

Sources of Innovation and Technology Capability Development in the Indian Automobile Industry

Dinar Kale
ESRC Innogen Centre
Development Policy and Practise
Faculty of Maths, Computing and Technology
The Open University
Email: D.Kale@open.ac.uk

Abstract: In the last decade the Indian auto industry has shown increasing levels of technological sophistication and significant growth. The Indian auto industry consists of local firms with indigenous design and development capability, well established global brands and has marketing presence in Indian as well as other emerging markets. This paper tracks capability development in the Indian auto industry and seeks to understand the factors both internal and external to firms that have shaped innovative capabilities. It points out that the Indian government's industrial policy secured development of basic capabilities but restricted innovative capability development in auto manufacturing. This paper reveals that key attributes of firm ownership such as managerial vision and diversified nature of business, helped Indian firms in the development of the innovative capabilities.

Key words: automotives, capabilities, India, innovation, technology

JEL classifications: O31, O32, O33, O38, O53, O25, O19

1. Introduction

Throughout the world innovation lies at the heart of economic growth and development for countries and firms in advanced as well as developing countries. Innovation in the form of new products, processes or organisation of labour brings growth to firms and development to economies. History is full of examples where lack of innovation has withered away the economies and firms precisely because those economies and firms lacked a "Schumpeterian vigour". Schumpeter explained wiping out of innovation-laggards by competition from radical new technologies and entrepreneurial firms as 'creative destruction'.

In the last decade the Indian auto industry has emerged as one of the fastest growing industries with increasing levels of technological sophistication in

the auto industries amongst the emerging countries. The Indian auto industry provides mass employment for local populations in the country and its export revenues help to boost foreign trade. It is quite evident that the Indian auto industry has followed a similar trajectory of development that is observed in other emerging countries such as Brazil, Mexico and Thailand. For example, similar to these countries, the Indian auto industry started with the assembly of automobiles, followed by the state enforced gradual increase in local content to full scale manufacturing and then to export promotion phase (Jenkins, 1995). However, significantly unlike these countries the Indian auto industry consists of local firms with indigenous design and development capability, well established global brands and has marketing presence in the Indian as well as other emerging markets (Rasiah, 2011). For example, in 2008 against expectations of global carmakers and international media the Indian firm Tata Motors designed and developed the world's cheapest car 'Tata Nano'. In the same year another Indian firm, 'Mahindra and Mahindra' launched a sports utility vehicle, 'Scorpio', again a product of the indigenous design and development effort. In 2010 Maruti Suzuki's car 'Alto' became the world's largest selling car by volume. These developments caught the other auto firms by surprise as their expectation of these Indian successes were low due to perceived mismatch between scale of challenges and prevalent capabilities of the Indian auto companies. Ratan Tata in an interview with Economic Times, (2008) describes pessimism amongst those in the automotive industry about the Tata Nano project,

I think, my friend Carlos Ghosn (Chairman, Renault-Nissan) has been the only person in the automotive area who has not scoffed at this. He has from day one said that this is a possibility that could only be done in a place like India. And he has not ridiculed anything.

This paper tracks capability development in the Indian auto industry and seeks to understand factors, both internal and external to firms, that shape innovative capabilities. It studies the policy framework that shaped the evolution of the industry and analyses the development of innovative capabilities using Rattan's 'theory of induced innovation'.

The current automobile industry in India is in many ways a product of a micro economic environment controlled by the state through various regulations and interventions. The different industrial policy regimes influenced firm level learning processes and shaped technological capability accumulation. This paper shows that industrial policy protected the domestic market and set up challenges for firms such as requirements for higher local content. This policy helped the development of basic capabilities in auto manufacturing and laid foundations of the auto component supplier industry. The Indian government applied the 'public-private partnership' (PPP) model to develop the 'people's

car' for the domestic market. Evidence suggests that the 'PPP' model worked spectacularly by infusing life into the domestic industry and improving the productivity efficiency of the Indian auto industry. However, it is also clear that overly protected domestic markets and highly regulated firm activities severely reduced growth of the sector.

This paper also points out an important role played by factors such as nature of demand and firm ownership in innovative capability development. It reveals that the key attributes of firm ownership such as managerial vision and diversified nature of business helped Indian firms in the development of innovative capabilities. Firm owners set up challenging goals and supported these goals by providing required resources. The diversified nature of the businesses facilitated inter-sector learning and allowed flow of talent and capital without any transaction costs.

The paper is organised as follows: Section two discusses the different theoretical perspectives on innovation in developing countries. Section three describes the salient features of global as well as the Indian automobile industry. Section four presents the methodology and section five documents the evolution of policy, a movement from the early protection policies to export focused liberalization initiatives. Section six analyses the impact of various factors internal and external to firms in development of innovative capabilities in the Indian auto industry. Section seven concludes the paper.

2. Technological Capabilities, Innovation and Developing Countries

Earlier research on developing countries mostly covered technological adaptation (a movement along the frontier) rather than technological innovation (a movement of the frontier), based on the premise that the adaptation of different technologies with which firms are not familiar would require the same kind of technical effort as developing new techniques of their own. It was noted that the late comer countries could develop technological capabilities by exploiting technological knowledge of firms in the advanced countries through imitation or trial and error methods. However, Nelson (2004) points out that technological capability development consists of much more than imitation of the industrial technologies and institutions of advanced economies. He suggests that the adaptation of technology to the local environment results in the development of new capabilities in developing country firms.

Kale (2007) clearly shows the key role of imitation and reverse engineering in the development of basic technological capabilities in the Indian pharmaceutical industry. Indian pharmaceutical firms developed new processes to manufacture product patent protected medicines at a cheaper price affordable to the local population. Thus in general the focus of technology capability

development in developing countries has been on the learning processes to establish a base for technological knowledge that did not previously exist, as opposed to renewing the accumulated knowledge base or using that knowledge base in a different way.

The transformation of South Korea and Taiwan into industrialized economies shifted the focus of research towards processes involved in the development of innovative capabilities (see for instance Hobday, 1995; Kim, 1997; Amsden, 1989). Some of the firms from Taiwan and South Korea were part of the 'Global Production Networks' (GPN) which came to prominence during the 1980s. In GPNs, usually an MNC is a lead firm. MNCs create these networks by breaking down the value chain into a variety of discreet functions and locate them wherever they can be carried out most effectively, where they improve the firm's access to resources and capabilities, and where they are needed to facilitate the penetration of important growth markets (Ernst and Kim, 2002). As a result MNCs shifted many manufacturing processes from the core countries to periphery countries and all those activities no longer considered to be part of the core business were outsourced. As a result of this, highly value added technology, capital and knowledge intensive processes are relocated to developing countries. Thus global production networks have provided new opportunities for local capability formation in developing countries and have emerged as a key catalyst for international knowledge diffusion (Ernst and Kim, 2002). In GPNs MNCs transfer technology by training engineers in local firms, providing detailed blueprints and setting strict quality control criteria (Westphal et al., 1985; Enos and Park, 1988).

Some researchers such as Kim (1997), Kale (2009) and Figueiredo (2003) have focused on organisational and managerial issues involved in the accumulation of technological capabilities and the development of innovative capabilities. Kim (1997) shows that South Korean electronics firms followed a deliberate and persistent technology strategy of starting with imitation. As firms acquired technological capabilities these firms gradually changed technology strategy from creative imitation to innovation. Top management in the firm constructed a crisis to expedite the learning processes within these firms and managed the learning process in such a way that allowed firms to achieve integration of different knowledge bases.

Kim (1997) also shows an important role of returned engineers and scientists from advanced countries in technology transfer to the local South Korean firms. Building on that, Saxenian (2006) points out the significant contribution made by engineers working in Silicon Valley to the development of Indian software and the Taiwanese electronics industry. Similarly, Kale (2009) shows the important role of scientists trained or employed by multinational

firms or advanced country universities in the development of innovative product R&D capabilities in the Indian pharmaceutical industry.

For a developing country firm the ultimate achievement is to be a technologically mature firm and Bell, *et al.* (1984) observe that the majority of infant industries in developing countries never achieve maturity because of their failure to build up adequate technological capabilities. Some firms in the Indian automobile industry are trying to achieve technological maturity by developing innovative products and this forms the focus of this paper.

3. Salient Features of the Automobile Industry

According to the International Organization of Motor Vehicle Manufacturers (OICA) (2010) about 9 million people are directly employed in auto manufacturing and component supply, representing over 5 per cent of the world's total manufacturing employment figures. Many people are employed in related manufacturing and services. Thus due to its ability to create mass employment, the auto industry forms a key sector of the economy for every major country in the world.

Global auto industry has an extremely concentrated industry structure: a small number of MNCs based in advanced countries dominate design, development and production of all automobiles in the main markets. In attempts to leverage design efforts across products sold in multiple end markets these MNCs concentrate work of vehicle design and development in, or near, their headquarters. These centrally designed vehicles are then tailored to local markets and parts are manufactured in multiple regions. Thus design activities and buyer-supplier relationships typically span multiple production regions, resulting in increased outsourcing and bundling of value chain activities in supplier firms and subsequent development of superior capabilities in developing country firms. This process was accelerated dramatically in the late 1980s with the emergence of global production networks and cross border trade.

In the automotive industry the absence of open, industry-wide standards and specificity of parts and sub-systems to particular vehicle models, ties suppliers to lead firms, limiting economies of scale in production and economies of scope in design (Sturgeon *et al.*, 2009). Suppliers are often the sole source for specific parts or module variants. This creates the need for close collaboration, raises the costs for suppliers that serve multiple customers and concentrates most design work into a few geographic clusters. In recent years auto suppliers have taken on a larger role in design and have established their own design centres close to their major customers to facilitate collaboration. Sturgeon and Lester (2004) point out that the largest suppliers, based in developed countries, have become 'global suppliers', with multinational operations and an ability to provide goods and services to a wide range of lead firms.

The dominance of leading automobile MNCs and the largest suppliers was enhanced by a wave of mergers and acquisitions, and equity-based alliances in the 1990s. This has created new challenges for firms in developing countries to acquire industry-level technical knowledge in design and development as well as in managing business process standards.

3.1 *Indian Automobile Industry*

The Indian automotive industry is worth around US\$34 billion and has contributed around 4.3 per cent of India's GDP in 2007. India ranks seventh in car production in the world and only Brazil, China, the United States, Japan, Germany and (South) Korea produce more automobiles than India. It is the 4th largest market in terms of volume. There was a 29 per cent growth

Table 1: Automobile Domestic Sales (SIAM, 2011)

Category	No. of vehicles (000)								
	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Passenger Vehicles	707	902	1,061	1,143	1,379	1,549	1,551	1951	2520
Commercial Vehicles	190	260	318	351	467	490	384	532	676
Three Wheelers	231	284	307	359	403	364	349	440	526
Two Wheelers	4,812	5,364	6,209	7,052	7,872	7,249	7,437	9370	11790
Grand Total	5,941	6,810	7,897	8,906	10,123	9,654	9,723	12295	15513

Source: Author's Calculation.

in passenger vehicle sales to 2.52 million vehicles in 2010 and the industry employed approximately 270,000 people (SIAM, 2010).

India's auto industry has undergone significant transformation in the last five decades and specifically after 2000. Table 1 shows that in 2010-11 the passenger vehicles segment registered a cumulative growth of 12 per cent while the sub-segment of passenger cars grew by 11.7 per cent, utility vehicles by 10.5 per cent and multi-purpose vehicles by 21.3 per cent. In the same period the commercial vehicles segment grew marginally at 4 per cent while heavy commercial vehicles declined by 1.66 per cent and Light Commercial Vehicles recorded a growth of 12.29 per cent (SIAM, 2011). Figure 1 plots the growth of the Indian passenger car industry from 1999 to 2009. The rapid growth in this sector has been mainly driven by the transformation in Indian domestic markets. In the past decade the purchasing power of the Indian middle class has

increased substantially, while the availability of financial options, competitive pricing as well as a reduction in government tariffs have helped lower the price of vehicles. The Indian passenger market is skewed toward mini and compact vehicles – these segments account for almost 80 per cent of car sales in the country (Sagar and Chandra, 2004).

Figure 1: Turnover of Passenger Car Manufacturers in India (SIAM, 2010)



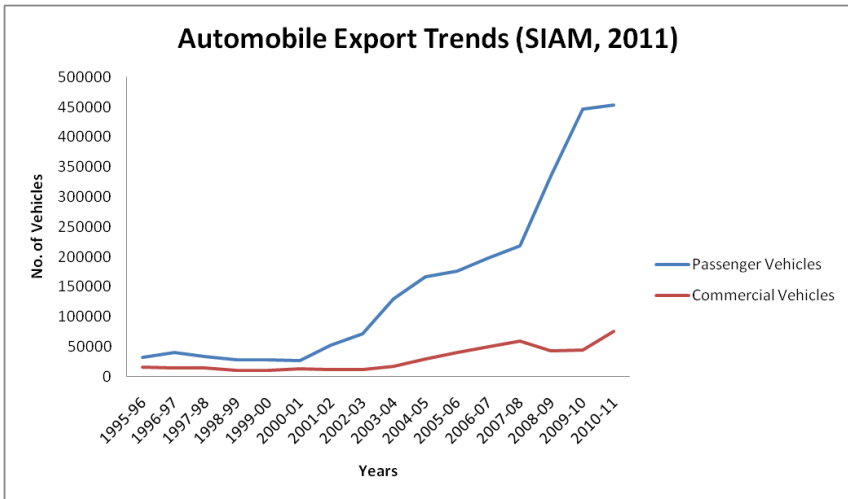
Source: Author's Calculation.

From the beginning of 2000 many MNC automobile firms such as Hyundai Motors, Nissan, Toyota, Volkswagen and Suzuki have set up production facilities in India to serve Indian domestic as well as overseas markets. By 2010 this resulted in India emerging as a hub for the production of passenger cars. For example automobile exports to the UK have grown by over 8 times from \$52 million in 2006-07 to \$481 million in 2009-10. By 2009 India (0.23m) surpassed China (0.16m) as Asia's fourth largest exporter of cars after Japan (1.77m), Korea (1.12m) and Thailand (0.26m) (Nair, 2009).

Hyundai, the South Korean company, has emerged as the biggest exporter of the country, by exporting more than 250,000 cars annually from India (Federation of Indian Chambers of Commerce and Industry [FICCI], 2010). Maruti Suzuki exported 79,860 cars in 2009, doubling the number it exported in 2008. Tata Motors exports its passenger vehicles to Asian and African markets, and is targeting the European market with its Tata Nano. As a result,

exports of passenger cars have grown at a CAGR (compound annual growth rate) of 31 per cent per annum from 2000 and now the passenger car segment dominates India’s automobile exports with a 76 per cent share (FICCI report, 2010). Figure 2 plots the rise in Indian auto exports and shows that in 2010 exports had surpassed 454,000 units (SIAM, 2010).

Figure 2: Passenger Car Export Trends (SIAM, 2011)



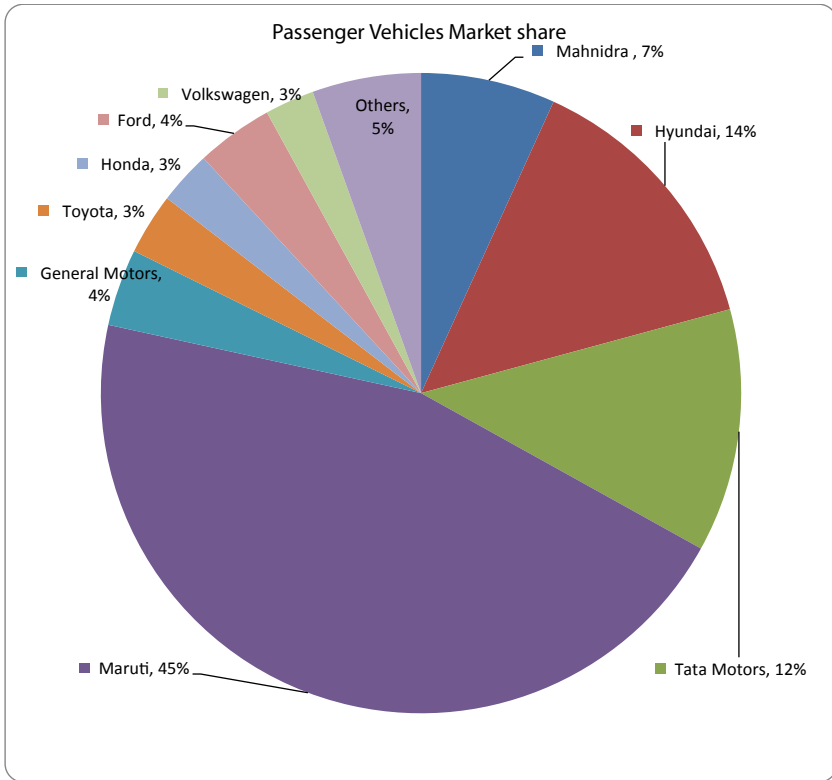
Source: Author’s Calculation.

Traditionally Indian car exports comprised compact cars and were exported to South America, Africa, Europe, Latin America and the Middle East. However by 2010 the UK has emerged as India’s largest automobile export market while Italy became the second largest at \$433.77 million, followed by Germany, the Netherlands and South Africa at \$233.22 million, \$217.51 million and \$209.95 million in 2009-10 respectively (FCCI, 2010).

However, compared to global industry, Indian industry still remains small. In 2010 it accounted for 5 per cent of the world vehicle production and sales respectively (OICA, 2010). According to a FICCI report (2010) Indian industry had only a 1 per cent share in the global automobile export market in 2009 and was ranked 22nd globally.

The passenger car sector is dominated by 3-4 players accounting for 85 per cent of the total annual sales (SIAM, 2007). Figure 3 shows the market shares of leading players in the Indian automobile industry for 2007.

Figure 3: Market Shares of Key Players in Passenger Vehicle Market (SIAM, 2010)



Source: Author’s Calculation.

4. Research Methodology

A qualitative multi method approach was chosen as the best way to analyse sources of innovation in the Indian automobile industry. The top three Indian firms which have developed indigenous cars were chosen as case studies and primary data were collected through interviews with key managers in these three firms.

Table 2: Firms Under Study (OICA, 2009; Annual Reports, 2010)

Name of the firm	Year established	Business focus	Turnover (Rs Million)	per cent from overseas	Main products
Tata Motors (Telco)	1945	HCV, LCV, Passenger cars	33094	9.8	Tata Indica, Tata Nano
Maruti Suzuki Ltd	1983	LCV, passenger cars		~10	Maruti 800, Zen, Alto
Mahindra and Mahindra	1959	Tractors, jeep, SUV	13238		Scorpio

Source: Author's Calculation.

The industry leader is Maruti Udyog Limited (MUL) with a 46 per cent market share followed by Tata Motors and Mahindra & Mahindra. In the last two decades these firms have emerged as India's leading automobile manufacturers and innovators in the passenger car segment. By 2008 Maruti had two manufacturing facilities located in Gurgaon and Manesar south of New Delhi. Maruti's Gurgaon facility has a production capacity of 350,000 units per annum. The Manesar facilities, launched in February 2007 comprises a vehicle assembly plant with a capacity of 100,000 units per year and a Diesel Engine plant with an annual capacity of 100,000 engines and transmissions. Manesar and Gurgaon facilities have a combined capability to produce over 700,000 units annually.

Telco (Tata Engineering and Locomotive Company, renamed as Tata Motors in 2002) is India's largest automobile company with revenues of \$8.8 billion and 23,000 employees (Tata Motors Annual Report, 2007). It belongs to the business conglomerate Tata Group, and is ranked as the world's fourth largest truck manufacturer, the second largest bus manufacturer and the 21st largest car manufacturer in 2007 (OICA, 2007). Tata Motors was listed on the NYSE in 2004 and the manufacturing base in India has spread across Jamshedpur (Jharkhand), Pune (Maharashtra), Lucknow (Uttar Pradesh) and Pantnagar (Uttarakhand). The company is setting up two new plants, at Dharwad (Karnataka) and Sanand (Gujarat). Tata Motor's journey from construction equipment manufacturing to producing the world's cheapest car is quite remarkable. In the last five decades Tata Motors has emerged as a car manufacturer with the most comprehensive research, design and development capabilities in the country.

Mahindra & Mahindra (M&M) is the largest manufacturer of utility vehicles and tractors in India. It has five manufacturing sites for automobiles

and exports them to Europe, Australia, South Africa and Iran. It also has two manufacturing sites for tractors and exports them to Africa, the USA and the Middle East. The company has built up alliances with Willys and Chrysler of the US for utility vehicles, Peugeot of France for engines, Nissan of Japan for Engines and Ford motor of the US to produce Fiesta and Escort cars. In the past six decades Mahindra & Mahindra has made a transition from ‘tractor and jeep maker’ to a modern passenger car maker.

Secondary data consisted of company annual reports, industry websites, newspapers and business magazines. Ruttan’s (2001) framework was used as an analytical framework to categorise and analyse different factors underlying sources of innovation in the Indian automobile industry. Thus analysis focused on the factors that are internal, as well as external firm level processes of innovative capability development.

4.1 Drivers of Innovation

Ruttan (2001) identified three drivers of induced innovation and distinguishes between both demand and supply inducements to innovation. These three drivers provide an analytical framework for analysing sources of innovation in the Indian automobile industry.

The first is that of demand and Ruttan observes its general role – “changes in demand represent a powerful inducement for the allocation of research resources” – but there is no elaboration either of the relative importance of demand as an inducement to innovation, or of biases in the interaction between particular patterns of demand and particular paths of technical change (Kaplinsky, 2010).

Kaplinsky (2010) argues that demand plays a crucial role by stimulating the pace of innovation. He further explains that rapid market growth, particularly where markets are large, characteristically draws forth new products and also affects the rate of change in process technology. Furthermore, markets are clearly an important determinant of the direction of technical change. High income markets place an emphasis on quality and differentiation, and can be tolerant of high acquisition costs. In contrast, low income markets characteristically are prepared to sacrifice product quality and variety for low relative price and low acquisition costs.

The second factor inducing the direction of technical change identified by Ruttan is relative factor prices of production. Ruttan explained the concept quoting Hicks (1932: ...) “a change in the relative factor prices of production is itself a spur to innovation and to inventions of a particular kind, directed at economising the use of a factor which has become relatively expensive”.

Ruttan’s third factor inducing patterns of technical change relates to the path dependencies of innovating firms. Firms guided by routines, developed

over the years to master their operation and will scan familiar surrounding known contacts and data-sources in the search for improvements in process and products. These firms thus have their own path-dependencies and trajectories (Dosi, 1982). These differentiated and path dependent learning processes form the basis for changing capabilities. So both historical and contemporary analysis needs to be undertaken in order to understand the dynamics of innovation processes (Nelson and Winter, 1982)

In this paper Ruttan's driver of innovation and sources of technological knowledge identified in literature provides an analytical framework for studying technology capability development in the Indian automobile industry.

5. The Evolution of Capabilities in the Indian Automobile Industry: From ISI to Liberalisation

India's auto sector has evolved through three different policy regimes which can be characterized as eras of protectionism (1950-1983), deregulation (1983-1993) and liberalization (post 1993) (Sarippalle, 2006). Figure 4 charts the capability creation model in the Indian automobile sector.

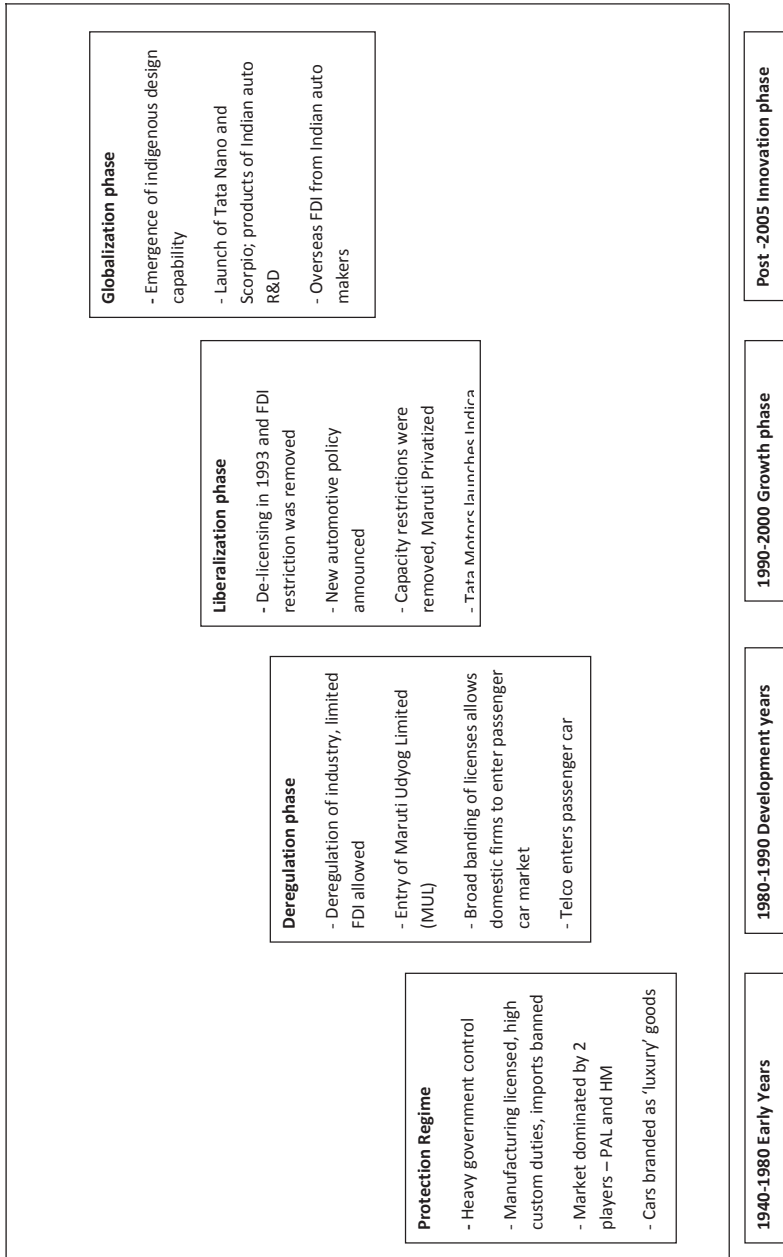
In the deregulation and liberalization eras foreign direct investment (FDI) was allowed in two waves: the first was in 1983 – restricted FDI and the second in 1993 – Mature FDI. All these policy changes had a significant impact on the development of firm level capabilities, domestic market and industrial structure.

5.1 Protection and Licensing Regime 1950 to 1984

Soon after independence the Indian government banned import of completely built vehicles in 1949 and from 1953 the Indian government allowed only those firms that had manufacturing plants in India to operate. The existing players were protected from any foreign or domestic competition. In the 'license raj' era Indian industry was tightly regulated by government 'red tape' and the market was supplied by two manufacturers: Hindustan Motors (HM) and Premier Automobiles Ltd (PAL). The Government also imposed price controls and as a result within a few years the numbers of car manufactures were reduced from 12 to 5. The era of protectionism was marked with the restriction on the entry of foreign companies and steep tariffs against imports.

HM manufactured an 'Ambassador' model based on the 1950s Morris Oxford model and PAL in collaboration with the Fiat produced the Fiat 1100 branded as 'Padmini'. HM and PAL were licensed to make just 50,000 cars between them. In the 1960s the Indian government refused permission to HML and PAL to upgrade their models through foreign collaborations (D'Costa, 2004).

Figure 4: Auto Growth Trajectory



In 1945 the Tata business group set up Tata Motors Limited, formerly known as Telco, to manufacture locomotives and other engineering products while in the same year Mahindra and Mahindra, a jeep and tractor manufacturer was also founded as a steel trading company.

In 1954 Telco formed a collaboration with Daimler-Benz AG to manufacture commercial vehicles and the first vehicle was rolled out within 6 months of the contract. In 1959 Telco established a research and development centre at Jamshedpur and by 1961 started exports of 1210 Tata Mercedes Benz trucks to Sri Lanka. By the time collaboration ended in 1969 the import content was reduced significantly (Venugopal, 2001). Soon Telco widened its product range to cover 'Heavy Commercial Vehicles' and progressively introduced a number of new models of its own design.

Mahindra & Mohammed (M&M) renamed as a Mahindra & Mahindra in 1948 started manufacturing business by building Willys Jeeps in India. Soon it expanded into agricultural and commercial vehicles and gradually expanded its presence from the automotive and farm equipment sector to automotive components.

This period witnessed slowest CAGR at 3.5 per cent from 1959 to 1980. Due to the protected environment firms were mainly insulated from competition and had an assured market for growth (Saripalle, 2006).

5.2 *Deregulation Period: 1980 to 1990*

Since 1970 the Indian government gradually added the automotive industry to a list of core industries that were prioritized for promotion and started treating the industry's needs favourably. The government set up policies to promote competition, efficiencies and modernization. With that vision the early 1980s witnessed the beginning of deregulation of the Indian auto industry. The government allowed entry of domestic manufacturing in the passenger car segment, permitted increased foreign capital and overseas collaborations, and finally reduced the impact of production licenses on the scope of manufacturing operations.

In 1975 as a general industrial policy the government permitted an automatic capacity expansion by 25 per cent every five years and removed price controls. In 1981 the Indian government announced a new policy of allowing 'broad-banding' of licenses. This was a specific policy measure that permitted a vehicle manufacturer to produce different kinds of vehicles instead of one kind as decreed by the industrial licenses. In the past it was mandatory for an automobile manufacturing company to obtain a license from the Indian government for each type of vehicle it proposed to manufacture. With broad banding policy the Indian government encouraged production of a range of related products and economies of scale. The government also introduced more

liberal import policies. In 1986 importers of capital equipment were allotted nearly a 50 per cent increase in their foreign exchange quota. Previously imports were restricted to reduce the outflow of scarce foreign exchange.

5.2.1 First Wave of Foreign Direct Investment (FDI)

FDI in the auto sector was first allowed in 1983 when Suzuki was invited as a joint venture. In 1971 Sanjay Gandhi, son of Indira Gandhi, established Maruti Limited with the mission of developing an indigenously designed affordable, cost-effective, low maintenance and fuel efficient car. However despite government support Maruti failed to develop the indigenously produced 'people's car' and subsequently in 1980 the government of India took over the company. In 1983, Maruti formed a joint venture with Suzuki Motor Corporation of Japan. Initially the Indian government was in favour of a joint venture with Volkswagen and VW Golf was the chosen car. However the government felt that Golf was an expensive car for the Indian market and decided to go to Europe and Japan to search for partners. The Indian government wanted an overseas partner to bring in 40 per cent equity and had talks with Nissan, Mitsubishi, Daihatsu and Suzuki. Only Suzuki was willing to take up 26 per cent equity with an option to raise it to 40 per cent. Thus the government chose Suzuki as a partner and the 550cc Fronte model as the 'people's car'.

Subsequently India allowed four Japanese firms – Toyota, Mitsubishi, Mazda and Nissan – to enter the Indian market for light commercial vehicles (LCVs) through joint ventures with Indian companies. In the 1980s these four firms collaborated with private Indian firms, and some shared equity with state level governments. Indian firms such as Telco, Mahindra & Mahindra, Hindustan Motors, Premier automobiles and DCM entered into joint ventures with international players like Mercedes, Ford, General Motors, and Peugeot for assembly of medium sized cars from knocked down kits. Table 3 lists the major joint ventures in the Indian automobile sector. Foreign partners now hold all or much of the equity in most of these cases even though most of them initially formed joint venture of equal sharing of equity (Mukherjee and Sastry, 1996). The inability of Indian partners to contribute towards capacity expansion allowed foreign partners to increase their stake or take total control by buying out their Indian partners (Sagar and Chandra, 2004).

Japanese participation in the automobile industry brought significant changes to the structure of the passenger car market, including utility vehicles (D'Costa, 2004). An established producer Standard Motor left the passenger car segment altogether and domestic players in the commercial vehicle segment started developing passenger cars albeit on a limited scale.

Gradually established players such as Telco entered the commercial passenger car segment capitalising on their engineering capabilities,

Table 3: Entry of MNC Firms in India and Different Modes

No	Foreign Company	Indian partner	Manufacturer name	Year of incorporation
1	Chrysler corporation ltd	Premier Auto Limited	Premier Auto Limited	1940
2	Fiat	Premier Auto Limited	Premier Auto Limited	1952
3	Daimler-Benz AG	Telco (Tata Motors)	Telco	1954
4	Suzuki Motor Company (Japan)	Government of India	Maruti Udyog Ltd	1982
5	Toyota	DCM	DCM Toyota India Ltd	1985
6	Mazda	Swaraj	Swaraj Mazda India Ltd	1985
7	Isuzu	Hindustan Motors	Hindustan Motors	1986
8	Nissan	Premier Auto Limited	Premier Auto Limited	1986
9	Peugeot, France	Premier Auto Limited	Premier Auto Limited	1994
10	Ford Motor company (USA)	Mahindra & Mahindra	Ford India Ltd	1995
11	Toyota Motor Corporation, Japan	Kirloskar Motors Ltd	Toyota Kirloskar Motors Ltd	1997
12	Mitsubishi Motors, Japan	C.K. Birla Group	Hindustan Motors	2002
13	Daimler Benz AG	Tata Motors	Mercedes Benz India Ltd	2004
14	Fiat Auto Spa (Italy)	Tata Motors	Fiat India Limited	2007

Source: Author's Calculation.

interchangeable parts of sufficient volume and economies of scale (D'Costa, 2004). Under the Indian government's 'broad-banding' license policy Telco entered the LCV market and in 1985 introduced Tata 407. Telco followed with two more models in 1987 – Tata 608 and Tata 709. In 1985 Telco applied to the

Indian government for permission to produce the Honda Accord passenger car in collaboration with Honda. Permission was refused under the FERA act by the Indian government. Consequently Telco began design and development work on a 'pick-up' that could carry both goods and passengers. The 'Tatamobile' – a utility vehicle launched in 1988. Deregulation of the auto industry segment allowed the entry of a new player (MUL), increased competition, severe restructuring pressures on existing players and an increase in market concentration. It had a positive impact on the performance of the auto industry reflected by CAGR of 18.6 per cent from 1980 to 1990.

However even after industry deregulation due to an obsession with self-reliance, the production of passenger cars throughout the 1980s and early 1990s remained tightly regulated through licensing.

5.3 Post 1993: Liberalisation of the Indian Auto Sector

Economic liberalisation in 1991 started a significant phase in the development of the Indian automobile industry. Auto licensing was abolished in 1991 and the weighted average tariff was decreased from 87 per cent to 20.3 per cent in 1997. In 2001 the Indian government removed auto import quotas and permitted 100 per cent FDI in the sector. The government reduced excise duties to 24 per cent on passenger cars and focused on developing supportive infrastructure.

In 1989 Suzuki increased its equity stake to 40 per cent and three years later to 50 per cent. In addition Suzuki paid a control premium of Rs10 billion to the Indian government for complete management control. In the post 2000 period Maruti has slowly started moving toward building its own design and development capability and carried out an in-house minor facelift of its largest selling model, the Zen. Now Maruti is working with parent company Suzuki to develop an Asian car and planning to set up an R&D centre with an investment of US\$200 million.

During this period another Indian firm, Tata Motors made rapid strides toward developing an advanced level of technological capability by launching the first indigenously developed Indian car, 'Tata Indica'. In 2002 Mahindra & Mahindra launched 'Scorpio' as a sports utility vehicle (SUV) – a product of in-house design and development effort.

5.3.1 Second Wave of FDI

The second wave of FDI played a crucial role in changing industry structure and brought dynamisms and intensive competition to the Indian auto industry.

The auto sector was subsequently significantly opened up from 1993, though still heavily regulated. Multinational enterprises (MNEs) were required to make specified capital investments and meet export obligations. Nevertheless, a high volume of FDI was encouraged with the sector's liberalization.

Additionally, government policies such as import barriers and local content requirements contributed to the influx of FDI. High tariffs forced original equipment manufacturers (OEMs) to set up plants in India because they could not access the market through exports. Local content requirements of up to 70 per cent forced OEMs and their suppliers to make significant capital investments. These changes led to an influx of globally competitive auto makers into the Indian passenger car market. Specifically, 12 MNC firms – including Ford, General Motors, Hyundai, Daewoo, Honda, Toyota, Fiat and Mercedes Benz entered the market. Few MNC firms entered the Indian market with 100 per cent subsidiary such as Hyundai while firms such as Daimler Benz established partnership with local firms.

In 2004 Tata Motors signed a joint venture with Daimler-Benz for manufacturing Mercedes Benz passenger cars in India. Mercedes held 51 per cent of the equity in joint venture and a plant was set up in the Pune complex at a cost of US\$106 million. The Mercedes Benz India Limited (MBIL) plant assembled completely knocked down (CKD) kits imported from abroad and concentrated on producing a luxury car in relatively small numbers.

Previously there were only four car assemblers in the country with MUL holding 62 per cent of the market share (Gulyani, 2001). The entry of global players made the Indian auto industry more efficient and domestic markets very competitive. The increased competition led to restructuring to cut costs, enhance quality and improve their responsiveness to demand.

As a result from 2001-2007 car sales have grown at an impressive CAGR of 15.5 per cent. Of the total sales roughly 10 per cent were contributed by exports. The export of Indian cars has grown at a CAGR of 30 per cent from 2001 and 71 per cent of the Indian car exports were comprised of compact cars. MNC firm Hyundai Motor India emerged as the leading exporter with 68 per cent share in total exports.

Currently, there are more than 30 international-quality models in the market, some of which are now being exported to MNCs' home markets.

In the post liberalisation era, leading Indian auto manufacturers are in the process of transforming from local players to global companies. Now, more foreign sales are made through directly owned or JV based foreign operations than through exports from Indian manufacturing facilities. Indian companies have bought capacity or made alliances with other automakers in East Asia, South America, Africa and Europe. For the top five Indian automakers revenue from the overseas market is close to an average of 9 per cent. The main challenge for Indian auto makers is to establish a reputation for world class technology, which requires substantial and long term investments.

6. Discussion and Analysis of Sources of Innovation and Technological Capability Development

This section covers the analysis of factors that has contributed to the development of innovation and technological capability in the Indian automobile firms. External factors include role of demand and impact of industrial policy while firms knowledge sources, nature of business and managerial leadership emerged as key sources of innovative capability.

6.1 Important Role Played by Nature of Demand

Analysis of the Indian automobile industry shows the important but often neglected role of demand. It is one of the biggest drivers of innovation in Indian automobile industry. Indian firms' business models were focused on domestic markets and markets in other countries with similar characteristics such as Africa, Latin America and South Asia. These markets were characterised by low purchasing power, lack of transport infrastructure such as roads and an agriculture based economy. As a result Indian firms twice endeavoured to produce a 'people's car' and came up with economical cars – Maruti Suzuki in 1984 and Tata Nano in 2009. Ratan Tata (Economic Times, 2008) explains the role of local conditions in developing the world's cheapest car, Tata Nano:

you could not help but notice that there were three or four family members on a scooter, the kid standing in the front, the guy driving the scooter and the wife sitting side saddle holding a little kid. And when you're driving a car, you certainly say, Oh my god, be careful, they may slip. Add to that slippery roads and night time too. Any of these reasons can be dangerous for transport.

So, I set about thinking, can we make a four wheel vehicle from scooter parts initially and I, in fact, addressed an Automotive Component Manufacturers' Association (ACMA) meeting saying that can we all get together produce an Asian peoples' car.

Keeping in mind the nature of domestic demand and with aspiration to produce cars affordable to poor populations, Tata Motors started innovating with different components. Ratan Tata (Economic Times, 2008) further explains the process:

Do we have rolled up plastic curtains instead of windows? Do we have openings like auto rickshaws have instead of doors or do we have a safety bar? As we went on, we had many early concepts that went that kind of way till we finally decided that the market does not want a half car. The market wants a car.

They all relate to costs. Perhaps the bigger, more visible issue is that somewhere we needed to benchmark ourselves against something. And we took Maruti 800 as a benchmark.

What has been done is like door locks, we have the same lock on all four doors, both left hand and right hand. I think most of the benefit we got on that we used less steel and we just made the car smaller outside yet big inside”.

6.2 Firm Level Sources of Innovation

The Indian auto industry is dominated mainly by diversified and large business groups such as Tata Group and Mahindra and Mahindra with a strong leadership in form of Mr. Ratan Tata and Mr. Anand Mahindra respectively. This factors certainly had significant influence on development of technological capabilities in these firms. However it also emerged that Indian firms are using diaspora connections and overseas acquisitions for building innovative capabilities. This section covers all these points in detail.

6.2.1 Firm Ownership and Managerial Vision

The Indian auto industry is mainly dominated by diversified and big business groups such as the Tata Group and Mahindra & Mahindra.

The ambition and vision of Ratan Tata to develop the first ‘Indian car’ and then ‘people’s car’ were driving forces behind the development of Tata Indica and Tata Nano.

In 1993 Ratan Tata, Chairman of Telco mooted the idea of making a small car indigenously in India without licensing or financial/technological collaborations with a foreign car manufacturer. Ratan Tata personally has a passion for cars and his ambition was fuelled when the Indian government turned down Telco’s proposal for a joint venture with Honda to manufacture the Honda Accord. Ratan Tata (Economic Times, 2008) explains, “In fact, even for the Indica, I went to Automotive Component Manufacturers’ Association. I said can we have an Indian car because no car has been designed in India. That time I was actually criticised. This time I had no response.”

In 1994 Ratan Tata formally announced that Telco was committed to making a car that would be built indigenously and would be affordable to the common people. Tata budgeted US\$500 million for the Indica project and raised finances using various financial instruments such as Global Depository Receipts (GDRs) and Yankee Bonds. The proceeds were maintained abroad in foreign currency and withdrawals were timed to meet foreign currency needs (Venugopal, 2001).

Tata Motors were the first company to produce an indigenous passenger car using their technological capabilities built on knowledge of manufacturing commercial vehicles. It started with Tata Motors setting up a design team at the Engineering Research Centre (ERC) in mid-1994 and by 1995 the team came up with two basic models. However Ratan Tata brought in the Italian car designing institute IDEA for further design development. A team of designers from Tata Motors led by their programme manager interacted with the IDEA team for the entire duration of the project. Some designers and engineers were deputed to the IDEA. Tata was assisted by Le Moteur Moderne of France in configuring a gasoline engine. Tata Motor entered into a joint venture agreement with Cummins Engine Co. Inc. for manufacturing high horsepower and emission friendly diesel engines in 2003. Cummins JV helped Telco to develop diesel engines to conform to strict emission norms and helped the company introduce a diesel version of cars and trucks.

Tata Motors decided to perform key activities in-house such as engine and transmission manufacturing, welding and painting of body panels and car assembly. All other activities were outsourced. Tata Motors involved major suppliers in the design process making them early partners. The smaller vendors were grouped into two tiers – tier 1 and tier 2. The tier 2 vendors supplied parts to tier 1 vendors who put together the subassembly and supplied the same to Tata motors. In 1997 Telco invested in the Tata Autocomp Systems Limited (TACO), a company promoted by Tata Industries to set up a series of joint ventures with internationally acclaimed component manufacturers. Subsequently TACO formed a joint venture with leading auto component manufacturers which became key suppliers to Tata Motors.

Tata Motors imported several major items of equipment from foreign suppliers such as high-speed machining centres from Germany and the USA, and the gear cutting machines from Germany and Italy. In 1995 Telco purchased the Australian plant of Nissan for US\$20 million. This plant was producing the Nissan Bluebird which subsequently closed down. The Nissan plant together with 21 robots were shipped to Telco's machine tool division and installed at a factory in Pune. Three presses for forming body panels of the Indica were commissioned. Of these one was bought new from Germany. The other two presses were bought as used equipment from Mercedes Benz and modified to suit Indica (Venugopal, 2001). In January 1999 Tata Motors launched an indigenously developed Tata Indica, a modern hatchback with a diesel engine.

In 2008 Tata Motors launched Tata Nano, the world's cheapest car priced at US\$2500. Tata Nano was a product of Tata R&D and involved innovative design to keep cost down. Tata Motors brought in suppliers such as Bosch, a German maker of appliances and motors, and Delphi, a world leader in

automotive parts in early-stage design, challenging them to be full partners in the Nano innovation by developing lower-cost components.

In the case of Mahindra & Mahindra, the ambition of Anand Mahindra to transform a tractor manufacturing company to a passenger car firm fuelled design and development effort for 'Scorpio'. Mahindra & Mahindra built a Scorpio with active supplier involvement from concept to product for \$120 million, including improvements to the plant. The new Mahindra Scorpio SUV had all of its major systems designed directly by suppliers with the only input from Mahindra being performance specifications and program cost.

6.2.2 Diaspora Connections

Indian auto company owners realised that their Indian managers' lacked knowledge and made a strong effort to attract Indian engineers based overseas working in MNC firms. Tata Motors and Mahindra & Mahindra offered challenging positions to attract these engineers back to work in India. Tata Motors brought V. Sumantran from General Motors to lead their Tata Indica project. V. Sumantran had 15 years of working with GM before joining Tata Motors. Dr. Pawan Goenka who led the design team for Mahindra & Mahindra has a PhD from Cornell University and spent 14 years with General Motor's research centre in Michigan before returning to India. These returnees had experience of auto design and development effort in MNCs and that knowledge was valuable in filling knowledge gaps in the Indian firms.

6.2.3 Family Owned Diversified Businesses Facilitating Inter-sector Learning

Leading Indian firms in the auto industry are part of family owned business groups. In the 1980s many Indian businesses invested in unrelated businesses as a way of protecting their income from the government's protection policy and stringent tax regime. Khanna and Palepu (2000) suggest that profitability of group affiliated firms exceeds that of other companies. However the relation is non-linear, since beyond a certain level diversification is associated with higher profits. They argue that these groups make up for what is lacking such as under-developed financial markets, imperfections of labour markets, limited enforcement of contracts, inadequate rule of law and other institutional deficiencies. Business groups fill these gaps by building institutions for the benefit of group members.

In emerging markets firms find it difficult to attract investment in new ventures due to little availability of information and few safeguards. In such cases diversified business can point the investors to their track record or invest internally. For example historically Tata companies have come together to finance their new ventures. In 1982 their group created Tata Industries, a venture

capital vehicle funded with a special pool of investment money drawn from the member companies.

Indian groups are creating value by developing managers and spreading the cost of professional development throughout the group. These groups have internal management-development programs, often with dedicated facilities and are geared toward developing the skills of experienced managers and in some cases for all levels of employees in an attempt to develop their human capital. Tata Administrative Services – an in-house training programme with a national reputation for excellence – established in 1956, has aimed to create a cadre of general managers for Tata groups.

Khanna and Palepu (2000) further suggest that groups can provide much needed flexibility for labour markets in general. Governments in emerging markets usually have strict labour laws making it difficult for companies to adjust or lay off their workforces. Examples in India suggest that Indian business groups develop extensive internal labour markets of their own. When one company in a group faces declining prospects, its employees can be transferred to other group companies that are on the rise – even to companies in otherwise undesirable locations. The growing companies benefit by receiving a ready source of reliable employees and groups are able to put new talent to good use. By allocating talent to where it is most needed, conglomerates have a head start in beginning new activities. The case of the Tata Group encourages group companies to facilitate mobility of talented employees to another company if it benefits both. Cross-company teams of ‘stars’ are assembled to resolve any difficult problem an individual company is having.

Diversified groups add value by acting as an intermediary when their individual companies or foreign partners need to deal with the regulatory bureaucracy. Experience and connections give conglomerates an advantage. The larger the company, the easier it is to carry the cost of maintaining government relationships (Khanna and Palepu, 2000).

Tata today have strong market shares in many sectors of the Indian economy and internal learning as well as access to capital due to the diversified nature of their business forms key strengths of the group.

6.2.4 Overseas Acquisitions/JV/Subsidiary

Indian firms such as Tata Motors and Mahindra & Mahindra with global aspirations are acquiring firms overseas, establishing new subsidiaries and forming new partnerships in overseas countries. Tata Motors has been at the forefront of overseas acquisition in the Indian auto industry. In 2004, it bought Daewoo’s truck manufacturing unit, now known as Tata Daewoo Commercial Vehicle, in South Korea. In 2007 Tata Daewoo Commercial Vehicle Co. Ltd. launched the heavy duty truck ‘Novus’, in Korea and this proved an important

source of learning for Tata Motors' heavy commercial business segment. To augment its presence in Europe in 2005 Tata Motors acquired 21 per cent stake in Hispano Carrocera SA, a Spanish bus manufacturing Company. In 2006 Tata Motors formed a joint venture with Marco Polo, Brazil to manufacture and assemble fully built buses and coaches. In 2008 Tata Motors completed acquisition of Jaguar and Rover for \$2.3 billion. Tata Motors have also established plants in Malaysia, Kenya, Bangladesh, Spain, Ukraine and Russia to assemble knocked down units exported to these countries.

Mahindra & Mahindra have also opened subsidiaries in Australia, South Africa, Italy and Uruguay to assemble knocked down units and supply auto components. In 2005 Mahindra & Mahindra acquired a leading auto component manufacturer Stokes Group in UK.

6.3 Policy Induced Sources of Innovation

In the last five decades there has been a substantial development of technological capabilities in the Indian automobile industry Establishment of Maruti Udyog Limited with Suzuki Motor paved the way for the emergence of modern Indian industry.

6.3.1 Adoption of 'Public-private Partnership' Model for Basic Auto Technology Capability Development

The Indian government adopted a public-private partnership model by establishing Maruti Udyog Limited in joint venture with Suzuki and that infused life in the Indian automobile industry. MUL created history by going into production in a record 13 months rolling out its first vehicle, the Maruti 800 in 1984. This was the first domestically produced car in the country with completely modern technology. Till 1990 MUL dominated the Indian market with Maruti 800 becoming a choice of car with 62 per cent of the market share. Before MUL arrived, India's auto sector had for decades been offering two models, this figure climbed to eight after MUL's entry.

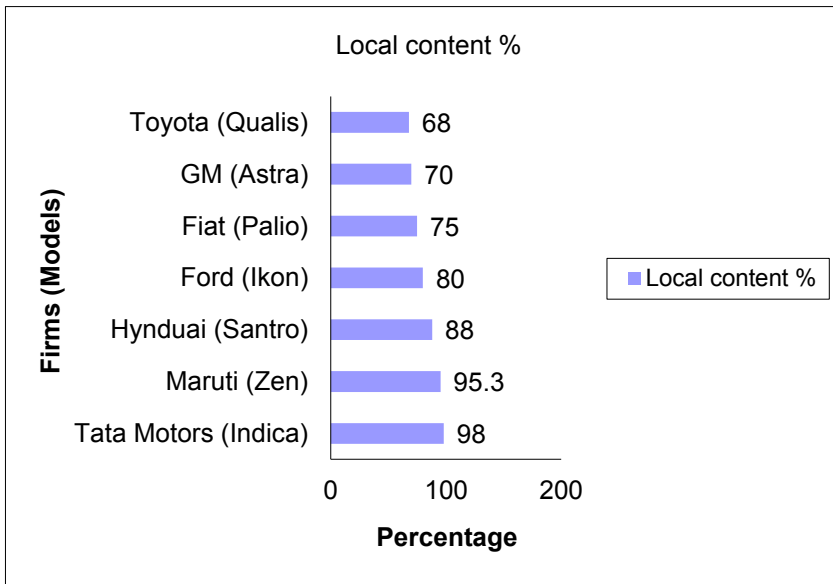
6.3.2 Local Content Requirement

Saripalle (2006) suggests the protection policy did encourage acquisition of basic production capabilities, however it did not equip the firm with coordination capabilities necessary for survival in a competitive environment. For example the government pursued a policy of indigenisation till the beginning of 1993 and that created a chain of world class auto component suppliers. The need to reduce cost also provided an impetus for indigenisation. For example, in the beginning Maruti 800 model had 97 per cent import content and only tyres and batteries were sourced locally. The government set a target of 93 per cent

localised within five years and so the company started to develop local vendors from scratch. The Company attracted entrepreneurs by offering them land at company's complexes and supplied electricity from its own power station. In addition Suzuki engineers helped the new manufacturers with automation and management practises such as just-in-time manufacturing.

Sagar and Chandra (2004) credit the process of indigenisation as a key regulation responsible for enhancement of technological capabilities. Indigenisation requires modifying design to local needs, sourcing components from local suppliers and validating all components and sub-systems for Indian standards. This required collaborative effort between local suppliers and parent company engineers. This led to a gradual movement of Indian firms toward development of technological capabilities in the country. MUL had an aggressive plan for indigenisation from inception and by 1990 it achieved 95.3 per cent local content. Tata Motor's Indica had about 95 per cent local content for both the petrol and diesel version (Figure 5). Indian firms are already drawing on local engineering design capability that allowed Tata Motors and Mahindra & Mahindra to develop entirely new vehicle platforms locally. The lead designers of Tata Nano and Scorpio are the product of Indian engineering institutes and have worked in Indian companies.

Figure 5: Percentage of Local Content (KPMG, 2007)



Source: Author's Calculation.

In spite of the success of government policy in building auto supplier industry, India continues to be a net importer of auto components with its trade deficit for automotive components having expanded to US\$4.4 billion in 2009-10 from US\$210 million in 2004-05 (SIAM, 2010).

6.3.3 Key Role of Foreign Partners and Impact of Foreign Direct Investment

The McKinsey report (2003) shows that entry of MNC firms has produced positive results – increased productivity, higher output, better and cheaper products, and (most probably) higher wages.

Analysis of the auto industry suggests that sector performance has improved steadily since 1993. Labour productivity has grown at an annual rate of 20 per cent, FDI firms at 38 per cent being as productive as US plants on average. Auto industry output has grown at over 15 per cent per year, up from 13 per cent in 1983-1993 and from less than 1 per cent in the decade prior to 1983. Significantly, the components industry benefited from spillover effects, more than tripling its size during the period as new car sales boomed and MNCs outsourced more of their cost base. Competition was also provided by international components firms, which entered the sector to serve international assemblers, resulting in increased quality and reliability.

The impact of FDI on increased productivity and competitiveness has ensured that benefits accrue to consumers and labour. Firms, on the other hand, have been forced to reduce their margins with increased competition. In the 1980s, Maruti-Suzuki used to enjoy profit margins of 10-12 per cent, significantly higher than the global average of 5 per cent. However, with the influx of new MNC firms, Maruti-Suzuki's profit margin declined to 3-4 per cent, while European and US firms selling larger cars have been losing money. Some local assemblers went out of business because of the competition, others entered into joint ventures with foreign firms to keep afloat. A few local assemblers that developed products customized to local needs have managed to remain in business.

FDI also contributed to improving auto sector productivity in upstream activities. Supplier productivity increased as foreign firms co-located suppliers (i.e., put them in a common area) and required home-country suppliers to invest in India. This led to the creation of a reliable auto-component supplier industry, which encouraged more MNC firms to enter the Indian market. Overall, the impact of FDI on the auto industry was highly positive.

7. Conclusion

By the end of the 1970s in many low income countries, technological progress remained an exogenous process located largely in the north. These countries

were reduced to be supplier of increasingly efficient, but capital-intensive and large-scale technologies depending on high-quality infrastructure, and owned predominantly by actors in the north. However the last two decades have witnessed technological innovations emerging from developing country firms.

The evolution of the Indian automobile industry shows the influence of Indian industrial policies on development innovative capabilities in Indian firms. However it also indicates the key role of managerial vision, influence of MNC firms, linkages to knowledge sources outside firms and entrepreneurial aptitude in the movement of Indian firms from imitators to innovators. Much of the innovation has been “behind the frontier” yet it has resulted in a rapidly expanding, internationalizing sector catering to customers at the ‘middle of pyramid’.

The case study evidence on the Indian auto industry points out that in developing countries government policies, specifically protection policies in the early stages of development, play an important role in the development of basic technological capabilities. In the case of India, industrial policy set up challenges such as the requirement for auto makers to develop products via a higher percentage of local suppliers. These conditions helped the development of local auto component capabilities and established a supplier base. However recent further liberalization of foreign trade regulations under India-ASEAN and India- South Korea Free Trade Agreements (FTAs) and forthcoming India-EU and India-Japan FTAs will certainly affect the cost competitiveness of Indian auto suppliers, but are expected to help automobile manufacturing firms. Some of the evidence suggests that it has become most cost effective to import components to India rather than just importing raw material and manufacturing components here (ICRA, 2010). It seems that FTAs may bring down the cost of certain raw materials and intermediate inputs for the Indian auto components industry, their exposure to the risks related to possible loss of business from OEMs and lower incremental capital assets creation is likely to remain (ICRA, 2010).

In the past the Indian government used imagination and set up Public-Private-Partnerships as a way of capability development rather than sole public or private sector initiative. However Saripalle (2006) shows that in the case of the Indian auto industry, firms established before 1985 had highest growth rates in the protection phase until 1991 while post-1985 firms show higher growth in the deregulation period with decline in growth in the liberalization period though above the industry average. This clearly indicates the limitation of government policies in influencing technological development of the industry in a competitive environment.

Evidence shows that innovative capability development in firms such as Tata Motors and Mahindra & Mahindra is influenced by managerial vision,

collaboration and competing with MNC firms in domestic markets. Analysis also reveals that the nature of demand does shape innovation trajectories, however it also crucially points out that managerial vision and the nature of firm ownership play an equally significant role in harnessing innovation and growth.

The findings of the research have policy and managerial implications specifically for automobile manufacturers from countries such as Brazil and Mexico, which have strong OEM (original equipment manufacturer) presence but weak technologically advanced local firms. Although diversity of markets and governance systems in developing countries limits application of policy lessons, but at firm level, findings such as role of managerial vision and impact of inter-firm learning in the development of innovative capabilities certainly have important implications.

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