure development alone during 2012 to 2017.

Despite having a suitable factor market to attract export oriented FDI, India has not been able to fetch adequate FDI in manufacturing just because of inadequate infrastructure and inflexible labour markets (Sahoo 2012a; Pradhan and Abraham 2005).

The regional analysis carried out in the present study revealed large differences in the inter-regional performance of manufacturing in both economies but the level of variation among Indian states has been higher as compared to Chinese provinces. Ark et al., (2008) states, "During the course of reforms in China the inefficient activities which were carried out at the wrong places, given the large differences in gaps for comparative productivity and labor cost levels relative to the national average, have been mostly eradicated leading to decreased regional variation in Chinese manufacturing during the period of study. Such transition forces, on the other hand, do not seem to be at work in India, at least not during the time period of this study". The small change in inequality (and in many cases an increase in dispersion) points to the existence of barriers to resource mobility. Spread of Indian regional manufacturing showcased higher regional specialization and greater industrial concentration as compared to China. Regression analysis carried out in the present study confirmed the positive role of diversification externalities in TFPG of manufacturing sector and diversity is higher in China's regional manufacturing at its present level of development as compared to Indian regional manufacturing. The higher specialization showed by

Indian regional manufacturing also acts as impediment in the way of attaining higher TFPG.

The Way Forward

Having achieved a high level of cheap labour intensive manufacturing, China should look into its next stage of industrial development, especially high-end products. Similarly, if India has to take advantage of its low-cost manufacturing it will have to work on improving productivity in its low-technology labour-intensive sector. The challenge for India lies in strengthening its low technology intensive and labour intensive base first so as to take the advantage of low labour cost and its vast labour pool. In India low technology intensive industries have shown improved efficiency but this has been accompanied by low technical progress. India needs firm base in low end products in the value chain so as to embark on the path of high end product manufacturing with high rate of technical progress and higher technical efficiency.

The competitiveness of Indian manufacturing depends heavily on the availability of a low-cost skilled workforce. To provide skilled labour to manufacturing sector India need to undertake significant reforms in the education sector. There is a case of 'missing middle' in India which refers to relatively weak vocational and technical education sector. The rapid growth of manufacturing in the PRC was certainly helped by the broad dissemination of industrial education (Anantaram and Saqib, 2010). The challenge for further industrial growth in China seems to be quality and improving efficiency. China needs to implement measures to narrow down the efficiency gap and keep the technical progress emulating through leaning by doing, absorbing advanced technology and improving efficiency of manufacturing processes.

The pattern of regional concentration of manufacturing in China depicts that some industries are still becoming more concentrated only in coastal regions leading to increased specialization in these regions. This hints that rising labour cost alone may not be a sufficient condition for industries to re-locate from coastal to central China. Many other factors might be holding these industries to the coastal regions. On the other hand, the newly developing industrial bases in inner China are getting more diversified with time and showing better growth performance. Indian states also need to diversify their industrial structure to enter the next level of industrial growth. Further, the policies of specialization and diversification should be formulated according to the nature of an industry as dynamic externalities have differential effects on labour intensive and capital intensive industries. The variations across regions in their social, economic, technological and labour market characteristics should be addressed in both India and China which can induce wide variations in productivity level and growth of an industry.

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Appendix

Table A1 : Two-Digit Classification of Manufacturing Industries

ISIC -3.1 Code - Industry Name	Present Study Name Used	NIC-2004 Code	GB-2002 Code
15 - Manufacture of Food Products and Beverages	Food Industry	15	1314+15
16-Manufacture of Tobacco Prodcts	Tobacco Industry	16	16
17-Manufacture of Textile	Textile Industry	17	17
18-MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR	Apparal Indsutry	18	18
19-TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE, HANDBAGS SADDLERY, HARNESS AND FOOTWEAR	Leather Indsutry	19	19
20-MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK,EXCEPT FURNITURE;MANUFACTURE OF ARTICLES OF STRAW AND PLATING MATERIALS	Wood Industry	20	20
21-Manufacture of paper and paper product	Paper Industry	21	22
22: PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	Printing	22	23
23: MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	Coke and Petroleum Industry	23	25
24: MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS	Chemicals Industry	24	26+27+28
25: MANUFACTURE OF RUBBER AND PLASTIC PRODUCTS	Rubber Industry	25	29+30
26: MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS	Non-Metallic Mineral Industry	26	31
27-Manufacture of Basic Iron & Steel + 28-MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENTS	Metal Industry	27+28	32+33+34
29-MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.+30 +31: MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS N.E.C + 32: MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION EQUIPMENT AND APPARATUS+33	Machinery Indsutry	29+30+31+32+33	35+36+41+39
34: MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS+35	Transport Industry	34+35	37
36: MANUFACTURE OF FURNITURE; MANUFACTURING N.E.C	Other Manufacturing	36	21+42+24

Table A2: Concordance of Industrial Classification of India with ISIC-3.1

ISIC-3.1	NIC-2004		GB-2002

15 - Manufacture of Food Products and Beverages	**15**		**13**	**14**	**15**				
151- Production, processing and preservation of meat, fish, fruit vegetables, oils and fats.	151		133	135	136	-1363	137	139	-1391
152-Manufacture of dairy product	152		144						
153-Manufacture of grain mill products, starches and starch products, and prepared animal feeds	153		131	132	1391	1363			
154-Manufacture of other food products	154		141	134	-1493	all other remaining			
155-Manufacture of Beverages	155		15						
16-Manufacture of Tobacco Prodcts	**16**		**16**						
160-Manufacture of Tobacco Products	160		161	162	169				
17-Manufacture of Textile	**17**		**17**						
171-Spinning, weaving and finishing of textiles.	171		171	172	173	174			
172-Manufacture of other textiles	172		175						
173-Manufacture of knitted and crocheted fabrics and articles	173		176						
18-MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR	**18**		**18**	**193**	**194**				
181-Manufacture of wearing apparel, except fur apparel	181		18						
182-Dressing and dyeing of fur; manufacture of articles of fur	182		193	194					

19-TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE, HANDBAGS SADDLERY, HARNESS AND FOOTWEAR	**19**		**19**	**-193**	**-194**				
191-Tanning and dressing of leather, manufacture of luggage handbags, saddlery & harness.	191		191	192	-1921				
192-Manufacture of Shoes	192		1921						
20-MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK,EXCEPT FURNITURE;MANUFACTURE OF ARTICLES OF STRAW AND PLATING MATERIALS	**20**		**20**						
201-Saw milling and planing of wood	201		201						
202-Manufacture of products of wood, cork, straw and plaiting materials	202		202	203					
21-Manufacture of paper and paper product	**21**								
210Manufacture of paper and paper product	210		221	222	223				
22: PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	**22**		**23**						
221:Pulishing+222:Printing	221+222		231	232					
223:Reproduction of recorded media	223		233						
23: MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	**23**		**25**	**25**					
231-Manufacture of coke oven products	231		252	252					

232-Manufacture of refined petroleum products	232			251					
233-Processing of nuclear fuel	233			253					
24: MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS	**24**		**26**	**27**	**28**				
241-Manufacture of basic chemicals	241		261	262					
242-Manufacture of other chemical products	242		263	264	265	266	267	27	1493
243-Manufacture of man-made fibers	243		28						
25: MANUFACTURE OF RUBBER AND PLASTIC PRODUCTS	**25**		**29**	**30**					
252-Manufacture of rubber products	251		29						
253-Manufacture of plastic products	252		30						
26: MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS	**26**		**31**						
261-Manufacture of glass and glass products	261		314						
269-Manufacture of non-metallic mineral products n.e.c.	269		31	-314	347				
27-Manufacture of Basic Iron & Steel	**27**		**32**	**33**					
271-Manufacture of Basic Iron & Steel	271		32						
272-Manufacture of basic precious and non-ferrous metals	272		33						

273-Casting of metals	273		3591						
28-MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENTS	**28**		**34**						
281-Manufacture of structural metal products, tanks, reservoirs and steam generators	281		341	343	3511				
289-Manufacture of other fabricated metal products; metal working service activities			3592	342	344	345	346	348	349
29-MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.	**29**		**35**	**36**					
291-Manufacture of general purpose machinery	291		35	-3511	-3592				
292-Manufacture of special purpose machinery	292		36						
293-Manufacture of domestic appliances, n.e.c.	293		395	396					
30- MANUFACTURE OF OFFICE, ACCOUNTING AND COMPUTING MACHINERY	**30**		**404**	**4113**	**4154**	**4155**	**4159**	**4126**	
31: MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS N.E.C	**31**		**39**						
311-Manufacture of electric motors, generators and transformers	311		391	3921					
312-Manufacture of electricity distribution and control apparatus	312		392	-3921					
313-Manufacture of insulated wire and cable	313		393						

314-Manufacture of accumulators, primary cells and primary batteries	314		394						
315-Manufacture of electric lamps and lighting equipment	315		397						
319-Manufacture of other electrical equipment n.e.c.	319		399						
32: MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION EQUIPMENT AND APPARATUS	**32**		**40**	**-404**					
321-Manufacture of electronic valves and tubes and other electronic components	321		405	406					
322+323-Manufacture of television and radio transmitters, receivers and apparatus for line telephony and line telegraphy	322+323		401	403	407	409			
33- MANUFACTURE OF MEDICAL, PRECISION AND OPTICAL INSTRUMENTS, WATCHES AND CLOCKS	**33**		**41**						
331-Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes except optical instruments	331		411	412	419	-4113	-4126		
332-Manufacture of optical instruments and photographic equipment	332		414	4151	4152	4153			
333-Manufacture of watches and clocks	333		413						
34: MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	**34**		**372**						
341-Manufacture of motor vehicles+342+343	341+342+343		372						

35: MANUFACTURE OF OTHER TRANSPORT EQUIPMENT	**35**		**37**	**-372**					
351-Building and repair of ships & boats	351		375	3791					
352-Manufacture of railway and tramway locomotives and rolling stock	352		371	3792					
353-Manufacture of aircraft and spacecraft	353		376						
359-Manufacture of transport equipment n.e.c.	359		373	374	3799				
36: MANUFACTURE OF FURNITURE; MANUFACTURING N.E.C	**36**		**21**	**42**	**24**				
361-Manufacture of furniture	361		21						
369-Manufacturing n.e.c.	369		42	24					

Table A3: Technological Classification of Three-Digit Manufacturing Industries

India	China
HT	**HT**
300	300
321	321
322+323	322+323
331	331
332	332
333	333
353	NA
MHT	**MHT**
241	241
242	242
291	291
292	292
293	293
311	311
312	312
313	313
314	314
341+342+343	315
352	319
359	341+342+343
315	352
319	359
243	243
MLT	**MLT**
231	231
232	232
251	251
252	252
261	261
269	271
271	272
272	281

281	289
289	351
351	262
273	
LT	**LT**
151	151
152	152
153	153
154	154
155	155
160	160
171	171
172	172
173	173
181	181
191	182
192	191
201	192
202	201
210	202
221+222	210
361	221+222
369	223
182	361
223	369

Table A4: Compound annual Growth Rate of of Value Added in Indian and Chinese Manufacturing

	1995-2001	2001-2007	2008-2012	1995-2012	1995-2001	2001-2007	2008-2012	1995-2012
Food	-0.6	10.3	20.2	9.8	9.3	13.6	16.7	14.6
Tobacco	10.2	6.3	4.7	8.5	3.2	14	11.4	11
Textile	4.7	10	23.8	10.6	8.7	18	11.2	12.8
Apparel	4.1	13.5	11.6	9.3	10.7	17	9.4	13
Leather	0.4	10.4	10.3	7.9	7.3	19.3	10.4	14.8
Paper	18	10.3	19.4	12.7	9.9	18.6	11.5	14.1
Publishing	5.9	14.2	26.4	13.2	1.1	14.6	8.9	10.7
Coke and Petroleum	5.7	26.3	7.2	16.4	19.3	17.9	14	16.3
Chemical	-1.5	9.9	11.7	7.4	11.1	20.2	11.7	14.6
Rubber	0.9	9.8	21.2	13.5	9.8	19.5	12.7	14.6
Non-Metallic Mineral	11.7	18	-6.6	9.5	-1.7	19.8	17.6	14.4
Basic Metal	-1.4	22.6	17.7	10.2	10.5	23.3	12.5	16.6
Machinery	-3.5	16.1	20.6	11.3	10.7	12.2	8.7	10.8
Wood	-6.7	10.5	23.4	10.6	18.2	18	12.6	14.8
Transport	2	14.5	18	12.3	1.1	38.9	13.2	20.3
Other	1.8	11.9	5	10.1	-24	28	12.6	12.5

Source: Prepared by author from ASI, India and CIEY, China Various Years

Table A5: Compound annual Growth Rate of of Employment in Indian and Chinese Manufacturing

	1995-2001	2001-2007	2008-2012	1995-2012	1995-2001	2001-2007	2008-2012	1995-2012
Food	-0.4	2	3.2	2.5	0.1	-1.2	3	2.7
Tobacco	2.1	-2.5	-2.1	0	-5.5	-4.1	-1	-2.7
Textile	-1.6	3	2.8	2.2	-3.7	3.8	-3.9	-0.1
Apparel	5.6	9.8	0.6	5.3	4	7.7	-6.6	2.9
Leather	3.9	5.9	5.9	6.3	3.3	10.7	-2.2	5.7
Paper	1.4	5.7	3.1	3.1	-3.3	2.8	-2.2	0.5
Publishing	-1.1	3.7	7.4	4.4	-5.1	3.6	-6.5	-0.7
Coke and Petroleum	-2.6	6.6	-2.7	2.1	-7.8	4.3	3.3	1.2
Chemical	0.8	2.3	4.9	3.2	-3.9	2.9	-1.1	0.4
Rubber	-5	4.2	4.5	4	-1.6	7.9	-2.4	2.9
Non-Metallic Mineral	0.3	5.3	5.6	5.3	-12	1.9	-0.3	-1
Basic Metal	7.6	9.7	3.2	3.9	-2.5	4.6	-0.8	1.8
Machinery	-11.8	5.2	4.7	3	3.1	5.8	1.2	4.3
Wood	-9.4	4.2	-0.6	0	3.2	13.3	5.1	8
Transport	-9.3	5.9	8.1	3.6	-1.1	20.7	-3.3	7.6
Other	-0.4	7.8	3.8	5.9	-34	18.3	-4.3	1

Source: Prepared by author from ASI, India and CIEY, China Various Years

Table A6: Compound Annual Growth rate of Capital Intensity

Industry	India				China			
	1995-2001	2002-2007	2007-2012	1995-2012	1995-2001	2002-2007	2007-2012	1995-2012
Food	10.14	29.09	27.69	9.69	27.64	34.24	13.94	31.35
Tobacco	33.28	45.68	17.90	15.37	7.40	26.91	10.25	24.58
Textile	3.08	22.99	30.27	4.52	30.14	38.26	13.59	30.68
Apparels	-2.55	0.42	11.40	-1.46	17.52	9.44	17.79	11.82
Leather	-0.33	12.54	11.84	-0.29	25.92	13.32	22.21	16.72
Wood	10.69	15.46	32.43	13.26	38.44	41.04	22.10	37.16
Paper	6.52	20.70	11.32	3.40	29.96	32.92	17.51	27.86
Publishing	22.17	23.16	16.14	7.66	23.48	31.72	14.88	28.87
Coke & Petroleum	20.78	6.51	39.03	27.11	6.11	26.85	13.73	23.84
Chemical	8.06	27.50	15.20	5.97	14.49	41.00	21.52	29.23
Rubber	7.62	19.28	9.57	4.20	27.79	46.85	21.14	38.46
Non-Metallic	12.48	26.27	-0.14	7.15	10.05	43.14	33.97	39.98
Basic Metal	2.33	7.95	0.27	8.05	11.59	46.30	25.48	39.68
Machinery	7.23	17.10	7.02	7.76	30.46	23.10	28.00	19.37
Transport	14.83	10.88	14.64	7.66	17.87	23.37	28.01	20.03
Other	12.07	10.05	-2.46	5.55	-4.12	41.19	19.24	38.89
All Industries	6.57	19.35	10.03	8.37	18.02	28.14	18.17	26.82

Source: Prepared by author from ASI, India and CIEY, China Various Years

Table A7: Mean Efficiency Scores of Indian Manufacturing Industries

India	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
300	0.851	0.842	0.836	0.844	0.848	0.839	0.834	0.842	0.836	0.734	0.848	0.852	0.842	0.837
321	0.760	0.961	0.957	0.840	0.758	0.958	0.954	0.837	0.892	0.865	0.843	0.761	0.962	0.958
322+323	0.896	0.897	0.892	0.896	0.894	0.894	0.889	0.893	0.628	0.626	0.899	0.897	0.897	0.892
331	0.649	0.603	0.636	0.631	0.647	0.601	0.634	0.629	0.981	0.951	0.829	0.837	0.841	0.831
332	0.985	0.985	0.985	0.985	0.982	0.982	0.982	0.982	0.836	0.800	0.989	0.986	0.986	0.986
333	0.828	0.857	0.861	0.839	0.826	0.855	0.859	0.836	0.835	0.795	0.842	0.829	0.858	0.862
353	0.828	0.857	0.861	0.839	0.826	0.855	0.859	0.836	0.835	0.795	0.875	0.860	0.898	0.895
HT	**0.828**	**0.857**	**0.861**	**0.839**	**0.826**	**0.855**	**0.859**	**0.836**	**0.835**	**0.795**	**0.875**	**0.860**	**0.898**	**0.895**
241	0.860	0.961	0.957	0.840	0.758	0.958	0.954	0.837	0.892	0.865	0.843	0.761	0.962	0.958
242	0.896	0.897	0.892	0.896	0.894	0.894	0.889	0.893	0.628	0.626	0.899	0.897	0.897	0.892
291	0.985	0.985	0.985	0.985	0.982	0.982	0.982	0.982	0.836	0.800	0.989	0.986	0.986	0.986
292	0.895	0.895	0.976	0.856	0.773	0.977	0.973	0.854	0.910	0.882	0.860	0.915	0.900	0.895
293	0.946	1.057	1.053	0.923	0.834	1.054	1.050	0.921	0.981	0.952	0.927	0.837	1.058	1.054
311	0.986	0.986	0.981	0.985	0.983	0.983	0.978	0.982	0.691	0.689	0.989	0.987	0.987	0.982
312	0.853	0.883	0.887	0.864	0.851	0.880	0.884	0.862	0.860	0.819	0.901	0.886	0.925	0.921
313	0.984	0.984	0.986	0.865	0.781	0.987	0.983	0.862	0.919	0.891	0.868	0.925	0.909	0.904
314	0.829	0.858	0.862	0.840	0.827	0.856	0.860	0.837	0.835	0.796	0.843	0.830	0.859	0.863
341+342+343	0.923	0.923	0.918	0.922	0.921	0.921	0.916	0.920	0.647	0.645	0.926	0.924	0.924	0.919
352	0.869	0.821	0.855	0.850	0.767	0.819	0.853	0.848	0.892	0.979	0.854	0.862	0.866	0.856
359	0.883	0.903	0.897	0.894	0.851	0.880	0.884	0.862	0.861	0.824	0.990	0.987	0.987	0.987
315	0.853	0.883	0.887	0.864	0.851	0.880	0.884	0.862	0.860	0.819	0.868	0.854	0.884	0.888
319	0.889	0.908	0.912	0.856	0.819	0.908	0.909	0.854	0.871	0.835	0.871	0.880	0.898	0.896
243	0.933	0.933	0.928	0.932	0.930	0.930	0.925	0.929	0.654	0.652	0.935	0.933	0.934	0.928
MHT	**0.906**	**0.925**	**0.932**	**0.891**	**0.855**	**0.927**	**0.928**	**0.887**	**0.822**	**0.805**	**0.904**	**0.898**	**0.932**	**0.929**
231	0.689	0.501	0.616	0.512	0.638	0.690	0.602	0.804	0.767	0.731	0.767	0.805	0.844	0.861
232	0.749	0.672	0.678	0.706	0.750	0.750	0.673	0.864	0.828	0.793	0.828	0.865	0.911	0.930
251	0.675	0.575	0.594	0.626	0.666	0.677	0.576	0.790	0.750	0.709	0.750	0.792	0.825	0.841
252	0.675	0.694	0.542	0.654	0.689	0.676	0.695	0.790	0.723	0.657	0.723	0.791	0.796	0.812
261	0.674	0.592	0.539	0.621	0.654	0.676	0.593	0.789	0.721	0.654	0.721	0.791	0.794	0.809
269	0.664	0.521	0.418	0.557	0.587	0.666	0.522	0.779	0.656	0.533	0.656	0.781	0.722	0.736
271	0.700	0.647	0.605	0.662	0.701	0.701	0.648	0.815	0.767	0.720	0.767	0.816	0.844	0.861
272	0.721	0.666	0.623	0.682	0.722	0.722	0.668	0.839	0.790	0.741	0.790	0.841	0.869	0.887
281	0.695	0.612	0.549	0.633	0.670	0.696	0.613	0.811	0.738	0.665	0.738	0.813	0.812	0.828

289	0.714	0.660	0.617	0.675	0.715	0.715	0.661	0.831	0.783	0.734	0.783	0.832	0.861	0.878
351	0.735	0.680	0.635	0.695	0.737	0.736	0.681	0.856	0.806	0.756	0.806	0.857	0.887	0.904
273	0.709	0.624	0.560	0.646	0.684	0.710	0.625	0.827	0.753	0.678	0.753	0.829	0.828	0.844
MLT	**0.700**	**0.620**	**0.581**	**0.639**	**0.684**	**0.701**	**0.630**	**0.816**	**0.757**	**0.698**	**0.757**	**0.818**	**0.833**	**0.849**
151	0.574	0.336	0.544	0.553	0.591	0.603	0.621	0.694	0.627	0.697	0.673	0.700	0.784	0.753
152	0.447	0.344	0.518	0.527	0.461	0.590	0.608	0.661	0.681	0.739	0.754	0.679	0.707	0.792
153	0.5550	0.511	0.526	0.535	0.572	0.583	0.601	0.677	0.608	0.728	0.671	0.761	0.769	0.714
154	0.597	0.349	0.566	0.575	0.615	0.627	0.646	0.722	0.652	0.725	0.700	0.728	0.815	0.783
155	0.583	0.537	0.553	0.562	0.600	0.612	0.631	0.711	0.639	0.765	0.705	0.799	0.807	0.749
160	0.590	0.466	0.548	0.558	0.595	0.607	0.626	0.703	0.633	0.739	0.692	0.763	0.797	0.749
171	0.603	0.479	0.561	0.571	0.608	0.620	0.639	0.716	0.646	0.752	0.705	0.776	0.810	0.762
172	0.461	0.354	0.534	0.543	0.475	0.608	0.626	0.681	0.701	0.761	0.776	0.700	0.728	0.816
173	0.453	0.215	0.423	0.432	0.470	0.482	0.500	0.573	0.506	0.576	0.552	0.579	0.663	0.632
181	0.505	0.349	0.506	0.515	0.518	0.570	0.588	0.657	0.618	0.696	0.678	0.685	0.734	0.737
191	0.644	0.501	0.398	0.537	0.567	0.646	0.502	0.759	0.636	0.513	0.636	0.761	0.702	0.716
192	0.516	0.355	0.465	0.507	0.507	0.576	0.554	0.667	0.615	0.637	0.660	0.681	0.707	0.725
201	0.621	0.493	0.578	0.588	0.627	0.639	0.658	0.738	0.665	0.775	0.726	0.799	0.834	0.785
202	0.594	0.450	0.481	0.544	0.567	0.620	0.571	0.722	0.639	0.642	0.674	0.747	0.748	0.742
210	0.574	0.433	0.548	0.573	0.579	0.631	0.620	0.724	0.688	0.711	0.728	0.732	0.774	0.798
221+222	0.596	0.459	0.536	0.568	0.591	0.630	0.616	0.728	0.664	0.709	0.709	0.759	0.786	0.775
361	0.633	0.503	0.590	0.600	0.639	0.652	0.671	0.753	0.679	0.790	0.741	0.815	0.851	0.800
369	0.588	0.447	0.521	0.562	0.579	0.627	0.602	0.724	0.664	0.687	0.704	0.746	0.769	0.772
182	0.610	0.475	0.556	0.581	0.609	0.640	0.637	0.738	0.671	0.739	0.722	0.781	0.810	0.786
223	0.617	0.480	0.561	0.586	0.615	0.646	0.643	0.746	0.678	0.746	0.729	0.788	0.818	0.794
LT	**0.569**	**0.427**	**0.526**	**0.551**	**0.569**	**0.611**	**0.608**	**0.705**	**0.646**	**0.706**	**0.697**	**0.739**	**0.771**	**0.759**

Source: ASI, India various Years. The model has been calculated using Frontier 4.1 computer program.

Table A8: Mean Efficiency Scores of Chinese Manufacturing

	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
300	0.711	0.726	0.738	0.870	0.768	0.842	0.863	0.897	0.924	0.952	0.924	0.952	0.962
321	0.825	0.842	0.854	0.862	0.884	0.837	0.858	0.892	0.919	0.947	0.919	0.947	0.956
322+323	0.683	0.697	0.709	0.841	0.739	0.843	0.864	0.898	0.925	0.953	0.926	0.953	0.963
331	0.768	0.784	0.796	0.866	0.826	0.839	0.860	0.895	0.922	0.949	0.922	0.950	0.959
332	0.740	0.755	0.767	0.858	0.797	0.840	0.861	0.896	0.923	0.951	0.923	0.951	0.960
333	0.740	0.745	0.757	0.856	0.787	0.840	0.861	0.896	0.923	0.951	0.923	0.951	0.975
HT	**0.745**	**0.758**	**0.770**	**0.859**	**0.800**	**0.840**	**0.861**	**0.896**	**0.923**	**0.950**	**0.923**	**0.951**	**0.963**
241	0.851	0.859	0.879	0.851	0.869	0.877	0.895	0.922	0.931	0.954	0.942	0.970	0.972
242	0.783	0.791	0.809	0.781	0.797	0.805	0.822	0.846	0.854	0.877	0.866	0.892	0.894
291	0.906	0.915	0.936	0.827	0.844	0.853	0.870	0.896	0.904	0.927	0.916	0.943	0.945
292	0.613	0.619	0.633	0.921	0.940	0.949	0.968	0.978	0.988	0.997	0.989	0.998	1.000
293	0.994	0.995	0.996	0.767	0.783	0.790	0.806	0.830	0.839	0.862	0.850	0.876	0.877
311	0.867	0.875	0.896	0.851	0.869	0.877	0.895	0.922	0.931	0.954	0.942	0.970	0.972
312	0.867	0.875	0.896	0.851	0.869	0.877	0.895	0.922	0.931	0.954	0.942	0.970	0.972
313	0.875	0.884	0.904	0.819	0.837	0.845	0.862	0.888	0.896	0.919	0.908	0.935	0.937
314	0.884	0.893	0.913	0.897	0.916	0.925	0.944	0.972	0.982	0.992	0.987	0.989	0.991
315	0.893	0.902	0.922	0.906	0.925	0.934	0.953	0.981	0.991	0.983	0.987	0.990	0.992
319	0.901	0.910	0.931	0.834	0.851	0.860	0.877	0.903	0.912	0.935	0.923	0.926	0.928
341+342+343	0.910	0.919	0.941	0.964	0.984	0.978	0.983	0.994	0.979	0.984	0.982	0.985	0.987
352	0.924	0.933	0.954	0.944	0.964	0.974	0.993	0.954	0.969	0.984	0.974	0.977	0.979
359	0.740	0.747	0.765	0.782	0.799	0.807	0.823	0.847	0.856	0.877	0.866	0.869	0.870
243	0.854	0.862	0.882	0.922	0.942	0.951	0.970	0.980	0.972	0.974	0.973	0.976	0.978
MHT	**0.857**	**0.865**	**0.884**	**0.861**	**0.879**	**0.887**	**0.904**	**0.922**	**0.929**	**0.945**	**0.936**	**0.951**	**0.953**
231	0.829	0.842	0.844	0.846	0.872	0.889	0.891	0.884	0.888	0.914	0.901	0.919	0.928
232	0.830	0.843	0.845	0.847	0.873	0.890	0.892	0.885	0.889	0.915	0.902	0.920	0.929
251	0.819	0.831	0.834	0.836	0.861	0.878	0.880	0.873	0.877	0.903	0.890	0.908	0.917
252	0.803	0.815	0.817	0.820	0.844	0.861	0.863	0.856	0.859	0.885	0.872	0.890	0.899
261	0.783	0.795	0.797	0.799	0.823	0.840	0.842	0.835	0.838	0.863	0.851	0.868	0.877
271	0.759	0.771	0.773	0.776	0.799	0.815	0.817	0.810	0.813	0.838	0.826	0.842	0.851
272	0.732	0.745	0.747	0.749	0.772	0.787	0.789	0.782	0.785	0.809	0.797	0.813	0.821
281	0.824	0.836	0.838	0.841	0.866	0.883	0.885	0.878	0.882	0.908	0.895	0.913	0.922
289	0.795	0.807	0.809	0.811	0.836	0.852	0.854	0.847	0.851	0.876	0.864	0.881	0.890
351	0.784	0.796	0.798	0.801	0.825	0.841	0.843	0.836	0.840	0.865	0.852	0.869	0.878

262	0.805	0.817	0.819	0.822	0.846	0.863	0.865	0.858	0.862	0.887	0.874	0.892	0.901
MLT	0.797	0.809	**0.811**	**0.813**	**0.838**	**0.855**	**0.856**	**0.850**	**0.853**	**0.879**	**0.866**	**0.883**	**0.892**
151	0.675	0.696	0.717	0.731	0.753	0.775	0.806	0.778	0.817	0.842	0.875	0.910	0.798
152	0.675	0.695	0.716	0.730	0.752	0.774	0.805	0.777	0.816	0.841	0.874	0.909	0.683
153	0.674	0.695	0.715	0.730	0.752	0.774	0.805	0.777	0.816	0.840	0.874	0.909	0.697
154	0.664	0.684	0.705	0.719	0.741	0.763	0.793	0.766	0.804	0.828	0.861	0.895	0.938
155	0.704	0.725	0.746	0.761	0.784	0.808	0.840	0.811	0.851	0.877	0.912	0.948	0.737
160	0.701	0.722	0.744	0.759	0.782	0.805	0.837	0.808	0.848	0.874	0.909	0.945	0.779
171	0.697	0.718	0.739	0.754	0.777	0.800	0.832	0.803	0.843	0.868	0.903	0.939	0.721
172	0.680	0.700	0.721	0.736	0.758	0.781	0.812	0.783	0.823	0.847	0.881	0.916	0.843
173	0.708	0.729	0.751	0.766	0.789	0.813	0.845	0.816	0.857	0.882	0.918	0.954	0.754
181	0.679	0.699	0.720	0.734	0.756	0.779	0.810	0.782	0.821	0.846	0.879	0.915	0.696
182	0.678	0.698	0.719	0.734	0.756	0.778	0.809	0.781	0.820	0.845	0.879	0.914	0.826
191	0.498	0.513	0.528	0.539	0.555	0.571	0.594	0.573	0.602	0.620	0.645	0.671	0.743
192	0.670	0.690	0.711	0.725	0.747	0.769	0.800	0.772	0.811	0.835	0.868	0.903	0.678
201	0.693	0.713	0.735	0.749	0.772	0.795	0.827	0.798	0.838	0.863	0.897	0.933	0.807
202	0.652	0.672	0.692	0.706	0.727	0.749	0.779	0.752	0.789	0.813	0.845	0.879	0.676
210	0.670	0.690	0.711	0.725	0.747	0.769	0.800	0.772	0.811	0.835	0.868	0.903	0.608
221+222	0.606	0.624	0.643	0.656	0.675	0.696	0.723	0.698	0.733	0.755	0.785	0.817	0.638
223	0.619	0.638	0.657	0.670	0.690	0.711	0.739	0.713	0.749	0.771	0.802	0.834	0.722
361	0.574	0.591	0.609	0.621	0.639	0.659	0.685	0.661	0.694	0.715	0.743	0.773	0.752
369	0.447	0.461	0.475	0.484	0.499	0.514	0.534	0.515	0.541	0.557	0.580	0.603	0.778
LT	**0.655**	**0.668**	**0.688**	**0.701**	**0.722**	**0.744**	**0.774**	**0.747**	**0.784**	**0.808**	**0.840**	**0.874**	**0.744**

Source: CDO, China The model has been calculated using Frontier 4.1 computer program.

Table A9 : Geographical Typology of Chinese Provinces

Beijing	Coastal
Hebei	Coastal
Shanxi	Central
Liaoning	Coastal
Jilin	Central
Heilongjiang	Central
Shanghai	Coastal
Jiangsu	Coastal
Zhejiang	Coastal
Anhui	Central
Fujian	Coastal
Jiangxi	Central
Shandong	Coastal
Henan	Central
Hubei	Central
Hunan	Central
Guangdong	Coastal
Guanxi	Coastal
Sichuan	Western
Shaanxi	Western
Other	Western

Table A10: Hausman Fixed Random Statistics for Indian States

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	Random	Difference	SE
TFPG 1998	-1.034234	-1.35695956	0.32272556	0.010900848
Specialization	-0.227103	-0.21010241	-0.01700069	0.836405173
Competition	0.040100	-0.26960517	0.309705166	0.009218527
Diversity	0.368000	0.06234112	0.30565888	0.008746127
Electricity Per Capita	0.843000	0.54320262	0.29979738	0.008094295
Exports	2.091000	1.80660294	0.28439706	0.006554931
FDI	1.082000	0.78515188	0.29684812	0.007780454
Competitiveness Score	0.352000	0.04614368	0.30585632	0.008768747
labour Regime	0.298000	-0.10852268	0.40652268	0.027365718

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 10.71

Prob>chi2 = 0.029

Table A11: Hausman Fixed Random Statistics for China's Provinces

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	Random	Difference	SE
TFPG 1999	-2.033	-1.8297	-0.2033	0.46518801
Specialization index	-0.2271	-0.20439	-0.02271	0.097851697
Competition index	0.401	0.3609	0.0401	0.10768209
Diversity index	0.468	0.4212	0.0468	0.11292216
Electricity Per Capita	0.443	0.3987	0.0443	0.11087241
Exports	3.141	2.8269	0.3141	0.98113929
FDI	2.971	2.6739	0.2971	0.88762569
SEZ dummy	0.321	0.2889	0.0321	0.10248369
Coastal Dummy	0.298	0.2682	0.0298	0.17069298

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 8.49

Prob>chi2 = 0.031

Table A12: Modified Wald test for groupwise heteroskedasticity in fixed effect regression model of India

H0: sigma(i)^2 = sigma^2 for all i chi2 (19) = 39.77 Prob>chi2 = 0.0000

The null is homoskedasticity (or constant variance). Above we reject the null and conclude heteroskedasticity.

Table A13: Modified Wald test for groupwise heteroskedasticity in fixed effect regression model of China

H0: sigma(i)^2 = sigma^2 for all i chi2 (20) = 43.62 Prob>chi2 = 0.0000

The null is homoskedasticity (or constant variance). Above we reject the null and conclude heteroskedasticity.

Table A 14: Determinants of TFPG at the Regional Level in India: The Regression Results

	Model 1	Model 2	Model 3	modal 4

TFPG 1998	-0.0467*** -0.0123	-0.0569*** -0.0147	-0.0428*** -0.0108	-1.034* (-14.671)
Specialization	0.0232*** 0.00605			-0.2271* (-3.363)
Competition		0.00695 0.0217		0.0401** -2.183
Diversity			0.0312*** 0.00793	0.368* -5.001
Electricity Per Capita	0.0163 0.0111	0.0127 0.00991	0.0158 0.0105	0.843** -2.056
Exports	0.00326 0.00934	0.015 0.0113	0.0215* 0.0111	2.091** -1.902
FDI	0.298 0.134	0.0829 1.004	0.16 0.046	1.082* -6.572
Competitiveness Score	0.374*** 0.119	0.356*** 0.108	0.314*** 0.102	0.352* -4.519
labour Regime	0.00473 0.0227	0.0317*** 0.0081	0.0286*** 0.00734	0.298 -0.134
Constant	0.0345*** -0.0113	0.0654** -0.0303	0.0247*** -0.00665	0.0544*** -0.0119
Number of Observations	380	380	380	380
R^2	0.49	0.61	0.52	0.62

Source: Prepared by Author. Note: *,** indicates significant at 1 per cent and 10 per levels, respectively. Figures provided in brackets are the t values. All regressions include industry dummies.

Table A 15: Determinants of TFPG at the Regional Level in China: The Regression Results

	Model 1	Model 2	Model 3	modal 4
TFPG 1999	-0.0146*	-0.0140*	-0.0148**	-2.033*
	-0.00769	-0.00716	-0.00754	(-3.607)
Specialization index	-0.0116			-0.2271*
	-0.0241			(-4.143)
Competition index		0.0165***		0.401*
		0.00528		-5.183
Diversity index			0.00596	0.468*
			0.00781	-4.001
Electricity Per Capita	0.0042	0.00347	0.00929	0.443**
	0.00595	0.0086	0.00702	-2.016
Exports	0.0122	0.0165***	0.00517	3.141**
	0.0249	0.00636	0.00824	-2.388
FDI	0.0114**	0.0127	0.0171	2.971**
	0.00515	0.00966	0.0227	-2.051
SEZ dummy	0.0346	0.0796	0.0362	0.321
	0.0309	0.0515	0.0302	-1.019
Coastal Dummy	0.0213*	0.0338**	0.000181	0.2980*
	0.0117	0.0131	0.00921	-3.832
Number of Observations	399	399	399	399
R^2	0.62	0.68	0.67	0.7

Source: Prepared by Author. Note: *,** indicates significant at 1 per cent and 10 per levels, respectively. Figures provided in brackets are the t values. All regressions include industry dummies.

Table A16: Mean Efficiency Scores of Indian States

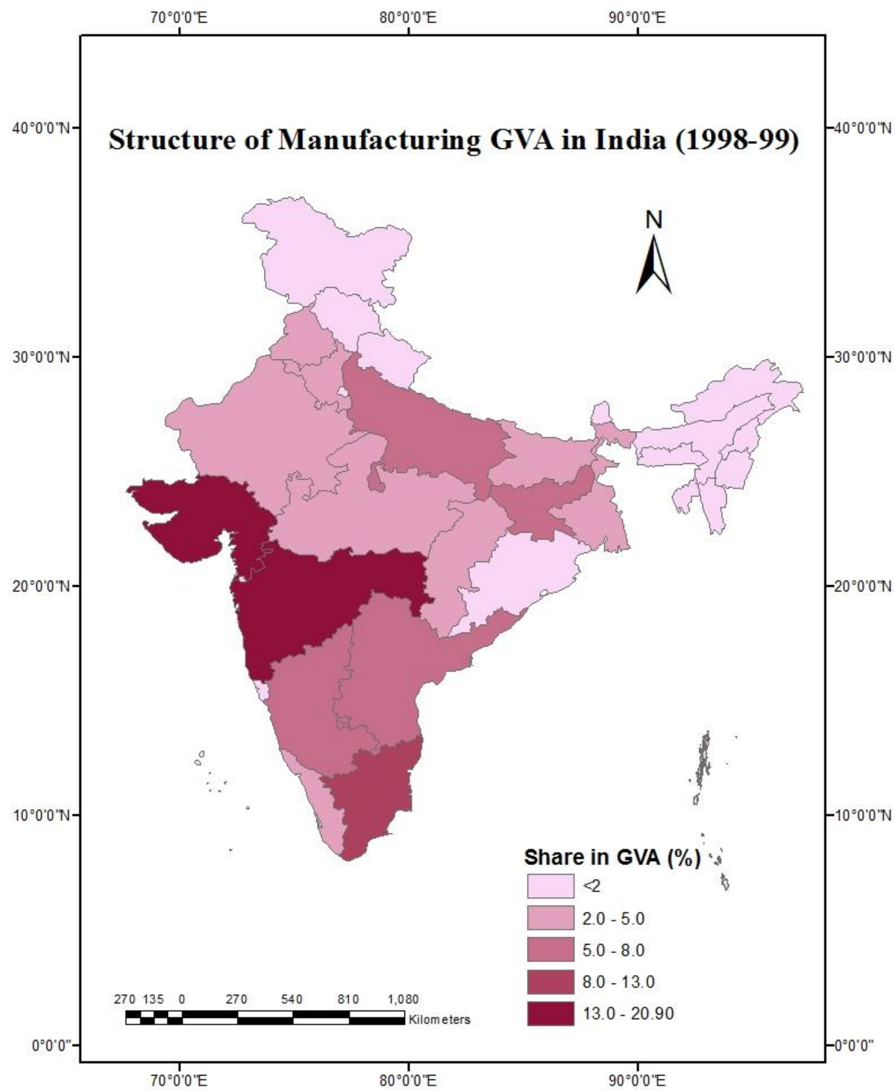
	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
A.P.	0.6167	0.6180	0.4876	0.5746	0.5844	0.6241	0.6366	0.6557	0.7374	0.6634	0.7751	0.7253	0.7998	0.8360
Assam	0.5839	0.5953	0.4598	0.5404	0.5654	0.5939	0.6244	0.6215	0.7233	0.6560	0.7236	0.7070	0.7654	0.7950
Bihar	0.5901	0.6014	0.4645	0.5460	0.5713	0.6000	0.6308	0.6278	0.7306	0.6627	0.7310	0.7142	0.7732	0.8031
Chattisgarh	0.5936	0.6049	0.4706	0.5537	0.5737	0.6060	0.6306	0.6350	0.7304	0.6607	0.7432	0.7155	0.7795	0.8114
Gujarat	0.8554	0.8667	0.8754	0.8955	0.8507	0.8685	0.8772	0.8948	0.9216	0.9306	0.9536	0.9421	0.9703	0.9723
Haryana	0.8181	0.8295	0.8418	0.8439	0.8464	0.8718	0.8892	0.8910	0.8840	0.8875	0.9142	0.9009	0.9189	0.9281
H.P.	0.8190	0.8304	0.8427	0.8448	0.8473	0.8727	0.8902	0.8920	0.8850	0.8885	0.9152	0.9018	0.9199	0.9291
Jharkhand	0.6014	0.6127	0.6188	0.6331	0.9205	0.9399	0.9493	0.9682	0.9777	0.9875	0.9974	0.9895	0.9977	0.9997
Karnataka	0.7286	0.7399	0.7473	0.7645	0.7821	0.7985	0.8065	0.8226	0.8473	0.8556	0.8766	0.8661	0.8686	0.8704
Kerala	0.5991	0.6105	0.4750	0.5556	0.5806	0.6091	0.6396	0.6367	0.7385	0.6712	0.7388	0.7222	0.7806	0.8102
Maharashtra	0.8946	0.9059	0.9150	0.9360	0.8267	0.8441	0.8525	0.8696	0.8957	0.9044	0.9274	0.9159	0.9433	0.9452
M.P.	0.6053	0.6166	0.4797	0.5612	0.5865	0.6152	0.6460	0.6430	0.7458	0.6779	0.7462	0.7294	0.7884	0.8183
Odisha	0.6219	0.6332	0.5028	0.5898	0.5996	0.6393	0.6518	0.6709	0.7526	0.6786	0.7903	0.7405	0.8150	0.8512
Punjab	0.6974	0.7087	0.6237	0.5597	0.6461	0.6837	0.7101	0.6250	0.8272	0.7527	0.6782	0.7527	0.8288	0.8279
Rajasthan	0.7236	0.7349	0.6797	0.6354	0.6954	0.7369	0.7364	0.6811	0.8557	0.8060	0.7563	0.8060	0.8575	0.8866
Tamil Nadu	0.8639	0.8753	0.8840	0.9043	0.8195	0.8367	0.8451	0.8620	0.8878	0.8964	0.9194	0.9079	0.9352	0.9370
Uttrakhand	0.7286	0.7399	0.7447	0.7568	0.8559	0.7868	0.8405	0.8615	0.8960	0.9228	0.9505	0.9231	0.9508	0.9751
U.P.	0.5045	0.5158	0.3548	0.4654	0.5068	0.5073	0.5764	0.5541	0.6674	0.6153	0.6367	0.6605	0.6810	0.7066
West Bengal	0.6165	0.6279	0.5498	0.6111	0.6814	0.6471	0.7084	0.7078	0.7817	0.7691	0.7936	0.7918	0.8159	0.8409
India	0.6875	0.6983	0.6325	0.6722	0.7021	0.7201	0.7443	0.7432	0.8150	0.7835	0.8193	0.8112	0.8521	0.8707

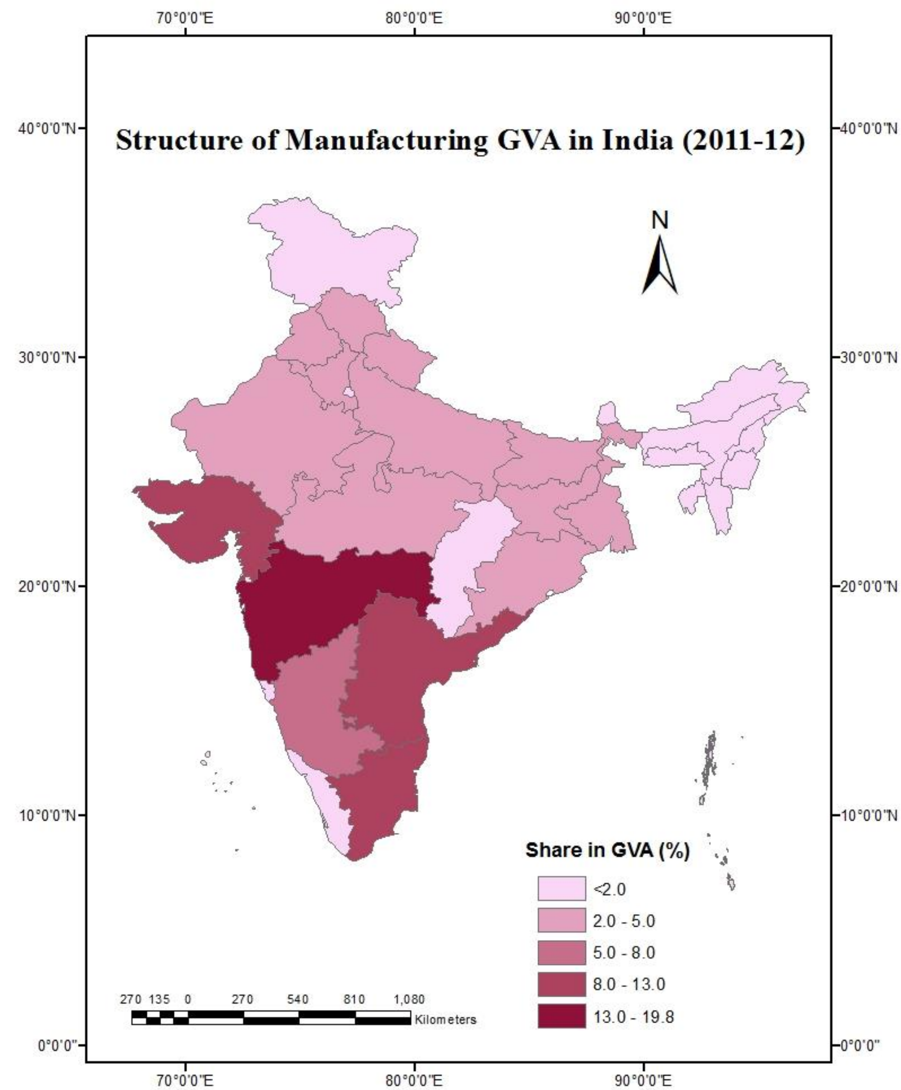
Source: ASI, India various Years. The model has been calculated using Frontier 4.1 computer program

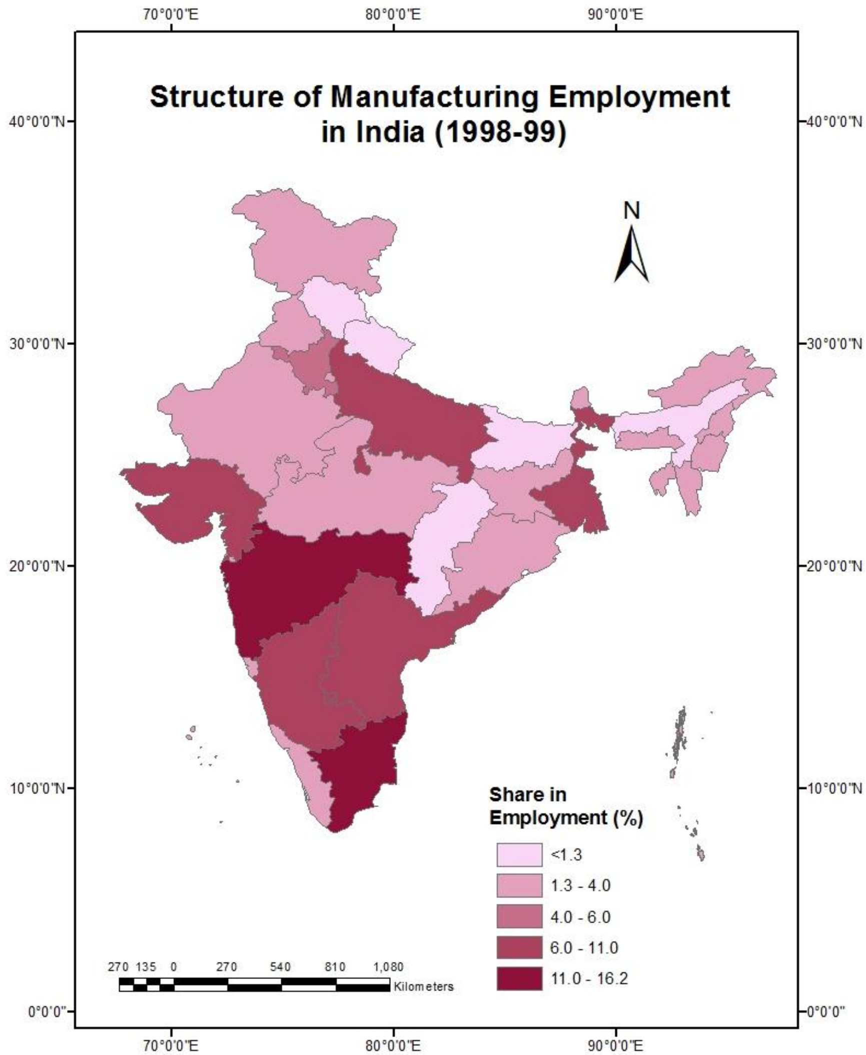
Table A17: Mean Efficiency Scores of Chinese Manufacturing

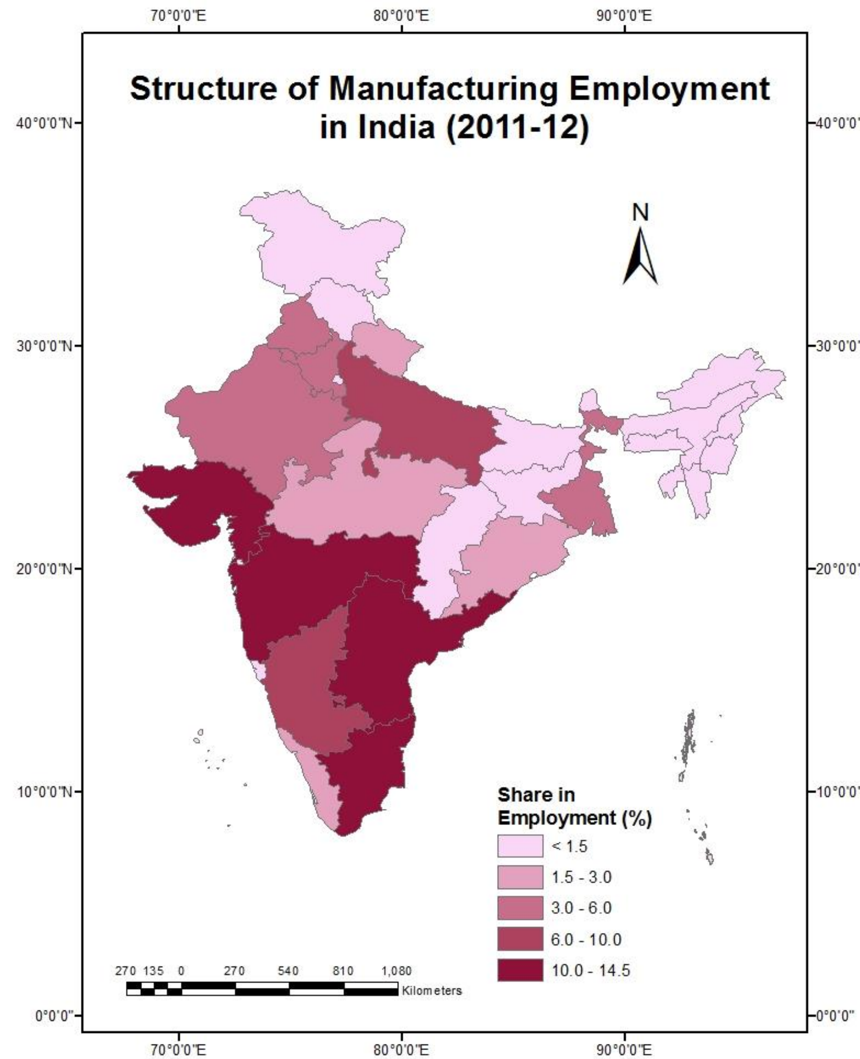
	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Anhui	0.5010	0.6160	0.5117	0.6382	0.6899	0.6020	0.8035	0.7673	0.7310	0.7673	0.8051	0.8440	0.8609
Heilongjiang	0.6717	0.6783	0.7064	0.7498	0.7501	0.6730	0.8636	0.8285	0.7933	0.8285	0.8653	0.9113	0.9295
Henan	0.5751	0.5940	0.6256	0.6657	0.6768	0.5763	0.7904	0.7497	0.7090	0.7497	0.7920	0.8247	0.8412
Hubei	0.6941	0.5422	0.6537	0.6886	0.6759	0.6955	0.7896	0.7234	0.6572	0.7234	0.7912	0.7957	0.8117
Hunan	0.5915	0.5385	0.6212	0.6535	0.6756	0.5927	0.7893	0.7214	0.6535	0.7214	0.7909	0.7935	0.8094
Jilin	0.5212	0.4183	0.5565	0.5870	0.6657	0.5222	0.7794	0.6564	0.5333	0.6564	0.7810	0.7220	0.7364
Jiangxi	0.6470	0.6048	0.6619	0.7014	0.7009	0.6483	0.8145	0.7672	0.7198	0.7672	0.8162	0.8439	0.8608
Shanxi	0.6664	0.6230	0.6818	0.7224	0.7220	0.6677	0.8390	0.7902	0.7414	0.7902	0.8406	0.8692	0.8866
Beijing	0.6115	0.5487	0.6334	0.6703	0.6962	0.6127	0.8110	0.7379	0.6649	0.7379	0.8126	0.8117	0.8279
Fujian	0.8415	0.8363	0.8442	0.8485	0.8390	0.8338	0.8417	0.8362	0.7339	0.8476	0.8518	0.8423	0.8371
Guangdong	0.9607	0.9572	0.8395	0.7581	0.9578	0.9543	0.8370	0.8919	0.8652	0.8429	0.7612	0.9617	0.9582
Guanxi	0.8966	0.8916	0.8955	0.8937	0.8939	0.8889	0.8928	0.6283	0.6265	0.8991	0.8973	0.8975	0.8925
Hebei	0.6025	0.6363	0.6308	0.6472	0.6007	0.6344	0.6289	0.9811	0.9507	0.8288	0.8367	0.8409	0.8315
Jiangsu	0.9851	0.9848	0.9850	0.9821	0.9822	0.9819	0.9821	0.8357	0.7995	0.9889	0.9860	0.9861	0.9858
Liaoning	0.8573	0.8612	0.8390	0.8259	0.8547	0.8587	0.8365	0.8346	0.7952	0.8424	0.8292	0.8581	0.8621
Shandong	0.8573	0.8612	0.8390	0.8259	0.8547	0.8587	0.8365	0.8346	0.7952	0.8749	0.8604	0.8978	0.8945
Shanghai	0.8948	0.9763	0.8563	0.7733	0.9770	0.9734	0.8537	0.9098	0.8825	0.8597	0.9154	0.9002	0.8952
Zhejiang	0.8698	0.8996	0.8448	0.8084	0.8955	0.8969	0.8422	0.8597	0.8243	0.8590	0.8683	0.8854	0.8839
Other	0.5028	0.5898	0.5996	0.6393	0.6518	0.6709	0.7526	0.6786	0.7903	0.7405	0.8150	0.8512	0.8003
Shaanxi	0.4750	0.5556	0.5806	0.6091	0.6396	0.6367	0.7385	0.6712	0.7388	0.7222	0.7806	0.8102	0.7860
Sichuan	0.4797	0.5612	0.5865	0.6152	0.6460	0.6430	0.7458	0.6779	0.7462	0.7294	0.7884	0.8183	0.7939
China	0.7001	0.7036	0.7139	0.7287	0.7641	0.7344	0.8128	0.7801	0.7501	0.7989	0.8326	0.8555	0.8564

Source: CDO, China The model has been calculated using Frontier 4.1 computer program.


Structure of Manufacturing GVA in India (1998-99)
N
Share in GVA (%)
<2
2.0 - 5.0
5.0 - 8.0
8.0 - 13.0
13.0 - 20.90
270 135 0 270 540 810 1,080
Kilometers
70°0'0"E
80°0'0"E
90°0'0"E
40°0'0"N
30°0'0"N
20°0'0"N
10°0'0"N
0°0'0"


Structure of Manufacturing GVA in India (2011-12)
N
Share in GVA (%)
<2.0
2.0 - 5.0
5.0 - 8.0
8.0 - 13.0
13.0 - 19.8
270 135 0 270 540 810 1,080
Kilometers
70°0'0"E
80°0'0"E
90°0'0"E
40°0'0"N
30°0'0"N
20°0'0"N
10°0'0"N
0°0'0"


Structure of Manufacturing Employment
in India (1998-99)
N
Share in
Employment (%)
<1.3
1.3 - 4.0
4.0 - 6.0
6.0 - 11.0
11.0 - 16.2
270 135 0 270 540 810 1,080
Kilometers
70°0'0"E
80°0'0"E
90°0'0"E
40°0'0"N
30°0'0"N
20°0'0"N
10°0'0"N
0°0'0"


Structure of Manufacturing Employment
in India (2011-12)
N
Share in
Employment (%)
< 1.5
1.5 - 3.0
3.0 - 6.0
6.0 - 10.0
10.0 - 14.5
270 135 0 270 540 810 1,080
Kilometers
70°0'0"E
80°0'0"E
90°0'0"E
40°0'0"N
30°0'0"N
20°0'0"N
10°0'0"N
0°0'0"


Structure of Manufacturing GVA in China (1999-2000)
N
Share in GVA (%)
<1.3
1.3 - 4
4.0 - 7.0
7.0 - 10.0
10.0 - 13.0
Xinjiang Uygur
Gansu
Qinghai
Xizang
Nei Mongol
Heilongjiang
Jilin
Liaoning
Beijing
Tianjin
Hebei
Shanxi
Ningxia Hui
Shandong
Shaanxi
Henan
Jiangsu
Anhui
Shanghai
Hubei
Sichuan
Chongqing
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
Hainan
Kilometers
80°0'0"E
90°0'0"E
100°0'0"E
110°0'0"E
120°0'0"E
130°0'0"E
50°0'0"N
40°0'0"N
30°0'0"N
20°0'0"N


Structure of Manufacturing GVA in China (2011-12)
N
Share in GVA (%)
<1.3
1.3 - 4.0
4.0 - 7.0
7.0 -10.0
10.0 - 13.70
Xinjiang Uygur
Gansu
Qinghai
Xizang
Nei Mongol
Heilongjiang
Jilin
Liaoning
Beijing
Tianjin
Hebei
Shanxi
Ningxia Hui
Shandong
Shaanxi
Henan
Jiangsu
Anhui
Shanghai
Hubei
Sichuan
Chongqing
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
Hainan
Kilometers
80°0'0"E
90°0'0"E
100°0'0"E
110°0'0"E
120°0'0"E
130°0'0"E
50°0'0"N
40°0'0"N
30°0'0"N
20°0'0"N


Structure of Manufacturing Employment in China (1999-2000)
N
80°0'0"E
90°0'0"E
100°0'0"E
110°0'0"E
120°0'0"E
130°0'0"E
50°0'0"N
40°0'0"N
30°0'0"N
20°0'0"N
Heilongjiang
Jilin
Nei Mongol
Liaoning
Xinjiang Uygur
Gansu
Beijing
Tianjin
Hebei
Shanxi
Ningxia Hui
Qinghai
Shandong
Shaanxi
Henan
Jiangsu
Shanghai
Xizang
Anhui
Hubei
Sichuan
Chongqing
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
Hainan
Share in Employment (%)
<2
2.0 - 4.0
4.0 - 6.0
6.0 - 9.0
9.0 - 12.0
0 320 640 1,280 1,920 2,560
Kilometers


Structure of Manufacturing Employment in China (2011-12)
N
80°0'0"E
90°0'0"E
100°0'0"E
110°0'0"E
120°0'0"E
130°0'0"E
50°0'0"N
40°0'0"N
30°0'0"N
20°0'0"N
Heilongjiang
Jilin
Nei Mongol
Liaoning
Xinjiang Uygur
Gansu
Beijing
Tianjin
Hebei
Shanxi
Ningxia Hui
Qinghai
Shandong
Shaanxi
Henan
Jiangsu
Shanghai
Xizang
Anhui
Hubei
Sichuan
Chongqing
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
Hainan
Share in Employment (%)
<2.0
2.0 - 5.0
5.0 -9.0
9.0 -13.0
13.0 - 17.8
0 320 640 1,280 1,920 2,560
Kilometers