Co-evolution of policies and firm level technological capabilities in the Indian automobile industry

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Co-evolution of Policies and Firm Level Technological Capabilities in the Indian Automobile Industry

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Abstract

Innovation in form of new products, processes or forms of productive organisation brings growth to firms and development to economies and therefore it is important to understand sources of innovation and technological capabilities. In this context this paper explores sources of innovation and technological capability in the Indian automobile industry. In last decade Indian auto industry emerged as one of the fastest growing industry with increasing levels of technological sophistication in auto industries amongst emerging countries.

This paper shows that industrial policy set up challenges for firm in form of constraint to develop products with higher local suppliers and helped development of auto component supplier industry. It also points out important role played by factors such as nature of demand and firm ownership in innovative capability development. Paper reveals key attributes of firm ownership which include managerial vision and diversified nature of businesses. The diversified nature of businesses has helped Indian auto firms in innovative capabilities by facilitating inter-sector learning.

1. Introduction

In the global world innovation lies at the heart of the economic growth and development for countries and firms in advanced as well as developing countries. 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 sweeping away of innovation-laggards by competition from radical new technologies as 'creating destruction'.

Innovation in form of new products, processes or forms of productive organisation brings growth to firms and development to economies and therefore it is important to understand sources of innovation and technological capabilities. In this context this paper explores sources of innovation and technological capability in the Indian automobile industry. In last decade Indian auto industry emerged as one of the fastest growing industry with increasing levels of technological sophistication in auto industries amongst emerging countries. Auto industry is a key in Indian economy as it provides mass employment to local population in the country and its export revenues helps to boost foreign trade. Significantly unlike other emerging countries such as Brazil, South Africa and Argentina Indian auto industry consists of Indian firms with indigenous design and development capability; global brands and presence in Indian as well as other emerging markets. In 2008 against expectations of global carmaker and international media Indian firm Tata Motors design and developed world's cheapest car 'Tata Nano'. Ratan Tata describes pessimism in automotive industry about 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".
(Economic Times, 2008)

In same year other Indian firm Mahindra and Mahindra launched a passenger car, 'Scorpio'; again a product of indigenous design and development. These developments caught other auto firms by surprise as their expectation of Indian success was low due to perceived mismatch between scale of challenges and capabilities of Indian auto companies. This paper tries to track capability development in Indian auto industry and seeks to understand factors; both internal and external of firms that shape innovative capabilities. It studies three Indian firms and analyses development of their innovative capabilities using Rattan's theory of induced innovation.

In the post independent era, Indian economic and industrial policy was dominated by an import substitution ideology where state interventions and regulations played a key role in directing firm and national level indigenous technology capability development. The Indian government shaped and directed objectives of self reliance through various policies focused on strictly regulating and restricting imports of the technology to protect the local technical effort by Indian firms. However, in 1990 the balance of payments crisis triggered major changes in the Indian government's industrial and economic policy orientation. From a relatively inward looking set of policies that was in place till the end of 1980s, the policy regime adopted in 1991, sought to break down the walls of protection within which the Indian industry had

developed in the past (Bhagwati,1993). From 1991 there has been shift towards the industrialisation with an open–economy and export promotion approach. There has been a massive increase in output, with the potential growth rate of the economy estimated to be around 8.5 % per year in 2006. Productivity growth has been the key driver behind the jump in GDP growth, contributing to nearly half of overall growth since 2003, compared with a contribution of roughly one-quarter in the 1980s and 1990s.

The existing automobile industry in India is in many ways a product of micro economic environment directed by state regulations and interventions. The different industrial policy regimes influenced firm level learning processes and shaped the technological capability accumulation in the Indian automobile industry**.** This paper shows that industrial policy set up challenges for firm in form of constraint to develop products with higher local suppliers and helped development of auto component supplier industry. Indian government applied public-private partnership (PPP) model to develop 'people's car' for domestic market. Evidence suggests that PPP model and industrial policy worked spectacularly by infusing life in domestic industry and improving productivity efficiency in Indian firms

This paper also point out important role played by factors such as nature of demand and firm ownership in innovative capability development. Paper reveals key attributes of firm ownership which include managerial vision and diversified nature of businesses. The diversified nature of businesses has helped Indian auto firms in innovative capabilities by facilitating inter-sector learning.

This paper is organised as follows: Section two discusses different theoretical perspectives on innovation in developing countries and illustrate key features of innovation process. Section three describes key elements of Indian industrial policy regime tracking movement from early protection policies to export focused liberalisation initiatives. Section four presents methodology and section five documents the evolution of policy and development of technological capabilities in Indian automobile industry. Section six compares learning mechanisms used by Indian automobile firms. Section seven concludes the chapter.

2. Sources of Innovation in developing countries

2.1 Innovation and developing countries

Earlier research on developing countries mostly covered technological adaptation (a movement along the frontier) than technological innovation (a movement of the frontier), based on the premise that adaptation of different technologies with which firms are not familiar would require same kind of technical effort as developing new techniques of their own. The ultimate achievement is to be a technologically mature firm and Bell, et al., (1984) observes that the majority of infant industries in developing countries never achieve maturity because of their failure to build up adequate technological capabilities.

The transformation of South Korea and Taiwan into industrialised economies shifted the focus of research towards processes involved in development of innovative capabilities (see for instance Hobday, 1995; Kim, 1997; Amsden, 1989). Some researchers have demonstrated the importance of foreign technology collaboration agreements for functions such as training engineers and obtaining detailed blueprints in case of Korean firms for acquisition of innovative capabilities (Westphal et al., 1985 and Enos and Pack; 1988). Hobday (1995) describes different learning strategies used by the firms to progressively assimilate foreign technology in order to develop design capabilities, to catch up and also leapfrog competitors at international level.

Nelson and Pack (1999) argue that the assimilation of increasingly modern technology and change in industrial structure were critical components of the transformation.
Some of the researchers such as Kim (1997), Dutr'enit (2000) and Figueirdo (2003) have focused on organisational and managerial issues involved in the accumulation of technological capabilities and the development of innovative capabilities. Kim (1997) show that these South Korean firms not only followed a deliberate and persistent technology strategy, which gradually changed as the firm acquired technological capabilities from creative imitation to innovation. Top management in the firm constructed a crisis to expedite the learning processes within the firms and implemented an active management of dynamic learning. Firms managed the learning process in such a way that different internal components of a knowledge system were articulated to strengthen the knowledge building process. Dutr'enit (2000) studying Mexican steel making firm shows that transition process in the firm was truncated because the support and the resources were unstable over different stages of innovation strategies applied by firm.
In general the focus of the DCL has been on the learning processes to establish a base of technological knowledge that did not previously exist, as opposed to renewing the accumulated knowledge base or using that knowledge base in a different way. Bell and Pavitt (1993) point out that change generating capabilities have become increasingly complex and specialised as they have become increasingly more differentiated from the capabilities required to use them and have become increasingly differentiated.

2.2 Key characteristics of innovation

In the contemporary global economy many researchers has shown the 'firm' as a central actor in the innovation process (Nelson and Winter, 1982; Bell and Pavitt, 1995). Consequently, understanding of sources of innovation needs to be rooted in the firm and its sociology (Penrose, 1957). Firms tend to move along particular trajectories in which past learning (by doing and by other mechanisms) contributes to particular directions of technical change, and in which the experience derived from those paths of change reinforces the existing stock of knowledge and expertise (Bell and Pavitt, 1993). The stock of past capabilities, routines provides the base on which firms develop the capabilities to cope with new technological change or new external environment: change is certainly possible, but it is conditioned by past. Patel and Pavitt (2000) showed that firms are in fact heavily constrained by their prior competencies in the extent to which they are capable of accumulating competencies in new emerging fields. The second firm-characteristic of innovation, in reality much if not most improvements in product and process arise out of a series of incremental changes occurring during production (Katz, 1987).
Bell and Pavitt (1993) points out that the technical as well as organisational dimension of managing knowledge is crucial in building capabilities for innovation. Thus technological capabilities refer to both; technical knowledge component which enables firms to generate innovations and organisation component which enables firms to manage the implementation of their in-house innovations and their linkages with external sources of knowledge. Production capabilities involve replicating the tasks while technological capabilities involve resources aimed at generating and managing changes in context of maintaining competitiveness in a changing environment (Bell and Pavitt, 1993). The distinction between technological and production capabilities reflects the increasing specialisation and professionalization of

the activities involved in generating and managing change. With teams of researchers working in the R&D departments of large, global multinational corporations (TNCs), technologies have become more complex and specialised and thus reducing the possibilities of acquiring the specialised knowledge through imitation (Bell and Pavitt, 1993). Pavitt (2003) suggests that it is necessary for firms to strategically manage integration of different specialised knowledge across the organisational boundaries of the firm referring to third key factor; management of innovation. It refers to structured routines designed to coordinate and integrate different types of knowledge (Tidd, Bessant and Pavitt, 2005).

The explicit investments in acquiring and accumulating knowledge and skill have become the necessary basis for building firm's 'change generating' or dynamic capabilities. As a result the effectiveness and nature of innovations will reflect the firm's ownership, its particular competences, its routines, its trajectory and the particular signals it responds to in the development of new processes and products (Ruttan, 2001).

3. Indian Automobile industry

The Indian automotive industry is worth around US$34 billion and contributed around 5% of India's GDP in 2007. It produced over 1.5 million vehicles and employed approximately 13 million people (KPMG, 2007). It ranked 11th in car production and 13th in commercial vehicle production globally. It is 4th largest market in terms of volume. According to Earnst and Young report (2009) India is expected to emerge as the world's seventh-largest automobile in terms of value by 2016 and third-largest by 2030 in terms of volume.

(Table 1 here)

India's auto industry has made significant transformation in the last five decades and specifically after 2000. Table 1 shows that in 2007 -08 passenger vehicles segment register the cumulative growth of 12 % while sub-segment of passenger cars grew by 11.7 %, utility vehicles by 10.5 % and multi purpose vehicles by 21.3%. In the same period commercial vehicles segment grew marginally at 4% while heavy commercial vehicles declined by 1.66 % Light Commercial Vehicles recorded a growth of 12.29 percent (SIAM, 2007). Fig. 1 plots the growth of the Indian passenger car industry from 1999 till 2005. The rapid growth in this sector has been mainly driven by the transformation in Indian domestic markets in form of substantial increase in the purchasing power of the Indian middle class, availability of financial options, competitive pricing as well as a reduction in government tariffs that have helped lower the price of vehicles. The Indian passenger market is skewed towards mini and compact vehicles – these segments account for almost 80% of car sales in the country (Sagar and Chandra, 2004).

(Fig 1 here)

From 2000 exports were becoming an important part in the growth of Indian Auto firms and have grown at a CAGR of 30% per annum. Fig 2 informs that in 2007 exports had crossed 198000 units and grew by 19.10 % (SIAM, 2007). In the year 2007 71% of the Indian car exports comprised of compact cars and were exported to South America, Africa, Europe, Latin America and the Middle East. However,

compared to global industry Indian industry still remains small; in 2007 it accounted for 3.15 % of the world vehicle production and sales respectively (OICA, 2007).

(Fig 2 here)

The passenger car sector is dominated by 3-4 players accounting for 85% of the total annual sales (SIAM, 2007). Fig 3 shows the market shares of leading players in the Indian automobile industry for 2007. The industry leader is Maruti Udyog Limited (MUL) with 46% market share followed by Tata Motors, Hyundai 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 an installed capacity of 350,000 units per annum. The Manesar facilities, launched in February 2007 comprises of 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.

(Fig 3 here)

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 (Annual Report, 2007-08). It belongs to the business conglomerate Tata Group, and ranked as the world's fourth largest truck manufacturer, and the second largest bus manufacturer and 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 a 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 most comprehensive research, design and development capabilities in the country.

Hyundai Motor Indian Company – a wholly owned subsidiary of Hyundai – began commercial production in 1998 and after a few years emerged as the second largest and fastest growing car manufacturer in India (Sagar and Chandra, 2004).

Fig 4 charts capability creation model in the Indian automobile sector. Sarippalle (2006) points out that India's auto sector has evolved through three different policy regimes which can be characterised as era of protectionism (1950-1983), deregulation (1983-1993) and liberalisation (post 1993). In the deregulation and liberalisation era foreign direct investment 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 development of firm level capabilities, domestic market and industrial structure.

(Fig 4 here)

4. Research methodology

A qualitative multi method approach was chosen as the best way to analyse sources of innovation in the Indian automobile industry. Top three Indian firms which have developed indigenous cars were chosen as a case study and primary data was collected through interviews with key managers in these 3 firms. Secondary data consisted of company annual reports, industry websites, news papers and business magazines. Rattan framework was used as an analytical framework to categorise and analyse different factors underlying sources of innovation in the Indian automobile industry. Crucially analysis was also focused on the firm based factors to understand impact of firm based factors such as managerial vision and inter firm learning as well as outside of firm issues such as government policy.

Drivers of Innovation

Ruttan (2001) identified three drivers of induced innovation and distinguishes between both demand and supply inducements to innovation. These three drivers provides analytical framework to analyse sources of innovation in Indian automobile industry.

The first is that of demand, 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, nor of biases in the interaction between particular patterns of demand and particular paths of technical change (Kaplinsky, 2010).

Kaplinksy (2010) argues that demand plays a crucial role by stimulates 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. For another, markets are also 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 inducing factor to the direction of technical change identified by Ruttan is relative factor prices of production. Ruttan explain 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 leaning processes forms 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)

These drivers of innovation provide important tools to analyse the innovative capability development in the firms from developing countries. In case of this paper these drivers provides analytical framework to study sources of innovation and technology capability development in the Indian automobile industry.

5 The evolution of capabilities in the Indian automobile industry: from ISI to liberalisation

5.1a Protection and licensing regime 1950 to 1984

Soon after the independence the Indian government banned import of completely built vehicles in 1949 and from 1953 the Indian government adopted a policy that allowed only those firms that had a manufacturing programme 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 market was supplied by two manufacturers: Hindustan Motors (HM) and Premier Automobiles Ltd (PAL). 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 restriction on the entry of foreign companies and imposing steep tariffs against imports.

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

In 1945 Tata Motors Limited, formerly known as Telco, was set up to manufacture locomotives and other engineering products by Tata business group. By 1954 Telco manufactured its first commercial vehicle in collaboration with Daimler-Benz AG and the first vehicle 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). To develop design and development capability Telco established 'Engineering Research Centre' (ERC) at Pune to provide impetus to automobile research and development in 1966; first of its kind in India. ERC built a strong team of 800 qualified designers and engineers and undertook design and development of vehicles as well as machine tools, dies, fixtures and other capital equipment. In 1975 Telco acquired Investa Machine Tools & Engineering in Pune and soon commissioned an alloy foundry at Pune to meet its press tools and casting requirements. In 1979 Telco established a large complex in the western part of the country; in Pune to augment its production facility.

From the beginning Telco put emphasis on training employees. In the Pune complex the first building was a training centre (Venugopal, 2001). It worked with local institutes and developed courses for workmen, supervisors and engineers.

By the late 1970s Telco widen its product range to cover Heavy Commercial Vehicles and progressively introduced a number of new models of its own design.

This period witnessed slowest CAGR (compound annual growth rate) at 3.5% from 1959 to 1980. Due to protected environment firms were mainly insulated from competition and had assured market for growth (Saripalle, 2006).

5.1b Deregulation Period: 1980 to 1990

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

In 1975 as a general industrial policy the government permitted an automatic capacity expansion by 25% every five years and removed price controls. In 1981 the Indian

government announced new policy of allowing 'broad-banding' of licenses. This was a specific policy measure that permitted a vehicle manufacture 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 vehicle it propose to manufacture. With broad banding policy Indian government encouraged production of 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% increase in their foreign exchange quota, previously imports were restricted to reduce the outflow of scarce foreign exchange.

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 indigenously designed affordable, cost-effective, low maintenance and fuel efficient car. However despite of government support Maruti failed to develop 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 to Maruti. Initially the Indian government was in favour of a joint venture with Volkswagen and VW Golf was the chosen car. However 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 overseas partner to bring in 40% equity and had talks with Nissan, Mitsubishi, Daihatsu and Suzuki. Only Suzuki was willing to take up 26% equity with an option to raise it to 40%. Thus government chose Suzuki as a partner and 550 cc 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 1980s these four firms collaborated with private Indian firms, and some shared equity with state level governments (see Table 7). 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 Puegeot for assembly of medium sized cars from knocked down kits. Table 2 lists the major joint venture 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).

(Table 2 here)

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 commercial vehicle segment started developing passenger cars albeit on a limited scale.

Birth of Maruti Udyog Limited (MUL)

Establishment of Maruti Udyog Limited (MUL) in 1981 marked a new phase for the automobile industry in India. Within a decade production of passenger cars increased fivefold and MUL went on to capture more than 50% share of the domestic market.
Indian government established Maruti Udyog Limited in 1981 with the objective of modernising the Indian automobile industry and producing indigenous developed cars for the needs of growing population. A joint venture agreement was signed with Suzuki Motor Company in 1983 by which Suzuki acquired 26% of equity and agreed to provide the latest technology as well as Japanese management practises.
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 complete modern technology. In the beginning Maruti 800 model have 97% import content and only tyres and batteries were source locally. Government set up a target of 93% localised within five years and so the company started to develop local vendors from scratch. Company attracted entrepreneurs by offering them land at company's complexs and supplied electricity from its own power station. In addition Suzuki engineers helped the new manufactures with automation and management practises such as just-in-time manufacturing. Till 1990 MUL dominated the Indian market with Maruti 800 becoming a choice of care with 62% 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.

Entry of Telco (Tata Motors) in passenger car sector
Gradually established players such as Telco entered commercial passenger car segment capitalising on their engineering capabilities, interchangeable parts of sufficient volume and economies of scale (D'Costa, 2004). Under Indian government's 'broad-banding' license policy Telco entered LCV market and in 1985 introduced Tata 407. Telco followed it two more models in1987; 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. Based on the Tatamobile designer parameters – technically known as the Tata 207 platform – but with new modifications Telco introduced two new models Tata Sierra, a two-door personal transport and Tata Estate, a four door vehicle. ERC successfully carried out the design and development work for Telco's commercial vehicles and played a key role in design and development of Tata Sierra and Tata Estate in 1980s.
Taking benefit of liberalised import regime in 1992 Telco obtained know-how from AVL Austria for the development of a fuel-injected petrol engine to provide petrol option on 207 platform vehicles. In the same year it imported know-how for the design and body styling of a five door version of the Tata Sierra which was under development. When these machines were imported engineers and workers were sent to foreign manufacture's facilities for training.
Tata Motors performed large parts of its manufacturing activities in-house. It installed facilities to manufacture engines, gear boxes and transmission mechanisms, body panels, castings and forgings and important component sub-assemblies. Telco established a machine tools division and started manufacturing its requirement of machine tools, and dies fixtures in-house. In 1994 the machine tools division built four basic robots for spot welding and arc welding with technology imported from

Nachi-Fujikashi Corporation of Japan. The division also started manufacturing CNC (Computerised Numerically Controlled) machines for use in its vehicle manufacturing operations.
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 positive impact on performance of auto industry reflected by CAGR of 18.6% from 1980 to 1990.
Although even after industry deregulation due to obsession with self –reliance, the production of passenger cars throughout the 1980s and early 1990s remained tightly regulated through licensing.

5.1c. Post 1993: Liberalisation of Indian auto sector

The economic liberalisation in 1991 started significant phase in the development of Indian automobile industry. Auto licensing was abolished in 1991 and weighted average tariff was decreased from 87% to 20.3% in 1997. In 2001 the Indian government removed auto import quotas and permitted 100% FDI in the sector. The government reduced excise duties to 24% on passenger cars and focused on developing supportive infrastructure.
In this period Mahindra & Mahindra made a transition from 'tractor and jeep maker' to a modern passenger car maker. In 2002 Mahindra & Mahidnra launched Scorpio as a sports utility vehicle (SUV) - a product of in-house design and development effort.
In 1989 Suzuki increased its equity stake to 40% and three years later to further 50%. In addition Suzuki paid a control premium of Rs 10 billion to the Indian government for complete management control. In post 2000 period Maruti has slowly started moving towards building its own design and development capability and carried out in-house minor facelift of its largest selling model, the Zen. Now Maruti is working with parent Suzuki to develop an Asian car and planning to set up R&D centre with investment of US$ 200 million.
During this period other Indian firm; Tata Motors made rapid stride towards developing advance level of technological capability by launching first indigenously developed Indian car, 'Tata Indica'. Venugopal (2001) explains in detail effort of Tata Motors in developing 'Tata Indica'.
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 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. 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 set up a design team at 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 programme manager interacted with IDEA team for the entire duration of the project. Some designers and engineers were deputed at the IDEA. Tata was assisted by Le Moteur Moderne of France in configuring 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 to 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 supply 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 joint venture with leading auto component manufacturers which became key suppliers to the Tata Motors.
Tata Motors imported several major items of equipment from foreign suppliers such as high-speed machining centres from Germany and 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 Tato 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 product of the 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. Looking downstream at the manufacturing and distribution chain, Tata plans to build the Nano as a kit, shipping parts to local business for assembly.

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 in 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% 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% subsidiary such as Hyundai while firms such Daimler Benz established partnership with local firms (Table 2).

In 2004 Tata Motors signed a joint venture with Daimler-Benz for manufacturing Mercedes Benz passenger cars in India. Mercedes held 51% of the equity in joint venture and a plant was set up in Pune complex at a cost of US$ 106 million. Mecedes 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 % 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 has grown at an impressive CAGR of 15.5%. Of the total sales roughly 10% was contributed by exports. The export of Indian cars has grown at a CAGR of 30% from 2001 and 71% of the Indian car exports comprised of compact cars. MNC firm Hyundai Motor India emerged as the leading exporter with 68% 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.

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, Spanish bus manufacturing Company. Tata Motors have also established assembly plants in Malaysia, Kenya, Bangladesh, Spain, Ukraine and Russia. In 2006 Tata Motors acquired Marco Polo, Brazil to manufacture and assembly of 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. Discussion and analysis of sources of innovation and technological capability development

6.1 Important role played by nature of demand

Analysis of 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 model were focused on domestic market 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 rural based economy. As a result Indian firms twice

endeavour to produce 'people's car' and came up with economical cars; Maruti Suzuki in 1984 and Tata Nano in 2009. Ratan Tata explains role of local condition in development of 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".

(Economic Times, 2008)

Keeping in mind nature of domestic demand and with aspiration to produce care affordable to poor populations, Tata Motors started innovating with different components. Ratan Tata 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 Maruti800 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".

(Economic Times, 2008)

6.2 Firm level sources of innovation

6.2a Firm ownership and managerial vision

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

In the case of the Indian automobile industry ambition and vision of Ratan Tata to develop the first 'Indian car' and then 'people's car' were driving forces behind development of Tata Indica and Tata Nano. Ratan Tata 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."

(Economic Times, 2008)

In case of Mahindra & Mahindra ambition of Anand Mahindra to transform a tractor manufacturing company to passenger car firm fuelled design and development effort for Scorpio.
Indian auto owners realised that lack of knowledge with Indian managers and made an 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 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.
In the post liberalisation era leading Indian auto manufacturers are in the process of transforming from local players to global companies. Now foreign sales are made through directly owned or JV based foreign operations than 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 top five Indian automakers revenue from overseas market is close to an average of 9%. The main challenge for Indian auto makers is to establish reputation for a world class technology and which requires substantial and long term investments. Vision for overseas acquisition

6.2b Family owned diversified businesses facilitating inter-sector learning
Leading Indian firms in auto industry are part of family owned business groups. In 1980s many Indian businesses invested in unrelated businesses as a way of protecting income from government protection policy and stringent tax regime. Khanna and Palepu (2000) suggest that profitability of group affiliated firms exceeds that of other companies however relation is non linear; beyond certain level diversification is associated with higher profits. They argue that these groups makes up for missing institutions 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 venture due availability of little information and few safeguards. In such cases diversified business can point their track record to the investors or invest internally. For example historically Tata companies have come together to finance their new ventures. In 1982 group created Tata Industries; a venture capital vehicle funded with a special pool of investment money drawn for 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. In case Tata Group encourages group companies to facilitate mobility of talented employee to another company if its benefits both. Cross –company teams of 'stars' are assembled to resolve difficult problem individual company is having.

Despite the elimination of the old "license raj," for example, Indian law still requires that companies get permission for a range of decisions, such as exiting businesses, changing prices on commodities, and importing raw materials. The law establishes subjective criteria for many of these decisions, so Indian bureaucrats have a great deal of discretion in how they apply the rules.

Diversified groups adds value by acting as intermediaries 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 the strong market shares in many sectors of Indian economy and internal; learning as well as access to capital due to diversified nature of business forms key strengths of the group.

6.2 Policy induced sources of innovation

6.2a Influence of government policy on development of technological capabilities

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

Saripalle (2006) suggests protection policy did encourage acquisition of basic production capabilities; however this does not equip the firm with coordination capabilities necessary for survival in a competitive environment. For example government pursued policy of indigenisation till beginning of 1993 and that has created a chain of world class auto component suppliers as well as developed firm level coordination capabilities require to manage them. In the case of Indian auto industry government policies and the need to reduce cost provided an impetus for indigenisation. Sagar and Chandra (2006) credits 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, sub-systems for Indian standards. This required collaborative effort between local suppliers and parent company engineers. This led to gradual movement of Indian firms towards development of technological capabilities in the country. MUL had an aggressive plan for indigenisation from inception and by 1990 it achieved 95.3% local content. Tata Motor's Indica had about 95% local content for both the petrol and diesel version (Fig 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.

(Fig 5 here)

6.2b Key role of foreign partners and impact of foreign direct investment

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 auto industry suggests that sector performance has improved steadily since 1993. Labour productivity has grown at an annual rate of 20%; FDI firms at 38% as productive as US plants on average. Auto industry output has grown at over 15% per year, up from 13% in 1983-1993 and from less than 1% 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 OEMs 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%, significantly higher than the global average of 5%. However, with the influx of new MNC firms, Maruti-Suzuki's profit margin declined to 3-4%, 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 last two decades has witnessed technological innovations emerging from developing country firms.

The evolution of Indian automobile industry shows the influence of Indian industrial policies in development innovative capabilities in Indian firms. However it also indicate the key role of managerial vision, influence of MNC firms, linkages to knowledge sources outside firms and entrepreneurial aptitude in movement of Indian firms from imitators to innovators. In case of auto industry much of the innovation has been "behind the frontier" yet it has resulted in a rapidly expanding, internationalising sector catering to customers at the 'middle of pyramid'.

The case study evidence on Indian auto industry points out that in developing countries government policies specifically protection policies in early stages of development plays an important role in development of basic technological capabilities. In case of India, industrial policy set up challenges such as requirement

for auto makers to develop products with higher local suppliers. These condition helped development of local auto component capabilities and established supplier base. Indian government used imagination and set up Public-Private Partnership as a way for capability development rather than sole public or private sector initiative. However Saripalle (2006) shows that in case of Indian auto industry, firms born before 1985 had highest growth rates in the protection phase until 1991 while post 1985 firms show higher growth in deregulation period with decline in growth in liberalisation period though above the industry average. This clearly indicates limitation of government policies in influencing technological development of the industry in 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. This paper also reveals that the way nature of demand shapes innovation however crucially points out that nature of market is not constrain for growth and profitability but lack of managerial vision and nature of firm ownership can hamper growth.

The findings of the research have policy and managerial implications specifically for automobile manufacturers from countries such as Brazil and Mexico which has 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 development of innovative capabilities certainly have important implications.

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Figures and Tables

Fig 1 Turnover of passenger car manufacturers in India (SIAM, 2007)

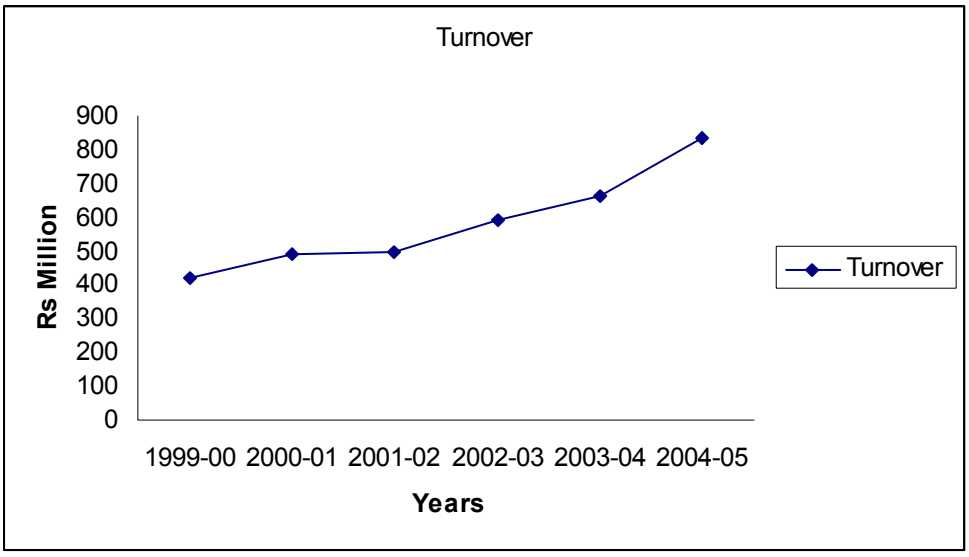


Fig 2 Passenger car export trends (SIAM, 2007)

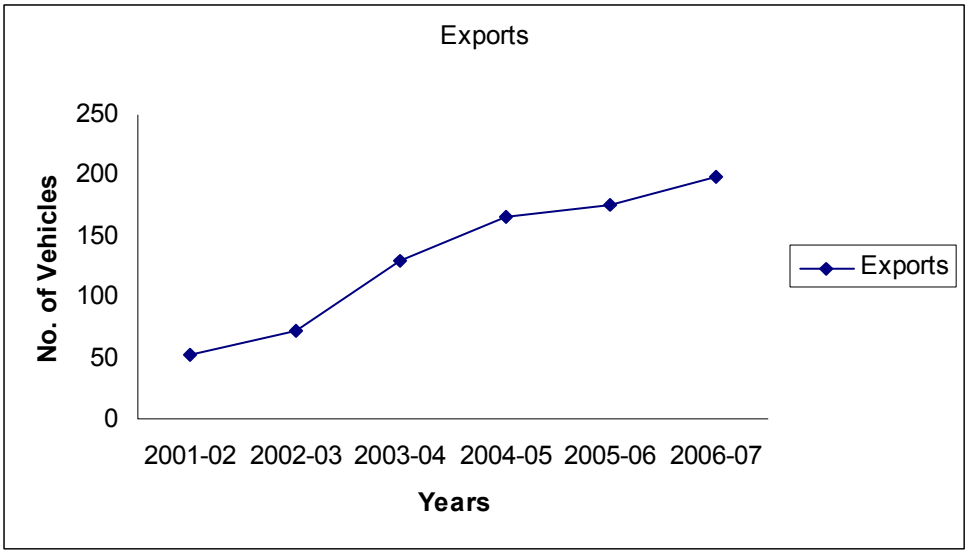


Fig 3 Market shares of key players in passenger vehicle market (SIAM, 2007)

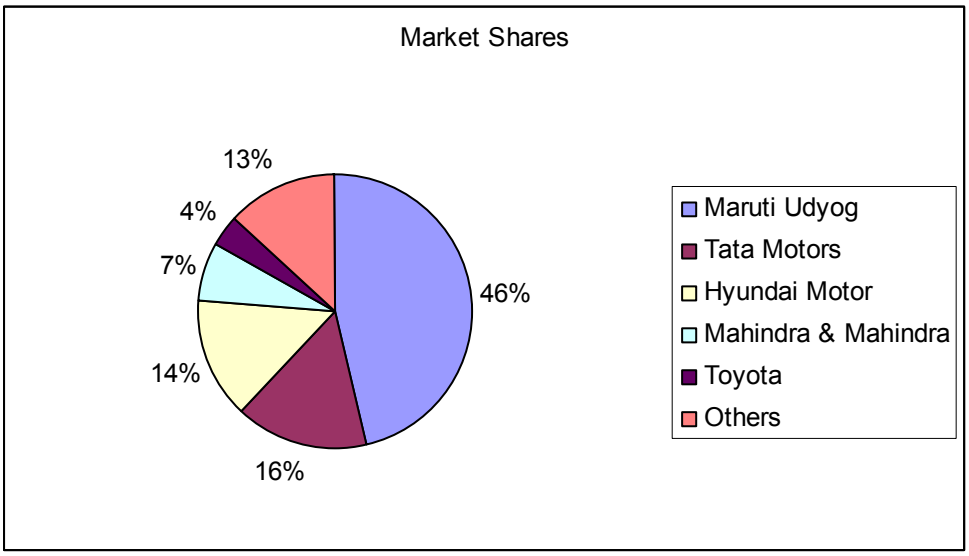
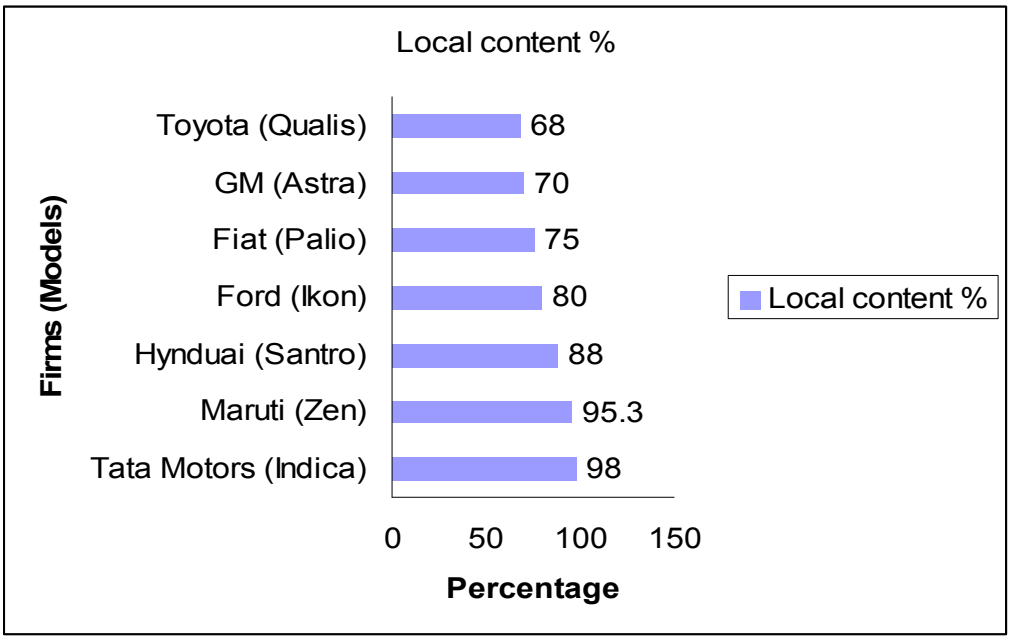


Fig. 4 Indian auto growth trajectory

Fig 5 Percentage of local content



Tables

Table 1 Automobile domestic sales (SIAM, 2007)

	No. of vehicles						
Category	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**
Passenger Vehicles	707,198	902,096	1,061,572	1,143,076	1,379,979	1,549,882	1,551,880
Commercial Vehicles	190,682	260,114	318,430	351,041	467,765	490,494	384,122
Three Wheelers	231,529	284,078	307,862	359,920	403,910	364,781	349,719
Two Wheelers	4,812,126	5,364,249	6,209,765	7,052,391	7,872,334	7,249,278	7,437,670
Grand Total	5,941,535	6,810,537	7,897,629	8,906,428	10,123,988	9,654,435	9,723,391

Table 2 Entry of MNC firms in India and different modes

No	Foreign Company	Indian partner	Manufacturer name	Foreign equity	Year of incorporation
1	Fiat	Premier Auto Limited	Premier Auto Limited		
2	Daimler-Benz AG	Telco (Tata Motors)			1954
3	Suzuki Motor Company (Japan)	Government of India	Maruti Udyog Ltd		1982
4	Toyota	DCM	DCM Toyota India Ltd		1985
5	Mazda	Swaraj	Swaraj Mazda India Ltd		1985
6	Isuzu	Hindustan Motors		0%	1986
7	Hino	Ashok-Leyland			1985
8	Nissan	Premier Auto Limited			1986
9	Peugeot, France	Premier Auto Limited	Premier Auto Limited	68.3	1994
10	Ford Motor company (USA)	Mahindra & Mahindra	Ford India Ltd		1995
11	Mitsubishi Motors, Japan	C.K. Birla Group	Hindustan Motors		2002
12	Toyota Motor Corporation, Japan	Kirloskar Motors Ltd	Toyota Kirloskar Motors Ltd		
13	Daimler Benz AG	Tata Motors	Mercedes Benz India Ltd		2004
14	Fiat Auto Spa (Italy)	Tata Motors	Fiat India Limited	50	2007
15	Ranault (France	Mahindra & Mahindra			2005