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Liberalisation and The Differential Conduct and Performance of Firms: A Study of the Indian Automobile Sector

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Summary: This paper analyses the behaviour of Indian Automobile firms operating under regulated and liberal economic policy regimes. Results from the step-wise discriminant analysis presented in this paper reveal that the conduct and performance of firms in this sector differ significantly between the regulated [1985-86 to 1990-91] and liberal [1991-92 to 1995-96] economic policy regimes with respect to foreign equity participation, in-house R & D efforts, technology imports, capital intensity, advertisement, exports, growth and profits.

Key Words: liberalisation, firm's conduct, performance of firms, Automobiles, developing countries, India.

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1. Introduction:

Developing an appropriate public policy towards the industrial sector has been an important task for Indian policy makers for a long time. When India moved away from an inward looking industrialisation strategy to a more 'open' economy in 1991, industrial firms needed to restructure themselves to retain competitiveness. Much of these restructuring is needed to correct the inefficiencies created by operating in a protected market. The Automobile sector has been a major candidate in the industrialisation process since the beginning of planned development. Automobile industry in India has been subjected to substantial policy changes over the last two decades. The policy changes were in two doses and took the form of partial de-regulations introduced in 1985 and liberalisation measures launched since 1991. The pre 1985 regime could be described as an era of strict controls and regulations. The initial changes, introduced in 1985, eased the licensing requirements, broad-based the classification of vehicles for issue of licenses, allowed selective expansion of capacity and partially relaxed controls with regard to foreign collaborations, imports of capital goods, raw materials and spares. Though these measures represented a "domestic liberalisation", the policy environment continued being geared towards imposing trade and investment regulations, constraining the growth of big business houses and regulating exchange rates. It was only after 1991 that notable broad-based changes in policy that had far reaching implications actually came into being. These changes dispensed with the bulk of controls and regulations and for the first time since independence assigned a central role to market forces. To list some of these changes more explicitly -

approval for foreign investment upto 51% equity holdings came to be given automatically, most of the industries that comprise the manufacturing sector were removed from the licensing network, the monopolies [MRTP] act was amended - allowing big business houses to expand at will, domestic currency was made convertible in the trade account, the exchange rate was allowed to be influenced by the market and quantitative controls on imports of capital goods and components were removed. In addition to these measures aimed specifically at the industrial sector, the Government of India also adopted certain structural adjustment and macro stabilisation policy measures during the post 1991 period.

A growing body of literature has examined the impact of liberalisation in industrial and trade policies on manufacturing sector performance in different countries.[1] While most of the studies focused on making inter-country comparisons, a few studies analyse the impact of trade liberalisation on manufacturing productivity.[2] In an interesting study Aswicahyono, Bird and Hill [1996] attempt to capture the impact of liberalisation on industrial structure using data that covers a cross section of firms belonging to various industries in Indonesia. Their study focuses on variables such as concentration, ownership, size distribution, spatial distribution and total factor productivity growth, and their results suggest that liberalisation does not have a major impact on the industrial structure. They attribute the inability of their study to capture the effects of liberalisation to inter-sectoral differences within the industrial sector in Indonesia and the short period of time taken under examination. Basant [2000] explores changes in some key corporate strategies in response to economic reforms introduced in India since 1991 and points out significant changes with respect to mergers and acquisition activities of multinationals,

[1] Refer USITC (1997) for a detailed review.
[2] Roberts and Tybout (1996) present research studies based on data on panels of producers surveyed in five newly industrializing countries: Chile, Columbia, Mexico, Morocco

foreign technology purchase, R & D and manufacturing capabilities.

Most of the earlier studies that attempted to analyse the differential behaviour of firms in terms of conduct and performance variables have brought out the differences between multinationals and local enterprises.[3] Siddharthan [1998], on the basis of an analysis of Automobile firms in India over the period 1987-88 to 1989-90, found that even within the multinationals, Japanese affiliates differ from those of Western Countries. He observed a significant difference between Japanese multinationals in India and unaffiliated Indian firms as well. Much of this variation is due to the differences in the management techniques that the Japanese firms adopt over the other multinationals and unaffiliated Indian firms.

This paper compares major aspects of conduct and performance of Indian automobile firms operating under two different policy regimes. The study covers all firms manufacturing Cars, other four-wheeled utility vehicles and Light, Medium and Heavy Commercial Vehicles. The sample includes Japanese and other multinational affiliates and unaffiliated Indian firms. The analysis deals with different elements of conduct and performance: namely, technology acquisition, imports of components, vertical integration, product differentiation, capital intensity, profits, growth and exports. The significance of the difference between these conduct and performance indicators across the two policy regimes is first evaluated using a univariate statistical criterion. The variables identified, by the univariate process, those differentiate the behaviour of firms, are then analysed with the help of a multivariate step-wise discriminant analysis.

The paper begins with an examination of the variables representing the conduct and performance of firms that are palpably felt to be influenced by liberalisation [section 2]. In

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and Turkey.

section 3, the hypotheses developed by the study are given. Section 4 presents the sample, data and the method of analysis, while section 5 discusses the results. In section 6 the major conclusions of the study are presented.

2. Policy Regimes, Firms' Conduct and Performance:

The Automobile industry in India grew under a highly regulated and protected economic environment over the period 1950 to 1985. Automobile manufacturing firms were subjected to strict product specific and capacity licensing and as a result very few firms dominated all the products. These restrictions provided no motivation or incentive for the firms to bring about technological upgradation. Moreover, capacity licensing restricted the firms from enjoying scale advantages. Accumulation of technological capability took place mostly by adaptation of specific technological trajectories and learning by doing in the process of indiginisation of production.

The policy environment during the period 1985-86 to 1990-91 permitted a limited increase in technology inflow through various modes. Inflow of technology from abroad brought about a shift in the technology frontier as well as a change in the technological trajectories in which the firms had been operating. However, partial relaxation of this kind failed to bring about a drastic change in the non-competitive environment in which the firms had been operating for a long time. Moreover, relaxation of restrictions, without decontrolling foreign exchange and thus maintaining the artificially high value of the Indian rupee, led to a substantial increase in the dependency on imports.

Liberalisation of economic policies and the outward orientation introduced since 1991, on the other hand, brought about a dramatic change in this industry. These policy measures

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[3] Refer Dunning (1993) and Kumar (1990), for example.

considerably transformed the environment in which the firms had been operating. As a consequence, the industry witnessed the entry of new firms and adoption of strategies by the already existing firms to introduce technological change and improve their performance. The new players brought in modern engineering, efficient processes and effective shop-floor layouts. The new manufacturing strategies include breaking up of the plant into modules and cells, reduce the complexity of purchasing logistics, reduction of inventories and product complexity, and creation of simpler processes by encouraging flexibility and teamwork. These firms also make extensive use of CAD/CAM in their plants. Moreover, the materials used have also undergone a change from steel and cast iron to aluminium and thermoplastics. Some of the existing firms have oriented their systems by replacing the batch system by work flow, organising the production in product modules and by keeping the product-mix flexible in order to save time, reduce cost and increase quality. The new joint ventures, it appears, are becoming catalysts to activate the capabilities of the existing plants in areas of cost control and product development. As a result, the policy changes to introduce market-induced efficiency have had far reaching implications in the form of technology acquisition, growth in output and exports.

In the empirical analysis to follow the observations for eleven years namely 1985-86 to 1995-96 are classified into two periods; 1985-86 to 1990-91 [period 1] and 1991-92 to 1995-96 [period 2]. The first period covers the initial phase when the economy was partially opened up - in the form of de-regulation, relaxation of controls and restrictions on imports of technology and components and spares. The second period [beginning 1991] represents the period when major changes in the macro-economic environment came into being, with an across the board liberalisation of controls and restrictions, implementation of the structural adjustment programme and efforts came to be directed at globalising the economy.

On the whole, Indian Automotive sector grew at a much faster rate in the post 1991 era [14.31 % per annum] when compared to [8.56 % per annum] the period of 1985-91 [Table 1]. The growth rate of all the sectors within the 4 wheelers and Commercial vehicles has been in double digit with the LCV sector registering the maximum [of 19.93 % per annum] in terms of the growth rate as well as increase over the earlier period. Medium and Heavy commercial vehicles sector also registered a growth rate of about 11% per annum, which is a 100% increase over the previous period, 1985-86 to 1990-91. In the 4-wheeled drives sector Jeeps [other utility vehicles] experienced the maximum increase in growth [from about 5.57 % per annum to 14.4 % per annum] between the two periods. The Car sector also had an increase of about 2.5 percent in its growth rate over the two periods. This was the only sector which had a double-digit growth rate during the first period [which can be attributed to Maruti] and has improved its performance during the 1990s.

TABLE : 1

ANNUAL AVERAGE GROWTH OF PRODUCTION OF AUTOMOBILES [%]

SECTORS/PERIOD	1985-86 to 1991-92	1991-92 to 1995-96
CARS	12.63	15.17
JEEPS	5.57	14.40
ALL 4 WHEELERS	11.10	14.84
M&HCVS	5.39	11.32
LCVS	7.33	19.33
ALL CVs	6.03	13.93
TOTAL	8.56	14.31

SOURCE: ACMA, STATISTICAL PROFILE
NOTE: M&HCVs refer to Medium and Heavy Commercial Vehicles, LCVs refer to Light Commercial Vehicles and CVs refer to all Commercial Vehicles.

During this growth process, the industry experienced changes in the strategy adopted by

many firms in that efforts were made to build up technology acquisition, product quality was improved and in general the industry became more competitive.[4] Studies [Ansal 1990, Rao 1993, Basant 1997 and Narayanan 1998] have pointed out that economic policy forces have an impact on the extent and direction of technological efforts of firms. Ansal [1990] analysed the experience of three Turkish trucks manufacturing firms under import substitution and export-oriented industrialisation strategies and found that technological efforts of firms are directed by the conditions created by industrialisation policies. While the technological efforts during import substitution era were generally directed at increasing the local content of products, the export-oriented policy induced the firms to direct efforts to reduce costs and improve quality by implementing changes that upgrade the production process. Rao [1993] found that the investment strategies for R & D, plant modernisation and expansion, material and machine tool inputs undertaken by Indian Automobile firms are all related to the technological position of the firm on product and process dimension. Basant [1997] on the basis of a study of large companies in India reports that the policy environment in which it is operating influences a firm's technology strategy among others. Narayanan [1998] also found that inter-firm differences in competitiveness in the automobile sector in India, depended on technological trajectory advantages during the licensing regime and on the variables capturing technological paradigm shifts after the introduction of de-regulation policies during the mid 1980s.

Before 1983 the passenger Car sector[5] of the Indian Automobile industry consisted of only three firms with limited capacity. In 1983, Maruti [which is a joint venture of the Government of India and Suzuki Motors, Japan] entered the industry and dramatically affected

[4] For a detailed discussion on the evolution of the automobile industry in India, refer Narayanan (2001).
[5] This sector includes cars and other four wheeled drives.

the market share of all firms. Maruti enjoyed as much as 50% of the market share during the first period of this study. Later Maruti, with its range of four wheeled vehicles, was able to push up its market share during the 1990s to 60%. Telco, a leading Commercial Vehicle manufacturer in India, also entered the Car segment after 1991 and introduced four wheeled passenger cars that are ideally suited for long distance travel on Indian roads. The entry of Telco virtually decreased the market share of the two formerly leading car manufacturers in India - Hindustan Motor and Premier Automobiles - to single digit. These two firms, Hindustan Motor and Premier Automobiles, continue to struggle for survival in the face of competition that has resulted from the entry of new subsidiaries of the world's leading auto manufacturers: General Motors and Ford Motor Company [from USA], Mercedes Benz [from Germany], Daewoo Corporation [from Korea] and Automobiles Peugeot [from France]. All these firms have entered into the Indian Car segment after this sector was de-licensed in 1993 and their products hit the market in 1996. Most of these new firms are multi-product firms. The installed capacities of Maruti, Telco and the new firms that have been established since 1993 are much higher than those of the older firms. Recently there are two more entrants in the Car segment - Honda [Japan] and Hyundai [Korea] - which have introduced small sized cars to compete with Suzuki. Market share of Maruti Suzuki has declined from as high as 89% during the early 1990s to 54% by the late 1990s. Telco also introduced a small sized car during 1998, keeping in mind the idiosyncrasies of the Indian market. The Car segment, therefore, has emerged as a leading competitive sector in India during the post liberalisation period.

The LCV sector also experienced substantial changes in the market share of firms during both the policy regimes. In the first period, inspite of a limit on the extent of foreign equity investments, selective permission for foreign investment involving technology transfer were

given, which facilitated a number of entries in this segment. Most of the new firms had Japanese collaborations [Toyota, Mitsubishi and Nissan], whereas earlier the Indian LCV sector comprised of only three firms [Bajaj, Mahindra and Standard Motor]. The Japanese collaborations created much higher capacities than the Indian firms did. Telco also diversified into LCV assembly [with the help of its own R & D efforts] in 1986 and became the second largest market-share holder in this segment. Bajaj, which belongs to one of the leading automobile business houses, had a market share of about 30% during the 1st period, and with technological upgradation of its LCVs, Bajaj was able to increase its market share by 3% during the 1990s. Telco has come to enjoy as much as 45% of the market share in this segment during the 1990s. Another Indian firm, Mahindra experienced a drastic decline in its market share from about 15% during the 1st period to about 5% during the second. Standard Motor has gone out of the market. All the joint ventures from Japan also experienced a reduction of about 50% in their market share between period one and two. Possibly the major factor that enabled Telco and Bajaj to succeed were their ability to suit their LCVs to Indian road conditions and the fact that technological upgradation of their plants and products was initiated. One of the responses to low market shares was that certain new firms diversified into the Car segment. For example, DCM TOYOTA, which was a joint venture between DCM of India and Toyota of Japan during the first period, was taken over by Daewoo Motors of Korea with majority equity holdings during the second period. This marked the diversification of this LCV firm in the first period to the Car segment in the second.

Unlike the Car and LCV segments, the Medium and Heavy Commercial Vehicles category witnessed moderate changes. Hindustan Motor and Premier Automobiles, which had a small market share during the early eighties, went out of the market during the second half of

the 1980s itself. Competition strengthened between Ashok Leyland and Telco [though Telco is still the market leader with 70% share] on account of the former firm's technical collaboration with IVECO FIAT SpA [from Italy] for technological upgradation as a reaction to Telco's R & D achievements. Kathuria (1996) observed that there are evidences of substantial technological learning in this segment inspite of the limited number of firms. Volvo India Private Ltd. has entered this segment in 1997 and Volvo's technological configurations represent a major shift in the paradigm in which the other two firms have been operating in India. Ashok Leyland has become a subsidiary of the Hinduja Group [a non-resident Indian business group] with 51% foreign equity during the second period. Recent years have witnessed the emergence of competition between these three firms in the Heavy Commercial Vehicle segment.

Literature points out that with a change in the policy regime, firms can choose to adopt strategies that would enable them to shift to a higher growth-profit frontier. The strategies adopted could be in the form of an emphasis on vertical integration, product differentiation and capital deepening. Further, given a trade-off between growth and profits, there may be a difference in the emphasis on either growth or profits, atleast in the short-run [period immediately after liberalisation]. The global players will try to improve their prospects by increasing their exports.

On the basis of these possible effects of liberalisation on the behaviour of firms and drawing upon the empirical knowledge, this study formulates hypotheses [in Section 3] concerning the nature of differences in the behaviour of firms across the two policy regimes. The parameters to capture the behaviour of firms have been classified into technology acquisition, product improvements through imports of components, vertical integration, product differentiation, capital intensity and performance.

3. Hypotheses:

The variables used in the analysis and their definitions are provided in Table 2. Details of the policy environment in which the firms have been operating during the two periods along with a brief summary of the effect of these policies are presented in Table 3. This table does not provide information on all the variables included in the study, but only those which were subjected to direct policy influence in both the periods.

Table 2: DEFINITION OF VARIABLES USED IN THE ANALYSIS

VARIABLE	DEFINITION
AD, advertisement intensity	expenditure on advertisement as a proportion of sales turnover
AGE, age of the firm	depreciation as a ratio of gross block
CI, capital intensity	book value of plant and machinery as a proportion of sales turnover
EX, export intensity	Value of exports as a ratio of sales turnover
FE, foreign equity participation	percentage of foreign equity shares to the total paid up capital of the firm
GROWTH, growth of firms	rate of change in annual sales turnover
IMCAP, import of capital goods	value of imports of capital goods as a proportion of sales turnover
IMCOM, import of components	value of imported components as a proportion of sales turnover
LR, Disembodied technology imports	lumpsum and royalty payments as a proportion of sales turnover
PCM, price-cost margin	gross profits as a proportion of sales turnover
RD, In-house Research & Development	research and development expenditure as a proportion of sales turnover
SIZE, firm size	log value of annual sales turnover
VI, vertical integration	value added as a proportion of sales turnover

Interaction Terms	FE*RD, LR*RD & IMCAP*RD

TABLE: 3 POLICY REGIMES AND BEHAVIOUR OF FIRMS

Variable	Period I		Period II		Prediction
	Policy Regime	Behaviour	Policy Regime	Behaviour	
FE	Restrictions on equity investment [40%]. Permission granted on case by case basis.	Foreign equity Collaborations [mostly with 26% share] jointly with Indian firms to set-up new plants.	Automatic approval upto 51% foreign equity. Permission granted for setting up a [100 %] subsidiary.	Multinational subsidiaries in the Car sector. Spurt in majority holdings and resultant management control.	+ signifi-cant
LR	Limited permission. Restrictions on lumpsum and royalty payments.	Used mostly for incremental changes in technology.	Automatic approval of lumpsum know how upto Rs.10 million and royalty upto 5% of domestic sales and 8% of exports.	Inflow of standardised technology through the transfer of design and drawings.	+ signifi-cant
IMCAP	Permission required. Strict exchange control.	Used mostly as a part of a package of technology transfer or as an alternate mode of technology acquisition.	No permission required. Regulation through tariffs. Rupee convertible on current account. Rupee value determined mainly by market.	Decline in the use of this mode of technology acquisition due to decrease in the value of rupee and the corresponding higher cost of imports.	- signifi-cant
IMCOM	Permission required. Exchange rate controls.	Was a source of technological upgradation. Used due to favourable exchange rate.	No permission required. Regulation through tariffs. 'Market determined' exchange rate.	Decline due to high costs of imports. Devaluation of rupee led to increase in cost.	- significant
EX	Promotional policies for export oriented units. Certain monetary and fiscal incentives. Strict exchange control.	Most of the products directed to local market requirements. Very limited efforts for exports.	Efforts for globalisation and removal of restrictions on trade, including rupee convertibility	Substantial increase in exports to earn foreign exchange. Greater MNC participation and decline in the value of rupee.	+ signifi-cant

Note: FE denotes intra-firm technology transfer through foreign equity participation, LR stands for disembodied technology imports against lumpsum and royalty payments, IMCAP represents imports of capital goods, IMCOM refers to imports of components and parts and EX stands for exports.

3.1 Technology Acquisition:

Technology acquisition by a firm can be facilitated through imports [technology transfer from abroad] and in-house R&D efforts. Technology acquisition from abroad consists of technology imports through the market or "arms-length" purchase of technology against **lumpsum and royalty** payments [**LR**], intra-firm transfer of technology through foreign direct investment (**foreign equity** participation [**FE**]) and technology transfer through the supply of machinery and equipment, where the technology is embodied in the **imported capital good** itself [**IMCAP**]. **An in-house research and development effort of firms [RD] is** one of the important methods of location, adaptation, assimilation and development of the imported technology. Following Ansal [1990], Basant [1997] and Narayanan [1998], it could be argued that the technological strategies adopted by a firm could be different during varying policy regimes. The present study examines the role of all the four technological factors identified above during the two policy periods.

3.1.1 Intra-firm Technology Transfer:

Restrictions on foreign equity investment and selective permission allocate a limited role for intra-firm transfer of technology. Moreover, since most of the firms during the first period were established with minority foreign equity holding, diffusion of technological knowledge in India could also have been slower. With liberalisation multinational firms could have majority equity holdings and therefore influence management of the firm as well. This ability to influence the management may have led to transfer of design and drawings which accelerated the diffusion of technological knowledge and also enabled such concerns to develop export markets in association with the Indian firms. The study, therefore, hypothesises a more important role for FE in the second over the first period and emerges as an important

discriminant.

3.1.2 Disembodied Technology Imports:

Restrictions on technology collaborations involving heavy lumpsum and royalty payments resulted in selective use of imports of disembodied technology during the first period. Liberalisation of restrictions on lumpsum and royalty payments could have led to an increase in the use of this mode of technology imports. The increasing presence of multinationals and transfer of better quality technology could have also led to an increase in technology [lumpsum and royalty] payments. Perez and Soete [1988] point out that emergence of a new techno economic paradigm opens up windows of opportunity to latecomers to catch up with the leaders. The possible spillover effects of multinational investments can manifest themselves in the form of greater purchase of technology by other firms in the industry. The study, therefore, hypothesises a significantly large role for disembodied technology imports during the second over the first period.

3.1.3 Imports of Embodied Technology:

Imports of capital goods [embodied technology] usually form a part of the package of technology transfer through the market [Siddharthan and Safarian, 1997]. Strict exchange rate controls and the consequent over valuation of the rupee could have made it an attractive mode of technology acquisition during the first period. This may have encouraged imports even in the face of obstructions involved in obtaining permission to import. The use of imported of capital goods, during the post liberalisation period, however, could have declined. This is because one of the key 1991 policy changes included the devaluation of rupee and a move towards market determined exchange rate, which in turn increased the cost of imports. The study hypothesises a significant decline in the imports of capital goods intensity over the two

periods mainly due to higher cost of imports.

3.1.4 In-house R & D Efforts:

The absence of competitive pressure and the perpetuation of sellers markets may lead to low R & D activity in firms belonging to a developing country. Limited use of in-house efforts, either for adaptation of imported technology or in locating technology imports could also explain low R & D activity. With a more open policy environment, increasing competition and higher costs of technology imports, firms may realise that to catch up with technological frontier, they need to direct their efforts to build capabilities for technology generation, rather than depend on imports. As a result expenditure on in-house R & D would increase in a liberalised environment. Reddy [1997], on the basis of a survey of 32 R & D units of transnational corporations in India, found evidence suggesting an increasing trend of investments on R & D seeking to develop new products and processes. This, he argued, was facilitated by the availability of trained personnel. Since auto industry has been one of the major beneficiaries of multinational participation during the liberalisation period, it may be appropriate to hypothesise an increasingly important role for R & D intensity.

3.1.5 Technology Interaction:

As stated earlier, firms operating in a restrictive regime directed their in-house R & D efforts either to complement imported technology to facilitate technological trajectory shifts or to locate their technology imports. Some firms in the process of diffusion of imported technology, as a result, could have used the interaction between technological imports and in-house efforts. With the entry of leading multinationals and transfer of design and drawings, the technological search activity during the post liberalisation period may have resulted in bringing about cost reduction and technological upgradation of vehicles to face global challenges. This

could have been undertaken by developing technological trajectory advantages. The study, therefore, analyses the difference in the role played by technology interaction [between imported technology and in-house R & D] variables over the two policy regimes. The means of all the three interaction variables [**FE*RD, LR*RD and IMCAP*RD**] are expected to be higher in the second period over the earlier one and emerge as important discriminants.

3.2. Imports of Components:

Firms use imported components and parts either as a part of a 'package' in the transfer of technology or due to certain costs and quality advantages. In an era of domestic liberalisation, restricted trade and strict exchange rate control, imports of components were used by some firms as a source of technological upgradation of their product. Higher imports could also be because firms would choose the quicker option of importing the parts and components rather than encouraging parallel technology transfer to component manufacturers as well. With an across the board change in trade policy, devaluation of the currency, move towards tariff controls and more realistic exchange rate, however, dependency on imports of components may actually decline. This is because of the choice between importing at a higher price and domestic procurement. To stay put in competition, firms may use the latter option. The study, therefore, expects a reduction in the dependency on imports **of components** [**IMCOM**] between the two policy regimes.

3.3 Product Differentiation:

Advertisement is an important aspect of non-price rivalry among firms. The absence of effective competition during the first period could have been a source of low advertisement intensity. The presence of a number of multinationals after the 1991 policy reforms, and the resultant scope for non-price competition may have led to an increase in advertisement

expenditures. Dunning [1981] has found an increasing dependency on advertisement for a given rise in multinational participation. Since the Automobile industry witnessed entry of a number of multinationals during the post 1991 period, it is only appropriate to hypothesise a positive and increased use of **advertisement** [**AD**] as a varying strategy over the policy changes.

3.4 Vertical Integration:

Following Williamson [1985] it could be argued that **vertical integration** [**VI**] takes place in order to economise on transaction costs. The restricted policy environment during the second half of the 1980s would have encouraged firms to depend on the easier options of either importing or procuring required components and parts from the market. Liberalisation of economic and trade policies [especially with a more realistic exchange rate] can lead to higher costs of imported components and parts. In addition the emergence of non-price competition may cause firms to produce most of the components and parts themselves to ensure quality and timely delivery. The study, therefore, postulates an increased vertical integration as a strategy by firms operating under a liberalised regime in contrast to their behaviour under the earlier policy regime.

3.5 Capital Intensity:

The study also explores the role played by **capital intensity** [**CI**] across the two policy regimes. The government policy of permitting technical and financial participation by well-known foreign auto producers since 1985 triggered the anvil of many new enterprises in collaboration with foreign firms. The relaxation of control such as broad banding and permitting automatic expansion of capacity were helpful in creating capacity far in excess of immediate needs. This has particularly been the case with LCVs. The reaction of established firms to this policy change was to widen their capital base so as to expand capacity and facilitate

diversification. Rao [1993] has reported that firms adopted different strategies with respect to foreign collaboration, R & D and capital intensity of production depending upon the product configuration, size and degree of vertical integration. However, the major thrust of liberalisation policy has been to improve enterprise efficiency levels to reduce investment costs. Policy measures clearly identified the need to reduce capital-output ratios in the manufacturing sector. Firms went in for expansion of capacities basically to reach minimum economic scales of operation. The objective of this move was to ensure economies of scale and creation of additional capacity with relatively low capital outlay. But the Cars segment experienced maximum entry during this period. As a result it is very difficult to predict both the changes in the mean value of capital intensity and its importance as a discriminatory factor in the behaviour of firms.

3.5 Performance:

The performance of automobile firms operating under partially de-controlled and liberalised regimes has been compared in terms of **price-cost margins** [**PCM**], **growth** [**GROWTH**] and **exports** [**EX**]. Most of the studies linking liberalisation to performance have analysed the impact of trade liberalisation on productivity and efficiency of firms. Evidence on the relationship between trade liberalisation and firm-level productivity improvements vary across countries and industries [Tybout, 1992].

3.5.1 Price-Cost Margins:

Competition seeking to maximise profits could be a preferred objective of all firms in the short-run. During the initial period under study, which was characterised by extensive regulations and unfulfilled demand, the price-cost margins of firms would have been quite high. However, introduction of products involving technological upgradation by new firms, could

lead to lower profits for older firms. In other words, the new firms, which had been set up with foreign equity participation and technology, might have performed better. As a result, during the first period, the average profits earned by all firms in this industry could be low. With liberalisation and change in the macro environment, profit margins can be expected to have gone up. This is because most of the firms in all the segments of this industry would have already been established and new firms would not yet have garnered a large market share. The study thus hypothesises an increase in the importance of having a high price cost margins across the two policy regimes.

3.5.2 Growth:

Following Marris [1964], it could be argued that a shift to a higher growth and profit frontier usually takes place with a change in the economic environment in which the firms operate. During the post 1985 period, firms in this industry concentrated primarily on creating capacity and obtaining a large market share. With the intense competition that has come to characterise the industry since the 1991 policy changes, firms would have attempted to shift to a higher growth-profit frontier. The study explores whether there has been a substantially differential rate of growth across the two policy regimes.

3.5.3 Exports:

Growth through geographical diversification would have been a preferred strategy by firms, either due to insufficient domestic demand or to fulfil the export obligations that the Government has imposed from time to time. During the first period, increased production was basically aimed at catering to the requirements of unfulfilled demand. As a result, barring a few firms, which had been exporting their vehicles for a long time, achieving a high domestic market share was the preferred objective of most of the firms. However, with a more open

economic environment and introduction of new technological sophisticated vehicles by both the Indian as well as the multinational firms, there may have been some orientation towards external markets. Further, a fall in the value of Indian rupee would have made Indian vehicles cheaper internationally and could possibly have stimulated exports. The study, therefore, postulates an increased role for exports in the post liberalisation period in contrast to the second half of eighties.

4. Sample, Data and the Method of Analysis:

The study uses data from the annual reports and balance-sheets of individual companies. The data set contains firm level data for 11 automobile manufacturing companies for the period 1985-86 to 1995-96. The data relate to firms assembling or producing cars and other four-wheeled drives, light commercial vehicles, and medium and heavy commercial vehicles. Though the nature of the markets differ for these products[6], policy changes introduced in 1991 brought about drastic changes in the relative position of firms in all these segments. The study attempts to identify the important factors in the behaviour of firms across the two policy regimes with the help of Discriminant Analysis. Discriminant analysis is a statistical technique used to study the differences between two or more groups of observations with respect to several variables simultaneously [Klecka 1980].

In this study, the significance of the difference in the behaviour of firms between the two policy regimes is first evaluated by the Univariate Statistical criterion. The Univariate test is non-parametric. It is basically used to test for the equality of group's means for every variable considered in the study. The testing criterion are Wilks' Lambda [W] and F value [F]. In the

[6] For example, while the cars and other four wheeled drives are mainly meant for personal use, the light, medium and heavy commercial vehicles are used for commercial purposes.

Univariate analysis Wilks' Lambda is given by

W = Within-group sum of squares/total sum of squares.

W = 1 if the observed group means are equal and tend to be close to zero when within group variability is smaller than the total variability. Variables are chosen on the basis of the W scores and their significance determined by the F values.

Once the variables are selected by the univariate analysis, all the variables are introduced in a multivariate statistical procedure to identify the discriminants. The choice of a variable to be included in the step-wise procedure is governed by the Univariate Wilks' Lambda score. Variable with the lowest W is introduced in the first step and is paired with others step-by-step. The best separation between the two groups is given by

$$PD = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ... + \alpha_n X_n.$$

Where the Xs are the values of the independent variables and αs are co-efficients estimated from the data.[7] PD is the discriminant score for firms operating under period 1 and 2. The results of the discriminant analysis are discussed in the next section.

5. Empirical Results:

The results of the statistical exercise are given in Tables 4 to 9. Table 4 provides the group means of all the conduct and performance variables used in this study across the two policy regimes as well as the mean value of total observations. From this table it emerges that there is a substantial difference between the strategies adopted by the firms operating in the first and second policy periods. These differences are prominent in growth, exports, price-cost margins, advertisement, R & D, imports of capital goods, foreign equity participation and one of the interaction factors [FE*RD]. As hypothesised, while in the case of EX, PCM, AD, RD, FE

[7] Refer SPSS Inc (1990) for a detailed procedure of the

and FE*RD the mean values have increased across these policy regimes, both GROWTH and IMCAP reveal a declining trend. The decline in the average growth rates of firms across the two policy regimes is contrary to expectation. This could be because most of the firms had very high growth rates during the first period and therefore are unable to increase it any further. It also may be the case that a shift to higher growth-profit frontier has only enabled them to earn more profits rather than to achieve high growth rates.

Table 4 also clearly shows that on an average foreign equity participation has increased during the 1990s over the later half of the 1980s and that firms were spending more on in-house R & D and advertisement. Firms, which acquired technology on an intra-firm basis and those who have procured technology at "arms-length" from the market, are complementing their technology imports with higher in-house R & D efforts during the liberalisation regime compared to the earlier one. However, firms that have gone in for imports of capital goods (embodied technology) appear to be an exception to this. Moreover, vertical integration as a strategy to build competitiveness has also assumed greater importance during the liberalisation phase over the earlier period. With regard to the performance indicators, on the average, firms are exporting three times more than what they were doing earlier, and earning a much higher price-cost margin as well.

TABLE 4: GROUP MEANS OF VARIABLES CONSIDERED IN THE STUDY

PD	GROWTH	CI	PCM	AD	RD	IMCOM	IMCAP
1	.28201	.48030	.06573	.01157	.00390	.09682	.03865
2	.15145	.40163	.09087	.02197	.00845	.07710	.01290

analysis.

Total	.22267	.44454	.07716	.01629	.00597	.08785	.02695

PD	FE	EX	LR	VI	FE*RD	LR*RD	IMCAP*RD
1	18.8378	.01787	.01008	.14775	.05957	.00003	.00018
2	27.3040	.05961	.01005	.16561	.17836	.00007	.00011
Total	22.6860	.03684	.01007	.15587	.11356	.00005	.00015

Note: 1 refers to the observations for the period of partial de-regulations [1985-86 to 1990-91] and 2 refer to the liberalisation period [1991-92 to 1995-96].

Table 5 presents the results of univariate test. From the F and t values given in the table, EX, FE*RD, RD, LR*RD, AD, FE, PCM, CI, GROWTH and VI emerged significant in differentiating the behaviour of firms across policy regimes. The other four variables did not emerge significant. The Univariate test clearly highlight the importance of technology acquisition [FE, RD, FE*RD, LR*RD], vertical integration, product differentiation and capital intensity variables along with all the performance indicators as major factors in distinguishing the behaviour of firms across the two policy regimes.

TABLE 5: RESULTS OF UNIVARIATE ANALYSIS

Variable	Wilks' Lambda	F	Significance
GROWTH	0.98610	1.523	0.2199
CI	0.95411	5.195	0.0246
PCM	0.94882	5.826	0.0175
AD	0.91877	**9.549**	0.0025
RD	0.86878	**16.31**	0.0001
IMCOM	0.99450	0.597	0.4413
IMCAP	0.99212	0.858	0.3564
FE	0.94390	6.419	0.0127
EX	0.76898	**32.45**	0.0000
LR	1.00000	0.19E-03	0.9889
VI	0.98898	1.203	0.2751
FE*RD	0.84641	**19.60**	0.0000
LR*RD	0.88762	**13.67**	0.0003
IMCAP*RD	0.99822	0.193	0.6616

Note: Figures in blocks and underlines represent significance at 1% and 5% respectively.

Tables 6 and 8 present the results of multivariate analysis. In table 6 all the variables are considered. In Table 8 capital intensity [CI] is excluded. CI was dropped due to problems of its' possible linear relationship with other variables. The rank of order of the discriminating power of selected variables is given by F to remove statistic.

TABLE 6: RESULTS OF MULTIVARIATE DISCRIMINANT ANALYSIS

Variable	F to remove	Wilks' Lambda
RD	23.947	0.67729
EX	22.834	0.67140
CI	15.266	0.63134
GROWTH	9.681	0.60178
AD	1.123	0.55648

TABLE 7: Classification of Results

		No. of Predicted Group Membership	
Actual Group	Cases	1	2
Group 1	60	52	8
		86.7%	13.3%
Group 2	50	13	37
		26.0%	74.0%

Percent of "grouped" cases correctly classified: 80.91%

Note: 1 refers to the observations for period 1 [partial de-regulation: 1985-86 to 1990-91] and 2 refer to the period 2 [liberalisation: 1991-92 to 1995-96].

TABLE 8: RESULTS OF MULTIVARIATE DISCRIMINANT ANALYSIS

Variable	F to remove	Wilks' Lambda
EX	23.488	0.72768
GROWTH	5.4916	0.62332
RD	3.2063	0.61007
PCM	1.6943	0.60130
LR*RD	1.1042	0.59788

FE	1.0632	0.59764
LR	1.0852	0.59777

TABLE 9: Classification of Results

Actual Group	No. of Cases	Predicted Group Membership 1	2
Group 1	60	55	5
		91.7%	8.3%
Group 2	50	15	35
		30.0%	70.0%

Percent of "grouped" cases correctly classified: 81.82%

Note: 1 refers to the observations for period 1 [partial de-regulation: 1985-86 to 1990-91] and 2 refer to the period 2 [liberalisation: 1991-92 to 1995-96].

From the tables [6 & 8] EX, RD, CI, GROWTH, PCM, LR*RD, AD, LR and FE emerged as the most important discriminants in that order. The results clearly point out the role of exports during the post liberalisation over the first period in distinguishing the behaviour of firms. Firms also seem to have given preference to earn larger price-cost margins, though possibly at the cost of a lower growth rate. This reiterates the contention that operating under a different policy regime and accomplishing paradigm shifts are both essential to make the firms more competitive [in terms of exports and profits], but need not automatically put them on a higher growth path. In order to stay in competition, firms use both intra-firm and licensing mode of technology acquisition along with in-house R & D efforts. Moreover, with the emergence of the interaction factor [LR*RD] as an important discriminant, it could be argued that the technology acquired through the market needs to be complemented with in-house R & D efforts to build capabilities. The presence of multinationals with majority holdings and control over the management also appeared to have triggered the need for product

differentiation. With liberalisation and market-determined exchange rate, firms seem to have identified the need for in-house technological efforts.

Disembodied technology imports, LR, also emerged as a significant discriminant. This needs some explanation because LR was not chosen by the univariate analysis. Disembodied technology imports against lumpsum and royalty payments, which hardly show any difference between the two periods, are not sufficient for firms to facilitate technological paradigm or trajectory shifts. However, with increasing competition in the post liberalisation period, LR was one of the important modes of technology acquisition for Indian Automobile firms. LR in turn stimulated their in-house technological efforts and helped in promoting exports. As a result, LR mode of technology acquisition emerged significant in discriminating the behaviour of firms across the two policy regimes.

Further, the results also show that efforts to improve the utilisation of capital stock to reduce investment costs seems to have been a strategy adopted by firms in this industry in a more open environment. As pointed out before, one of the important thrusts of the liberalisation policy measures has been to encourage efficient utilisation of capital stock. Firms in this industry appear to have taken a lead in this direction and this explains the role of CI as an important discriminant.

The emergence of GROWTH as a discriminant clearly brings out the difficulties encountered by firms in maintaining a high growth rate. This could also be because, in this study, GROWTH is measured in terms of annual sales turnover. During the second period investment in Indian Automobile industry increased many fold, and it is possible that sales will go up with a lag.

These results support the view that liberalisation policy introduced in India since July

1991 had far reaching implications for the strategy of firms in terms of technology acquisition and performance. The accuracy of prediction [given in tables 7 and 9] of both the results [80.91% and 81.82%] is also very high. Further nearly 70 to 75% of the cases are classified correctly for liberalisation phase while 87 to 92% seems to be the order for the previous period.

Analyses of the "wrongly" classified observations in both the groups provide the following results. During the first period, while most of the firms were correctly classified for all the years, Telco and Eicher were the only two firms misclassified during 1989-90 and 1990-91. Both Telco and Eicher Motor had much higher R & D and exported more than the rest [industry average]. These two firms were behaving in a manner similar to those operating under a more liberal policy environment.

During the liberalisation period, Hindustan Motor was the only firm that was mis-classified in all the years. This is because Hindustan Motor hardly made any effort to bring about technological paradigm shifts and had very low R & D intensity as well. The behaviour of this firm did not differ substantially over the two policy periods. Other firms like Mahindra, Premier Automobiles and Swaraj Mazda were also classified wrongly during the early years of liberalisation. However, they adjusted their behaviour during the latter years to be identified correctly along with other firms in the liberalised regime.

While the percentage of cases correctly classified is an important indicator of the effectiveness of the discriminant function, according to SPSS Inc [1990], a "good" discriminant function is also the one which has higher between group variability when compared to within-group variability. The goodness of discriminant function is given by eigenvalue, where an eigenvalue = between-group sum of squares/within-group sum of squares. The higher the eigenvalue is, the better is the function. In this analysis eigenvalue was estimated to be 0.816.

Thus the results presented in Tables 4 to 9 gives a good indication of the differences in the behavioural aspects of Automobile manufacturing firms operating under various policy environments in India.

6. Conclusions:

This paper has attempted to compare the differences in the conduct and performance of Indian automobile firms operating under two different policy regimes. The analysis covers firms manufacturing/assembling cars, other four-wheeled utility vehicles, light, medium and heavy commercial vehicles. A step-wise discriminant analysis was used to identify the discriminants in the behaviour of firms across the two policy regimes.

The results of the statistical exercise confirmed the major hypothesis of the paper that firms operating under different policy environments behave differently. Much of this difference in the behaviour of firms is with respect to variables representing technology acquisition and performance. Firms in this industry, during the recent times, have shown a preference to acquire technological capabilities using three out of the four modes considered by the study. Specifically, firms have facilitated intra-firm transfers through foreign equity participation, arms-length purchases of design and drawings through lumpsum and royalty payments and through in-house R & D efforts. Imports of capital goods, which were the preferred mode of effecting technology transfer during the first period, actually declined during the second period. Among the three technology interaction variables, firms chose the interaction between disembodied technology purchases and in-house R & D efforts to facilitate technological trajectory advantages in the post liberalisation period as against the first period.

The differential behaviour of firms with respect to the performance indicators was found to be in terms of their ability to achieve higher exports during the second in contrast to the first

period. This difference in the ability of firms to be more export oriented was due not only to the trade liberalisation measures and exchange rate de-control introduced by the Government of India during the 1990s, but also to the technological paradigm shifts that they could accomplish through intra-firm transfers. Needless to mention that these transfers have mostly been from the parent multinationals to their local affiliates.

Firms in this industry also differed in terms of the choice of "to buy" or "to make" decisions. While firms in the regulated regime preferred to buy most of the parts and components from the market, during the post liberalisation period, firms opted to produce most of them in-house. A move towards achieving economies of scale and efficient utilisation of the additional capacity during the second period also made the firms differ across the two policy regimes. The insistence of firms on non-price competition through higher advertisement outlays in a more liberal economy also makes yet another difference between the liberalisation and controlled regimes.

Earlier studies have pointed out that the technological strategies adopted by a firm could be influenced by the policy regime in which it is operating. However, the impact of these differences in technological strategies on the behaviour of firms operating under liberal and restrictive policy regimes has not been examined. While studies have found that industrial structure, conduct and productivity performance are all affected by the liberalisation policy measures, it has been rarely attempted to empirically test whether firms belonging to a particular industry behave differently under alternate policy regimes. The present study is an attempt to bridge this gap in the literature.

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