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Innovation (and upgrading) in the automobile industry: the case of India

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Abstract

This paper focuses on the automobile industry and examines the nature of global value chains in it with reference to the case of India. The aim is to explore the relation between lead firms, particularly MNCs, and the extent to they have contributed to the development of the Indian automobile industry through transfer of technology and imports. The paper is based on secondary sources and a primary survey. A survey of the passenger car segment was conducted in Delhi NCR, Pune and Chennai between January 2014 and February 2015. The Indian automobile sector has grown differently from that of other developing countries, especially China. In contrast to China, India has relied more on home-grown lead firms to propel its industry. A disadvantage of this approach is that the absorption of global best practices has been slower than in China. Though capable of end-to-end production, India has become an assembly hub for large cars and manufacturing hub for small cars. This is due to the fact that India has become one of the largest markets for small cars worldwide and has also started exporting small cars.

Keywords: *Global value chains, automobile industry, organization of production, Innovation Systems, R&D, localization, imports.*

JEL classification: *L22, F23, L62, O32*

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Innovation (and upgrading) in the automobile industry: the case of India

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1. Introduction

One of the key drivers of industrial development in an economy is the integration of its local firms into global supply chains (GVCs). As a concept, discussion of GVCs started by end of 1970s with work on commodity chains. Later the idea of a global commodity chain was introduced in description of the apparel commodity chain (Gereffi, 1994). The shift in terminology to 'GVCs' from 'commodity chains' captured the determinants of the organization of global industries (Bair, 2005).

The GVC literature stresses on the role played by the lead firm in transferring knowledge to their suppliers. This knowledge is particularly important for small firms, whose participation in GVCs leads to obtaining information about type and quality of product and technologies used by global market leaders to access global markets. This information needs to be combined with local technological capabilities to successfully produce products in local market conditions and using local inputs. Only then, successful technological learning and technology transfer occurs (Morrison, et al., 2008). The dynamics of governance patterns is crucial for understanding opportunities critical for upgrading, improving competiveness and moving up the value chain (Pietrobelli and Rabellotti, 2010a).

This paper focuses on the automobile industry and examines the nature of GVCs in it in India. The Indian case is examined with a view to exploring the relation between lead firms, particularly MNCs, and the extent to which these firms have contributed to the development of the Indian automobile industry through transfer of technology and imports. It also explores the innovation done in India by the MNCs and the domestic firms. A survey of the passenger car segment was conducted in Delhi NCR, Pune and Chennai between January 2014 and February 2015 for this paper.

The paper is organised in the following manner: section 2 presents a brief survey of the issues in the literature associated with GVCs. The concept of Innovation Systems (IS) is introduced and its relation with GVCs is discussed. Section 3 discusses the automobile industry and how it has spread to emerging markets. Section 4 discusses the Indian automobile industry. The concept of innovation in the automobile sector especially in relation to the National Innovation System of a country is also discussed in this section. The learning and improvement in technological capabilities over time as Indian firms engaged in assembling and manufacturing have been examined through a survey. The survey's design and its findings are discussed in Section 5. Section 6 concludes.

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2. Literature Survey[1]

Gereffi (1999) introduced the concept of producer- and buyer-driven chains. There is a difference between buyer-driven and producer-driven supply chains. The latter exist in high-tech sectors (such as the semi conductor and pharmaceutical industry) where lead firms are placed upstream and control the design and assembly to a large extent, and in different countries. The automobile industry is dominated by producer (or manufacturer) driven value chains. Buyer-driven chains exist when retailers and marketers control production. The production in this case can be entirely outsourced, with the lead firms focusing on marketing and sales. The lead firms in buyer-driven chains have developed greater bargaining powers than the suppliers who face stiff competition (amongst themselves). This is the case for apparel.[2]

There are three kinds of governance issues in GVCs (Humphrey, 2003). First, what is coordinated when value chains are characterized by explicit coordination of activities? Humphrey and Schmitz (2001) argue that the three critical coordination decisions are: what is to be produced (product design); how it is to be produced (specification of processes); and logistics issues (how much is to be produced, when and how it is to be delivered). The second question concerns why firms might go to the trouble and expense of coordinating the value chain. In other words, under what circumstances are GVCs coordinated explicitly? The reasons clearly relate to what is coordinated: 1. Product design is coordinated when buyers play a role in design. In the auto industry, outsourcing of key components and systems means that while the component manufacturer may supply the basic design and technology, coordination is required because of the interface between different components in the vehicle. 2. Coordination of processes in industries such as garments, and also the food industry, relate not only to quality control, but also to performance, with increasingly stringent safety, labour and environmental standards. 3. Logistics issues arise in the auto industry predominantly in relation to just-in-time delivery. In part, this issue is solved through proximity, but whatever the distance, the concern with inventory reduction requires coordination of production schedules.

The third question concerns the inter-firm relationships put in place to achieve this coordination. Drawing on the work of Sturgeon (2002), and Humphrey and Schmitz (2002), it is possible to distinguish two particular types of relationships between customers and suppliers in GVCs. Captive suppliers are subordinated to more powerful buyers who specify many of the parameters of product, process and logistics. Modular[3] suppliers have specialized

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1 There is a vast literature on GVCs - here the focus is only on the aspect of the literature that is pertinent to this paper. For comprehensive discussions on various aspects of the GVC literature refer to OECD (2012), UNCTAD (2013), etc.

2 Gereffi (1994)

3 Gereffi et al. (2005) have developed a taxonomy that combines five governance categories based on combinations of the complexity of inter-firm transactions, the ability of participating firms to codify such transactions, and the capabilities of the supply base to fulfill the requirements of these transactions in an independent manner. These governance categories are (i) Market—with low buyer and low producer concentration, buyer not involved in product definition; (ii) Captive (quasi-hierarchical)—one firm exerts a

competences and work for a variety of customers. Process and product technologies develop incrementally (modular production systems). Sturgeon argues that contract manufacturers in the electronics industry that supply sophisticated services to many different customers are a good example of a modular supply relationship. For consumer electronics, technological accumulation emerges mainly from corporate research and development (R&D) laboratories and universities.

Sturgeon et al. (2008) note that the automobile industry is a set of linked, specialized clusters where global integration has proceeded at the level of design and vehicle development whereas for production, regional integration has occurred since the mid 1980s for technical and political reasons. Global integration has proceeded farthest at the buyer -supplier relationship. Production is organized regionally or nationally with bulky, heavy and model specific parts production concentrated close to final assembly points, and lighter, more generic parts produced at a distance to take advantage of scale economies and low labour costs. Vehicle development is concentrated in a few design centres.

Cattaneo et al. (2013) discuss the concept of how countries move from imports to exports and is shown in the figure 1A. In the initial phase, investment is made by lead firm and as localization increases gradually, firms move to export of locally produced goods to the exports markets.[4] Lang et al. (2008) argues that there are five stages of localization: home players, exporters, explorers, settlers and global players. In each of these stages of localization, there are differences with respect to R&D, sourcing, manufacturing and sales, with firms doing virtually no local R&D, sourcing or manufacturing in the home players stage to large R&D, full fledged sourcing, and manufacturing in the several large scale plants that serve the local and the export markets in the final stage (global players).[5]

These considerations lead to three questions. First, how do these changes affect the way the industry globalizes? Second, what are the consequences of these changes for industry structure, particularly in emerging markets? Third, how is coordination changing in the Indian industry? This leads to a discussion of the automobile industry in general, and in emerging markets and then to the Indian automobile industry.

2.1 Concept of innovation in GVCs and its relation to National Innovation Systems

Innovation has been defined by Schumpeter as an outcome of new combinations made by an entrepreneur, resulting in a new product, a new process, a new source of supply for raw materials or other inputs, a new market, or a new way of organizing business (Schumpeter, 1934). This process may be breakthrough or incremental.

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high degree of control over other firms, high buyer dependency, high buyer concentration, buyer's competence in essential chain activities is higher than producer's; (iii) Modular—similar to captive except capability in supply base is high; (iv) Relational—complex interaction between buyer and seller; and (v) Hierarchy—which involves vertical integration.

4 India is in the third phase, since exports by lead firms are taking place.

5 According to this categorisation, India is probably in the third or fourth stage.

National Innovation System[6] (or IS) developed mainly in the context of developed countries, and talks of the role played by institutions and organizations that affect the rate of technological change in an economic system (Lundavll, 1992; Nelson, 1993). Technological learning takes place in firms and is affected by firm specific characteristics (Lorentzen and Barnes, 2004). Application of the IS concept to developing countries, while more recent (Lundvall et al. 2009; Edquist, 2001), is more complicated. This is due to the fact incremental innovation and absorption of knowledge and technology new to the firm are more frequent (Pietrobelli and Rabellotti, 2011) and is based on firm-level activities that are not included in the formal measures of innovation. A large part of the technological activity in developing countries is in the absorption and improvement of existing technologies rather than frontier innovation (Lall and Pietrobelli, 2005).[7] The linkages between the main science and technology organizations (such as universities, R&D laboratories and research institutes) and local firms may be weak or non-existent in developing countries.

Inflows of knowledge and technology from external sources are essential components of learning and innovation in developing countries. In the context of GVCs, integration in GVCs helps firms get access to knowledge and through participation in such chains, learning and innovation is fostered. The relationship between GVCs and IS is non-linear and endogenous, with each affecting the other. Policies and institutions affecting international flow of equipment and services, human capital and foreign investments and GVC matter. In the case of firms, GVCs may contribute to improving the local IS, which will in turn affect decisions about local sourcing of inputs and also local firms' learning and innovation (Pietrobelli and Rabellotti, 2011). Since absorption of technology and diffusion[8] occur due to adaptations and modifications to suit local needs, learning capacity is not a sufficient condition for upgrading.[9, 10] For this to happen, firms must possess the competencies to incorporate the new technology into their production capacity (Lorentzen and Barnes, 2004). The challenge is not always about moving into more advanced functions but is often about deepening specific capabilities required to explore new opportunities in the value chain stage in which the firm is currently engaged in (Morrison, et al. 2008).

Learning in GVCs is influenced by the governance of GVC and different mechanisms of learning and innovation are likely to dominate in different types of chains (Gereffi, et al. 2005). Innovation and learning in the context of GVCs and developing countries in the auto industry have been examined in Humphrey et al. (2000), Humphrey (2003), Humphrey and

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6 Also referred to as Innovation System (IS)

7 Alternburg et al. (2008) point out that this may not be true in the case of China or India, which have IS similar to that of developed countries.

8 Technological diffusion is the process by which innovations (be they new products, new processes or new management methods) spread within and across economies (Stoneman, 1995).

9 Upgrading (or industrial upgrading) involves organizational learning to improve the position of firms or nations in international trade networks. Gereffi (1999) shows that upgrading occurs in products that are organizationally related through lead firms in GVCs, through forward and backward linkages from production and through marketing.

10 Upgrading in modular chains leads to positive externalities for the rest of the economy due to spillovers to other sectors served by the same supplier (Pietrobelli and Rabellotti, 2010a).

Memedovic (2003), Sturgeon and Biesebroeck (2011) and Gereffi (2015).[11] The typology of governance[12] of the GVCs proposed by Gereffi, Humphrey and Sturgeon (2005) discusses the conditions under which different patterns emerge: the complexity of the information involved in transactions, the possibility of codifying the information and competence of suppliers along the value chain. In modular value chains, complexity of transactions is high, there are capable potential suppliers, and the codification of transactions is high. Suppliers learn to produce components and modules to fully specified technical standards and the need to adhere to these standards induces learning. Lead firms put pressure on suppliers to innovate but do not become involved directly in the learning process. Hence lead firms exert external stimulus for learning and innovation among suppliers. On the other hand, in captive chains the codification and complexity of transaction is high but supplier have low competence (Pietrobelli and Rabellotti, 2010b).

In the automobile industry, a paucity of robust, industry wide standards and codification schemes limits the rise of true value chain modularity (Sturgeon et al., 2008). The reason for this is technical and structural. On the technical side, vehicle performance characteristics such as noise, vibration and handling are deeply interrelated and changes in one component has an impact on other components. Rising vehicle complexity can continue to thwart efforts to fully codify vehicle designs and design process. Information exchange between suppliers of complex parts and sub-systems and lead firms is necessarily intensive. On the structural side, the concentrated structure of the industry, gives lead firms an extraordinary amount of market power, leading to a more captive relationship (Sturgeon et al., 2008).

We next turn to a discussion of the automobile industry in general, and in emerging markets and then to the Indian automobile industry.

3. The automobile industry[13]

The most highly developed supply chain is that of the car industry (Sutton, 2004) and is the most global (Humphrey and Memedovic, 2003). The organization of GVCs in the automotive industry differs from that in other industries in the following ways: one, lead firms in this industry are few[14]and have the strength to drive supplier co-location at the regional, national, and local levels for operational reasons, such as just-in-time production, and design collaboration.[15] There are thick linkages between lead firms and Tier 1 suppliers. The need

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11 Discussed in section 4 for the Indian case.

12 Modular, relational, hierarchical, captive, market and arms' length are the different categories of goverennace structuresin GVCs. Each category has different levels of complexity of transactions, codification of transactions, and competence of suppliers. Hence the learning mechanism within each GVC chain is also different (Pietrobelli and Rabellotti, 2010a).

13 For a brief history of the geographical distribution of production, see Sturgeon and Florida (2004).

14 Humphrey and Memedovic (2003) report that in 2001, 13 companies produced more than 1 million vehicles each and accounted for 87 % of the world's vehicle production. Moreover, a leading number of companies have significant shareholding in smaller vehicle producers.

15 As the competence to design complex parts and sub-systems has shifted from auto manufacturers to suppliers, the need for co-design has meant that the captive or the market GVC linkages have become harder to maintain. The lack of open and industry level standards for vehicle parts and sub-systems has

for full co-location of parts with final assembly varies by type of component, or stage of production for a given process (Sturgeon et al., 2008). Second, the export of finished vehicles to large markets is often determined by political considerations. This motivates lead firms to locate production close to end markets and creates additional pressure for supplier co-location within regional-scale production systems.[16, 17]

There are strong agglomeration economies in the industry. Once automakers set up local technical centres, they tend to pressure 'global' suppliers to establish local engineering capabilities as well.[18] When this happens, global suppliers can begin to source inputs locally, providing opportunities and support for local Tier 2 suppliers to develop. Over time, it is possible for local firms to start serving automakers directly, and international opportunities can grow from there.[19] Thus, a virtuous cycle of development can only develop if the local domestic market is large enough to attract significant investment.[20]

3.1 Nature of GVCs in emerging markets

Since the late 1980s, a combination of factors,[21] has led to waves of investment in emerging markets, both to supply burgeoning local markets and for export back to developed economies. Slow growth in home markets and lure of emerging markets has driven automakers to set up final assembly plants in major and emerging markets, such as Brazil, India and China.[22] This was also encouraged by the liberalization of trade and investment rules in emerging countries.

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blocked the codification scheme for modular GVC linkages (Sturgeon et al., 2008). Linkages between lead firms and suppliers in the automotive industry require tight coordination, especially in the area of design, production and logistics (Humphrey, 2003).

16 Sturgeon and Biesebroeck (2010).

17 When firms set up operations in new places, they remain rooted with their home bases in several ways such as command and control functions, development and deployment of corporate strategy, and the function of product conception and design.

18 Sturgeon (2002) looks at nation-specific models of industrial organisation in which there are two broad categories: Captive Production Networks and Relational Production Networks. The former exist in the automobile industry of countries such as Japan and Korea where there is dependence on the lead firm for coordination. The latter are based more on trust and reputation as is observed in Italy and Germany. The Italian model is called the Egalitarian, Cooperative Network as it involves elaborate labour divisions while the German model the Self-Reliant model as they retain their strong end-product focus.

19 American firms have tended to develop market linkages and forge relational ties with their suppliers. However, they have also broken such ties after the necessary collaborative engineering work has been accomplished (Sturgeon et al., 2008). Japanese car makers on the other hand, developed captive ties with their suppliers, though the relationship has become more relational over time. These captive linkages with suppliers have been partly maintained especially when these relations were projected outside of Japan.

20 Sturgeon and Biesebroeck (2010).

21 These include real and potential market growth along with a huge surplus of low-cost, adequately skilled labour in the largest countries in the developing world (such as China, India, and Brazil).

22 Sturgeon and Florida (2004) has classified these countries as Type 4: Big Emerging Markets. Type 2 comprises of United States, Northern Europe and Japan also known as Large Existing Markets, while type 3 which comprises of the Peripheries of Large Existing markets such as Mexico, Canada, Spain, Portugal and East Europe. Type 1 is subset of Type 2: plants located in the same country where the firm has headquarters e.g. General Motors in United States etc.

However, the industry's growth in the developing world has been limited to a specific subset of countries.[23] The geographic shift of the industry from developed countries to emerging markets was most dramatic in large developing countries such as China, India, and Brazil (for reasons of market size, political pressure to build vehicles and economies of scale).[24] The development of automotive value chains has initiated a trend towards regionalism in Asia in recent years with these countries turning into final assembly hubs for the wider region. Lead firms have established local design, engineering facilities and regional headquarters. Lead firms demand that their largest suppliers have a global presence, as a precondition to be considered for a new partner (Sturgeon and Florida, 2004).

As car manufacturers establish base, existing SME suppliers in developing countries need to adapt to the demands of the large, international manufacturers. The auto-component market develops simultaneously as multi-national company (MNC) car manufacturers use small and medium enterprises (SMEs) in developing countries as sources for automotive parts. They increasingly rely on a limited number of first-tier suppliers who are able to provide auto components on a global scale to 'original equipment manufacturing' (OEM)[25] standards (UNCTAD, 2001).[26] As this sourcing trend continues, the scale of first-tier suppliers increases, often matching that of the MNCs. This change creates a new dynamics in the industry and smaller local suppliers are forced to adapt. Technology accumulation occurs automatically during operation of complex production systems, or in the R&D laboratories of MNCs and universities.[27]

As has happened in South Korea, the increasing production capacity in developing countries is followed – with a lag – by the emergence of important supplier firms. The minimum scale and quality requirements in the industry have to be met. The motivation to gain deep competencies in vehicle design and engineering, has driven local lead firms from China and India to acquire, or, attempt to acquire, distressed auto companies in the West. [28]

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[23] Small developing countries far from large existing markets have generally been unable to develop an automotive industry which is well connected with GVCs. In such countries with small and easily saturated markets, it is difficult for local firms to develop a significant role in the industry.

[24] Liberalization and political pressure/ support for local production have driven automakers to set up final assembly plants in these countries. Earlier, global suppliers have been concentrating an increasing share of product development in the industry's traditional design centres. Most of the early development took place in the USA, Germany, and Japan, where many lead firms and suppliers co-located. Now, since some developing country markets have grown sufficiently to warrant market-specific vehicles, lead firms and suppliers are setting up local design centres. Once these reach sufficient scale, more suppliers will follow.

[25] The term OEM refers to a manufacturer that supplies equipment to other companies to resell or incorporate into another product using the reseller's brand name.

[26] The automobile manufacturers require validation and enter into medium to long term contracts with these firms.

[27] OEMs have progressively outsourced a greater percentage of the vehicle content to automobile component manufacturers – this shift from supplying piecemeal components to sub assemblies and modules is termed as modularization. This has allowed auto component suppliers to move up the value chain (Edelweiss, 2014).

[28] Automakers used a variety of measures to lower the minimum scale of vehicle assembly plants and reduce the risk of investment in emerging markets. These measures included starting with small complete knock down (CKD) assembly plants, sharing large capital expenditures with other automakers, increasing reliance

Vehicle design and development are a notoriously difficult set of tasks, typically undertaken by companies that have been in the business for four to five decades. New vehicle designs commonly require more than 30,000 engineering hours, and three to five years to complete, as well as several billion dollars of up-front investment (Sturgeon et al., 2009).

Opportunities to move up in the value chain for suppliers in emerging economies have proliferated and are likely to become even stronger now that an increasing number of new models are developed specifically for local markets. While it appears that some large developing countries, especially China and India, are gradually gaining more independence and autonomy as their industries and markets gain size and importance, supplier countries such as Mexico and countries in East Europe remain as dependent appendages of adjacent regional production systems. The case of India is discussed in greater detail in the next section.

4. The Indian automotive industry

The automotive industry comprising the automobile and the auto component[29] segments – is one of the key drivers of a developing economy's growth. With its deep backward linkages and forward linkages, it is seen as a major driver and has been recognized as a sector with very high potential to increase the share of manufacturing in gross domestic product (GDP), exports and employment. It facilitates improvement in allied sectors through backward and forward linkages. The automotive industry in India comprises of all vehicles, including 2-3 wheelers, passenger cars and multi-utility vehicles, light and heavy commercial vehicles, and agricultural tractors and other earth moving machineries, besides the component segment for all these categories.[30] It also includes OEMs, Tier I/II suppliers and after market.

Starting from just 0.5 million in 1970s and around 1 million in the 1980s, the total production of vehicles trebled in 1991 and went up to 6.5 million in 2002.[31, 32] The turnover of the Indian automobile industry is about US$ 58.5 billion and that of the auto component industry is close to US$ 67 billion (2012–13).[33] The OEMs, Tier I/ II suppliers and after markets accounts for 22 percent of India's manufacturing GDP.[34] The industry manufactures a wide range of products to meet both domestic and international demand. The sales of passenger

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on suppliers and moving to modular vehicle design to simplify final assembly process (Sturgeon and Florida, 2004)

29 Including the OEMs and the aftermarket.

30 See Kathuria (1987) for an account of the automobile industry in pre-independence India.

31 Production accelerated after 1980s when partial decontrol was introduced. The effect of complete decontrol took time to exert an all round impact on the economy as it shows there was a short recessionary period 1991–1994, after which there was sign of revival. Towards 1998-99, the industry again showed an upward trend reaching a record high in 2002. In 1998-99, the industry produced a total of 4.5 million vehicles (including 2 and 3 wheelers), and reached a turnover of Rs. 420 billion (equivalent to US$ 104 billion), thus making India as the fifth largest auto producer among emerging markets. With continuous policy support and rapid expansion of the domestic market, competitiveness in the industry intensified fuelling a high growth rate (with a CAGR of 12 percent) in the 1990s.

32 For details on development of Indian automobile industry, see Parhi (2008) and Tiwari and Herstatt (2014).

33 Make in India (http://makeinindia.com/sector/automobiles/)

34 19 million jobs are provided by this industry directly or indirectly (SIAM)

cars touched 1.2 million units in 2006 and 2.6 million units in 2014-15. At the global level, India ranks number eleven in the passenger car market. With only one percent of the population owning a car, annual sales in India are expected to increase from two million units by the end of the decade. [35]

India's indigenous passenger car industry was launched in the 1940s with the establishment of Hindustan Motors and Premier Automobiles Limited.[36] The two companies together garnered most of the market share till the 1970s.The market for automobiles was also not very big given the low rate of economic growth during this period. Efforts to establish an integrated auto components industry in India were initiated in the 1950s.[37]

Until about the mid-1980s, the automobile industry was protected by high import tariffs and production catered to the demands of local automobile manufacturers. Manufacturing was licensed and the market was restricted, with quantitative restrictions on imports of automobiles and auto-components and a high tariff structure. The early 1980s[38] saw the entry of Japanese manufacturers in India to set up car and commercial vehicle factories in partnership with Indian firms. In 1981, a company called the Maruti Udyog Limited (MUL) was incorporated by the government, which went into a joint venture (JV) with the Suzuki Motor Corporation of Japan to manufacture vehicles.[39] The company developed a very strong ancillary vendor network around it, which was unforeseen in the Indian industry. This and other strategic moves made it the country's largest car manufacturing company with an installed capacity of 1, 00,000 units and about 80 percent of market share in a decade's time. [40]

This phase saw a resurgence of the sector. Around the same time, the Government of India also put into place a Phased Manufacturing Programme (PMP) for localization of components, under which domestic OEMs had to increase the proportion of domestic inputs over a specific period. With the entry of several Japanese and foreign OEMs, many Indian companies started JV collaboration. A number of JV collaborations with foreign partners enabled Indian companies to benefit from technology transfers, and improve quality.[41] The largest number of JVs came from Japan and more than 50 percent were in manufacturing of passenger cars. Companies first outsourced manufacturing to local players, gradually moving from imports to indigenous production. They also established technology development

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35 Sale of passenger card was 2.5 million units in 2010-11 (SIAM).

36 India's automotive industry saw a very slow-paced growth from 1940s till 1980s.

37 The Indian auto component industry was pegged at USD 38 billion while the global auto component industry size is USD 730 billion was FY 14 (Edelweiss, 2014).

38 By this time, however, the government felt the need to introduce modern, fuel efficient and low-cost utility cars that could be affordable for mass consumers. There was now a significant demand for passenger cars which was growing.

39 At the time there were five passenger car manufacturers in India - Maruti Udyog Ltd., Hindustan Motors Ltd., Premier Automobiles Ltd., Standard Motor Production of India Ltd., and Sipani Automobiles.

40 MUL dominated the domestic passenger car market (with a market share of about 83 percent) till around 1996-97.

41 Foreign companies typically entered the market taking local players as joint venture partners to gain local market knowledge and smooth out other operations. Vehicle manufacturers also supported component manufacturers through equity participation, technical collaboration, etc.

centres in the country to meet their global requirements for single and multiple segments in some cases.[42] Factors such as proximity of component base, geographic location conducive to trade, and big markets have helped companies make their investment decisions.

Beginning in the middle of 1991, the Government of India made some broad-ranging changes in its economic and industrial policies in the direction of further liberalization. Mass emission regulatory norms for vehicles were also introduced in this decade as well as a National Highway Policy announced. Policy support was crucial for growth of the industry and when the PMP policy ended in 1991, the government introduced a Memorandum of Understanding (MoU) system that continued to emphasize localization of components. The Indian automobile market in general and passenger cars segment, in particular, witnessed liberalization. By the end of the decade, many major MNCs including Daewoo, Peugeot, General Motors, Mercedes-Benz, Honda, Hyundai, Toyota, Mitsubishi, Suzuki, Volvo, Ford and Fiat were operating at a significant scale in the market and also started operations in the middle-sized car segment. Many of these had come up with state-of-art models of vehicles and also entered with their parts suppliers. In fact, foreign presence in the passenger car segment was much more than all the other segments of automobiles[43] and production and exports were dominated by Maruti and Hyundai.

4.1 Present scenario

By the turn of the century, there emerged a huge amount of optimism for developing India into a low-cost small car making hub for domestic and international markets. The small-car[44] segment did particularly well and India's potential as a global hub for manufacturing in this segment began to be recognized. India's strengths were - large unsaturated domestic market for small cars (given the presence of a large middle economic class), low production costs due to availability of low-cost labour and other inputs, English speaking skilled engineering talent and the beginnings of an ecosystem with government support. Global affiliations and tie ups slowly enabled technology upgrading and the expansion of scale of production in the industry. Indian companies maintained their traditional strengths in casting, forging and precision machining, fabricating (welding, grinding and polishing) at technology levels matching the required scale of operations.[45]

Today, India is the second-fastest growing market for automobile and auto-components in the world (after China) with well-developed manufacturing facilities, R&D and testing centres.

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[42] Testing facilities for forging and casting based manufacturing companies were generally small but in line with international standards. These companies needed to adhere to international standards pertaining to environment, minimum wage and child labour by importing countries (through various certification requirements and regular auditing) which they are able to meet.

[43] This was followed by the multi-utility vehicle (MUV) segment.

[44] Passenger cars whose length does not exceed 4000 mm (Tiwari and Herrstatt, 2013). The classification system followed in India is A1 to A6, with A1 the smallest (Tata Nano). B1 and B2 are vans and MUVs (SIAM). Europe follows the system of A segment mini, B segment small and C segment medium cars. Apart from length of the car, body mass of the car and seating capacity are also considered in deciding the size of the car elsewhere.

[45] Maruti's import content as a percentage of sales fell from 23% in 2002 to 6% in 2014 (Edelweiss, 2014).

The turnover of the automotive industry comprised more than 45 percent of India's manufacturing GDP during 2013-14. Major companies dominating the sector, both domestic and foreign, are highly globalized players. Many of them had started manufacturing in India in the 1990s when the domestic policy environment was relaxed with economic and industrial sector reforms. Investments in capacity addition and R&D were made along with enforcement of strict environmental standards. India's domestic carmakers, viz. Tata Motors, Mahindra & Mahindra and Ashok Leyland, too, had developed significant R&D and technology innovation capabilities by this time.[46] Various trade and investment restrictions were removed to speed up the momentum for large scale production. Exports from the sector now increased significantly and India was listed among top producers in the global market.

The auto-component industry manufactures a wide range of products to meet both domestic and international demand.[47] It has been able to modernise its technology, improve quality and has developed capabilities to manufacture components for new-generation vehicles. Indian companies maintained their traditional strengths in casting, forging and precision machining, fabricating (welding, grinding and polishing) at technology levels matching the required scale of operations. They also achieved significant success in garnering engineering capabilities and adapted to local requirements through local design.[48] With time, more and more Tier 1 companies relocated whole and complex systems to India rather than building basic parts of processes. Continued inflow of technological foreign know-how and competition with other Asian production centres such as China helped local firms make improvements in quality, capacity and productivity.[49] Today, endowed with the potential of low-cost quality products, India edges over other developing countries with respect to component manufacturing.[50]

As of now, the Government of India encourages foreign investment in the automobile sector and allows 100 percent FDI via the automatic route. It is a fully delicensed industry and free imports of automotive components are allowed. Some major measures undertaken by the Government to boost manufacturing in the past have included lowering of excise duty on vehicles, and the introduction of the Automobile Mission Plan for the period 2006–2016[51] aimed at accelerating and sustaining growth in this sector. The Automotive Mission Plan 2016 aims to accelerate and sustain growth in the sector and has projected a CAGR of 16 percent in the industry's turnover over the next decade. The government has also set up National Automotive Testing and R&D Infrastructure Project (NATRiP) at a total cost of

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46 It was believed that with given capabilities, manufacturers could produce cars customized for different countries of the world.

47 The four companies that are in the top 10 list of India's auto component segment are Motherson Sumi, Amtek Auto, Bharat Forge and Mahindra CIE. These companies have grown due to their focus on international acquisitions and manage them efficiently post acquisition (Edelweiss, 2014).

48 The domestic auto component industry sales are dominated by power train, while globally it is speared across power train systems, exterior systems and interior systems. Indian vehicles lag their global counterpart in terms of power train technology, safety and infotainment content, electronic stability control, ABS, front and side airbags etc. (Edelweiss, 2014).

49 Sutton (2007) illustrates the difficulties faced by second-tier suppliers in China and India in meeting the quality standards set by foreign carmakers.

50 Following the international trend, Indian OEMs are also outsourcing modules to component suppliers.

51 http://www.siamindia.com/

US$ 388.5 million to enable the industry to come on a par with global standards. The sector operates under a well-established regulatory framework of the Ministry of Shipping, Road Transport and Highways, which plays a part in providing a boost to this sector.

4.2 India's automobile development model

India's model automobile developmental model has certain specific features. Firstly, it is different from other countries like Mexico and China, whose industries have developed by relying mostly on foreign lead firms and suppliers to provide with vehicle designs and investment. The improvement in the breadth and depth of local capabilities in India was aided later through foreign acquisitions undertaken by local firms.[52]

Second: India has not been large and rich enough to support assembly of vehicles without modification, as it happened in South Africa, Thailand, and Turkey, for example.[53] These countries have become final assembly hubs for their wider regions. Third, plants located here have mainly served the domestic market and exports have surged only recently. Fourth, the mix of vehicles produced and exported by the country has predominantly constituted compact cars and small trucks.[54] A fifth aspect is that activity in India has been less concentrated (because of logistical issues), making it less advantageous for suppliers to establish large local operations.

Chinese lead firms have grown on the global supply chain emerging around the JV car assemblers; on the other, they provide some local first-tier suppliers with important 'learning' opportunities. Local lead firms, contract out much of their design work (and even some of the engineering and testing) to vehicle engineering companies. The 'integral' design architecture of motor vehicles highlights the fact that these firms will have to master design and development capabilities to be independently successful. However, there has not been as much technology transfer as had been hoped for due to the inadequacies of intellectual property (IP) protection in China. Nevertheless, private firms, such as Chery and Geely that operate independently have provided domestic suppliers with important opportunities to upgrade their capabilities and to become more deeply involved in production systems. Competition with the most advanced domestic firms – Chery, Geely and SAIC – is a major stimulus for some foreign lead firms to pursue an aggressive localisation strategy. Only by sourcing locally almost as much as Chinese lead firms, have foreign automakers been able to

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[52] Earlier, because of a slowly growing per capita income, market potential was not perceived to be large enough to convince foreign lead firms to invest in India rather than countries such as China.

[53] India has a large and growing middle economic class that prefers buying small/compact and mid-sized cars mainly for reasons of affordability. Sturgeon and Florida (2004) pointed out that in India, people tend to buy sub B-class sedan as the initial car and then upgrade to a new B-class with more options or a stripped down C-class.

[54] The export of passenger cars in value terms increased from US$ 93.7 million to US$ 5.5 billion from 1999-2000 and 2010-11. The share of automobiles in India's merchandise trade increased from 0.25% to 2.2% over the same period (Tiwari and Herstatt, 2014). The major exporters in 2010-11 were Hyundai, Maruti Suzuki and Nissan and small cars formed the bulk of the exported passenger cars. Within the small cars, hatchbacks (A2 or compact) were the dominant export item.

compete for the lucrative middle of the market. Lang et al. (2008) felt that localization in China was more advanced than in India,[55] and also that suppliers have progressed further in the localization process than OEMs.[56]

In contrast to China, [57] India has relied more on home-grown lead firms to propel its industry.[58] A disadvantage of this approach is that the absorption of global best practices has been proceeding more slowly (Sutton, 2004). Nevertheless, the development of the Indian automotive industry has accelerated very quickly in the past several years. This improvement in the breadth and depth of local capabilities has been aided, most notably, by foreign acquisitions. As noted by Sturgeon and Biesebroeck (2010), every aspect of vehicle development and production, including design and engineering, existed in local firms from the beginning, which allowed the industry in India to surge forward. Indian industrial policy promoted local lead firms from the start, and domestic capabilities in design,[59] vehicle development, and engineering emerged.[60] When local expertise was missing, independent lead firms, such as Tata Motors, acquired Western companies or formed international JVs. [61, 62]

Sutton (2004) reports higher defect rates (in parts-per-thousand) for Indian versus Chinese suppliers. Because the foreign automakers invested more aggressively to build up a local supply chain in China than in India, it is not surprising that Indian suppliers were lagging Chinese suppliers in both productivity and quality (Sutton, 2004). A follow-up study by

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55 R&D activities concentrate on making small adaptations to existing products, local sourcing is limited to simple parts, and local manufacturing tends to take the form of CKD assembly or small scale local production. Foreign OEMs in India have localised sales functions.

56 Due to the continuous price pressure from OEMs, many suppliers have shifted to Chian and India. Lang et al. (2015) note that MNCs are facing competition from emerging market players from Chain, India and Latin America in automotive supply industry.

57 For China, the tremendous success of the SAIC JVs with GM and Volkswagen has made Shanghai a world class hub of the global auto industry.

58 One reason for this is as suggested by Sturgeon and Biesebroeck (2012), has been India's lower per capita income which has grown slowly compared to China which did not attract foreign investors in the country.

59 Design of the small car is also happening in case of Maruti's A star model: the car was styled at the domestic R&D centre of Maruti though some innovations were developed externally. This includes an air intake filter system for the A-star developed by Mann and Hummel Filter Private Limited, a wholly owned subsidiary of Man and Hummel group of Germany (Tiwari and Herstatt (2014). In case of Hyundai, Hyundai Motor India Engineering Private limited has been set up a subsidiary of Hyundai Motors India Limited (HMIL). This is a part of HMC's global innovation network, and is involved in data analysis, component development, localization of components besides design and product development of several future products. The R&D centre will facilitate development of India's Hyundai's global hub for manufacturing and engineering of small cars (http://www.hyundai.com/in/en/)

60 The two countries are also supplying to very different markets: China to Russian Federation and Ukraine while only a small percent of Indian cars are sold to developing countries such as Algeria. Indian small cars are selling in the westerns European markets (Amighini, 2012).

61 Vehicle design and development have traditionally been difficult tasks for firms requiring substantial investment in terms of finance, time and effort.

62 Cumulative R&D expenditure of the automobile sector was approximately US$ 780 million in 2010-11, with an increase of 27.5% on year on year basis for the 4 wheeler segment (SIAM, 2012). The four wheeler segment accounts for 90% and engine manufacturers contribute 2% to the total R&D in the automobile segment (Tiwari and Herstatt, 2014). There has been a slight increase in the share of R&D done by auto components manufacturers in 2013 over 2003, though more than 50% of the patents filed were by Tier I suppliers.

Brandt and Van Biesebroeck (2008) three years later, shows remarkable improvement by the Chinese firms that is unlikely to be matched in the Indian industry, which has been growing more slowly.

The transition of automotive industry to a relatively 'high-value' and volume industry towards the 1990s significantly induced dynamism in the auto component sector too. In the 1980s, component manufacturers also entered in JVs with European and US firms. The industry grew by around 20 percent annually in the 1990s and the average annual growth of exports was around 15 percent between 1991 and 2002. In 1996-97, investment in components marked a little above $1500 million and rose by more than 30% to $2300 million in 2001-2002. Interestingly, about 60 percent of firms in the organized sector began production only after 1980.[63] High growth took place in engine, drive transmission and steering parts. All through the period, engine parts, being high value-added in its nature, have been contributing most to total production. Overall, the post liberalization period induced a CAGR of about 20 percent (Parhi, 2008).

Many international component manufacturers such as Delphi, Lucas-TVS, and Denso followed their customers (global car manufacturers) and started manufacturing in India, often starting by entering into JVs with Indian suppliers. With an outward look of component manufacturers (increasing exports, more so to the western destinations), and competitive pressures from international firms in the export and domestic markets, the component industry had to upgrade the process and product qualities and technology standards to gain and sustain and gain capabilities.[64] Many manufacturers now adhered to the global environmental norms regarding emission/technological standards and quality certifications. A majority of Automotive Component Manufacturers Association of India (ACMA) members have already secured ISO 9001 certifications and a sizeable portion have got QS 9000 certification.

Many independent local suppliers have not managed to either link with global sourcing partners or upgrade their capabilities to reach OEM standards. While this has left some local SMEs behind, opportunities to become local suppliers in second-tier sourcing have emerged. Local suppliers need to upgrade and respond to expectations of MNCs and their OEM partners in terms of quality, supply and delivery times so as to stay competitive, domestically and internationally (UNCTAD, 2010).

The export-led and GVC-engaged strategies of firms in the Chinese auto industry have provided a boost to technological learning more quickly and broadly than they have in India. Nevertheless, Indian automakers have developed a deeper and broader set of competencies that could stand them in good stead in the long run. As markets shift to developing countries,

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63 For details on development of Indian automobile industry, see Parhi (2008) and Tiwari and Herstatt (2014).

64 Global assemblers and large component producers set stringent operational requirements in terms of cost, quality, delivery and flexibility for their suppliers. They also introduced new technology – more composite parts needing new capabilities to produce them. The focus of innovations has been more on process changes while the locus of these changes have shifted from assembling units to auto component units.

increasing the potential for sales of simpler, lower cost vehicles, it is unclear which of these approaches will win out in the long run, or if they will eventually converge to make the distinction less than clear.

When it comes to network trade, India again stands out among other East Asian countries (Athukorala, 2013). For India, road vehicles and other transport equipment accounted for 28 percent of the total network exports in 2010-11 (compared to an average of 13.2 percent for East Asia). Various automakers have established assembly plants in India and even started using India as an export platform for their global production networks. There are various reasons for expansion of this sector. First, the low value-to-weight nature of products of the automobile industry does not make air transport feasible, which leads to location of industries in regions of high demand. Second, there are a handful of auto makers that purchase components from a number of manufacturers which makes it necessary to locate the parts and component manufacturing close to the assemblers in order to secure the orders. Another feature of this industry is how high tariffs (with an anti-export bias) co-exist with rapid export growth.[65]

5. Methodology and survey findings

5.1 Methodology

This paper is based on a combination of quantitative and qualitative methods for collecting primary data on automobile firms. Initially, the supply chain was examined and all activities and production processes in the automotive industry understood/documented. Information from a detailed survey was used to identify contribution of different segments to value addition, employment and exports.[66] Secondary information from export-import data was used to capture information about segments which are doing well.

All passenger car firms in India were approached for the study and a structured questionnaire[67] was used for the primary survey. Some firms did not agree to participate.[68] The questionnaires were administered to the firms in the period January 2014 to February 2015 via face-to-face interviews in Delhi NCR, Pune and Chennai. Questions were asked regarding the nature of the value chain, the problems faced in further integration and moving up the value chain. Information was also collected from other key stakeholders including industry associations. Information from the industry associations was useful in understanding how production was organized in the industry, and the roles played by domestic firms and MNCs in pushing the frontiers of technology. The supply chain, including all activities and production processes in the automotive industry, is shown in the appendix figure 2A.

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65 See http://www.siamindia.com/economic-afairs.aspx?mpgid=16&pgid1=18&pgidtrail=20

66 Details of firms in terms of their sales, employment, exports and imports etc. are shown in Table 2A.

67 The questions put to the firms have been listed in the Appendix.

68 For purposes of the survey, firm level information has been collated to present an industry view of the issues. Names of firms reporting information will not be divulged to protect confidentiality.

5.2 Data analysis

Between 2005 and 2014 (see Table 1A), the exports and imports of motor cars and parts related to motor cars, have been presented. [69,70, 71] From the table we note that the main exports consist of passenger vehicles (SITC 7812) in 2005 as well in 2014. Other items that were imported include Other vehicle parts (SITC 78439).[72] The above broadly reconfirmed that passenger vehicle (corroborating Amighini's (2012) point) and parts related to it were major trading products for the Indian industry.

5.3 Findings from the survey[73]

The production process in the passenger car segment of the automobile industry is easily understood in terms of blocks: steering and transmission, brakes and engine equipment, tyres, etc. A car has many components – in some cases as many as 30000 parts go into an engine. Different suppliers make different parts and one supplier cannot make more than a few parts. To understand the value chain of a car (given the large number of parts), we can divide the manufacturing into several sub-systems: e.g. engine block and steering system, transmission system. The engine-clutch-gears are the important components in a car. The most important elements of the value chain of the industry with respect to employment creation are brakes and engine equipment. Usually a supplier will focus (and manufacture) on parts belonging to the same system.

The largest contribution to exports is from tyres, engine and transmission parts with USA and Europe (countries such as Germany, UK, Turkey and Italy) forming the top export destinations. Products such as engine parts, gear boxes and steering parts are also exported to these countries. Some companies have warehouses in the UK and US which cater to other parts of the world. Factors such as proximity of a component and, strategic geographic location help trade.

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69 The usual pattern in a country is that as a local automotive industry develops, the country initially runs a trade deficit in parts because it does not have the local capabilities to produce advanced components or the quality standards to sell in advanced markets. Brandt and Van Biesebroeck (2008) show that China only started to run a trade surplus in parts in 2005. Significant parts exports emerge only when final assembly capability is quite mature. In the context of GVCs, these exports might be dominated by global rather than local suppliers.

70 Amighini (2012) notes that there has been a radical change in the countries that supply auto parts to India: from USA, Japan and Germany in the mid 1990s to South Korea and China in the 2000. South Korea is the laeding supplier of parts to India mainly due to the operation of Hyundai.

71 Amighini (2012) points out that while auto parts dominate exports by China in 2008, auto parts while important, for India's exports has been declining since 1995 and exports of motorcars and other means of transport have increased for India. In terms of net trade, China is a net importer of cars while India is a net exporter of cars and is dependent on foreign imported parts for its final production. The two countries are also supplying to very different markets.

72 In the HS classification, this corresponds to 8708. The significant item of import in this category (according to Department of Commerce, Government of India) in 2014-15 is Other parts and accessories of vehicle of heading 8701 to 8705 (HS 870899) and gear boxes (HS 870850). However, both these items were exported as well in the same year.

73 Questionnaire used has been presented in Appendix A.

In the passenger car segment, interviews with some industry sources revealed that predominant imports included electronic parts, critical engine parts, and motors. When the related technology is not available locally, then parts are imported. Cost and accuracy of components is important. For example, the crankshaft is a very important part but difficult to make in India; it is made in Japan and Thailand. Another example is the electronic brakes and electronic control systems (which have stringent specifications as well).[74] Components such as the cylinder block can be made in India or Thailand. The indigenous market for components such as engines is limited however, and companies have even started exporting these from India. New technologies are introduced and developed only slowly in countries such as India. India still needs to mature and take steps improve the skill level of its workforce.[75]

Component imports are in two categories, one, high tech parts, which come mainly from Germany, Japan, Korea and Thailand; and aftermarket parts which usually originate in China. Regulations are needed for the after-market and there is a need to check the penetration of spurious parts in the country.

Plants in India started by assembling cars for the the domestic market. An increasing number of new models are being developed specifically for local markets now, opportunities to move up in the value chain for suppliers in emerging economies have proliferated and are likely to become even stronger. Domestic firms are using local content for almost all manufactures (85-90 percent). For MNCs, at the time of setup, parts like engines, brakepads, clutches, fuel pumps/filters etc. are imported. Localisation is low initially (50-60 percent) and increased gradually as domestic capability of vendors' increase.

The presence of final assembly plants can provide opportunities for local suppliers producing, especially, bulky, heavy, or fragile parts, such as seats. Proximity to plants assembling existing vehicle designs can create export opportunities as well, even when supply contracts are based on existing blueprints, because identical vehicles are being produced elsewhere in the world.

In recent years, India's automotive sector has gained more independence as its market size is expanding (local and overseas), and as the local design content of vehicles increases to meet the needs of local consumers.

5.4 Innovation and upgrading in the Indian automobile industry

5.4.1 India's strengths and weaknesses

Table 3A in appendix presents details of the some of the firms that were interviewed during the survey. Due to the confidential nature of the data, the names of the companies have not

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[74] It is common for companies to set up joint ventures with local partners in the sector.

[75] Currently, engineers engaged in advanced jobwork are either trained in India or sent abroad (usually to the company's headquarters, for MNEs).

been revealed. The information contained in the table does not reflect that of any particular model of a passenger car, but that of the company as a whole. We have asked firms about the nature of their imports, whether this has gone down, their exports and the nature of their exports.[76] We have talked to firms manufacturing passenger cars in all segments: small, mid size and large. Most passenger car manufacturers produce (or assemble) various models of cars in the country.[77] The major assembly and manufacturing plants located in Maharashtra, Gujarat, Delhi NCR, Pune and Chennai. Learning in new production techniques (where source of knowledge may be obtained through foreign partners or through independent search activities and re-engineering) is present in all the firms as can be seen from table 3A. Innovation is also occurring in all the firms and all the firms have R&D centres in India. Some of the firms (namely B, C and D) are reporting doing designs in India. Firm A and E reported some designing in India though global models are designed and manufactured in the parent country of the MNC. The localization rate is also high for most firms (this can be seen in Table 2A). India's strength lies in end-to-end production, especially in the small-car segment.[78]

As far as imports are concerned, as is evident from the table 3A, transmission parts and Electronic Control Module are sourced from abroad. Most of the respondents felt that it was done since either there are stringent specifications for these items or they are not produced in India.

The metals used in this industry, iron, aluminium and steel are also available locally. Lightweight materials such as magnesium composites[79] which are not locally available are imported. Some industry players feel that India lacked the technology for making newer cars with lightweight products (using modern plastics, aluminum and magnesium) and substantial investment in capital goods is needed. India is also good at manufacturing engines, though they are designed elsewhere.[80]

5.4.2 Issues in this sector

The companies interviewed listed the following issues as hindering the sector's growth : 1. Infrastructure – proper roads, availability of water, power, and gas for paints, etc., 2. Lack of single-window clearance system, 3. Archaic labour laws, 4. Finance – high rate of interest, 5. Delay in implementation of goods and services tax (GST).

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[76] As is evident from the questionnaire, questions specifically related to upgrading were not asked since the most important objective was to establish the nature of the value chain in India. Hence information on upgrading or scores related to the nature of upgrading cannot be provided. However, questions related to design and innovation was asked as well as questions regarding exports and imports of firms. These have been reported in Table 3A.

[77] In case of some MNCs, some models are manufactured in the parent country and imported as Complete Built Up (CBUs).

[78] As discussed earlier and also in Tiwari and Herstatt (2014).

[79] Highly inflammable and requires strict establishment of safety norms.

[80] See footnote 59.

Firms feel that there is too much red tapism, and they need to interact with too many governmental agencies, which results in company management boards becoming overly cautious in their growth plans and holding back from upgrading technology or expanding. India still needs to mature and take steps improve the skill level of the workforce, set up crash-testing facilities, etc.

Labour skills are also an issue. The available labour tends to prefer moving into high earning, easy jobs and hence retention is becoming a problem. Lack of education and talent is also a big problem in the country with team spirit and discipline lacking. Inadequate incentives are provided for people in manufacturing products for exports, resulting in very poor risk cover and loss when the global industry slows down, especially on account of long inventory pipelines. There is excess capacity of up to 30 percent in automobile industry.

5.4.3 Way to go up the value chain

Process upgrading, involving increasing the efficiency of and between individual links in the chain is the requirement of the sector.[81] Conceptualization and design are critical stages in the manufacture of a car and entail high value addition. These functions are generally performed at the company's headquarters of MNCs, especially for the premium segment. Assembly of engines, electronic and technologically advanced parts and marketing also involve significant value addition to the final product but are undertaken at local level.

5.4.4 Some hindrances to future growth

There are certain issues in the Indian market model. The current framework for manufacturing does not provide a flexible and competitive level playing field for the industry to operate and upgrade. There is a greater need for a strong Tier 2 and Tier 3 support to Tier 1 and OEMs for Indian manufacturing companies to remain healthy and globally competitive.

Research for new product development is lagging behind in India which is one of the reasons that its participation in GVCs in this sector is still not significant compared to countries such as China, Japan or Germany. Infrastructural constraints are also hindering the growth of the sector. There are also limitations on applying the latest technology in the country. Small companies are not able to meet global demands, which require higher levels of technology. The fact that small firms are cautious about making investments in technology makes the industry lag behind global players. This affects the Tier 2/3 support to the industry to upgrade and operate at globally competitive levels. This is an entry barrier to new players because of

[81] There are four types of upgrading in value chains (UNCTAD, 2010). One, process upgrading which involves increasing the efficiency of and between individual links in the chain. This can be achieved, for instance, through improvements in logistics or adoption of best practices and standards. Second, product upgrading involves the ability to produce components and sell new, competitive and innovative products developed by firms. The third is functional upgrading that seeks to increase the value added by changing the mix of activities conducted within the firm by resorting to outsourcing or focusing on activities in which they specialize. Fourth, chain upgrading, which allows suppliers to move altogether to a new value chain.

the high capital investments needed and hence growth is compromised, with only large and big players of MNCs dominating the segment.

6. Conclusion

Inflows of knowledge and technology from external sources are essential components of learning and innovation in developing countries. In the context of GVCs, integration in GVCs helps firms get access to knowledge and through participation in such chains, learning and innovation is fostered. However, absorption of technology and diffusion occur due to adaptations and modifications to suit local needs, learning capacity is not a sufficient condition for upgrading. For this to happen, firms must possess the competencies to incorporate the new technology into their production capacity. The challenge, as noted by Morrison, et al. (2008) is not always about moving into more advanced functions but is often about deepening specific capabilities required to explore new opportunities in the value chain stage in which the firm is currently engaged in.

The development of automotive value chains has initiated a trend towards regionalism in Asia in recent years with these countries turning into final assembly hubs for the wider region. Lead firms have established local design, engineering facilities and regional headquarters. Indian industrial policy promoted local lead firms from the start, and domestic capabilities in design, vehicle development, and engineering emerged. As noted by Sturgeon and Biesebroeck (2010), every aspect of vehicle development and production, including design and engineering, existed in local firms from the beginning, which allowed the industry in India to surge forward. India has relied more on home-grown lead firms to propel its industry. The literature reveals that strategies of firms in the neighbouring Chinese auto industry have provided a boost to technological learning more quickly and broadly than in India (Sutton, 2004).

Though capable of end-to-end production, India has also become an assembly hub for large cars and manufacturing hub for small cars. This is due to the fact that India has become one of the largest markets for small cars worldwide and has also started exporting small cars. Firms have started exporting to other countries as well as the home country of the MNC parent (e.g. in case of Maruti). Indian based car makers are engaged in global innovation networks, and sourcing suitable technologies from all over the world to complement their own R&D efforts. To meet the future needs of the sector and compete in the overseas market, manufacturing technologies will need to be upgraded continuously. The lack of indigenous technologies can constitute a major handicap for moving up the value chain. This includes the need for large investments associated with developing new technologies that are green and compliant with recognized high efficiency standards. On this front, engine technology, particularly small engines for hybrid and electric systems have bright prospects in the market.

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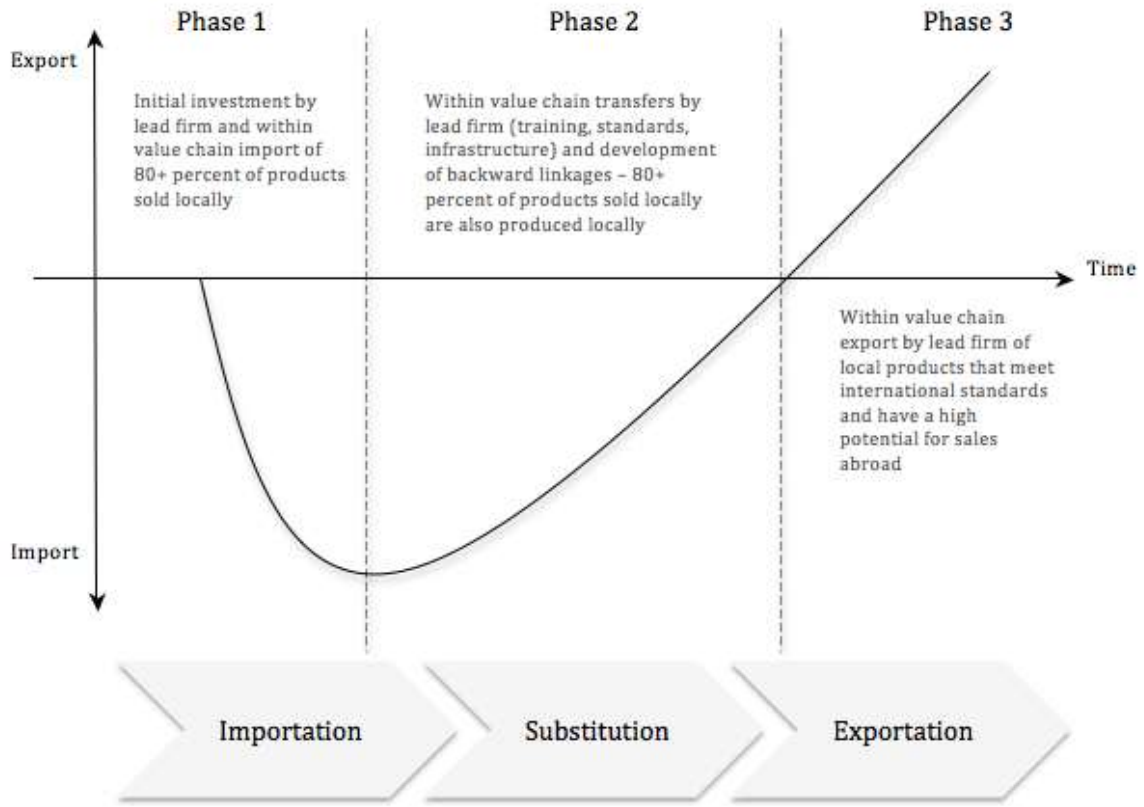
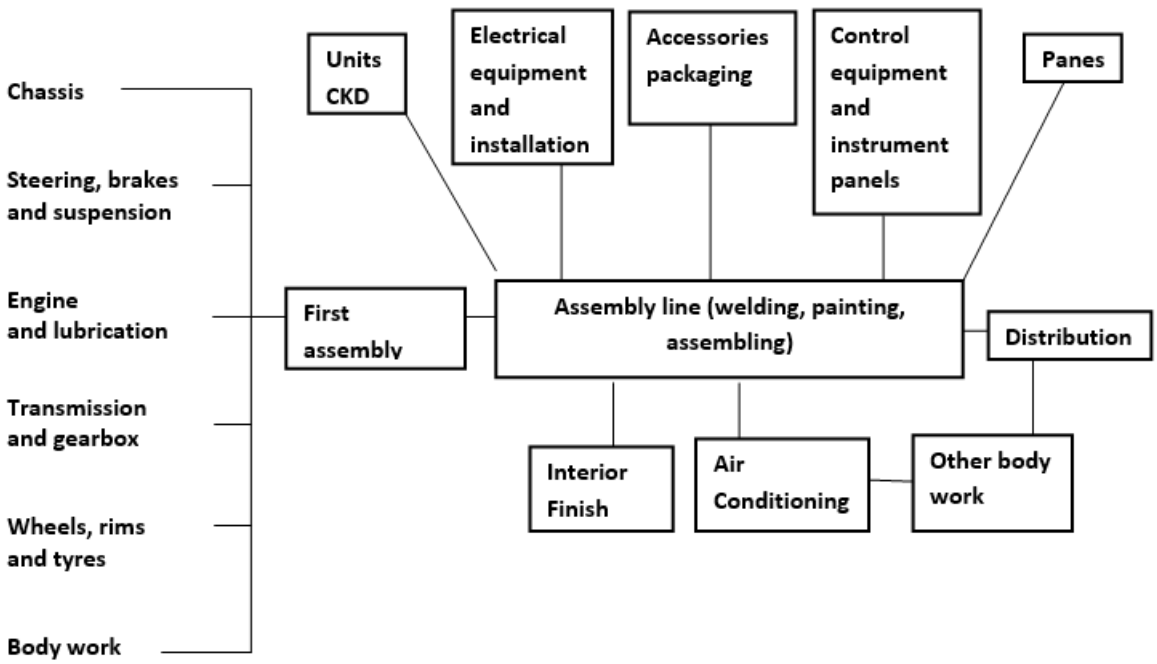
Figure 1A: Different phases of localization



Source: Cattaneo et al. (2013)

Figure 2A: Supply chain of the Indian automotive industry



Source: Adapted from UNCTAD (2010)

Table1A: India's trade with the world in passenger automobiles (SITC 3 - Trade value in 1000 USD)

Product Code	Description	2005		2014	
Gross Exports					
7812	Pass motor veh exc buses	949301	21.01	5768248	22.13
78439	Other motor vehcl parts	778253	17.22	3046580	11.69
78434	Motor vehicle gear boxes	78896	1.75	331215	1.27
7841	Motor veh chassis+engine	125235	2.77	314772	1.21
78431	Motor vehicle bumpers	112963	2.50	209082	0.80
78435	Motor veh drive axle etc	5498	0.12	184644	0.71
78433	Motor vehicle brake/part	26154	0.58	156605	0.60
6251	Tyres new for motor car	43554	0.96	98615	0.38
78432	Motor veh body parts nes	12955	0.29	73180	0.28
78229	Special motor vehcls ne	4817	0.11	20509	0.08
78425	Motor vehicle bodies nes	711	0.02	18495	0.07
82112	Motor vehicle seats	758	0.02	10999	0.04
76212	Mtr vehc radio rec only	405	0.01	8120	0.03
78421	Motor car bodies	111	0.00	2324	0.01
76211	Mtr vehc radio/player	1	0.00	72	0.00
78436	Mot veh non-drive axles	7295	0.16	-	-
Total		2146907	47.52	10243460	39.30
Grand Total (all categories)		4519072	100	26067062	100
Gross Imports					

7812	Pass motor veh exc buses	131083	2.50	188165	1.46
78439	Other motor vehcl parts	624529	11.92	2363341	18.40
78434	Motor vehicle gear boxes	44709	0.85	558583	4.35
7841	Motor veh chassis+engine	1535	0.03	37284	0.29
78431	Motor vehicle bumpers	22036	0.42	46463	0.36
78435	Motor veh drive axle etc	21741	0.42	166622	1.30
78433	Motor vehicle brake/part	25888	0.49	159201	1.24
6251	Tyres new for motor car	13474	0.26	199235	1.55
78432	Motor veh body parts nes	19239	0.37	359006	2.79
78229	Special motor vehcls ne	11575	0.22	10839	0.08
78425	Motor vehicle bodies nes	395	0.01	72748	0.57
82112	Motor vehicle seats	253	0.00	38167	0.30
76212	Mtr vehc radio rec only	4583	0.09	73748	0.57
78421	Motor car bodies	910	0.02	36935	0.29
76211	Mtr vehc radio/player	4594	0.09	48255	0.38
78436	Mot veh non-drive axles	3325	0.06	-	-
Total		929869	17.75	4358592	33.93
Grand Total (all categories)		5238534	100	12844631	100

Source: UN Comtrade

Table 2A: Comparison of some selected automobile companies in India

	Maruti Suzuki India Limited	Hyundai Motor India Limited	General Motors India Private Limited	Tata Motors Ltd	Fiat India Automobiles Pvt. Ltd	Honda Cars India Ltd.	Mahindra & Mahindra Ltd.	Renault India Pvt Ltd	Nissan Motor India Pvt Ltd.	Volkswagen India Pvt. Ltd.	BMW India Pvt ltd	Mercedes-Benz India Pvt. Ltd	Skoda Auto India Pvt. Ltd	Toyota Kirloskar Motor Pvt. Ltd	Ford India Pvt. ltd
Gross Turnover (Rs. in million)	537685	296761	27256	414057	41489	N.A	405793	60045	N.A	87664	26139	49107	52144	180455	133204
Products	Passenger cars Utility vehicles Engines CKD Components/ Systems	Passenger cars	Passenger cars Engines	Passenger cars Utility vehicles Commercial vehicles	Passenger cars Engines Components /Systems	N.A	Commercial vehicles Passenger vehicles Three wheelers Engines	Passenger cars Utility vehicles Engines	Passenger cars Utility vehicles Engines Components /Systems	Passenger cars Engines - diesel	Passenger vehicles Engines Components /Systems	Passenger cars Engines Components /systems	Passenger cars Engines Components /systems	Passenger vehicles Engines Components /Systems	Passenger cars Engines
Domestic Sales (in no.)	973531 (cars) + 68198 (utility vehicles)	418791 (cars) + 1877 (utility vehicles)	30335 (cars) + 21504 (utility vehicles)	109470 (cars) + 23850 (utility vehicles)	10380	157617 (cars) + 31445 (utility vehicles)	223968 (passenger vehicles)	4006 (cars) + 39378 (utility vehicles)	26589 (cars) + 20885 (utility vehicles)	45018	N.A	N.A	14877 (cars) + 126 (utility vehicles)	60821 (cars) + 80526 (utility vehicles)	22849 (cars) + 52289 (utility vehicles)
Employment	22476	13581	4500	49159	2342	8535	19836	195	N.A	3278	650	891	865	8361	9087
Cumul	276751	1280	6100	21824	42721	7238	11529	3951	N.A	44910	4900	12620	775	63925	1220

ative Investment (Rs. in million)		57	0			0	4								00
Market share * (approx. %)	45	15	3	7	Negligible	5	8	4.5	N.A	1	N.A	N.A	N.A	5	3
Installed capacity (in numbers)	1510000	680000	282000	1637000	191000	240000	750300	480000	N.A	200000	14000	20000	89000	310000	440000
Capacity utilization	Around 80%	Around 80% or more	Around 25%	33%	5%	Around 80% or more	N.A	N.A	N.A	55%	N.A	N.A	37.5%	51%	78%
Localization share*	Upto 95%	Up to 90% for volume models	50-60%	Upto 90%	Up to 90% for jeeps	N.A	N.A	Up to 97%	Up to 90%	70%	Up to 50%	<50%	N.A	N.A	Up to 90%
R&D Expenditure (Rs. in million)	6560	339	353	N.A	100	N.A	15337	N.A	N.A	119	N.A	N.A	N.A	N.A	N.A
Exports (number)	121713	191221	2011	2512	18	8403	4879 (utility vehicles)	3758 (cars) + 291 (CKD/ DKD)	120196 (cars) + 61 (utility vehicles)	64994	N.A	N.A	63	N.A	N.A
Imports (Rs. in million) CIF (Raw Materi	42919	50613	N.A	4995	3242 (2895+38+309)	N.A	7272	N.A	N.A	30224	N.A	N.A	30119 (28365+1754)	49662	N.A

al + Components/ Systems + Capital Goods)															
Joint Venture/ Financial Collab. in India (paid up foreign equity in Rs. and in %)	Suzuki Motor Corporation - 56%	-	-	-	FCA Italy S.p.A (12226-50%)	-	-	-	-	-	-	-	-	Toyota Motor Corp., Japan (6230, 89%)	-

Source: SIAM (2016)

Notes: (a) Figures pertain to FY 2014-15

(b) The localization percentage varies from model to model, according to cost advantage and flexibility in manufacturing schedules.

(c) N.A stands for 'Not available'

* *Source:* Newspaper articles

Table 3A: Survey findings

	A	B	C	D	E
Main reasons for initiating operations in India	Large market	Large market	Large market; Diversification of portfolio	Large market	Expanding presence in South Asia; Large potential market
Sourcing from abroad (imports)	Electronic control module and transmission parts;	Critical components like air bags, ABS controllers/modules, engine controllers, certain relays and switches, electronic modules	Used to import some raw materials such as sheet metal and high technology items such as air bags etc. because they are not available in India. Earlier this company also used to import ABS (Anti-breaking system) but now they are sourced from local vendors.	Raw material + components/ systems	Raw material + components/ systems
R&D centre	Yes;	Yes; To some extent	Yes; Most research is done in India	Yes	Yes
Whether designs in India	Yes but global models designed and manufactured in more advanced parent country	To some extent (as the company's various design centres globally have to compete for work)	Yes, mostly	Yes	Yes to some extent (global models designed and manufactured in more advanced parent country)
Challenges in India	None	1. Infrastructure – Road, water, power, gas for paints etc. 2. Archaic labour laws	1. Logistics issues - Poor road infrastructure 2. Customs – transparency issues at the time of imports 3. High taxes and duties which add to product costs	None	1. Skilled workforce is not available 2. Poor road infrastructure poses limitations on application of technology.

Source: Authors' compilation based on industry sources

Appendix A: Questionnaire

1. Basic information

Name of the company: _____

Address:_____
_____

2. What proportion of your total inputs is sourced from India or from abroad?

	% of total costs
Domestic	
Foreign	

3. For each part of the value chain given below, please make a check mark to indicate where the part is done and in what proportion?

		Domestic	Foreign
Car model 1 Name:_____	Design		
	Raw materials		
	Parts		
	Assembly		
	Marketing		
	Distribution and sales		
Car model 2 Name:_____	Design		
	Raw materials		
	Parts		
	Assembly		
	Marketing		
	Distribution and sales		

Car model 3 Name:_____	Design		
	Raw materials		
	Parts		
	Assembly		
	Marketing		
	Distribution and sales		
Car model 4 Name:_____	Design		
	Raw materials		
	Parts		
	Assembly		
	Marketing		
	Distribution and sales		

4. If exporting from India, please fill in the following information related to your company's exports

	Country name and proportion of exports
CKDs	
SKDs	
CBUs	

5. Please identify the weakest link in your supply chain.

a) Exports - _____

Reasons _____

b) Domestic - _____

Reasons _____

6. Please fill in the following information related to your company's imports

		Proportion/ number
Body and Chassis	In- house production	
	OEM/Tier 1 supplier	
Engine parts	In- house production	
	OEM/ Tier 1 supplier	
Suspension and braking parts	In- house production	
	OEM/ Tier 1 supplier	
Transmission and steering parts	In- house production	
	OEM/ Tier 1 supplier	
Electrical parts	In- house production	
	OEM/ Tier 1 supplier	
Other parts (specify)	In- house production	
	OEM/ Tier 1 supplier	

7. Please specify the type of arrangement that your company has with most OEM/Tier 1 suppliers

	Subsidiary	Contract	Joint venture	Others (specify)
Body and Chassis				
Engine parts				
Suspension and braking parts				
Transmission and steering parts				
Electrical parts				
Other parts (specify)				

8. If you import from abroad, please indicate for each of the following parts, whether the reason is major, minor or not at all a reason for importing

		Major reason	Minor reason	Not at all a reason
Body and Chassis	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			
Engine parts	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			
Suspension and braking parts	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			
Transmission and steering parts	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			

Electrical parts	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			
Other parts (specify)	Domestic quality issues			
	Domestic cost too high			
	Domestic supply issues			

9. How do you rate Indian vis-à-vis foreign suppliers in terms of quality and reliability of supply (e.g timeliness, low defect rates etc.)?

10. Do you see the above trend in sourcing changing in the next five years? How?

11. Do you see the above trend in exports changing in the next five years? How?

12. Do you encounter problems when buying from domestic/foreign markets? (rank 1-5, with 1 most important)

	Rank
Tariff/tax related problems (specify)	
Improvement in infrastructure	
Logistics	
Customs and visa procedures	
Improving visibility	
Any other (please specify)	

Domestic:

_____
_____
_____
_____
_____

Foreign:

_____
_____
_____
_____
_____

13. How do you maintain quality control with your suppliers?

_____
_____
_____
_____
_____

14. When importing, do you specify the following?

	2010			2013		
Machineries	Source	Quality	Type	Source	Quality	Type
Worker Compliance	Minimum wage	Child labor	Health	Minimum wage	Child labor	Health
Shipment	Delivery	Risk	%FOB/CNF	Delivery	Risk	%FOB/CNF

15. When exporting, do you specify the following?

	2010			2013		
Machineries	Source	Quality	Type	Source	Quality	Type
Worker Compliance	Minimum wage	Child labor	Health	Minimum wage	Child labor	Health
Shipment	Delivery	Risk	%FOB/CNF	Delivery	Risk	%FOB/CNF

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