CHAPTER: VII
IMPACT OF FDI ON PRODUCTIVITY AND R&D OF FIRMS IN INDIA

7.1 INTRODUCTION :

After having dealt with the effects of FDI on economic growth and on balance of payment in India, in the present chapter we will examine how R&D (Research and Development) and productivity of firms in automotive sector and overall economy are influenced by the presence of foreign direct investors in India. It needs to be mentioned here that the main objective of the augmentation of reforms in Indian industry, trade, technology policies in the year 1991 was to foster competition in Indian manufacturing sector so as to make this sector more efficient and globally competitive.

The state of technology in the host country plays a key role in the enhancement of growth rates of the economy as has been highlighted by literature on economic growth in recent times. In fact the state of technology and its proper diffusion plays a pivotal role in the process of economic development of different countries. Achieving and upholding competitive advantage in a globally integrated competitive world means that business enterprises need to focus on dynamic upgradation of existing technology and indulge in continuous innovation in order to enhance their productivity. For the domestic companies it is essential to remain technologically adept to survive competition. For developing nations one way to bridge the technology gap with OECD[1] and other developed nations is promoting indigenous R&D. Innovation or R&D is primarily a learning process. This takes place in diverse ways i.e. via reverse engineering of the imported products, learning by doing, using, observing

[1] Organisation of economic co-operation and development

and sharing with others[2]. Adoption of foreign technology and acquisition of human capital through various means are certainly important conduits for the international diffusion of technology. Thus improving the state of technology through technology diffusion has drawn the attention of the policy makers in developing economies. It is in this context that many countries strive to attract foreign direct investment (FDI) through MNCs in the hope that multinationals will act as the conduit of technology /knowledge spill over. FDI is often considered as vital to improve productivity of domestic firms via technology transfers and spill over effects. Out of all the channels available foreign direct investment by multinational corporations (MNCs) is considered to be a very important conduit of advanced technologies. Technologically most of the MNCs are among the highly advanced firms, a substantial part of the world's research and development investment is also comes from MNCs[3]. This is probably one of the most important reasons of inviting MNCs in the country. The underlying idea is that multinationals have access to higher levels of technology which tend to make them more productive than their domestic counterparts.

It may be possible that imported technology with certain degree of indigenisation act as the substitute for local R&D which often leads to perpetual dependence of host economies on imported technology. These types of imported technology strategies are also known as import and adapt technology (IAT) strategy.[4]

The relation between FDI and local R&D and productivity spillover also depends on the method of technology imported. For instance if technology is imported through FDI then its effects are going to be totally different from that of technology imported under licensing by locally owned firm.

[2] See Taganas and Kaul, EPW 2006.
[3] FDI mainly flows through MNCs, therefore in this chapter they are used interchangeably.
[4] See Shastri 1999.

Regarding the effect of the functioning of the MNCs on the research and development of host country the policy makers on one hand recognise the positive role of MNCs in technology diffusion and on the other hand they are concerned about the negative effect of MNCs presence on the innovative capacity of the local firms as most of the time local firms merely adapt the technology they have purchased from MNCs.

Efforts have been made in this context to examine, whether the presence of MNCs and foreign direct investment has improved the research and development facilities in Indian firms more specifically in its automotive industry. Over the years several studies have been conducted in India and abroad. In the following section we will review the studies conducted in India.

In one of the first such studies Subramanian, (1972) revealed that foreign controlled firms have not shown any distinct sign of better performance with respect to asset (here technology) utilisation. In another study by Subramanian and Pillai (1972, 1991) it was found that technological capabilities of a country can be a function of indigenous research and development, technology imports and the relationship between the two. They found that technology import can either be a substitute or a complement of indigenous R&D. They found that increasing value added index is corrected with the decreasing degree of foreign association. Similarly the findings of Balasubramanyan (1996) state that though the firms operating with foreign technology have shown an increase in labour productivity, their performance in terms of overall efficiency was not very impressive.

Katrak (1985) considered the strategy of "import and adapt" technology (IAT) i.e. the strategy of importing a technology and then adapting it to suit local conditions to examine firstly, whether the IAT strategy stimulate local R&D and second, do the expenditures on adaptive R&D differ between large and small, indigenous and foreign-owned, private and public sector enterprises? He considered import of capital goods and royalty payments as variables representing technology imports. In his

study he used two data sets, one, the department of science and technology data set and two, the Reserve Bank of India data set. He found import of technology did stimulate in-house R&D but its magnitude was limited, and the effect was weaker for the more complex technologies. Second, larger enterprises undertook proportionately less R&D than the smaller ones.

Kumar (1987) studied the effect of technology imports on domestic R&D by using cross section data for 43 countries for the period 1978-81. He considered FDI as means of technology transfer in addition to the technology imports through licensing .The study reveals that most of the time FDI acts as a substitute for domestic R&D. The study reveals technology imports had a complementary effect in the case of licensing firms.

In a similar type of study Siddharthan (1988) analysed the role of technology imports through licensing and local R&D activities undertaken in lieu of hefty payments in case of Indian manufacturing firms. The study used cross sectional data of 166 firms belonging to six manufacturing industries. The study found a complementary relation between domestic R&D activities and technology imports through licensing. The study however revealed that in private sector units this relation was more profound than in public sector units.

In another study Katrak (1997) for a sample of 82 Indian enterprises in electrical and electronic industries, (of which 53 have import agreements), regressed the logarithm of R&D expenditures and the logarithm of R&D manpower on technology imports and other variables like size. For the R&D expenditures equation, the coefficient of technology imports was significant and positive but for the R&D manpower equation, it was negative and significant. He concluded that technology imports had a significant negative impact on technological intensities measured in terms of R&D manpower but when the intensities were measured in terms of R&D expenditures. He attributed the difference in the results to the inclusion of the purchase of machinery in R&D expenditures.

Siddharthan (1992) used firm-level data for a sample of 69 Indian private sector firms reporting R&D expenditure for the period 1985-87.He used foreign equity participation and lump-sum payments as a percentage of sales turnover and technology import variables to explain R&D intensity. The coefficients of both the variables were positive and significant,

Romer (1993) put forth that "idea gap" exists between rich and the poor countries and FDI by facilitating the transfer of technological and business know how, helps the poorer countries to reduce the gap.FDI may thus boost the productivity of all the firms and not just those which received the capital directly implying a complementary relationship between technology imports and in-house R&D.

Contrary to above mentioned opinion in a study Chugan (1999) came to the conclusion that foreign owned units have made more contribution in value addition in absolute terms but in relative terms non foreign owned units perform better. He further stressed that labour productivity is better in case of foreign owned firms while capital productivity is higher in case of non foreign owned firm.

On a different note Sarkar and Lai (2009) by using firm-level panel data in India from Capitaline 2005 and estimating it by the Ordinary Least Square (OLS) technique examined the relationship between foreign direct investment (FDI) in an industry and output of domestic firms in the same sector. They also investigated whether domestic firms have benefited from technology transfer by measuring the dispersion (deviation between most efficient firms and rest of the firms in an industry) of overall output in the specific sector. They suggested that foreign investment affects the firms' output positively and significantly and domestic firms are less productive in sectors with more foreign investment compared to those firms in sectors with relatively small foreign presence. The results of estimation of the model indicate that domestic firms in sectors with greater foreign presence deviate from the most efficient firm largely due to increasing competition and hence make losses in respect of their output and productivity That means there is a negative spill over from foreign investment to domestic firms.

Kathuria, V (2010) used techniques from a stochastic production frontier and panel data to test for the spillover hypothesis that 'presence of foreign-owned firms and disembodied technology import in a sector leads to higher productivity growth for domestic firms'. The study uses panel data for 368 medium and large sized Indian manufacturing firms for the period 1975–1976 to 1988–1989. The results indicate that there exist positive spillovers from the presence of foreign-owned firms but the nature and type of spillovers vary depending upon the industries to which the firms' belong. There exist significant positive spillovers for the domestic firms belonging to the 'scientific' subgroup provided the firms themselves possess significant R&D capabilities. However, for the 'non-scientific' subgroup presence of foreign firms itself forces the local firms to be more productive by inducing greater competition. However, the results change marginally when the initial level of productivity (i.e. the technology-gap) is considered.

Prasada Reddy (2011) found that until the mid-1980s, the globalization of corporate R&D had been mainly limited to location of R&D units within the industrialized countries. However of late he found that the trend towards globalization of research and development and thereby performance of innovation activities of MNCs away from the home countries has increased. This caught the attention of policymakers and corporate management. He also found that since 2000, some companies from the emerging economies have started entering the global markets with innovative products and services, developed through their own R&D. These new developments have managerial implications for companies, policy implications for the host countries (where such R&D is performed), and the home countries of the companies.

Similar type of studies related to get a sense of the impact of FDI on productivity and R&D activities of host country's firms have also been conducted in other countries. They have provided mixed results.

A number of theoretical papers that have found positive impacts are Aitkin and Harrison (1999)– they used panel data on Venezuelan plants and found positive correlation of FDI with plant productivity. Similarly Gorg and Strobl (2003) used a Cox proportional hazard model which they estimated using plant level data for Irish firms/manufacturing industries and found that multinational companies have positive impact on plant survival, through technology spillovers. Likewise Jonathan et al (2007) used plant-level panel data covering U.K. manufacturing firms and found positive correlation between a domestic plant's TFP and the foreign-affiliate share of activity in that plant's industry. Chuang and Lin (2007), by using Taiwanese firm-level data, and Xiaolan Fu (2008) using a panel dataset from China confirmed that foreign direct investment has a positive impact, on productivity. Javorcik (2010) reviewed the evidence on international technology transfer taking through the flows of foreign direct investment (FDI). He concluded that FDI is indeed an important channel of transmitting technologies and know-how across countries.

On a different note however Oluyomi and Oyebanji (2012) examined the influence of FDI on innovative activities of manufacturing firms in Kenya and Nigeria using binary logistic regression model their result indicated that an improvement in domestic firm productivity is not automatic. It depends on the learning experiences provided by supply chain and technology licensing that domestic firms take.

It is clear from the review of literature that economists have different opinions regarding the impact of FDI on productivity and R&D activities of the firms in the host country. Empirical evidence on productivity diffusion produces mixed results. Some of them have found the impact of the presence of MNCs in host countries' R&D activities as positive, whereas others have found negative effect of MNCs presence. Moreover very few studies have captured the effect of FDI on productivity and R&D in the automotive sector in India. It is pertinent to find, why firms are looking beyond their home country/countries for R&D activities in order to understand the global innovation networks. Many R&D centres of

global firms are getting set-up in India. This gives a new thrust to the issue of R&D internationalization and gave an impetus to undertake the present study.

Rest of the chapter is subdivided into four sections. In section two sources and methodology of data analysis is described. Section three describes the important concepts of productivity indicators along with coverage of the companies undertaken for study. Section four presents findings based on the productivity efficiency indicators and Cobb Douglas production function and Log linear Regression analysis. Finally conclusions are drawn.

7.2. SOURCES OF DATA AND METHODS OF ANALYSIS:

To assess the growth in efficiency of FDI firms relative to automotive firms the necessary data are taken from various surveys by RBI and CMIE's Prowess database. Prowess is a database of the financial performance of Indian companies'. Annual reports of individual companies are the principal source of this database. Automotive industry[5] and all FDI firms[6] have been considered for examining the growth in efficiency, this enabled comparative analysis. Further, to get a wider picture of the impacts of FDI an effort has been made to compare the performance some other firms where there is no FDI inflow, we have termed them as non FDI firms.

For understanding the impact of imported technology, we have considered Labour productivity (LP), Capital productivity (CP), Total factor productivity (TFP) Capital intensity (CI) and Profitability Index (PI) of all the three group of firms (mentioned earlier in this chapter) which are operating in India have been considered as indicators of efficiency. These areas are covered to understand the impact of FDI on Indian economy from a wider perspective.

[5] This group includes the major automobiles and auto components manufactures in India, which have foreign collaboration.
[6] All FDI firms imply firms in other sectors apart from automotive sector which receive foreign direct investment.

7.3 ANALYSIS:

The analysis is divided into two parts. In the first part effect of FDI on productivity based on various productivity indicators is discussed and in the second part effect of FDI on R&D activities of automotive, all FDI firms and non FDI firms are discussed.

7.3.1 INDICATORS OF PRODUCTIVITY:

Some important indicators which were considered important to study productivity /efficiency of firms are discussed below:

1. ***Capital Intensity:***

It is a ratio of fixed assets to total wage bill. As wages are considered to be proxy for labour variable, the capital intensity measures capital per employee. In a country like India where labour is not only abundant and cheap but skilled as well, firms will find it difficult to enjoy scale economies and also have problems of underutilisation of resources. A capital intensive firm will tend to work in high cost zone. Thus it is important to test the capital intensity of these firms to understand the growth of their productivity.

2. ***Total Factor Productivity:***

TFP is calculated by dividing the sales of each year by total wages and capital cost (method to derive it already discussed earlier).TFP growth is a composite measure of technical change and the changes with which the known knowledge is adapted and applied.

3. ***Labour Productivity:***

Whether the presence of FDI in a firm enhances its labour productivity or not is tested by labour productivity variable. It is measured by dividing the total value added (VO) in a given year by the number of labour (L) employed in that year, the total of wages and salaries are taken as proxy for labour variable.

4. ***Capital productivity:***

To measure capital productivity value of output per unit of net fixed assets has been considered.

5. ***Profitability Index:***

It is difficult to predict the impact of FDI on profit, however more profitable firms may be able to take more innovation and improve their productivity by increasing their scale of production. Higher profits also indicate that the firm is getting higher rewards from domestic sales. IT (imported technology) may also reflect that they are operating in a concentrated market structures and enjoying a monopoly power in the domestic market. These domestic firms are therefore less innovative and may find it difficult to sell their products abroad.

The labour productivity of automotive and other FDI companies is measured by dividing the total value added (VO) in a given year by the number of labour (L) employed in that year. As figures for labour employed are not published by the RBI surveys as well as CMIE, the total of wages and salaries are taken as proxy for labour variable. Thus LP=VO/W. For estimating capital productivity value of output per unit of net fixed assets has been considered (VO/FA). For assessing value of capital, fixed assets are considered in terms of their book value.

It is understood that the traditional method of estimating the labour and capital productivity may lead to misinformation and misjudgement on the direction of change in the overall efficiency of the firms under consideration. This problem is overcome by estimating TFP.

There are various methods and a number of methods could be used to calculate TFP, depending on the availability of data. Mostly methods developed by Solow, Kendrix and Translog are employed to calculate TFP. However in this study, because of unavailability of the required data the method developed by Balasubramanian in his study, which was incorporated by Dunning (1970) has been used.

For studying Total factor productivity (TFP) following equations have been used:

TFP = Sales / W+TA.r

where ‘r’ represents the rate at which an enterprise can borrow or the highest profit that can be earned from the total assets, r is assumed to be 8% in this study.TFP is calculated by dividing the ‘sales’ of each year by ‘total wages’ and ‘capital-cost’. The ‘capital-cost’ is derived by multiplying the total value of ‘net fixed assets’ by the ‘opportunity cost of capital’ (r).

TFP value is considered and calculated, as TFP growth is a composite measure of technical change and the changes with which the known knowledge is adapted and applied.

The capital intensity is calculated in terms of ratio of fixed assets to the total wage bill (FA/W).This shows the requirement of fixed assets per unit of wages and salaries.

The profitability is indicated in terms of ratio of profit before tax to the total assets. (PBT/NFA)

Cobb Douglas production function has been used as an alternative method of analyzing productivity changes. It enables to understand the changes in the productive shares of labour and capital over a period of time.

Log Sales = Log a + b Log W + C Log FA

Here Sales comprise of sales of different firms, W denotes wages and salaries and net fixed assets for FA.

Here it is worth mentioning that Cobb-Douglas production function assumes the elasticity of substitution as unity and is thus restrictive in nature. Nevertheless many studies in the context of Indian manufacturing sector have shown that the elasticity of substitution was close to unity, hence the use of Cobb Douglas was justified.

7.4. R & D INTENSITY OF THE AUTOMOTIVE FIRMS, NON FDI FIRMS AND ALL FDI FIRMS IN INDIA:

The R & D intensity of FDI firms, firms with no FDI inflow and the automotive firms are compared. The R&D intensity is calculated as a ratio of reported R&D expenditure to value of sales for the period 1991-2011 from the financial statistics provided by different RBI survey reports.

For testing the relationship between R&D and imported technology in automotive and other FDI firms' data published by CMIE and RBI had been considered. The expenditure on imported technology is considered through the payments of royalties, technical fees and R&D expenditure over a period from 1991-2013. One of the limitations of RBI data is that the industry level totals may include enterprises that do not undertake R&D. Problem may also arise because of transfer pricing due to which amounts charged for importing technology through foreign direct investment may differ from the price paid for comparable technology imported through licensing arrangements. Nevertheless as these payments are monitored and regulated by the government of India this problem may not be a serious one.

7.5. COVERAGE OF THE FIRMS:

For the present study around 65 major automotive companies and overall FDI companies (as mentioned in Table 2.A) in other sectors for two different periods v*is* a *vis* 1991-00 and 2001-13 are taken into consideration. By comparing all FDI firms, with automotive and non FDI firms on the basis of various productivity indicators for the above mentioned period, efficiency of all these different categories of industries was analysed.

TABLE: 7.1.A. COVERAGE OF FDI FIRMS

Period Covered	Number of FDI firms covered
1991-94	275
1994-95	241
1995-96	268
1997-99	321
1999-00	334
2000-01	465
2001-03	490
2003-04	508
2004-06	501
2006-08	502
2008-11	745

Source : RBI monthly bulletin (various issues)

TABLE: 7.1.B COVERAGE OF NON FDI FIRMS

Years	No. of firms
1990-92	1802
1993-95	1720
1996-97	1930
1998-00	1927
2001-03	2031
2004-05	2214
2006-08	3114
2009-10	3192

7.6. TIME PERIOD OF PRESENT STUDY :

For the present study a period between 1991 to 2012 has been considered. This long time period provides a good opportunity to study the effects of FDI inflows on R&D activities and productivity of automotive firms, FDI firms and non FDI firms in India. This also enables us to understand the impact of various other supporting factors including policy changes implemented over the period of time on FDI inflows in India. Further, the two sub periods i.e. 1991-2000 and 2001-2012 have been considered to understand and compare the impact of FDI on India's R&D and productivity from a wider perspective in these two periods. This also helps to take into consideration the various dynamic changes that took place in the Indian economy during these two sub-periods. However for non FDI firms data were not available for 2012 and 2013 .This may be considered as a limitation of the present study.

7.7. INDUSTRIAL EFFICIENCY: THE FINDINGS :

The different Productivity indicators are shown in Table 3. The growth of labour productivity of all FDI firms for the period 1991-2010 as a whole is at 1.3 percent. As compared to this the labour productivity of the automotive firms is -3.6 percent for the entire period 1991-2012 (a period of 22 years). This shows that all FDI firms have performed better than automotive firms in terms of labour productivity. Although all FDI firms in terms of labour productivity have shown better performance but the rate of improvement is not very impressive. With regards to capital productivity, as is evident from the table (Tab 3) all FDI firms have registered a negative growth of -2 percent for the entire period from 1991 to 2012. On the other hand the capital productivity of automotive firms has shown a better performance of 1.37 percent for the entire period. It is important to understand here that a positive growth of labour productivity has not compensated for the negative capital productivity growth as measured by the value of output per unit of net fixed assets. TFP growth of all FDI firms has been extraordinary with a growth rate of 252.4 percent

for the whole period from 1991 till 2012. In comparison to this automotive firms have registered a positive growth of 65.76 percent only for the same period. This may be due to the fact that the total assets and wages as a proportion of value of output are lower for all FDI firms as compared to automotive firms of India. It is thus clear that in terms of TFP all FDI firms have certainly performed better than automotive firms of India.

The capital intensity index (FA/W) registered higher values of growth rate (5.88 percent) for the entire period (1991-2012) for all FDI firms. This proved that they have used more capital for each unit of labour. The average annual growth of capital intensity in terms of fixed assets has registered a higher growth during the sub period (1991-2000) as it was during this period that the results of economic- reforms started pouring in. However when the capital intensity index is examined for automotive industry simultaneously, it reveals that extensive induction of foreign technology in automotive firms of India may have contributed positively to labour productivity but it has not done so in terms of capital intensity efficiency as it registered a negative growth. Thus we can infer that technologies which have been imported have not been absorbed properly. Taking into consideration TFP of all FDI firms the technology has been imported very carefully by taking into consideration the intricacies of technology at the right time and stage of production. Therefore the TFP index for these firms shows a higher growth.

TABLE: 7.2 PRODUCTIVITIY INDICATORS ALL FDI/AUTOMATIVE AND NON FDI FIRMS

PRODUCTIVITY INDICATORS	ALL FDI FIRMS			AUTOMOTIVE FIRMS			NON FDI FIRMS		
	Annual Average Percentage Growth		20 years Aver	Annual Average Percentage Growth		22 year Ave	Annual Average Percentage growth		20 years Ave
1. Labour productivity									
2. Capital productivity	1991-00	2001-12		1991--00	2001-12		1990-99	2000-09	
3. Total factor productivity	0.25	0.85	1.37	-8.39	1.56	-3.61	2.35	-0.29	0.99
	-2.57	0.5	-2	-4.45	10.94	1.37	0.2	-0.3	-0.03
4. Capital intensity	25.2	75.34	252.48	63.12	9.27	65.76	21	49.2	95.78
5. Profitability Index	4.11	0.72	5.88	-7.21	-4.21	-3.29	2.12	0.006	1.04
	-6.2	1.5	-1.03	0.3	17.14	7.79	-1.66	8	2.5
6. R&D Intensity	-3.95	19.58	3.65	80	3.57	40.9	-0.38	2	1.92

Source : Compiled from Appendix – 6, 7 and 8(1) & 8 (2).

Taking into consideration the profitability Index it has shown a negative growth rate of (-1.03) percent for all FDI firms for the entire period i.e.1991-2012 .This negative growth rate is probably due to the fact that this period just marked the beginning of the economic reforms and there was too much of volatility in the economy which prevailed during this period in terms of FDI policies and other general terms and conditions of the business. Automotive firms on the contrary showed a substantial improvement by registering a growth rate of 7.79 percent for the whole period of 22 years. This may probably be due to the fact that during this period the Indian economy witnessed an impressive annual growth-rate in its GDP. Another reason which could be cited for the positive growth rate and better performance of the automotive is the young working population of India. This section of the Indian population aspires to own their own vehicle whether two wheeler or four wheeler. Also growing developmental need of the economy demanded a well developed transport system for transferring goods and services to different regions of the country catering to increased demand and supply. This fact also has contributed to the excellent performance of the automotive industry in terms of capital productivity and profitability.

The labour productivity of Non FDI firms is 0.99 percent for the entire period 1991-2010 (20 years). On the other hand the capital productivity of these companies is -0.03 percent. In this context we can say that automotive firms are better performers out of the three groups of firms. TFP growth percent of non FDI firms is 95.78 percent. This may be due to the fact that the total assets and wages as a proportion of value of output are higher for non FDI firms.

The capital intensity index (FA/W) is 1.04 percent of non FDI firms. This performance when compared to all FDI is certainly better. This has proved that they have used more capital for each unit of labour and have imported technology very carefully. Taking into consideration the profitability Index of non FDI firms it shows a positive growth rate of 2.5 percent for the entire period i.e.1991-2010.Thus it is clear that with regard to various

efficiency indicators, non FDI firms have also performed better. Nevertheless we can observe that the overall performance of all FDI firms is certainly better than non FDI firms in India. This confirms the fact that the technological and innovative capabilities shared by all FDI firms certainly improved the performance of host firms which received the foreign direct investment.

7.8. PRODUCTION FUNCTION ESTIMATES:

Production function estimates are based on the following equation /model.

Sales= a +b W+C FA

TABLE: 7.3: ESTIMATES OF COBB DOUGLAS PRODUCTION FUNCTION FOR ALL THE THREE GROUPS OF FIRMS IN INDIA (1991-2012)

Firms	Independent Variable	Co-efficient of independent variable	Corrected R2
Automotive firms	Net fixed asset	0.272 (0.739)	0.9765
	Wages	12.0909 (0.000)	
All FDI firms	Net fixed asset	1.305974 (0.00)	0.9982
	Wages	5.737089 (0.004)	
Non FDI firms.	Net fixed asset	1.035 (6.53)	0.9997
	Wages	-1.0060 (3.41)	

Source: Compiled from Appendix – 8 (1) & 8 (2) and 9,10

Note: Parentheses are t- values, total observations: 20

In this section, the production function estimates are presented. The estimates of the Cobb Douglas production for the three groups of firms are shown in the above Table: 4 .The total wages and salaries (W) paid by the firms are considered as a proxy for the labour variable. Similarly the Net fixed assets are used as a proxy for capital variable. Thus the coefficient as worked out in the table measures the elasticity of value added (VO) with respect to capital outlay and expenditure on labour (wages and salaries) incurred by different firms. If we compare the labour coefficient of all the group of firms then automotive firms have surely performed better compared to all FDI firms and non FDI firms. Value added in terms labour outlay is more in automobile industry which shows that inspite of imported technology in this industry these firms are more labour intensive. FDI firms are better performers in the field of value added in terms of capital outlays. Capital outlays are more for all FDI firms as they are more capital intensive because of imported technology. Although they adapt the technology as per the local demand and conditions. In Non FDI firms the coefficient of net fixed asset is more in comparison to wages .This is an indication of the fact that in order to meet the competition from FDI firms in future these firms are spending more on capital intensive technology. The coefficient of wages is negative for non FDI firms.

It shows that labour and capital coefficients are positive and statistically significant for all FDI firms and automotive firms. However the capital coefficient is negative but labour coefficient is positive and significant. For automotive firms the labour coefficient is higher than capital coefficient. For all FDI firms the coefficient of labour is numerically higher than the coefficient for capital. This difference between labour and capital coefficient is higher for automotive firms. Thus it appears that the foreign firms are more efficient in the use of capital. The elasticity of value added with respect to labour is higher for all FDI firms while elasticity of value added with respect to capital is higher for automotive firms. For non FDI firms however the labour coefficient is negative but capital coefficient is positive and significant. For non FDI companies the capital coefficient is higher than labour coefficient.

7.9. METHODOLOGY FOR TESTING THE RELATIONSHIP BETWEEN R&D AND IMPORTED TECHNOLOGY:

The relationship between foreign technology and R&D is studied by applying the following method:

1. Let expenditure on research and development be denoted by Rd and technology imports be denoted by IT. The subscript‘t’ denotes the time period.

   Thus

   $Rd_t = f(IT)_t$ which is stated in the following form

   $\text{Log } Rd_t = a + b \text{ Log } IT_t$

   In the above equation the co efficient ‘b’ is the elasticity of IT with respect to R&D. The sign as well as the magnitude of ‘b’ can be interpreted as an indicator of direction and degree of dependence of local R&D on imported technology.

   As already mentioned the impact of technological import on R&D depends on the forms of technology imports. Therefore it is considered necessary to estimate the regression for automotive and other FDI firms separately. A positive sign value greater than unity will indicate a high degree of dependence of domestic research and development on IT. Conversely if the sign is negative and the value is less than unity, it can be stated that external dependence is low.

   To test the impact of imported technology on R&D activities of FDI, Automotive firms and non FDI firms of India R&D expenditure has been taken into consideration

7.10 RESEARCH AND DEVELOPMENT:

Local research and development activities of the firms play a crucial role in their growth, output generation and increase in its overall productivity. Generally a firm undertakes R&D to become more competitive and therefore perform better. A firm which undertakes research and development activities has a competitive edge over the other firms. In terms of quality and value added they are considered superior in comparison to others.

Imported Technology: Import of technology takes place through the import of designs, drawings, patents, and technical assistance; this involves the payment of technical fees royalties and other payment in foreign currencies.

7.11 RESULTS:

The relationship between imported technology and R&D are presented in the next table-

TABLE: 7.4: LOG LINEAR REGRESSION EXPLAINING R&D EXPENDITURE OF AUTOMOTIVE, ALL FDI AND NON FDI FIRMS IN INDIA

Firms	Independent Variable	co-efficient of independent variable	Corrected R2
Automotive firms	R and D	0.979516	0.6463
All FDI firms.	R and D	0.562778	0.8986
Non FDI firms.	R and D	6.144386	0.9997

Source: Compiled from Appendix – 8(1) & 8 (2) and 9,10.

In the above equation the sign of 'b' coefficient which measures the elasticity of R&D with respect to imported technology is positive whatever is the form of technology (FDI).The positive relationship can be interpreted to mean complementarities between local R&D and imported technology. Such a relationship is expected because in India R&D is mainly of adaptive nature rather than innovative type. The positive sign is consistent with IAT strategy. If one considers the magnitude of elasticity coefficient then the result clearly shows that the marginal propensity to invest in R&D relative to technology imports is greater for all FDI firms as compared to automotive firms (refer the appendices 1 and 2). Although the rising trend of marginal propensity to invest in R&D by automotive firms is an indicator of the determination to achieve self reliance in the area. Non FDI companies have also gained by the presence of FDI firms giving them tough competition to keep the quality of the product up to date. This also points towards the endeavour to overcome the problem of lack of access to research laboratories by the all categories of firms. Also the firms are under pressure to absorb the technology before the expiry.

7.12 CONCLUSION :

In this chapter, the effects of foreign direct investment on productivity and R&D activities of local firms were examined. Further to get a wider picture a comparative study of the productive efficiencies of foreign collaborated automotive firms in all FDI firms and Non FDI firms in India has been done. This helped to understand the role played by FDI in enhancing the productivity of the firms which received it directly and also whether they had any positive impact on non FDI firms in India. A review of existing literature didn't provide a clear picture of the relationship between FDI and productivity and R&D activities of the local firms in India. Some studies revealed that there exists a complementary relationship between FDI and R&D, whereas others found a negative effect of the MNCs presence. Moreover very few studies have captured the effect of FDI on productivity and R&D in the automotive sector in India. Further the Cobb Douglas production function with respect to value-added has also been estimated for all the group of firms. The following are the main observation:

All FDI firms have performed better than automotive and non FDI firms in terms of labour productivity where as automotive firms have performed better in terms of capital productivity.

Again all FDI firms have excelled in terms of TFP compared to non FDI firms and automotive firms.

All FDI firms are more capital intensive than automotive and non FDI firms which is actually expected considering their category. This is because the use of capital intensive techniques needs more units of capital for a given unit of labour. This has contributed positively to labour productivity.

In terms of Profitability index growth, the performance of all FDI firms is found to be negative. Automotive firms have excelled in profitability compared to the other two groups of firms. Non FDI firms are better than all FDI firms in terms of profitability. This may be probably due to the fact that automotive and non FDI firms have performed better in terms of overall efficiency as indicated by TFP growth rates. They also have registered a better return on capital.

Looking at Cobb Douglas production function results, a comparison of coefficients indicate that the elasticity of value added with respect to capital is higher for automotive firm whereas the elasticity of value added with respect to labour is higher for all FDI firms.

The productivity analysis indicates that on the whole automotive firms are better than all FDI firms in the use of resources. One can conclude that imported technology has contributed positively in enhancing industrial efficiency in automotive sector compared to all FDI firms. Non FDI firms have also benefitted due to the competition provided by the presence of foreign firms in the economy, as profitability indicator of non FDI companies are better than all FDI firms in other sectors.

The result of regression analysis indicates that there exists a positive correlation between, imported technology and local R&D activities of firms. It has been found that the relationship between these two variables is mainly complementary.

When we consider the R&D intensity, which is measured as a ratio of R&D expenditure to the total value of sales, the result shows that automotive firms are more R&D intensive. The marginal propensity to invest in R&D relative to technology imports is more in automotive firms as compared to all FDI firms. It shows that firms in automotive sector which have imported technology through FDI have performed better in comparison to all FDI firms and non FDI firms. Nevertheless, propensity to invest in R&D activities and develop in house capabilities of non FDI firms is quite impressive. At present the advantages possessed by India in the automobile sector include advanced technology, cost-effectiveness, and efficient manpower. Besides, India has a well-developed and competent auto ancillary industry along with automobile testing and R&D centres**.** These attributes speak high for automotive sector of India hence the presence of FDI is felt with greater intensity. One of the positive attributes of automotive industry in India is that it grew at a rate of 18 percent per year until recently. We conclude by taking a note that economic reforms 1991 and continuous amendments of FDI related policies by the government of India have brought positive results for the automotive industry. However overall efficiency of the economy still has a long way to go.