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OUTWARD FDI AND KNOWLEDGE FLOWS
A Study of the Indian Automotive Sector

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Jaya Prakash Pradhan
Neelam Singh

Institute for Studies in Industrial Development
4, Institutional Area, Vasant Kunj, New Delhi - 110 070
Phone: +91 11 2689 1111*; Fax:* +91 11 2612 2448
E-mail: <info@isid.org.in> *Website:* <http://isid.org.in>

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Jaya Prakash Pradhan[*] and Neelam Singh[**]

[**Abstract:** *In recent years developing countries have emerged as significant participants in the OFDI (outward foreign direct investment) activities having the strategic asset seeking motive. Such OFDI which is assets exploiting cum augmenting involves potential two way cross border knowledge flows. This study examines these issues for the Indian automotive industry that is currently transnationalizing at a rapid rate in terms of both exports and OFDI. The study traces the technological capability building and several dimensions of OFDI in this industry. The case studies of two major automotive Groups highlight their competence building, and knowledge seeking operations. This study undertakes a quantitative analysis of the influence of OFDI activities on the in-house (domestic) R&D performance of Indian automotive firms during 1988–2008. As expected, the favourable impacts on R&D intensity appear to be stronger for developed vs. developing host nations, and for joint venture vs. wholly-owned ownership OFDI. The study concludes with suggestions to promote particularly the strategic asset enhancing OFDI.*]

Key Words: *OFDI; Strategic Assets-seeking FDI; R&D; Automotive Industry*
JEL Classification: *F21; F23; O32; L62*

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[*] Assistant Professor at the Institute for Studies in Industrial Development, New Delhi-110070. *E-mail:* pradhanjayaprakash@gmail.com

[**] Reader, Economics Department, Lady Shri Ram College (University of Delhi), Delhi 110024. E-mail: neelamsi@gmail.com

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1. Introduction

It is now widely acknowledged that outward foreign direct investment (OFDI) can play an important role in cross-border knowledge flows in many industries. The home country tends to benefit from technological learning and knowledge spillovers if it invests in relatively innovation-intensive foreign countries. This fact is especially true for developing country firms undertaking OFDI in R&D-driven developed countries. Also FDI host countries receive knowledge flows as inward FDI brings with it a bundle of knowledge assets in the form of new products, technologies, skills, managerial practices, new capital equipments, etc.

Traditionally, innovation-driven developed countries were the initial source of global knowledge flows through OFDI. They were the largest source of global OFDI flows for a long time. Very recently, a new and diversified pattern of OFDI is emerging with increasing participation of developing country firms in outward investment activities. Therefore, the OFDI led unidirectional pattern of knowledge flows from developed to developing countries is no longer a valid characterization. While there is increasing emphasis on technology sourcing motives of developing country firms from India, China, Korea, Taiwan and other developing home countries entering into developed countries (Dunning, Hoesel and Narula, 1996; Chen and Chen, 1998; Hoesel, 1999; Poon and MacPherson, 2005; Pradhan and Abraham, 2005; UNCTAD, 2006; Pradhan, 2008a b; Gammeltoft, 2008), the empirical evidence on knowledge spillovers from such activities are lacking.

Given this backdrop, the aim of this paper is to investigate the evolution of OFDI flows from the Indian automotive sector as a model of cross-border knowledge flows between India and host countries. India has made considerable progress in building domestic capability in this technology-intensive industry and is now emerging as a global centre for automotive manufacturing (Singh, 2007; KPMG, 2007). Indian vehicle manufacturers and auto component companies with their cost competitive and quality engineering products and services are emerging as developing country participants in the global/regional automotive value chains. The rise of OFDI from such a technology-intensive and export oriented industry based in a developing country clearly offers an interesting case study for understanding the process of cross-border knowledge flows.

The subsequent analysis in this study is structured as follows: Section 2 begins with a summary of the process of technological capability formation and learning in Indian automotive sector. It examines the crucial links between the technological activities of domestic automotive firms and changing government policy regimes with respect to inward FDI and technology. Section 3 discusses different possible channels of cross-border knowledge flows involved in outward FDI from Indian automotive sector. It further examines the trends and patterns of Indian automotive OFDI from 1970s and tries to identify firm-level strategic motives to draw implications for OFDI led cross-border knowledge flows. Case studies of two Indian automotive groups are also presented here to enable a clear understanding of knowledge flows via OFDI based on firm-level capability building and strategic knowledge-seeking operations. Section 4 undertakes a quantitative analysis of the link between OFDI and in-house R&D performance of Indian automotive firms during 1988–2008. The basic objective is to explore whether the OFDI status and OFDI intensity serve as channels of knowledge inflows to stimulate R&D of outward investing firms. Section 5 concludes the study with a few policy remarks.

2. Technological Capability Building and Learning

India's capabilities building in automotive sector can be seen in two distinct phases of policy evolution. The period since Independence till early 1990s represents the first phase in the evolution of Indian automotive sector. Like many other developing countries, India didn't have large base in the automotive industry at the dawn of Independence. As a part of the inward looking policy, this sector was subjected to restrictive policy measures on inward foreign investment and technology imports. In the absence of local technological capabilities in the sector, flows of foreign technologies were essential for the growth of the sector, but couldn't take place because of policy obstacles. The cumbersome approval for foreign technological licensing with unfavourable policy determined terms and conditions didn't help local firms to access international technologies. The heavy duties on imported cars and parts in turn provided initial technology importers an assured domestic market not withstanding their low productivity and quality performance.

The Indian passenger car segment was dominated by two adapted versions of old European designs, namely the Ambassador—a localized version of the Morris Oxford model manufactured by Hindustan Motors, and Premier Padmini—a localized version of a Fiat initially assembled but later manufactured by Premier Automobiles for nearly three decades since 1951. These two Indian companies hardly had any incentive to upgrade their technological strength from what they got under technological licensing. Of course, they did some adaptive innovation to fit the imported models to local preference and Indian road conditions. As a result, Indian car manufacturing segment had low production base characterized by old design, obsolete technologies and low efficiency. The entry of Maruti Suzuki—a joint venture between Government of India and Japanese company Suzuki Motor Corporation in early 1980s did expand the local production base significantly, but became the dominant player in the monopolistic

Indian market. Maruti has introduced new work culture and work practices and modern manufacturing process with significant impact on automobile ancillary segments. Indian auto parts suppliers to Maruti were introduced into stringent quality standards and timely delivery schedule. However, the monopolistic power of Maruti in the protected Indian automotive market was not conducive for comprehensive technological development in the sector. The state of motorcycle segment was similar to the passenger car segment. There were a few motorcycle manufacturers like Rajdoot, Escorts, and Enfield which offered a few two-wheeler models in the market. The Indian automotive sector under the pervasive regulation and protection (Kathuria, 1996) mostly emerged as a virtual sellers market, with little incentive for R&D and technology upgradation.

Notwithstanding these negative impacts of restrictive policies, this pre-1990s phase saw Indian automobile companies being forced to go for local production rather than just assembling imported parts and this has created indigenous base in automotive sector, of course, with low technology and suboptimal scale of production. High tariff on imported auto components led to the increasing use of locally produced auto parts providing boost to domestic auto ancillary sector. The measures like automatic expansion of licensed capacities by a certain percentage and broad-banding of licences (branching off into making related products) implemented in 1980s permitted greater flexibilities to Indian automotive firms. During the 1980s the motorcycle segment witnessed much competition due to new joint ventures and technical collaborations. The car sector was allowed one new entry, namely Maruti Suzuki. The size of Indian automotive sector in terms of value of production went up from US $2.6 billion in 1980–81 to US $5.9 billion in 1989–90 with an annual compound rate of 21.7 per cent (Table-1& Table-2).

The period following the initiation of economic liberalization in 1991 represents the second phase in the growth of Indian automotive sector. The liberalization of policies like abolition of industrial licensing, automatic approval for inward foreign investment, technology imports and liberal approach to trade, put this sector on a dynamic process of technological learning at the firm level. The New Industrial Policy of July 1991 has abolished the licensing requirement for commercial vehicles, public transport vehicles, automotive two wheelers, three wheelers and automotive components and ancillaries. It has also provided for automatic approval of foreign investment up to 51 per cent in these automotive segments. The car segment was de-licensed in 1993 and allowed automatic FDI approval up to 51 per cent foreign ownership in 1997. Where proprietary knowledge transfer and export commitment were involved the Foreign Investment Promotion Board (FIPB) could permit 100 per cent foreign investment into the automotive sector. The automobile policy 2002 permitted automatic approval of foreign equity investment up to 100 per cent in manufacturing of automobiles and components.

Table-1
Size of Organized Indian Automotive Sector, 1980–81 to 2002–03

	Indian Automotive Sector		
	Motor vehicles and parts	*Motor cycles and parts*	*Total*
Number of factories			
1980–81	1297	235	1532
1989–90	1569	550	2119
1999–00	2367	637	3004
2002–03	2579	595	3174
Production (US $ million)			
1980–81	2299	290	2589
1989–90	4571	1296	5867
1999–00	9705	3007	12712
2002–03	11697	4133	15829
Net value added (US $ million)			
1980–81	523	66	589
1989–90	950	150	1100
1999–00	1650	543	2193
2002–03	1567	838	2406
Fixed capital (US $ million)			
1980–81	544	83	627
1989–90	1124	494	1618
1999–00	5508	892	6400
2002–03	3779	951	4731
Number of workers (In thousands)			
1980–81	118	20	138
1989–90	129	44	174
1997–98	180	55	235
2002–03	183	68	252

Note: (i) The concordance used for manufacture of motor vehicles and parts is 374 under NIC-1970, 373+374 under NIC-1987 and 341+343 under NIC-1998. Manufacture of motor cycles and parts is represented as 375 under NIC-1970, 375 under NIC-1987 and 3591 under NIC-1998.
Source: Based Annual Survey of Industries, Central Statistical Organization, New Delhi.

As a result of these liberal policies a number of international players like Hyundai, General Motors, Ford, Toyota, Daimler Chrysler, Mitsubishi, Daewoo, Mercedes Benz, etc., entered the Indian automotive sector for manufacturing as well as for sourcing components for their overseas operations. Besides, expanding the size of the sector, entry of these new foreign firms had significant knowledge spillover on Indian automobile and component firms.

Table-2
Compound Annual Growth Performance of Organized Indian Automotive Sector, In per cent

	Indian Automotive Sector		
	Motor vehicles and parts	*Motorcycles and parts*	*Total*
Number of factories			
1980–81 to 1989–90	3.5	22.2	7.0
1990–91 to 2002–03	11.1	8.3	10.5
Production			
1980–81 to 1989–90	16.8	51.4	21.7
1990–91 to 2002–03	26.8	31.1	27.9
Net value added			
1980–81 to 1989–90	12.0	27.5	13.8
1990–91 to 2002–03	12.1	31.0	16.8
Fixed capital			
1980–81 to 1989–90	23.5	78.5	32.8
1990–91 to 2002–03	42.3	28.3	39.4
Number of workers			
1980–81 to 1989–90	1.6	23.0	5.3
1990–91 to 2002–03	7.0	10.0	7.7

Note: The growth rate has been obtained from the semi-log regression model of the form: LogY=a+bt, where growth rate = (antilog b-1)*100. Except the number of workers, other variables are measured in terms of US $ million.

Source: Same as Table-1.

The growing competition in the 1990s forced the existing Indian automobile firms to constantly upgrade their technological strength by focused in-house R&D activities and Indian component suppliers to local and foreign OEMs (Original Equipment Manufacturers) were pushed to adopt global standards of quality and manufacturing practices. The trade-balancing and localization requirements, then on new OEM investors, also contributed to this emphasis on quality improvement by component producers (Singh, 2007; Balakrishnan et al., 2007; McKinsey & Company, 2006). By 2003 the major Tier-1 auto component suppliers from India were close to the world-class quality standards. The organized sector units started increasingly adopting the automotive industry-specific quality management system (QMS) ISO/TS 16949 Standard. According to ACMA, the Automotive Component Manufacturers Association of India, 382 of the 558 ACMA members, i.e. 2/3rd of its Members are accredited for this Standard (ACMA, 2008b). In an econometric study of auto component firms, Singh (2008) finds a significant favourable effect of the industry-specific harmonized QMS Standard on the export participation at OEM and high Tier 'Levels'. There is also ample evidence indicating a surge in the emphasis by Tier-1 suppliers on employees' skills—on pre-job qualifications, in-house training, multi-skilling, sending employees for training at OEM plants and special courses (e.g., Okada, 2004). The OEMs have actively assisted in this process by insisting on training programme, including quality management system certification.

For Indian-owned automobile companies, since the mid-1990s the R&D efforts got a major push due to the imposition of stringent Euro norms requiring a quick upgradation of engine, and the intense market competition. After 1991 with FDI liberalization many global tier-1suppliers started operations in India. In the mid-1990s many global OEMs entered India; besides, they have encouraged their existing preferred suppliers to establish facilities here. Since around 2000 in the Indian automobile sector the improvements in safety features and pollution norms, and the introduction of telematics, etc., have involved technological improvements and imports (SIAM officials, quoted in Singh, 2007). At present, almost all the prominent firms in the Indian auto component industry have links with at least one international player - operating as a subsidiary/JV or in a technical tie-up (Singh, 2007). McKinsey & Company (2006) find that in India and China the large auto component suppliers have improved their operational performance over 2002–04 in terms of the rejection rates and productivity. The quality maturity is the most critical differentiator, being strongly related to both the domestic and exports growth rates. The best performers' quality levels are comparable with their TRIAD counterparts.

The Indian vehicle producers have been able to design vehicles through international collaborations with design, development and engine firms, and are collaborating with Indian and foreign universities and R&D institutes.[1] As a rare accomplishment for an emerging economy, Tata Motors, a 'Group' company, launched India's first indigenously developed car Indica in 1999. Tatas have consistently emphasized in-house R&D while selectively importing technology. Tata Engg. Research Centre at Pune is well-equipped, e.g. having crash test facility and NVH lab (SIAM, *Viewpoint*, IV (III), 2002). M&M successfully launched its India-developed multi utility vehicle model Scorpio in 2002.

Table-3 summarizes the trends in in-house R&D done by Indian automotive firms including foreign affiliates. It can be seen that in early 1990s, majority of automotive firms in India hardly had any significant in-house spending on R&D activities. The heightened competition from inward FDI and imports and stringent requirements from global buyers by mid-1990s have forced a significant proportion of them into R&D investment. Nearly 31 per cent of organized Indian automotive firms represented in the firm-level database, namely Prowess started doing R&D in 1995 but in terms of their sales such R&D accounts for less than 2 per cent (leaving four firms). By 1999 Indian automotive firms have shown ascending trajectory of R&D with as many as 11 firms

[1] Dilip Chenoy, Guest Column in *Auto Monitor*, September 1, 2005, 5(16).

Table-3
Distribution of Sample Firms by R&D Intensity, 1991–2007

R&D Intensity (%)	*Number of Firms*							
	1991	*1995*	*1997*	*1999*	*2001*	*2003*	*2005*	*2007*
Total Automotive Sector (All firms)	118	176	183	230	274	261	253	174
0.0	114	122	119	152	198	161	158	100
0.0–2.0	4	50	58	62	65	88	80	64
2.0–5.0		3	5	11	10	9	12	9
5.0–10.0		1	1	1	1	2	2	1
10.0–above				4		1	1	
Automobile ancillaries (All firms)	99	152	161	205	248	236	228	150
0.0	97	109	112	145	187	156	152	91
0.0–2.0	2	40	43	47	51	70	66	53
2.0–5.0		2	5	10	9	7	8	5
5.0–10.0		1	1		1	2	2	1
10.0–above				3		1		
Commercial vehicles (All firms)	6	6	5	5	5	5	5	7
0.0	5	3	1	1	2			2
0.0–2.0	1	3	4	4	3	3	3	3
2.0–5.0						2	2	2
5.0–10.0								
Passenger cars & multi utility vehicles (All firms)	4	6	5	8	9	6	6	7
0.0	3	3		2	3		1	3
0.0–2.0	1	3	5	4	6	6	5	4
2.0–5.0				1				
5.0–10.0				1				
10.0–above								
Two & three wheelers (All firms)	9	12	12	12	12	14	14	10
0.0	9	7	6	4	6	5	5	4
0.0–2.0		4	6	7	5	9	6	4
2.0–5.0		1			1		2	2
10.0–above				1			1	

Source: Based on Prowess database, version 3.1.

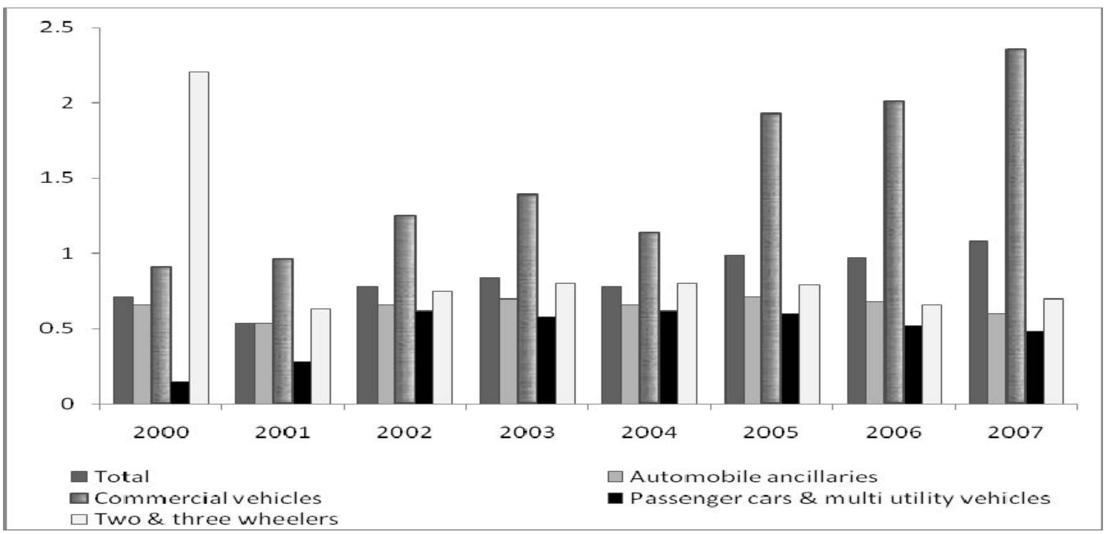
attaining R&D intensity in the range of 2–5 per cent, another firm achieving more than 8 per cent of R&D intensity and another 4 firms spending above 10 per cent of their sales on R&D[2]. The figures for early 2000s suggest that in-house R&D has become an

[2] Firms with 2–5 per cent R&D intensities are Bosch Ltd., Daewoo Motors India Ltd., I P Rings Ltd., Minda Industries Ltd., Pricol Ltd., Roto Pumps Ltd., Samkrg Pistons & Rings Ltd., Sar Auto Products Ltd., Stallion Shox Ltd., Sundaram Brake Linings Ltd., and Sundaram-Clayton Ltd. Maestro Motors Limited had 8.2 per cent R&D intensity. Amalgamations Valeo Clutch Pvt. Ltd., Sibar Auto Parts Ltd., Tata Auto Plastic Systems Ltd. and Yamaha Motor Escorts Pvt. Ltd. had above 10 per cent R&D intensities.

established channel for technological upgradation for a significant share of automotive firms in India. The proportion of automotive firms with above 2 per cent R&D intensity has gone up from 4 per cent of the total number of firms in 2001 to 6 per cent in 2007.

A comparison of the average R&D intensity across different segments of Indian automotive sector during 2000–2007 shows that commercial vehicle manufacturers have generally higher R&D intensity followed by two & three wheelers companies, automobile ancillary suppliers, and passenger cars & multi utility vehicles producers in that order (Figure-1). An analysis of R&D growth rate at individual automotive firms by these different segments during 2000–2007 further confirmed the fact that Indian automotive firms adopted a continuous R&D strategy in late 1990s or early 2000s (Appendix Table-1). A number of them transformed themselves from the status of minimal R&D into rapid path of R&D investment. As has already been pointed out, the openness of the automotive sector to global competitive forces and regulatory changes are currently driving this expanding R&D behaviour of automotive firms in India. Although there have been increasing incidents of global OEMs shifting more and more of the product development responsibilities to developing countries, in India R&D intensity of foreign affiliates has been relatively low in the vehicle sector (Narayanan and Vashisht, 2008; Singh, 2007). For the auto component firms Rasiah and Kumar (2008) in an econometric analysis find similar R&D intensity—average of R&D expenses to sales and R&D employment intensity—for foreign and local firms. In the auto component sector the R&D is still primarily oriented towards process development.

Figure-1
R&D Intensity (%) of Indian Automotive Sector by Segments, 2000–2007



Source: Based on Prowess database, version 3.1.

Unlike in-house R&D, which emerged as an important technological strategy of Indian automotive firms only since mid-1990s, inward licensing of foreign technology has been an important channel of enhancing their technological capabilities since 1940s–50s. In these initial years inter-firm technological transfer through licensing agreement took place between Hindustan Motors and Morris Motors (UK), Mahindra and Mahindra and Willys Overland (USA), Premier Automobiles and Chrysler (USA) and Fiat (Italy), Standard Motor Products of India Limited and Standard Motors (UK), Tata and Mercedes Benz, and Escorts and CEKOP (Poland). The protected domestic market and restrictive policy towards technology imports since 1960s severely cut-off Indian firms' access to new technologies through licensing agreements.

Table-4 shows that Indian automotive firms continued their reliance on purchase of disembodied technologies for improving their firm-specific capabilities even in 1990s and 2000s. In 1991 out of 118 firms in our dataset, there are as many as 56 automotive firms incurring technological spending on royalties and technical know-how fees as compared to just 4 firms incurring in-house R&D. This corroborates that until early 1990s, Indian automotive firms relied more on purchase of disembodied technologies, detailed specifications, designs, patents and trademarks than conducting their own R&D. For various years since 1995–2007, the share of automotive firms incurring disembodied technological spending in total number of automotive firms varies in the range of 41–48 per cent. There are a number of firms which are spending above 2 per cent of their sales on technology purchase. A list of 25 automotive firms with high technological spending intensity is presented in Appendix Table-2.

The recent technological and competitive capability developments of Indian automotive firms have been strongly supported by a network of institutions with state playing a lead role (see Box-1). Besides permitting 100 per cent automatic foreign ownership the Auto Policy 2002 proposed to undertake a number of measures to promote a globally competitive automotive industry that possesses global scale, adequate technology, productivity and quality requirements[3]. The state has been encouraging the use of low emission fuel auto technology and has enhanced the weighted deduction on R&D expenditure to the automotive sector from 125 per cent to 150 per cent[4]. In 2003, a Core Group on Automotive Research (CAR), involving the government, industry and academia, was formed (under TIFAC, DSIR, Delhi). In July 2005, the government approved the plan to set up National Automotive Testing and R&D Infrastructure Project

[3] http://dhi.nic.in/autopolicy.htm

[4] The Report of the Working Group on Automotive Industry, Eleventh Five Year Plan (2007–2012), Ministry of Heavy Industries & Public Enterprises, Department of Heavy Industry, August, 2006.

Table-4
Distribution of Sample Firms by Disembodied Technological Spending Intensity, 1991–2007

Disembodied technological spending intensity (%)	*Number of Firms*							
	1991	*1995*	*1997*	*1999*	*2001*	*2003*	*2005*	*2007*
Total Automotive Sector	118	176	183	230	274	261	253	174
0.0	62	104	108	128	142	136	136	99
0.0–2.0	50	64	67	80	117	107	100	66
2.0–5.0	6	7	8	18	13	16	16	8
5.0–10.0		1		1	2	1	1	
10.0–above				3		1		1
Automobile ancillaries	99	152	161	205	248	236	228	150
0.0	60	96	102	121	133	130	129	88
0.0–2.0	34	48	52	64	102	92	85	59
2.0–5.0	5	7	7	16	12	12	13	3
5.0–10.0		1		1	1	1	1	
10.0–above				3		1		
Commercial vehicles	6	6	5	5	5	5	5	7
0.0		1						3
0.0–2.0	6	5	5	5	5	5	5	3
10.0–above								1
Passenger cars & multi utility vehicles	4	6	5	8	9	6	6	7
0.0		1	1	2	4			
0.0–2.0	4	5	4	5	4	4	4	3
2.0–5.0				1		2	2	4
5.0–10.0					1			
Two & three wheelers	9	12	12	12	12	14	14	10
0.0	2	6	5	5	5	6	7	8
0.0–2.0	6	6	6	6	6	6	6	1
2.0–5.0	1		1	1	1	2	1	1

Source: Based on Prowess database, version 3.1.

(NATRIP) for establishing localized world-class automotive testing facilities in different automotive hubs in India that involves an investment of Rs 17.18 billion. This project is intended to 'deepen manufacturing, enhance employment, encourage localized R&D, boost exports, converge India's unparalleled strengths in IT and electronics with automotive engineering sectors to firmly place India on the global automotive map[5].' In

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5 This project involves: full-fledged testing and homologation centres at Oragadam SIPCOT industrial estate, Chennai, Tamil Nadu and at Manesar in Haryana; major upgradation of facilities at Automotive Research Association of India (ARAI), Pune, and Vehicle Research and Development Establishment (VRDE) at Ahmednagar; testing centre for tractors and off-road vehicles and specialized driving training centre at Rai Bareli, Uttar Pradesh; centre for specialized hill area driving training and in-use vehicle management at Silchar, Assam.
http://business.gov.in/outerwin.htm?id=http://natrip.in/home.aspx

October 2006 the NATRIP signed a Memorandum of Understanding with the Vehicle Certification Authority of U.K. for the issue of certificates in India after the testing at NATRIP Centres. The Government also has policy support for the setting up of auto cluster by contributing 75 per cent of the project cost while the remaining has to be raised by the stakeholders. A host of fiscal incentives like tax breaks, concessional duty on equipment imports, etc. are being given for the establishment of independent auto design firms.

The auto component industry association, ACMA and UNIDO have been operating cluster programmes for auto component firms in India. ACMA has been engaging in the quality and productivity upgradation of its members also through: six-sigma training; quality circles; the ACT-ATOS training programs; Young Business Leaders Forum; quality & productivity, exports, and technology awards—separately for SMEs and other members (*ACMA News*, and *ACT now*, various issues, ACMA). Both ACMA and the automobile industry association SIAM (Society of Indian Automobile Manufacturers) have been actively networking with automotive bodies and overseas associations, and at various policy fora. In recent years SIAM and ACMA have been focusing on the global competitiveness and technology-related issues. Clearly these institutional supports further encourage the competitive strength of Indian automotive firms.

Box-1
Major Recent Policy Measures/ Initiatives for the Indian Automotive Sector

Policy	*Remarks/ Details*
Quantitative import restrictions dismantled in early 2001.	
Through appropriate support measures, the March 2002 Auto Policy aims to make India a global hub for automotive components and a regional hub for small cars, and promises to encourage the R&D and vehicle designing.	o Advancing the 1990's FDI liberalization, this Policy allows 100% automatic foreign ownership.
In 2003 a Core-Group on Automotive Research (CAR), involving the government, industry and academia, was formed (under TIFAC, DSIR, Delhi).	o The 2006 technology roadmap identified the priority topics for R&D. o The consortium technology projects involve the research institutes, and tech-intensive SMEs & automotive firms.
Since July 2004, 150% deduction of R&D expenses from taxable income has been allowed.	Currently this Scheme is valid till March 2012.
o The National Automotive Testing and R&D Infrastructure Project, NATRIP was approved in July 2005 to enhance and upgrade the testing and validation infrastructure, and establish centres of excellence for automotive R&D. o It involves an investment of approx. $380 million	o Expected to harness the Indian strengths in automotive engineering, IT and electronics; thus to encourage the automotive exports, including OEM/ Tier Level exports and outsourcing of design & engineering services, and to crowd-in

contd...

Policy	Remarks/ Details
(Rs. 17.18 billion, of which the Industry would contribute Rs. 1.18 billion) over a 6-year period.	private investment in R&D/innovation. o It would spur the systems solution capabilities of Indian auto component firms and Indo-foreign JVs (Singh, 2008).
o In February 2006 India became a contracting party (voting member) of the 1998 GTR Agreement. The exposure to frontier technologies would facilitate global integration of the Indian automotive industry. o India has formed six 'WP.29 India Working Groups' for different auto component categories.	o The 1998 GTR Agreement aims at developing through wide participation the Global Technical Regulations (GTRs) for automotive products, bearing on the vehicle safety, fuel efficiency and emissions. o At present India is not a signatory to the 1958 Agreement, which imposes reciprocity for any Regulation adopted by a contracting party; India is an Observer, and is assessing the option of signing it.
NATRIP-VCA MoU: In October 2006 the NATRIP Implementation Society has signed a Memorandum of Understanding with the Vehicle Certification Authority (VCA) of U.K. for the issue of certificates in India after the testing at NATRIP Centres. (Note: Tata Motors have also entered into an agreement with the VCA for certification.)	o So far India had no homologation (vehicle road-worthiness) certification agency which is globally accepted. The automotive exporters have to send the products abroad for testing and approval—costly and irksome, especially for iterative product/ process development. o It shall reduce the cost of certification.
The 'Automotive Mission Plan (AMP) 2006-2016' launched in January 2007 recommends: o setting up of Automotive training Institute and Auto Design Centre, Special Auto Parks and auto component virtual SEZs; Technology Modernization Fund, with special emphasis on SMEs; o enhancing exports and related infrastructure and streamlining training/research institutions in and around auto hubs; and, o encouragement to establishing Development Centres for SMEs.	o The AMP 2006–2016 targets $40-45 billion automotive exports in 2016, including $20-25 billion component exports and $2–2.5 billion outsourcing of engineering services, like IT-intensive designing & styling. It also targets $145 billion total automotive turnover in 2016.

Source: ACMA sources; *ACT now*, April 2008, Volume IV, pp. 12–13; *Economic Times*, October 27, 2006; Singh (2007, 2008); www.natrip.in.

It is not surprising that with these institutional supports and strategic state interventions, the Indian automotive sector has evolved from a high growth stage of 21.7 per cent (production) in 1980s (from a low base) to a very high growth stage of 27.9 per cent in 1990–91 to 2002–2003. During the 1990s and early 2000s, Indian organized automotive sector has experienced 10.5 per cent growth rate in number of factory units (as compared to 7 per cent in 1980s), 39.4 per cent growth in fixed capital (as compared to 32.8 per cent in 1980s), and 7.7 per cent growth in employed workers (as compared to 5.3 per cent in 1980s) (Table-2). Total auto component exports from India have grown rapidly at 36.60 per cent per annum during 2002–03 to 2007–08 with exports accounting for as much as 20 per cent of sectoral turnover in 2007–08 (Appendix Table-3 & Table-4). For the vehicle sector the exports and turnover values have grown at 20.9 per cent and 12.3 per cent per annum during the corresponding period, with the export intensity reaching to 9.3 per cent in 2007–08.

3. Outward FDI and Cross-Border Knowledge Flows

Following the early works of Caves (1974), Globerman (1979) and Blomstrom and Persson (1983), the empirical studies on flows of knowledge spillovers through FDI mainly tested how the entry of foreign affiliates impacts the productivity levels of domestic sectors or enterprises. In addition to these researchers, a large number of scholars like Ari Kokko, Mona Haddad, Ann E. Harrison and Brian J. Aitken, among others, have made substantial contribution to the literature on FDI led knowledge spillovers (see Fan, 2002; Görg and Greenaway, 2004 for surveys). However, the focus of this literature is on knowledge spillovers from investing foreign firms to domestic companies and not on knowledge flows from domestic firms to investing foreign firms. Here the analysis is from the viewpoint of a host country or a host sector.

Recently, there is a growing recognition about the possibility that investing foreign firms may also be learning from domestic firms in a host country and absorbing knowledge spillovers. Here the analysis of FDI led knowledge spillovers is from the perspective of outward investing firms. Branstetter (2000) using patent citations data has found that there is a bi-way knowledge flow between Japanese firms investing in the U.S. and U.S. firms. With an increase in the number of their affiliates obtained through acquisition in the U.S., Japanese firms showed an increased tendency to cite the US patents as "prior art" in their U.S. patent application. This suggests that there is a direct measure of knowledge flows to Japanese firms investing in the U.S. Branstetter argued that acquisition has not only provided Japanese firms access to the proprietary knowledge assets of the acquired US firm, but also the latter's informal technological networks and knowledge sharing relationships in the U.S. innovation system. In the case of 13 industrial countries, Porterie and Lichtenberg (2001) have provided evidence that outward FDI acts as a channel of technology spillovers from host industrialized countries to home country. They found that the foreign R&D capital stock embodied in outward FDI flows possesses positive and highly significant output elasticity for home countries. Specifically, home countries like Germany, France, the United Kingdom, Greece and Japan investing in the U.S. have benefited more from the U.S. R&D capital stock through their outward investments than through their imports from the U.S. However, another developed country study on Sweden by Braconier, Ekholm and Knarvik (2001) reported no evidence of outward FDI-related R&D spillovers at firm and industry levels.

There is hardly any study on outward FDI and knowledge spillovers in the case of home developing countries. This is contrary to the increasing trend of developing country firms using outward FDI as a strategy of acquiring technological assets and skills. Makino, Lau and Yeh (2002) have found that Taiwanese firms with their strategic asset- and market-seeking motivations tended to invest in developed countries and invested in developing countries when they had labour-seeking motivation. Pradhan and Abraham (2005) have observed that overseas acquisitions of Indian firms are directed to developed countries in 78 per cent of the cases. This regional concentration is explained by Indian firms' desire to access large markets and to acquire firm-specific intangible assets like goodwill and brand names, technologies, marketing and distribution networks, and business expertise. The fact that Indian acquirers from manufacturing sectors are large-sized and R&D-intensive further confirmed that these firms have critical absorptive capacity to effectively integrate the acquired foreign intangible assets. Although Chinese overseas investment has been dominated by the motive to develop trading infrastructure and to secure access to natural resources and raw materials, of late, a number of Chinese firms such as Haier, TCL, and Lenovo, etc., are using OFDI to acquire foreign technology and management skills (Cai 1999; Wang and Boateng, 2007). The motive of strategic resources and technology acquisition was found to be important in 27 per cent of the cases of overseas M&As done by a sample of Chinese firms in the period 2000–2004 (Wang and Boateng, 2007).

The rising tendencies of developing country firms using OFDI to access new knowledge assets in developed countries can be analyzed from the perspective of resource-based theory of the firm. Southern firms based in less innovative developing regions possess a relatively narrow range and intensity of knowledge competencies and need to improve their competitive advantages in globalizing markets. Following the resource based view of the firm (Barney, 1991) it can be suggested that these developing region firms are more likely to engage in merger and acquisitions (M&As) as a strategy to quickly expand their knowledge base to meet growing competition (Gupta and Ross, 2001). The direction or location of such strategic asset acquisitions by developing country firms is likely to be biased towards advanced industrialized countries as they are relatively more endowed with the assets like technical knowledge, learning experiences, management expertise and organizational competence (Dunning, 1998). Theoretically, strategic acquisitions provide a quicker and an alternative way of acquiring innovative capabilities than undertaking long term in-house R&D efforts without any assured success (Deng, 2007; Pradhan, 2008b). For developing country acquirers like Indian companies, acquisitions allow them to achieve a higher bundle of resources or capabilities by integrating the target's firm-specific valuable resources like product development capabilities, process know-how, managerial expertise, marketing skills, relationships and networks. This transfer of knowledge from target to acquirer is direct and can be expected to create technological synergies that the parent company does not enjoy on its own.

In the context of outward FDI from Indian automotive sector, possible bi-way knowledge flows between Indian and host countries can also be predicted (Figure-2). Indian vehicles and automobile parts companies have been substantially improving their designing and engineering service capabilities. Indian vehicle companies like Tata Motors, Mahindra & Mahindra have shown remarkable strength in designing and building new vehicles. Indian auto ancillary manufacturers are also experiencing rapid upgradation of their manufacturing and quality capabilities. With these growing competitive capabilities Indian automotive firms are internationalizing their business activities. As per the industrial organization theory of FDI (Hymer, 1960; Kindleberger, 1969; Caves, 1971) and OLI (ownership-location-internalization) eclectic approach (Dunning, 2001), the outward investment activities of Indian automotive firms may partly be motivated to exploit their existing ownership or competitive advantages. In case of their manufacturing activities abroad, firm-specific advantages of Indian automotive firms get transferred to host countries. If their OFDI has gone for building trade-supporting activities, it would represent outflows of specialized marketing skills of Indian automotive firms. The cases of greenfield OFDI are also likely to act as a channel of appropriating possible externalities from the host developed country technology clusters and centres of innovation. They may help to improve investing firms' global visibility, their confidence on own technological capabilities and quick learning on design and preferences of customers there (Deng, 2007). The OFDI facilitates more focused marketing, anticipating the customers' requirements, and learning about delivery norms and product liability issues.[6] In this way, proximity to centre of demand and technology through greenfield OFDI may help investing Indian automotive firms in technological catching up with global competitors, buyers and suppliers.

The automotive customers buying critical components and modules spend considerable time and effort in selecting the suppliers, implying high fixed costs in switching the suppliers. The auto component producers view outward FDI as a gateway strategy to

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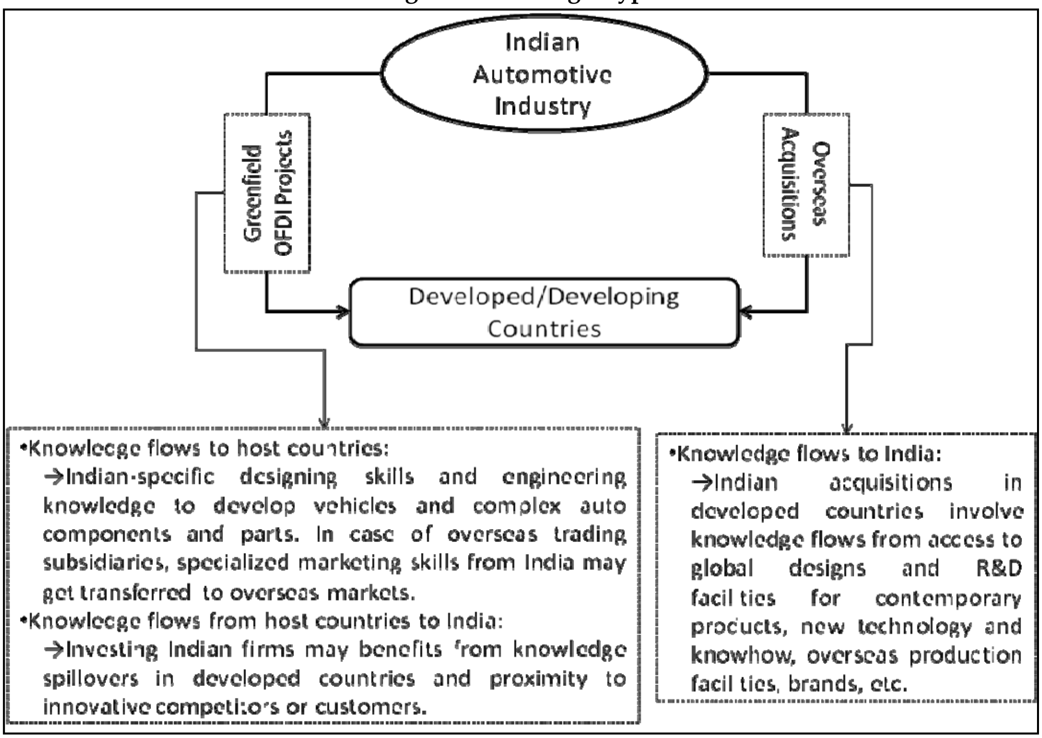
6 The automotive manufacturers fall in the high risk category of product liabilities as the defects in their component/ part may become known after loss of lives or grievous injuries, after installation in thousands of vehicles—largely sold to educated customers. See Auto Monitor, "Important defence in their war to capture global markets", FEATURES Section, February 19, 2007.

reach global OEMs—particularly the established customers of the acquired company. The direct supply relations with global automotive firms provide the supplier with opportunities of product and process developments and modifications through mutual learning and regular interactions (Singh, 2008). Thus, seeking access to major OEMs is not merely for marketing products, it is an important channel for knowledge flows in future. The OEMs now expect system solutions from their Tier-1 suppliers. Again the major OEMs and even some Tier-1 firms insist upon the just-in-time delivery, especially for modules/ systems—assemblies and sub-assemblies. Hence for direct supplies to OEMs, being close to the OEMs and industry design centres is important. For vehicle producers, having overseas operations in the vicinity of innovation networks and design centres is directly useful. Again, there is a great potential for outsourcing automotive R&D, designing and engineering services from India. This can be realized better with the Indian OFDI for automotive manufacturing and setting up R&D/ technical/ engineering centres, to take advantage of the locational externalities.

Figure-2
Potential Knowledge Flows through Types of Indian OFDI



The growing cases of strategic asset acquisitions undertaken by the Indian automotive firms clearly involve flows of new competencies from developed countries. In the auto component sector global Tier-1 firms possess the product knowledge (many of these firms are already in India, also through alliances), while a lot of process technology resides with large Tier-2/3 firms in Europe (ACMA, 2008b: 40). Strategic alliances with or acquisition of these Tier-2/3 firms are likely to ensure Indian auto component firms' access to the entire supply chain to address the problems of both product and process technologies. The vehicle sector acquisitions usually involve some parts/business of a firm with underlying technology, skills, brands, marketing and distribution centres, existing network of procurement, etc.

3.1. Outward FDI by Indian Automotive Firms

Indian automotive firms were observed to be early outward investors from Indian economy. Their OFDI activities started since early 1970s (Table-5). Probably, India's first automotive OFDI project was undertaken in 1972 by the Sah & Sanghi Group operating in the automobile distribution activities. A part of the group company, Bombay Auto Ancillary & Investments Private Limited, entered into a joint venture in Malaysia with about US $0.23 million for 35.7 per cent ownership. The joint venture unit, Auto Ancillary Manufacturers Sdn Bhd, situated at Kuala Lumpur in Malaysia is into manufacturing of tube valves. In 1974, Universal Radiators Limited undertook the second Indo-Malaysian joint venture for US $0.28 million. Universal Radiators was holding 10 per cent ownership of Malaysia Radiators Sendirian Berhad situated at Sanawang Industrial Estate, Seremban, Malaysia. The year 1977 saw three Indian joint ventures abroad, one each directed at Malaysia, Kenya and Singapore. Bolton India invested US $0.18 million for 45 per cent equity interest in Auto Ancillaries Limited, Nairobi for manufacturing auto springs for Kenya's motor vehicle assemblers. Gajra Gears Private Limited with an investment of US $1.8 million established a joint venture (68.84 per cent ownership), Gajra Gears NS Sdn Bhd, in Malaysia for manufacturing of automotive gears. Tata Precision Industries—the Singaporean joint venture in which Tata Motors Limited has undertaken US $4.5 million investment for 44 per cent stake—is into manufacturing and sale of high precision tools.

Clearly the initial OFDI projects from Indian automotive sector are more into manufacturing activities and involve local partners in host developing countries. These five Indian automotive firms have made their beginnings with trading activities related to automotive products but then moved into manufacturing in 1960s as a result of policy pressure in indigenising their businesses. After establishing modest manufacturing capabilities, these Indian companies started looking for overseas business opportunities in 1970s by transferring their modest competitive advantages into a few developing countries. Since the principal mode of their OFDI activities was joint venture, it can be argued that such Indian automotive OFDI has in fact transferred adapted knowledge that these firms have gained in localizing their production in India.

Table-5
Greenfield OFDI from Indian Automotive Sector, 1970–2007

Period	*OFDI value (US $ million)*			*Number of host countries*		
	Auto Components	*Motor vehicles and motor cycles*	*Total*	*Developed*	*Developing*	*Total*
1970–79	2.6 (5)	2.1 (1)	4.7 (6)		3	3
1980–89	0.2 (2)	0.6 (4)	0.8 (6)	3	2	5
1990–99	3.4 (6)	9.0 (5)	12.4 (10)	5	5	10
2000–07*	164.4 (43)	566.1 (8)	730.5 (50)	8	14	22
All years	170.6 (52)	577.8 (11)	748.5 (63)	9	18	27

Note: Number of investing firms is in parenthesis; * Data for 2001 is only from January to March, 2002 is from October to December and 2007 data is from January to March.
Source: Calculation based on a dataset compiled from unpublished remittance-wise information from Reserve Bank of India, published reports of Indian investment centre and unpublished firm-level information from Ministry of Commerce.

The participation of Indian automotive company in cross-border knowledge flows of intermediate technologies continued in 1980s with a number of new entrants and diversification into developed countries like USA, Germany and Greece. During 1980–89, a total of six Indian companies undertook an aggregate investment of US $0.82 million in 6 overseas joint ventures and subsidiaries. Clearly, there is a deceleration in aggregate automotive OFDI flows in 1980s when compared to its value in 1970s. Except Universal Radiators, OFDI during 1980s represents a group of new Indian automotive firms like Ashok Leyland, Bajaj, Autolite India, Mahindra & Mahindra and Scooters India joining overseas investment activities. While three OFDI projects are into manufacturing and marketing, rest three are into sales supporting activities. All the three overseas manufacturing ventures are in the form of joint ownership and all the three marketing ventures are wholly-owned subsidiaries.

In 1981, Mahindra & Mahindra invested US $0.28 million in K. Zaharopoulos—an Athens-based Greek industrial and trading company for 55.47 per cent equity stake. The Greek company in early 1970s was importing Romanian and Indian vehicles and later started manufacturing Jeep-type four wheeler vehicles based on designs of modified Indian Mahindra models[7]. After equity collaboration with Mahindra & Mahindra, the Greek unit was modernized, renamed 'Mahindra Hellas A.E.' and pushed into exporting

[7] http://en.wikipedia.org/wiki/Balkania_(trade_name)

to regional markets. Ashok Leyland entered into a joint venture with Government of Sri Lanka in 1983 for assembly and manufacture of commercial vehicles. Ashok Leyland has invested about US $0.31 million for 22.79 per cent ownership. The Sri Lankan joint venture, Lanka Ashok Leyland, imports chassis in both completely built-up and knocked down conditions from Indian parent company and in turn assembles the chassis and builds bodies to sell in the local market. The Public sector auto maker Scooters India established a wholly-owned subsidiary in Germany mainly for marketing purposes in 1982 and got another OFDI approval for Germany in 1989. Autolite India established its fully-owned U.S. trading subsidiary in 1989. The outward investment by Bajaj Holdings & Investment (formerly Bajaj Auto) in USA is for local distributional support and that of Universal Radiators is for manufacturing in Panama.

The 1990s has witnessed a revival of Indian automotive OFDI flows both in terms of number of outward investing firms and volume of investment undertaken. The period 2000–07 represents a distinct upward surge in OFDI flows from the sector with US $730 million worth of OFDI undertaken by a total of 50 Indian automotive firms. As argued before, the liberalization measures, heightened competition, the need to provide local product and service support, etc., have hastened this OFDI flows from the sector. The list of new automotive firms with different firm-specific capabilities joining the OFDI process is rapidly escalating and thus creating enormous scope for cross-border knowledge flows from India. Although the diversity of Indian greenfield OFDI has grown to cover 9 developed countries, developing countries are still area of their focus. There are a total of 18 host developing countries to Indian outward investing automotive firms. Developing countries host US $547.8 million, which account for more than 73 per cent of the total Indian automotive OFDI flows of US $748.5 million in 1970–2007.

The ownership structure of Indian automotive OFDI projects though continued to be jointly owned in 1990s but in 2000–07 there is strong preference for wholly-owned subsidiaries. In 1990s, there are 11 joint venture OFDI approvals as against 4 wholly-owned subsidiary approvals in total. All the approvals directed at developing countries are in joint venture forms. In developed region, four OFDI approvals are for wholly-owned subsidiaries and six OFDI approvals are for joint ventures. In 2000–07, the ownership preference of Indian automotive firms changed distinctly with approvals for wholly-owned subsidiaries accounting for as high as 85.81 per cent of the total approvals.

With the rise of greenfield OFDI by Indian automotive firms a significant outflow of knowledge from India can be expected. Specifically, host developing countries are expected to benefit from supply of research results and skills that Indian parent companies supply to their overseas subsidiaries. It can also be argued that knowledge transfer by Indian OFDI flows are somewhat intermediate in nature in this automotive sector and developing countries with similar factor conditions to India can be expected to get technologies best suited to their level of economic development and consumer preferences. The fact that more than 3/4th of Indian greenfield automotive OFDI is located in developing region suggests that Indian OFDI may be transferring substantial knowledge to southern countries.

Brownfield Automotive OFDI Flows

Very recently overseas acquisitions have gained prominence in the outward investment strategy of Indian automotive firms. During the early 2000s period, Indian automotive firms increasingly evaluated the potential contribution of cross-border acquisitions towards their composite firm-specific objectives of new markets, accessing new and complementary technological and skill assets, enhancing overseas trade supporting and distribution networks, etc. During 2002–2008 as many as 58 overseas acquisitions were concluded by a total of 30 Indian automotive firms involving US $1129 million (Table-6). An important aspect of this overseas acquisition trend is that developed countries are the major host, which is in complete contrast to the situation in greenfield outward FDI where developing region is the major destination. There are a total of 13 developed countries hosting acquisitions of Indian automotive firms as compared to just 6 developing countries (Table-7). Within the developed region, Europe led by UK and Germany is the most dominant sub-region in attracting Indian automotive acquisitions. U.S. is the third important host destination. Clearly, Indian automotive acquisitions have been more concentrated in technology-intensive developed countries. Table-8 provides a list of important overseas acquirers from Indian automotive sector during 2002–2008.

Table-6
Overseas Acquisitions by Indian Automotive Firms, 2000–08

Year	*Acquisition in US$ million*	*In number*				
		Acquisition deals	*Acquiring Indian firms*	*Target countries*		
				Developed	*Developing*	*Total*
2002	7.4	2	1	1		1
2003	41	4	3	2		2
2004	133	7	7	3	3	6
2005	288	16	14	7	2	9
2006	200.5	15	12	5		5
2007	380	10	9	5	2	7
2008*	79.3	4	4	4		4
All years	1129.2	58	30	13	6	19

Note: * data is from January to March. Value figures are only for those deals with disclosed amount.
Source: Based on dataset constructed from different reports from newspapers, magazines and financial consulting firms like Hindu Business Lines, Economic Times, Financial Express, Business World, Grant Thornton India, etc.

Table-7
Regional Composition of Indian Automotive Overseas Acquisitions, 2000–08

Region/country	*Acquisition in US$ million*	*In number*	
		Acquisition deals	*Acquiring Indian Firms*
Developed region	1002.2	51	28
Europe	779.8	38	22
Austria	77	1	1
Belgium	15	1	1
Czech Republic		1	1
France	6	1	1
Germany	378	13	10
Italy		2	2
Netherlands		1	1
Poland		1	1
Spain	16	1	1
Sweden	56	1	1
UK	231.8	15	9
North America	217.4	12	11
USA	217.4	12	11
Other Developed Countries	5	1	1
Bermuda	5	1	1
Developing region	127	6	5 *contd...*
Southern Africa		1	1
South Africa		1	1
East Asia	110	3	3
China	8	2	2
South Korea	102	1	1
South-East Asia	17	2	2
Malaysia		1	1
Singapore	17	1	1
South-East Europe		1	1
Romania		1	1
Grand Total	1129.2	58	30

Note & *Source*: Same as Table-6.

Table-8
Selected Leading Indian Automotive Acquirers Based on Aggregate Acquisition Value during 2000–08

Indian acquiring company	*Value in US $ million*	*Number of acquisition deals*	*Name of target countries*	*Description of acquisition deals*
Amtek Auto Ltd.	250.2	10	Bermuda, Germany, UK USA.	Strategic stake or acquisition of U.S. companies Midwest Manufacturing Co and Smith Jones Inc. , UK-based companies such as GWK Automotive, Lloyd (Brierly Hill), Sigma Cast Group, Triplex Ketlon Group, J L French''s (Witham) Ltd., German company Zelter Gmbh, Bermuda-based Tyco International.
Mahindra & Mahindra Ltd.	145.7	6	China, Romania, Germany, UK, Italy.	Strategic stake or acquisition of German companies Jeco Holding AG and Schoneweiss & Co. GmbH, UK-based Stokes Group, Italy-based G R Grafica Ricerca Design S.r.l (GRD), Romania-based SC Tractorul UTB SA, a Chinese tractor making unit.
Sakthi Auto Components Ltd.	130.0	1	Germany	Acquisition of German company Intermet Europe.
Tata Motors Ltd.	120.3	5	South Korea, Spain, Germany, South Africa, UK.	Strategic stake or acquisition of South Korean company Daewoo Commercial Vehicle, Hispano Carrocera S.A in Spain, CEDIS Mechanical Engineering GmbH in Germany, Nissan's truck manufacturing plant in South Africa, Jaguar and Land Rover brands.
Bharat Forge Ltd.	105.7	5	Germany, China, USA.	Strategic stake or acquisition of Carl Dan Peddinghaus GmbH and CDP Aluminiumtechnik GmbH & Co KG in Germany, FAW Group in China, Federal Forge Inc in U.S.
Tata Technologies Ltd	95.0	1	USA.	Acquisition of Incat International Pic in U.S.
Bajaj Holdings & Invst. Ltd.	77.0	1	Austria.	Acquisition of power sports bike maker in Austria.
Ucal Fuel Systems Ltd.	28.0	1	USA.	Acquisition of Amtec Precision Products in U.S.
Omax Autos Ltd.	22.0	1	USA.	Acquisition of an U.S. auto component firm.
Sanmar Engineering	20.7	1	Germany.	Acquisition of majority stake in Eisenwerk Erla—a German auto

contd...

Indian acquiring company	*Value in US $ million*	*Number of acquisition deals*	*Name of target countries*	*Description of acquisition deals*
Corporation				components company.
Sundram Fasteners Ltd.	19.6	3	UK, Germany.	Strategic stake or acquisition of precision forgings business of Dana Spicer Europe in UK, Bleistahl Produktions GmbH and Peiner Umformtechnik GmbH in Germany.
International Auto Ltd.	19.0	1	USA.	Acquisition of Miller Brothers Manufacturing in U.S.
Ashok Leyland Ltd.	17.0	2	Czech Republic, USA.	Acquisition of AVIA a.s. in Czech Republic, Defiance Testing and Engineering Services Inc in U.S.
T R F Ltd.	16.5	1	Singapore.	Acquisition of York Transport Equipment (Asia) Pte in Singapore.
Autoline Industries Ltd.	14.8	1	Belgium.	Majority stake in Stokota, Belgium.

Source: Same as Table-6.

The fact that overseas acquisitions of Indian automotive firms are concentrated in developed region reflects the general tendency of developing country firms undertaking strategic asset-seeking outward FDI. In various company press releases and managerial comments on acquisition deals, Indian automotive firms have put emphasis on several technology related objectives like enhancing global scale, new products or service areas, new technologies and skills and operational synergy, in addition to the traditional market access motive (Table-9). As Indian automotive firms are using brownfield OFDI in this strategic sense, it is indicative of cross-border knowledge flows from developed countries to India.

Table-9
Strategic Knowledge Acquisition Motives of Indian Automotive Firms

Indian acquiring company	*Managerial comments on overseas acquisitions*
Amtek Auto Ltd.	"We already have a turbocharging casting company in the name of Sigma Cast, so it's sort of a forward integration for us. Zelter's acquisition is part of the company's strategy to consolidate its position in specific product categories and become a global leader in the same." Santosh Singhi, CFO, Amtek Auto Limited.
Mahindra & Mahindra Ltd.	"The synergies resulting from this acquisition will not only help us strengthen our existing design capabilities but will also help us emerge as a global auto design powerhouse. Complementary capabilities between Mahindra & GRD (G.R. Grafica Ricerca Design S.r.l) will enhance the product development capabilities, provide a solid European footprint for M&M to leverage technologies & skillsets by harnessing the talent pool of designers and engineers."

contd...

Indian acquiring company	*Managerial comments on overseas acquisitions*
	Dr. Pawan Goenka, President, Automotive Sector, Mahindra & Mahindra. "Acquiring a design house like Engines Engineering provides us the perfect vehicle to penetrate into markets of Europe, China & Russia. It also gives us the impetus to scale up the business, have access to market & technology along with management skills." Mr. Hemant Luthra, President - Mahindra Systech. "Schoneweiss was highly regarded for its technical abilities and deep customer relationships with some of the marquee names in Europe. Through this acquisition M&M hoped to derive benefits across the various Systech entities and offer customers a comprehensive suite of products and technical skills." Mr. Hemant Luthra, President - Mahindra Systech. "With this acquisition (of Jeco Holding AG), the Mahindra group has taken a decisive and important step towards creating a global class and global scale business in auto components. This creates a platform that enables us to pursue our vision of building the auto components business as one of the core businesses of the Mahindra group." Anand Mahindra, Managing Director and Vice-Chairman, Mahindra & Mahindra.
Sakthi Auto Components Ltd.	"We got all the fits right, and the takeover (of Intermet Europe) has supported the growth. The Group's productivity and quality levels are up. We now have a phenomenal bandwidth, which did not exist earlier." Mr M. Manickam, Chairman of Sakthi Auto Components.
Tata Motors Ltd.	" We saw an opportunity in an entity (Daewoo Commercial Vehicle) that had a certain market share, that had a product line that we did not have, and that was a strategic fit for us. We brought in our marketing reach and made the company more profitable." Mr Ratan N Tata, Chairman of Tata Sons and Tata Motors. "This strategic alliance with Hispano Carrocera will give us access to its design and technological capabilities to fully tap the growing potential of this segment in India and other export markets, besides providing us with a foothold in developed European markets." Mr Ravi Kant, Executive Director - Commercial Vehicle Business Unit, Tata Motors. "Jaguar and Land Rover are two iconic British brands with worldwide growth prospects. We are looking forward to extending our full support to the Jaguar Land Rover team to realise their competitive potential." Mr Ratan N Tata, Chairman of Tata Sons and Tata Motors.
Bharat Forge Ltd.	"We deliberately chose to go to Europe first, because cost pressure there is very high now. They are willing to look at companies, which create a strategy that will synergise low-cost manufacturing with the technology environment, which the West offers. Our acquisition was planned with the thought of using this synergy. Carl Dan Peddinghaus GmbH (CDP) is high in technology, they are into chassis components largely for passenger cars, they are also into the power train business making forged pistons, while we make crankshafts - it is a fantastic fit! They do things that we don't and we do things that they don't. Totally, it gives a complete package to the customer." Mr Baba N. Kalyani, Chairman & Managing Director, Bharat Forge. "The Federal Forge acquisition is a significant step towards implementing the strategy of expanding our global footprint and establishing a manufacturing

contd...

Indian acquiring company	*Managerial comments on overseas acquisitions*
	presence in one of our largest markets - the US. Our strategy is to expand our `dual shore' manufacturing base through strategically located complementary facilities around the world." Mr Baba N. Kalyani, Chairman & Managing Director, Bharat Forge. "We need to develop global mindsets to build scale and cost excellence. We need to increase market access through global acquisitions. Besides having two manufacturing facilities in India, Bharat Forge has three manufacturing facilities in Germany, one each in Sweden, Scotland and the US. Global manufacturing operations provide enlarged market presence, a large range of products, deep penetration into newer market segments and technological edge." Mr Baba N. Kalyani, Chairman & Managing Director, Bharat Forge.
Tata Technologies Ltd	"We are experiencing strong organic growth, which we wish to complement with suitably targeted acquisitions. INCAT's broad geographic platform and extensive customer base represents an accelerated route to achieve our targets. We believe that the enlarged group will be a major player in the engineering and design services market on a global basis." Mr Patrick McGoldrick, CEO, Tata Technologies.
Bajaj Holdings & Invst. Ltd.	"This partnership is also another step in our globalization strategy. KTM's sharp brand positioning, differentiated designs, and hyper performance have inspired us to increase our stake in this participation. We are delighted with this opportunity to co-develop a range of products for both KTM and Bajaj brands and also excited by the prospect of introducing KTM products to India and South East Asia, as also to access the European market via KTM." Mr.Rajiv Bajaj, MD, Bajaj Auto Ltd.
Sundram Fasteners Ltd.	"SFL's strategy to acquire new customers would be through the acquisition of small boutique companies producing niche products, like in the case of Dana Spicer." Suresh Krishna, Chairman and Managing Director, Sundram Fasteners (SFL). "The acquisition of manufacturing facility in the UK has been a part of SFL's strategy to become a global player. The acquisition has given us access to new technology." K Ramas Ramaswami, Vice President-MFD, Sundram Fasteners (SFL). "The Company expects that access to customers of Peiner will also help in increasing the export of its products manufactured in India, including fasteners not currently in the manufacturing programme of Peiner. The Company will also be able to gain access to retail market through the strong distributor network of Peiner. Peiner's expertise in high strength construction fasteners will open new vistas for the Company globally." SFL Corporate Notices, BSE, Date: 2005-12-26.
Ashok Leyland Ltd.	"Avia is part of our inorganic growth plan and is a significant step in securing a beachhead in the European Union and the Eastern European markets. The acquisition will also give us a modern, international vehicle for our light and medium commercial vehicle range of trucks for India and other export markets." R Seshasayee, Managing Director, Ashok Leyland. "We have been looking for capabilities in the testing and validation area. The one that we acquired in Detroit, is a well-known firm called Defiance and has

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Indian acquiring company	*Managerial comments on overseas acquisitions*
	been engaged in testing for all OEMs in the US market. It has got a good strategic fit to our own operations and we would incubate thus, and overtime we expect this to scale up to significant levels." R Seshasayee, Managing Director, Ashok Leyland.

Source: Collected from various company press releases and interviews of managers reported in various newspapers and business reports.

3.2. Case Studies of Two Selected Outward Investing Automotive Groups

In this sub-section, the study analyzes cases of two Indian business groups that are actively undertaking outward FDI in the automotive sector. The selected groups, Tata and Amtek are aggressively trying to enhance their firm-specific technological and skill capabilities. These groups are likely to transfer their technological advantages abroad in cases of greenfield OFDI and also when integrating the acquired foreign entities. They are also expected to receive inflows of knowledge from their overseas acquisitions as well as greenfield investment, as argued earlier.

3.2.1. Tata Group and Automotive OFDI

The Tata Group is one of the largest Indian conglomerates, operating in 7 broad sectors. It is well-reputed for its engineering and IT skills, and its consistent emphasis on R&D, and also on advanced testing facilities and equipment. Its Group companies—Tata Motors and Tata AutoComp Systems Limited (henceforth TACO) are automotive manufacturing units. Besides those, the TATA Group has operations in several important automotive-related areas, like steel (over 100 years experience in this field, and significant OFDI in recent years), CAD/CAM/CAE, and supply chain management. The TATA Group's 2007–08 estimated gross turnover was $55 billion; the international income constituted 65% of the Group revenue; the Group exports products and services to 85 countries.[8]

Tata Motors

Tata Motors Limited is India's largest automobile company, with revenues of $8.8 billion and 23000 employees in 2007–08. In India it is the leader in commercial vehicles, and among the top three in passenger cars. The company is the world's fourth largest truck manufacturer, and the second largest bus manufacturer. It has been listed in the New

[8] Sources for the Tata Group study: Tata Motors Annual Report 2007–08; www.tatamotors.com accessed on August 26, 2008; Tata AutoComp Systems Limited, August 2008 (TACO20%.pdf); www.tacogroup.com accessed on August 17, 2008; *Auto Monitor*, various issues; other Media reports.

York Stock Exchange since September 2004. It is a primarily locally-owned and locally-controlled firm.[9]

It was established in 1945 as Tata Engineering and Locomotive Co. Ltd., TELCO; it changed the name to Tata Motors in 2003—to reflect its changing product portfolio. TELCO rolled out its first commercial vehicle in 1954, and started exports in 1961. The company's Engineering Research Centre at Pune, established in 1966, undertakes automobile R&D. It employs over 2,500 engineers and scientists, and is well-equipped with sophisticated instrumentation and testing facilities for engine development, checking emission levels, and testing engine components and assemblies against vibrations. At present Tata Motors has 6 R&D centres in Jamshedpur (since 1959), Pune and Lucknow in India, and in South Korea, Spain, and the UK. Tata Motors has developed India's first indigenously developed Light Commercial Vehicle (1986), Sports Utility Vehicle (1998), and mini-truck (2005), and India's first fully indigenous passenger car 'Indica' (1998). The unveiling of Tata Motor's Rs. 1-lakh 'Nano' car in January 2008 has made world headlines.[10]

During 2007–08 the foreign exchange earnings by Tata Motors were Rs. 28.44 billion, while the total expenditure in foreign exchange (including dividend remittances) was Rs. 32.44 billion. The total R&D and royalty & technical know-how expenses were Rs. 12.0 billion and Rs. 1.7 billion, being respectively 4.2% and 0.6% of its net turnover. The import of technology by Tata Motors during 2002–03 to 2007–08 has been from total eight sources for separate activities. Tata Motors has been selective in the import of technology, generally limiting it to specific products/projects.

Tata Motors has several domestic subsidiaries engaged in automotive-related activities, like engineering and automotive solutions, auto components (commercial vehicles axles and gearboxes) manufacturing, supply chain activities, machine tools and factory automation solutions, high-precision tooling and plastic and electronic components for automotive and computer applications, and automotive retailing and service operations. Its associate companies in India include the Tata AutoComp Systems Ltd. in which it has 50% shareholding, and Automobile Corporation of Goa Ltd, with 37.79% equity (the remaining held by EDC Ltd, a Government of Goa Enterprise), engaged in manufacturing sheet metal components, assemblies and bus coaches.

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[9] On March 31, 2008, 20.51% of its shares were held by NRIs, foreign companies and ADRs, and another 16.96% by foreign institutional investors.

[10] The commercial production is expected by end-2008. Note: 10 lakh = 1 million.

From time to time Tata Motors has concluded foreign collaborations for its plants in India, e.g., with Marshall Sons, UK, in late 1940s; with Daimler Benz, West Germany in 1954; and with Cummins Engine Company, USA in 1993. In 1994 it entered into a JV with Daimler-Benz/ Mercedes-Benz for manufacture of Mercedes Benz cars (Tata Motors exited it in 2001), and with Tata Holset Ltd, UK for turbochargers for diesel engines. In 2006, Tata Motors formed a 51:49 JV with the Brazil-based Marcopolo, a global leader in body-building for buses and coaches to manufacture fully-built buses and coaches for India and select international markets. One of Tata Motors plants inaugurated in 2008 is an industrial joint venture with Fiat Group Automobiles to produce cars and powertrains.

Outward FDI by Tata Motors: In terms of overseas production of vehicles, besides having franchisee/JV assembly operations in Malaysia, Kenya, Bangladesh, Ukraine, Russia and Senegal, Tata Motors has manufacturing operations in the UK, South Korea, Thailand, South Africa and Spain through subsidiaries and associates. These are:

- In 2004, it acquired the Daewoo Commercial Vehicles Company, S. Korea's second largest truck maker—later rechristened Tata Daewoo Commercial Vehicles Company.
- In 2005, Tata Motors acquired a 21% stake in Hispano Carrocera, Spain, with the remaining stake acquisition option. Hispano Carrocera has bus and coach manufacturing plants in Spain and Casablanca, Morocco catering respectively to the European and North African markets.
- Tata Motors (Thailand) is a greenfield investment producing pickup trucks; this JV was concluded in 2006.
- Tata Motors (SA) Proprietary Limited (TMSA), a 60:40 JV company incorporated during 2008 with the Tata Africa Holdings (SA) (Pte.) Limited for manufacturing and assembly operations of the Company's commercial vehicles and passenger cars in South Africa. This is acquisition of truck manufacturing plant of Nissan in 2007.
- Jaguar Land Rover, a business comprising the two iconic British brands that was acquired in 2008.

Tata Motors European Technical Centre, UK was set up in 2005 to work in synergy with Tata Motors's Engineering Research Centre at Pune. In January 2006 Tata Motors Ltd.-INCAT acquired CEDIS Mechanical Engineering GmbH, a German-based provider of automotive engineering and design services to some of the world's leading manufacturers. INCAT International Plc, a UK-based engineering and design services company serving global automotive, aerospace and engineering firms was acquired by Tata Motors's subsidiary Tata Technologies, through its subsidiary, Tata Technologies

Inc, USA, in 2005. Some of the other Tata Group companies too have been undertaking outward FDI in recent years—e.g., Tata Steel, like its strategic-asset seeking acquisitions of NatSteel Asia in 2004 and Corus Steel in 2007—providing intra-Group strength to the Tata Motors' international operations.

Tata Daewoo Commercial Vehicle Company Limited (TDCV), Korea, is a 100% subsidiary of the Company. It has launched several new products for the Korean as well as international markets. TDCV developed in 2006 South Korea's first LNG-Powered Tractor- Trailer. TDCV exported 3,000 units of heavy commercial vehicles during 2007–08, representing 2/3rd exports from Korea in this segment. Tata Motors is developing a platform for vehicles (called TWT) for 'tractor, tipper and cargo' segments, jointly at Tata Motors and Tata Daewoo Commercial Vehicles in Korea (ACMA, 2008a: 47).

Tata Motors acquired the Jaguar Land Rover businesses from Ford Motor Company in June 2008 for $2.3 billion in cash. The purchase includes perpetual royalty-free licences of all necessary Intellectual Property Rights, three manufacturing plants, two advanced engineering and design centres in the UK with complete vehicle testing and prototyping facilities, and worldwide network of National Sales Companies.[11] There are arrangements for supply of engines, powertrains, etc., from Ford plants, and commitments for support for accounting and IT services. The two technical centres can benefit immensely the Tata Motors for accessing the latest technology. Tata Motors believes that Jaguar was at the 'cusp' of growth with a pipeline of promising model line-ups (*Auto Monitor* sources).[12]

Tata Motors (Thailand) Limited, TMTL is a 70:30 joint venture between the Company and Thonburi Automotive Assembly Plant Co. for the manufacture, assembly and marketing of pickup trucks. The joint venture enables the Company to address the ASEAN and Thailand markets, the latter being the second largest 'pickup trucks' market in the world after the USA. The new plant has started production of the Xenon pickup truck— launched in Thailand in 2008.

Tata Motors European Technical Centre plc. (TMETC), a 100% subsidiary of Tata Motors is engaged in the business of design engineering and development of products for the

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[11] However, there are also important concerns: high CO_2 emissions of these models, and for Jaguar also the persistent losses and falling sales prior to the acquisition. The lowest CO_2 rating for any Land Rover or any Jaguar model is just below 200 g/Km. The European Union might limit the fleet average CO_2 by any car maker to 130 g/Km.

[12] Apparently the Jaguar management had invigorating ideas, but Ford was unwilling to put in further investment into this loss-making unit.

automotive industry. TMETC provides Tata Motors with design engineering support and development services, complementing and strengthening the Company's skill sets and providing European standards of (quality) delivery to the Company's passenger vehicles. "--- TMETC is a window to European design and engineering talent" (MD, TMETC in an interview to *Auto Monitor*, February 21, 2007). Its employees have experience in designing and developing vehicles to European standards for several automotive majors. Specifically the TMETC is focusing on body engineering, power-train engineering, chassis, ride and handling, electronics and systems integration. The TMETC team works from the University of Warwick, UK.

As seen above, all OFDI activities by Tata Motors so far have been in commercial vehicles segment—trucks and buses, except that of Jaguar Land Rover in 2008 in the passenger car segment. Tata Motors have been producing commercial vehicles since 1954. While they have been producing cars in India since 1991 in foreign collaborations, their car manufacturing operations really started in a significant way in 1999 with '*Indica*' production, an indigenously developed car; by 2007 Tata Motors had rolled over one million passenger cars off the *Indica* platform. The brand name and company name counts a lot in the passenger car segment. Tata Motors have earlier made marketing alliances with MG Rover, UK (starting 2002) and Khondro for the exports of Tata cars and with Rover/Phoenix Ventures for utility vehicles/pick-ups, however, with the sales being under the collaborator's brand name. We believe that the acquisition of Land Rover and Jaguar is going to give Tata Motors the much needed global visibility in the passenger car segment, even though the Tata Motors has announced that the Rover and Jaguar brands would be taken forward. As Ratan Tata said subsequent to this acquisition, "We are trying to be a car company of consequence".[13]

Tata AutoComp Systems Limited (TACO)

The Tata AutoComp Systems Limited, TACO was established in 1995. It is a holding company for a number of subsidiaries and JVs. The TACO Group has at present a total of 35 plants (3 primarily export-oriented units, EOUs in India) and 6 engineering/technical/design centres, a tooling business unit, and a supply chain management unit. It has nearly a billion dollar annual turnover; close to 20% of the total revenue is from the international business. For its domestic units the TACO Group has 15 global equity partners (in 12 manufacturing units and 3 engineering centres); all these partners are leading automotive enterprises in their respective domain. Tata AutoComp is moving increasingly into telematics & vehicle tracking system, and infotronics—the

13 *Auto Monitor*, Features: 'Tata takes the crown jewels', 1 June 2008.

promising segments of the auto component industry. It envisages being a global supplier by 2015 in the chosen areas of business.

Tata AutoComp has overseas manufacturing facilities for manufacturing and assembly of interior plastic products: at Coburg, Germany (TACO KunststoffTechnik, TKT), and at Nanjing, China (Nanjing Tata AutoComp Systems Limited, Nanjing TACO). It has an engineering centre in Yokohama, Japan, a representative office at Kagoshima, Japan, and a marketing office at Detroit. Its global presence in terms of the number of employees is just 522, as against over 13000 domestically.

In the area of interior plastic parts Tata AutoComp has achieved worldclass expertise and quality levels, through the TACO Interiors and Plastics Division (IPD) operating since January 1998, formerly known as Tata Auto Plastic Systems. TACO-IPD is 100% TACO-owned; it has at present program-specific collaboration with Faurecia (TA). It has won several suppliers Awards, including for 'zero defects ppm'. It also operates a 100% export-oriented unit. Since June 2006, TACO-IPD has a TACO-owned technical centre in India to support the manufacturing operations of TACO-IPD, India, and TKT, Germany and Nanjing TACO, China. This technical centre employs 100 engineers. Even the TACO Engineering Centre at Pune, also having an office in Japan, is entirely TACO-owned.

Tata AutoComp has so far made only one global acquisition, namely through its 100% subsidiary TKT, Germany in August 2005. This acquisition is aimed at gaining access to European markets. TACO acquired the business and assets of Wündsch Weidinger, a German automotive components (functional plastic parts and systems) producer for a consideration of 4 million euro. Weidinger's customers included major OEMs like Audi, Bentley, BMW, Daimler Chrysler, Volkswagen and Volvo. The acquired manufacturing facility offers development tool shop, precision injection moulding, surface enrichment and assembly operations; it employs 270 persons and has ISO/TS 16949 certification.

Nanjing Tata AutoComp Systems Limited, conceived in 2006 with a planned investment of $15 million, is the first overseas greenfield project by TACO. Incorporated in 2007, this wholly-owned subsidiary started operations in July 2008. It employs 94 people. It manufactures high quality kinematic small plastic components and sub-systems for the domestic Chinese as well as global automotive market, particularly the European market. The company in near future plans to produce larger plastic components, like door and instrument panels. The TACO views the Chinese plant not just as a manufacturing base, but as a window to the global market—to cater to global automotive majors in the US, EU and other emerging markets including the domestic Chinese market.

TACO's engineering facility at Yokohama, Japan (since September 2007), aims to offer design and product development facilities to the Japanese auto majors at competitive rates. The TATA Group is present in Japan also through its software firm TCS (since 1987) and some other Tata Group companies.

In a February 2008 interview to *Auto Monitor*, the Managing Director, TACO said that TACO's current focus "--- is on technology, to build depth in our existing businesses and continue in our globalisation plans." As regards the OFDI, TACO plans to have marketing offices in all major automobile markets, and also inorganic growth in its chosen areas of automotive operations; for greenfield manufacturing facilities, the company is open to joint ventures. He added that there is potential for the emergence of global auto component companies from India.

It is noteworthy that the OFDI by the TACO Group so far can be primarily traced to the strength of those TACO Group enterprises which have strong accumulated expertise and global standards as well as focused technical/ R&D base, and which are locally owned (not JVs). Of course, the OFDI activities of these enterprises also draw upon the strength of other TACO firms, as well as that of Tata Motors and other Tata Group Associates; the knowledge flows from these OFDI are also expected to extend to them as externalities. For example, the strategic alliance formed between TACO and INCAT, a Tata Technologies Company is aimed at establishing them as full-service suppliers for vehicle design and manufacturing within their respective markets. INCAT specializes in engineering & designing and IT services The INCAT -Tata AutoComp alliance has already secured a major project for the complete design and development of a new vehicle platform for a leading Chinese automotive OEM.[14]

3.3.2. Amtek Group and Automotive OFDI

Amtek Group: Amtek Auto Ltd., the Amtek Group's flagship company, was incorporated in 1985 to be a Maruti Suzuki supplier. At present the Amtek Group has 33 manufacturing plants, including in the US, UK and Germany.[15] The Amtek Group produces over 200 components, sub-assemblies and assemblies, mainly automotive products. The major categories are Connecting Rod Assemblies, Flywheel Ring Gears and Assembly, Steering Knuckles, Suspension and Steering Arms, CV joints, Crankshaft

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[14] Source: 'INCAT, Tata AutoComp Strategic Alliance Creates Full-Service Supplier for Global Automotive Product Development and Component Manufacturing' *PR Newswire*, March 13, 2008.

[15] Sources for the Amtek Group study: www.amtek.com; recent Annual Reports of Amtek Auto Ltd, Amtek India Ltd and Ahmednagar Forgings Ltd; corporate filings with the SEBI; business media reports.

Assemblies, and Torque Links. All its manufacturing plants are accredited with TS16949/QS9000 certification for quality system. Amtek Auto has TS 16949: 2002 and ISO 14001 certifications. The consolidated sales & other income of Amtek Auto and its subsidiaries during July 2007 to June 2008 were Rs. 49.8 billion (un-audited results). Amtek received the 'Economic Times–Emerging Company of the Year' Award in 2006. In September 2008 Amtek Auto won the UK Trade & Investment Award in the 'Investor of the Year' category for investing in new firms to drive growth and acquire technology.

The Amtek Auto Directors approved on 31st July 2008 the merger of Amtek India (a major Amtek Group firm), Amtek Castings India, and three subsidiaries of Amtek Auto, namely Ahmednagar Forgings, Amtek Crankshafts India (formerly Amtek Siccardi) and Amtek Ring Gears (formerly Benda Amtek)—with Amtek Auto Ltd. (subject to court approval). In view of this, we examine the outward FDI activities of the Amtek Group as a whole. As on 30th June 2008 while the shareholding by foreign corporate bodies is < 10% in both Amtek Auto and Amtek India, there is considerable shareholding by FIIs.

Technological Efforts: The Amtek Group has been importing technology mainly by way of having JVs with foreign partners: in recent years Amtek Tekfor, 2005; Magna Powertrain, 2006; Amtek VCST Powertrain, 2007; with American Railcar Industries in early 2008; with FormTech Industries LLC in August 2008, besides earlier Benda Amtek (plant set up in 1997) and Amtek Siccardi (1999). The collaborations with Benda Kogyo (Japan), Siccardi (France) and Tekfor (Germany) have been technical-cum-financial. Amtek has a technical collaboration with Aizen (Japan), and a recent one concluded with Teksid (Italy) in late 2007. The Amtek-Aizen and Benda-Amtek plants supply only to Maruti Suzuki, India. Most of the recent JVs are primarily/ entirely oriented towards exports, at least initially.

The Amtek Group has a well-equipped design centre with Design & Development facilities to support its customer requirements across the globe. It has facilities for 3D modeling, finite element analysis, process simulation, product data management, etc., and uses advanced design softwares to test the stiffness, strength, NVH and fatigue performance. Amtek's IT hub at Manesar, India is yet to start. There is also a modern design centre each at the Letchworth, UK and Hennef 2, Germany units.

Exports: As part of its internationalization efforts, the Amtek Group has also been concentrating on exports. The Amtek Group is a Tier-1 supplier to many global automotive majors. For example, during 2005 it received export contracts from Cummins USA and Detroit Diesel (USA) for ring gears for engines, and from John Deere Worldwide for components for three agricultural platforms. Amtek Auto's export earnings during 2006–07 were Rs. 3.54 billion, including indirect and deemed exports, while its sales & other income stood at Rs. 11.56 billion. The corresponding figures for Amtek India were Rs. 2.33 billion and Rs. 7.13 billion, and were Rs. 1.91 billion and Rs. 6.00 billion for Ahmednagar Forgings. These figures indicate about 30% exports to total revenue ratio.

Outward FDI by the Amtek Group

Along with a number of domestic acquisitions (starting 2001) and consolidation, the Amtek Group has made several overseas acquisitions in recent years. It has spent over $150 million during 2001 to 2007 for domestic and foreign acquisitions. The overseas acquisitions are:

2002	- Midwest Mfg./ Smith Jones, USA
2003	- Lloyds Brierly Hill Ltd., UK
	- GWK Group Ltd., UK
2004	- Sigmacast Iron Ltd., UK[16]
2005	- Zelter GmbH, Germany
	- Hallberg Guss Aluminum, UK[17]
2006	- JLF French, Witham, UK
2007	- Triplex-Ketlon Group, UK

Besides, Amtek Gear Inc. was incorporated in December 2004 to set up a greenfield manufacturing facility in the US by Amtek Auto. Amtek Siccardi established a subsidiary Amtek Aluminium Castings UK Limited at Bourne in June 2005. Both of these are 100% subsidiaries through the overseas investment companies.

During 2006–07 (July-June) the consolidated sales and other income of Amtek Auto was Rs. 37.21 billion, implying 3rd rank in India for Amtek Auto after Bosch India and Bharat Forge. The quantitative importance of the outward FDI by Amtek can be gauged from the fact that during 2006–07 Amtek Auto's foreign subsidiaries Amtek Investments UK Ltd., Smith Jones Inc, Amtek Investments US(1) Inc, and Amtek Deutschland Gmbh had total turnover of Rs. 17.81 billion.

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16 In 2006 Amtek India announced acquiring 100% equity stake of UK based Sigmacast Group Ltd., through its wholly-owned UK subsidiary Amtek Industries Ltd.; Sigmacast Group has one subsidiary, namely Sigmacast Iron Ltd. Various acquisition dates reported here are from the Amtek Group website (amtek.com).

17 This plant having aluminium castings manufacturing capacity of 20,000 tpa was acquired for $25 million. Its facilities were to be shifted to Amtek's plant at Ranjangaon, India. Again, according to the media reports, Amtek Group acquired the U.S.-based forgings business of the Tyco group for $5 million in January 2006; its 30,000-35,000 tpa forging line was to be transferred later to Amtek's Pune operations.

Knowledge Flows/Asset-seeking from Outward Investments: As seen below, the main motives for outward FDI by the Amtek Group have been seeking access to automotive global major players; gaining scale advantages and outsourcing opportunities for domestic units; asset-seeking, like access to highly automated lines employing advanced technology, and well-equipped design centres; value addition through backward integration; and product diversification.

Amtek acquired Smith Jones (US), one of the largest manufacturers of flex plate assemblies, on December 20, 2002, as a wholly-owned subsidiary; a day earlier, Midwest International Inc. had transferred its operations to Smith Jones who continues to use Midwest as the trading name. The two plants acquired were at Stanberry MO and Kellogg IA, now operating under Amtek Ring Gear Division. The manufacturing process of ring gears at Stanberry involves flex plate stamping followed by robotic MIG welding. It has 2 million pieces p.a. capacity for flywheel and flex plate assemblies. The Kellogg plant has highly automated manufacturing lines, and has extensive storage space and sophisticated material handling and packing equipment. Both units are QS-9000 certified.

GWK Amtek Ltd represents the acquisition of GWK Group, UK (for euro 3.23 million in 2003), a Tier-1 company, having two manufacturing facilities, namely King Automotive System Ltd., and, Coventry and Geo W Kings Ltd., Letchworth, Herts.[18] These TS 16949 accredited plants are now called Amtek Automotive Machining Division, Coventry and Letchworth respectively. Both the plants have undergone major upgradation and investment in equipment in recent years. The Letchworth plant has an in-house product design and development capability supporting all major CAD systems. A large part of GWK's purchases of forgings and castings, earlier from Europe, are now being shifted to Amtek in India. In 2003 Amtek also acquired Lloyds (Brierley Hill) Limited, the largest flywheel and ring gear manufacturer in the UK. Its products include engine ring gears, timing rings and inertia rings—supplied to global automotive engine manufacturers. Its business complements that of Amtek Ring Gears, India.

The acquired facility of Sigmacast Iron Ltd., a subsidiary of Sigmacast Group Ltd, has a large manufacturing facility at Tipton, UK, accredited with ISO/TS 16949: 2002 and ISO 14001, and having customers like Holset-Cummins and Ford. It produces Turbo Housings in excess of 1.7 million p.a. currently, and flywheel and

[18] According to the then GWK Group Chairman, this acquisition by Amtek is "---providing the business with a strong overseas parent company located in a lower-cost environment, which is mutually beneficial to Amtek, GWK and our customer base". In general, global automobile majors like Ford have been interested in their existing direct suppliers reducing their costs of operation, including through such acquisitions of their assets.

transmission housings. The plant has a pattern shop and computer solidification/flow simulation facilities. This facility now operates as Amtek Iron Casting Division, Tipton.

Amtek Auto set up a new facility, Amtek Gears Inc at Bay City near Detroit (USA) in February 2005 as a wholly-owned subsidiary. This unit, with an investment of $25 million and having an annual capacity of 9 million fly wheel ring gears, started commercial production in April 2005. Strategically located in the automotive hub of Detroit, it has clients like Tesma, Unimotion Gear, General Motors, Ford, and Nissan (India Brand Equity Foundation sources).

In July 2005 Amtek Group acquired through its 100% subsidiary Amtek Deutschland Gmbh, 70% equity in Zelter Gmbh, for euro 3 million; the remaining 30% equity was to be sold to Amtek Auto in April 2008. Zelter manufactures machined turbocharge housings. Zelter is an important Tier-1 supplier in this sub-segment, having many blue chip customers. It has two large state-of-the-art facilities in Cologne, Germany (Hennef 1 and 2). Zelter has invested more than euro 20 million over the last three years for upgrading and modernising its facilities, as well as setting up new automatic machinery lines (amtek.com). These units operating as Amtek Automotive Machining Divisions have over 100 CNC multi-purpose flexible machines and are offering full service supply. These plants are TS 16949: 2002, ISO 14001 and OHSAS 18001: 1999 accredited. The design centre at Hennef 2 is equipped with inventor and ideas 3-D Programs, and designs and manufactures all necessary tooling and clamping devices in its own tool and dye maker department. It also produces prototype and special samples on production machining equipment.

Amtek Auto acquired in June 2007 the entire assets of U.K. based JL French Ltd., JLF (Witham Plant), a manufacturer of aluminium high pressure die-casting (HPDC) for automotive application. JLF (Witham) has a fully equipped aluminum HPDC facility, having 18 HPDC lines, and about US $60 million turnover at 60% capacity utilization in 2007. Its customers include Land Rover, Jaguar, Trellborg, Ford and PAS (Peugeot). It has experience in full service supply for front-end auxiliary drive & engine/transmission bracket. This acquisition is aimed at expanding the customer and product portfolio as well as attaining technological edge in aluminium HDPC segment. The JL French's business has been developed to offer die-casting solutions including product design, simulation, testing, rapid prototyping, high pressure die-casting, precision machining and assembly.

In November 2007 Amtek Auto acquired a strong competitor in Europe, namely Triplex-Ketlon Group, one of the largest automotive precision machining Companies in

Europe— having over 180 different machining lines, a multi-location presence in the UK (3 facilities), annual sales revenue of $152 million and a profitable business. All its current customer contracts are long term. Amtek already had precision machining operations in Coventry and Letchworth in UK, Germany and India. With this acquisition the annual combined operations of Amtek was expected to increase to $650 million in the UK, and to about $770 million total overseas sales. This acquisition will provide Amtek an entry into new customers like Honda and Toyota in UK and also to some non automotive customers, and to high value gear manufacturing in Europe.

Both GWK and Triplex in the UK are engaged in the business of aluminium machining. Arising out of these acquisitions, Amtek also foresees highly profitable and huge outsourcing opportunities worth over $100 million for the Amtek Group's fast expanding forging, aluminium die-casting and other operations in India. The usage of aluminium components is increasing in the vehicle industry due to their lighter weight as compared to steel-made components; automobile manufacturers are interested in making lighter and more fuel-efficient vehicles to meet the corporate average fleet economy standards.

In sum, the Amtek Group has been quite aggressive in terms of acquisitions.[19] Amtek has located/acquired its overseas plants close to its European and US customers, thus reducing the lead-time for delivery. To cater to its export orders, Amtek has invested heavily in increasing production capacities in India through existing, new and acquired units. The business secured through its large overseas entities is being gradually shifted to its domestic units. Thus, Amtek has been able to leverage its Indian low cost facilities having high quality standards and manufacturing abilities for supplies to its overseas customers. With the rise in global outsourcing by automotive majors, the outsourcing orders from Amtek Group's overseas subsidiaries would further enhance the export earnings from Amtek's domestic units.

With foreign subsidiaries becoming the hub for good "clientele acquisition (i.e., access)", also for Tier-1 supplies from domestic units, this is bound to impact the capital formation for the Group's domestic operations. This is expected to trigger enhanced efforts directed at product/design and process development through R&D, and acquiring full service capabilities by the domestic units. We believe that these tendencies would become stronger after some corporate consolidation within the Amtek Group, which is expected soon (as mentioned above).

[19] However, it is difficult to say that this inorganic growth has been led by R&D. Amtek Auto and Amtek India have not shown the R&D expenses separately in the annual accounts. They have R&D activities in the area of product design and development.

4. OFDI and Domestic R&D

Previous discussions show that Indian automotive firms are transferring-out their modest knowledge through greenfield outward FDI projects and transferring-in foreign knowledge via overseas acquisitions and greenfield OFDI. The cross border knowledge transfers in the case of strategic acquisitions seem to be direct and immediate. However, the relationship between greenfield OFDI and inflows of foreign knowledge is not directly clear. Does outward greenfield presence contribute to knowledge base of Indian automotive firms? Is it a channel of international knowledge diffusion to outward investing Indian firms? Outward greenfield presence provides proximity to innovative competitors, foreign R&D infrastructure, knowledge centres and research results. In addition, investing Indian firms will get access to information on changes in global consumer preferences, safety standard, packaging style, etc. These factors could in turn create a channel for technological and non-technical information flows from overseas greenfield subsidiaries to Indian parent companies. Under the growing international competitive pressures, Indian parent firms in turn internalize this inflow of foreign knowledge information to improve their technological capabilities. Therefore, outward greenfield presence may help Indian automotive firms to learn from technological developments and strategies of competitors in foreign countries and to move to a dynamic path of innovation.

In this section we have made a preliminary attempt to test the hypothesis that outward greenfield presence is a channel of foreign knowledge flows to Indian automotive firms. Our basic objective is to investigate if the status and intensity of outward greenfield investment causes any systematic differences in Indian automotive firms' R&D behaviours. If we find that outward greenfield investment positively influence firms' in-house R&D activities then one can infer that there is inflow of overseas knowledge. That is the outward investing Indian automotive firms tend to step up their R&D to absorb knowledge spillovers from proximity to foreign knowledge and research results.

The Empirical Framework

The existing literature suggests that apart from OFDI there are several variables that can explain inter-firm variation in R&D activities (see for example, Lall, 1983; Siddharthan, 1988; Kumar and Aggarwal, 2005; Narayanan and Thomas, 2007 among others). These factors are discussed below:

Firm Age: The age of the firm can be an important determinant of its R&D behaviour. It is a proxy for firms' accumulated stock of knowledge from learning-by-doing. The knowledge stock consists of learning from its production, marketing, R&D and organizational experience. In the long run, older and surviving firms tend to have relatively larger endowments of quality competitive assets as less efficient firms disappear. Therefore, with increase in age, firms learn progressively from their search to achieve optimal scale economies in production and marketing, which in turn can have complementary effects on firms' technological activities.

Firm Size: Following Schumpeter's assertion that innovation is the key to capitalist development and large-scale enterprises are the most powerful engines of economic progress, a positive relationship between firm size and R&D activities can be deduced (Lunn, 1982). Large-sized firms possess relatively large resource base and higher risk taking capabilities than small-sized firms. R&D being a risky activity requiring huge resources, large-sized firms tend to be more active at it. Fishman and Rob (1999) built a theoretical model to show that there is a relationship between firms' customer base and R&D in an industry-equilibrium context. Their theoretical framework suggests that larger firms invest more in R&D than smaller ones because the effect of cost reduction (implemented through R&D) applies to a larger customer base and so is more profitable for them. There exist numerous empirical studies investigating firm size and R&D intensity with some pointing to a non-linear relationship[20].

Technology Purchase: Most often firms resort to purchase of technology to strengthen their competencies in certain product characteristics or processes. Since the technological licensing enables firms to get the required technologies from external sources, they tend to substitute the need for in-house R&D to develop technologies. However, purchase of technological know-how may require adaptive R&D to make changes in product or inputs to be suitable to local demand and factor conditions. Therefore, the relationship between technology licensing and in-house R&D may be substituting type or complementary, depending upon these two opposite effects. Apart from technology licensing, firms may purchase capital goods and equipments incorporating new process technologies. Such knowledge resources embodied in capital goods can also impart competitive advantage to firms.

Export-orientation: Exporting can be an important factor affecting firm-level R&D performance. Participation in export market is expected to increase firms' commitment to quality and efficiency improvement on a continuous basis. The overall efficiency consideration is crucially linked to strategic in-house R&D efforts. Hence, the export intensity is predicted to have a positive influence on R&D intensities of Indian automotive firms.

[20] In empirical estimation, we did test for non-linearity by including a squared term of the firm siz, but consistently the squared size didn't achieve any significant level. Therefore, we have included only firm size in the final estimation.

Inward FDI: R&D activities can also be related to the level of foreign ownership in firms. It is a known fact that foreign parent company transfers its intangible and tangible assets to its subsidiaries in a host country. With foreign-owned subsidiaries getting technology and knowledge transfer from their parent companies there is hardly any scope for doing substantial local R&D activities. There may be some adaptive R&D but certainly not frontier type innovation. However, recently R&D behaviour of foreign affiliates is changing dramatically as the parent foreign firms are internationalizing their R&D activities. Since parent firms are looking for new locations with low cost skilled manpower and high innovation potential, their foreign affiliates are increasingly entrusted with important innovative activities. In this context, R&D activities of foreign affiliates are transforming into important innovation activities in host countries. Given that India has developed a dynamic environment for innovation related to automotive sector, the possibility of foreign firms doing substantial R&D beyond adaption is very high. Therefore, we expect a positive relationship between foreign ownership and R&D intensity in Indian automotive sector.

Profit Margin: In the context of rapidly escalating costs of technology development, profitability performance of firms can have a bearing on their R&D activities. Higher profit margins of firms increase the size of internally generated resources potentially available for supporting a sustained in-house R&D programme. In their study of a sample of Japanese and U.S. Companies, Hundley, Jacobson and Park (1996) observed that such a relationship crucially depends upon managerial culture, long-term commitment of external financier (i.e., bank, financial institutions), character of capital market, etc. While profitability variations affected the R&D intensities of U.S. companies in highly research-intensive sectors, Japanese companies actually increase their R&D expenditures when profitability declines. It is argued that various stakeholders in Japanese companies possess a long-term commitment in their enterprise and view increased R&D as a strategy of longer-term growth and viability to counter short-term decline in profitability. On the contrary, key stockholders in the U.S. take more individualistic view about the firm and look at short-term viability. Clearly, the prediction on the nature of relationship between profitability and R&D in the case of Indian automotive segment also depends upon the characteristics of key stakeholders in Indian automotive firms like managers, investors, shareholders, etc. Therefore, the likely impact of profitability on R&D seems to be ambiguous in nature.

Liberalization: The policy regime related to industry, fiscal incentives for R&D, foreign investment, patent regime, trade, etc., can also stimulate firms' R&D activities. As discussed above, the policy regime towards automotive industry in particular became progressively outward looking and proactive over years since 1991. Dismantlement of industrial licensing, automatic FDI approval, increased incentives for R&D, increased safety standards, etc., are all liberalization and strategic policy measures that can have positive impact on firms in-house R&D. In this study, covering the period 1988–2008 (financial year ending March), we have introduced three dummies to represent progressive liberalization phases for the Indian automotive industry. LIBDUM1 covering the period 1988–1992 is the pre-liberalized phase characterizing restrictive state policies. LIBDUM2 encompassing 1993–2002 is the liberalized phase exemplifying favourable industrial, trade, and FDI policies. LIBDUM3 spanning 2003–2008 is the most active phase of state policies encouraging cluster, increasing R&D support and infrastructure, establishing required institutions, etc. In the estimation, the period 2003–2008 has been treated as the base with inclusion of LIBDUM1 and LIBDUM2.

Product Specialization: Product category can be another relevant determinant of firms' R&D activities. In general companies that are primarily vehicle manufacturers are likely to have larger product-R&D requirements covering product designing, engineering and testing than companies which are primarily auto component producers. To capture this aspect, we have introduced a dummy variable, ACOMDUM, for firms that are exclusively into auto component production. This dummy variable is expected to have a negative sign in the estimation.

Outward FDI: The importance of outward FDI as a medium of learning and technological accumulation for investing firms has already been discussed. This variable measured in both dummy and intensity form is expected to play a positive role in the R&D activities of outward investing Indian automotive firms. These two measurements of greenfield OFDI variable are again analyzed from the angle of development status of host region (i.e., host developed region versus host developing region) and from ownership participation (i.e., joint venture versus wholly-owned subsidiary). Bringing regional dimension to outward FDI is important as there are theoretical reasons to postulate that a greenfield presence in innovative developed region would brings more cross-border knowledge flows to the investing Indian automotive firms than a greenfield investment in developing region. The inflows of foreign knowledge from joint venture OFDI can also be expected to differ from that of the wholly-owned subsidiary led OFDI. In the case of joint venture OFDI, Indian investing companies get easier access to informal research networks and technological information possessed by the joint venture partner. The joint ownership gives ample scope for co-operation in R&D or simply getting relevant information on market, competitors and regulatory changes via local partner. These possibilities don't exist in the case of wholly-owned OFDI projects.

The dependent variable is the R&D intensity measured as total R&D expenses as a per cent of sales. Since a number of firms in a given year may not be doing R&D, this variable gets censored at the lower end at zero value. For example, in our sample dataset that we have constructed for the present estimation, there are only 1134 observations associated with R&D conducting firms as compared to 2603 observations of firms without R&D expenses. Table-10 presents the complete list of independent variables that are postulated to be affecting R&D activities of Indian automotive firms; it also discusses about their measurement. Taking into account these variables, the empirical framework of the present study can be expressed as given below; ε_{it} is the random error term.

$$RDINT_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 SIZE_{it} + \beta_3 DISTECH_{it} + \beta_4 EMTECH_{it} + \beta_5 EXPOINT_{it} + \beta_6 PROFIT_{it} + \beta_7 FDUM_{it} + \beta_8 LIBDUM1_{t} + \beta_9 LIBDUM2_{t} + \beta_{10} ACOMDUM_{it} + \beta_{11} OFDIDUM_{it}\ (or\ OFDINT_{it}) + \varepsilon_{it} \quad \ldots(A)$$

Estimation Method, Results and Inferences

Tobin (1958) has suggested the use of maximum likelihood (ML) estimator for models like our equation A that involves non-negative censored dependent variable. When the error terms satisfy the classical assumptions, the application of Tobit-ML estimation shall provide unbiased and consistent coefficient estimates as compared to biased estimates provided by ordinary least squares estimation. The present study has used Tobit estimation with robust standard errors for estimating equation A for a sample of 436 Indian automotive firms extracted from the Prowess database of the Centre for Monitoring Indian Economy (CMIE)[21]. The unbalanced panel dataset contain information from 1988–2008 covering a total of 3737 annual observations, of which 1134 observations relate to R&D-performing and 2603 observations relate to non-R&D performing automotive firms.

All financial firm-level variables except outward investment stock and equity share of foreign promoters are from the Prowess. The Prowess information on equity share of foreign promoters in Indian firms has been supplemented from information on shareholding obtained from the Bombay Stock Exchange[22]. The firm-level stock of OFDI has been calculated from a dataset compiled from unpublished remittance-wise information from Reserve Bank of India, published reports of Indian investment centre and unpublished firm-level information from Ministry of Commerce.

21 All estimations are conducted with the help of STATA version 8.1. The presented standard errors are robust to the problem of heteroscedastic errors. Using the Cook's Distance the influential observations were excluded from the estimated sample.

22 http://www.bseindia.com/shareholding/sharehold_search.asp

Table-10
Description and Measurement of Variables

Variables	*Symbols*	*Measurements*
Dependent Variable		
R&D Intensity	RDINT	R and D expenses as a per cent of sales.
Independent variables		
Firm Age	AGE	Number of years from the year of incorporation.
Firm Size	SIZE	Annualized sales in Rs. Million.
Technology Purchase	DISTECH	Expenses on royalties and technical knowhow fees as a per cent of sales.
	EMTECH	Expenses on imports of capital goods and equipment as a per cent of sales.
Export Intensity	EXPOINT	Exports of goods and services as a per cent of sales.
Inward FDI	FDUM	Assume 1 if a firm has foreign promoter ownership of at least 10 per cent, 0 otherwise.
Profit Margin	PROFIT	Profit before tax as a per cent of sales.
Liberalization	LIBDUM1	Assume 1 for years from 1988 to 1992, 0 otherwise.
	LIBDUM2	Assume 1 for years from 1993 to 2002, 0 otherwise.
Product Specialization	ACOM_DUM	Assume 1 for auto component manufacturers, 0 otherwise.
Outward FDI	OFDIDUM	Assume 1 for firms with OFDI, 0 otherwise.
	OFDIDUM_D	Assume 1 for firms with OFDI in developed region, 0 otherwise.
	OFDIDUM_DL	Assume 1 for firms with OFDI in developing region, 0 otherwise.
	OFDI_JV	Assume 1 for firms with OFDI in joint venture form, 0 otherwise.
	OFDI_WOS	Assume 1 for firms with OFDI in wholly-owned subsidiaries, 0 otherwise.
	OFDINT_L1	One period lagged OFDI intensity measured as OFDI stock as a per cent of total assets.
	OFDINT_DL1	One period lagged OFDI intensity in developed region.
	OFDINT_DLL1	One period lagged OFDI intensity in developing region.
	OFDINT_JVL1	One period lagged OFDI intensity in overseas joint ventures.
	OFDINT_WOSL1	One period lagged OFDI intensity in overseas wholly-owned subsidiaries.

contd.

Impacts of OFDI Presence

Table-11 summarizes pooled Tobit regression results on the determinants of R&D behaviour of Indian automotive firms. High values of Wald Chi-Square statistics of estimated regressions suggest that they are statistically significant and the explanatory variables contribute importantly to inter-firm differences in R&D intensity.

Table-11
Tobit Results on Outward FDI Status and R&D Performance of Indian Automotive Firms

Dependent variable: R&D intensity (%)

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
AGE	0.017452***	0.017880***	0.017780***	0.017388***	0.018045***
	(11.17)	(11.49)	(11.39)	(11.12)	(11.60)
SIZE	0.000007***	0.000008***	0.000007***	0.000006***	0.000008***
	(5.18)	(5.11)	(4.74)	(4.37)	(5.41)
DISTECH	0.140785***	0.135630***	0.137675***	0.138718***	0.134412***
	(3.60)	(3.54)	(3.54)	(3.57)	(3.51)
EMTECH	-0.003251	-0.003265	-0.003201	-0.003153	-0.003257*
	(1.58)	(1.63)	(1.62)	(1.60)	(1.65)
EXPOINT	0.004991**	0.005293**	0.006234***	0.006101***	0.005861***
	(2.40)	(2.55)	(3.02)	(2.96)	(2.82)
PROFIT	0.000098	0.000096	0.000096	0.000098	0.000095
	(1.59)	(1.55)	(1.56)	(1.59)	(1.53)
FDUM	0.691080***	0.697354***	0.658417***	0.682994***	0.672392***
	(9.19)	(9.23)	(8.80)	(9.08)	(8.94)
LIBDUM1	-2.106310***	-2.085800***	-2.112569***	-2.142829***	-2.084146***
	(11.12)	(11.03)	(11.16)	(11.27)	(11.02)
LIBDUM2	-0.254612***	-0.247283***	-0.272907***	-0.284149***	-0.256963***
	(3.66)	(3.52)	(3.94)	(4.11)	(3.66)
ACOM_DUM	-0.512255***	-0.576839***	-0.573119***	-0.546013***	-0.600038***
	(5.19)	(6.16)	(5.99)	(5.63)	(6.48)
OFDIDUM	0.633528***				
	(5.13)				
OFDIDUM_D		0.614130***			
		(4.51)			
OFDIDUM_DL			0.518022***		
			(2.92)		
OFDIDUM_JV				0.730703***	
				(4.46)	
OFDIDUM_WOS					0.339435**
					(2.35)
Constant	-0.885317***	-0.838319***	-0.806261***	-0.825398***	-0.802334***
	(7.08)	(6.89)	(6.67)	(6.75)	(6.66)

contd...

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
Log-likelihood	-3106.3351	-3109.0586	-3113.6387	-3108.5047	-3114.7996
Wald chi2(11)	598.49	544.40	567.28	588.56	522.93
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Observations with firms doing R&D	1134	1134	1134	1134	1134
Observations with firms without R&D	2603	2603	2603	2603	2603
Cragg & Uhler's R^2	0.182	0.180	0.178	0.180	0.177

Note: Robust z statistics in parenthesis; JV–joint ventures; WOS–Wholly owned subsidiaries; * significant at 10%; ** significant at 5%; *** significant at 1%.

All the OFDI dummy variables represented in different estimations generally come up with statistically significant coefficients with predicted positive signs. OFDIDUM emerges with a positive coefficient indicating that Indian automotive firms that have overseas presence through OFDI are likely to conduct more R&D than other firms. Therefore, outward investing Indian automotive firms are likely to benefit from global knowledge spillovers for doing more in-house R&D as they get proximity to innovation centres and innovative competitors in foreign countries. OFDIDUM_D and OFDIDUM_DL capturing locational geography by host developed and developing region are both playing a significantly positive role in the R&D performance of Indian automotive sector. Hence, irrespective of the location of their outward investment, foreign presence appears to be a promoting factor for in-house R&D. Indian automotive firms seem to be learning from not just innovative developed countries, but also from emerging countries like China, South Korea, Malaysia, Indonesia, Singapore and South Africa that have long industrial tradition and concentration of R&D within the developing region. However, the estimated coefficient of developed region OFDI is larger than developing region OFDI indicating greater knowledge flows from the former. This is as expected before since developed region is traditionally more innovative than developing region.

OFDIDUM_JV and OFDIDUM_WOS dummies capturing the ownership mode of outward investing Indian automotive firms also came up with statistically significant effect on R&D intensity with the former significant at 1 per cent level and the latter at 5 per cent level. This suggests that Indian automotive firms are generally benefitting in terms of more domestic R&D due to their OFDI presence, irrespective of their choice of ownership pattern. Since joint venture OFDI achieves relatively more significant and larger coefficient than wholly-owned subsidiary OFDI, there is some indication that R&D promoting effect of OFDI is better in the case of joint venture.

There are a number of other independent variables that are significantly affecting R&D activities of Indian automotive firms. AGE, SIZE, DISTECH, EXPOINT and FDUM all have significant positive coefficients throughout. Other factors being equal, R&D activities of Indian automotive firms grow linearly with their age. The greater the age of the firm, greater may be its accumulated knowledge stock that in turn encourages greater in-house R&D activities. Large-sized Indian automotive firms seem to have special advantage in conducting more R&D activities than small-sized firms. The finding on DISTECH suggest that external technology purchase, rather than substituting, has actually been promoting firm-level in-house R&D. Indian automotive firms buying disembodied technologies are more likely to spend also on in-house R&D. However, our dataset used here does not permit us to investigate if this additional R&D is for minor adaption of purchased technologies or for major technological improvement based thereon. Export-intensity also came out as an important factor for a deeper R&D involvement of Indian automotive firms. Global buyers appear to be imposing greater quality and efficiency requirements on the part of Indian automotive suppliers. Foreign affiliates in Indian automotive sector show relatively greater R&D performance than their domestic counterparts, holding other factors constant.

Liberalization dummies, namely LIBDUM1 and LIBDUM2 both came out with significantly negative coefficients. This suggests that R&D performance of Indian automotive firms in 2003–2008 was much higher than their performance in previous two periods 1988–1992 and 1993–2002. The sizes of the negative coefficients of LIBDUM1 and LIBDUM2 also imply that the difference in their average R&D intensity between 2003–2008 and 1988–1992 is much larger than the difference between 2003–2008 and 1993–2002. This corroborates the hypothesis that progression of policy measures from a restrictive phase (1980–1992) to a liberalized one (1993–2002) and then further to a strategically proactive one (2003–2008) have successively pushed up R&D intensity in the Indian automotive sector.

ACOM_DUM came out with a negative coefficient that achieves statistical significance at 1 per cent level. This seems to verify the hypothesis that R&D performance of primarily automotive component producers is on lower side as compared to that of automotive vehicle manufacturers. Among the rest two explanatory variables, PROFIT has a positive effect but consistently failed to achieve any acceptable level of significance. This finding seems to indicate that R&D activities in Indian automotive firms are not systematically depending upon their profitability performance. EMTECH has a negative sign in all the regressions but falls short of reaching 5 per cent significance level; it could at most achieve a significance level of 10 per cent marginally in one case.

Impacts of OFDI Intensity

In order to further explore the link between OFDI and R&D, we have employed OFDI intensity to re-estimate all the regressions for Indian automotive firms. The idea is to examine whether the in-house R&D of Indian automotive firms also gets affected when they increase their OFDI intensity rather than simply being outward investing firms. As R&D intensity has been found to be a contributory factor for OFDI of Indian manufacturing firms (Pradhan, 2004), the variable OFDI intensity contemporaneously raises the issue of bi-way causality. Therefore, we have introduced OFDI intensity in one year and two year lagged form in the estimation. The findings from the estimations using one year lagged and two year lagged OFDI intensities are summarized in Table-12 and Table-13 respectively.

Table-12
Tobit Results on One Year Lagged OFDI Intensity and R&D Performance of Indian Automotive Firms

Dependent variable: R&D intensity (%)

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
AGE	0.015561***	0.015532***	0.015597***	0.015541***	0.015602***
	(9.99)	(9.97)	(10.01)	(9.96)	(10.02)
SIZE	0.000008***	0.000008***	0.000008***	0.000009***	0.000008***
	(5.54)	(5.90)	(5.69)	(6.15)	(5.29)
DISTECH	0.152863***	0.150567***	0.151050***	0.150742***	0.150460***
	(3.33)	(3.31)	(3.32)	(3.31)	(3.31)
EMTECH	0.002486	0.002357	0.002586	0.002619	0.002433
	(0.81)	(0.77)	(0.84)	(0.85)	(0.80)
EXPOINT	0.005599***	0.005550**	0.005963***	0.005987***	0.005768***
	(2.60)	(2.58)	(2.77)	(2.78)	(2.68)
PROFIT	0.000226	0.000227	0.000226	0.000226	0.000226
	(1.20)	(1.20)	(1.20)	(1.21)	(1.20)
FDUM	0.627594***	0.629540***	0.622558***	0.629446***	0.621142***
	(8.23)	(8.27)	(8.17)	(8.25)	(8.17)
LIBDUM1	-1.998320***	-1.983747***	-2.003924***	-2.014318***	-1.985884***
	(9.79)	(9.67)	(9.81)	(9.85)	(9.68)
LIBDUM2	-0.215859***	-0.216795***	-0.223815***	-0.229107***	-0.217535***
	(3.07)	(3.08)	(3.19)	(3.27)	(3.09)
ACOM_DUM	-0.559983***	-0.577642***	-0.570346***	-0.551605***	-0.591511***
	(5.96)	(6.22)	(6.07)	(5.76)	(6.39)
OFDINT_L1	0.177300***				
	(3.85)				

contd...

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
OFDINT_DL1		0.291341***			
		(4.22)			
OFDINT_DLL1			0.153099***		
			(2.69)		
OFDINT_JVL1				0.212343***	
				(3.17)	
OFDINT_WOSL1					0.150270**
					(2.52)
Constant	-0.724089***	-0.70220***	-0.709344***	-0.725050***	-0.689264***
	(5.92)	(5.81)	(5.80)	(5.86)	(5.72)
Log-likelihood	-2992.79	-2994.4204	-2994.7055	-2994.3376	-2995.2757
Wald chi2(11)	494.03	505.00	467.52	466.93	485.15
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Observations with firms doing R&D	1114	1114	1114	1114	1114
Observations with firms without R&D	2194	2194	2194	2194	2194
Cragg & Uhler's R^2	0.156	0.155	0.155	0.155	0.155

Note: Robust z statistics in parenthesis; JV–joint ventures; WOS–Wholly owned subsidiaries; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table-13
Tobit Results on Two Year Lagged OFDI Intensity and R&D Performance of Indian Automotive Firms

Dependent variable: R&D intensity (%)

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
AGE	0.013722***	0.013659***	0.013735***	0.013661***	0.013728***
	(8.51)	(8.48)	(8.52)	(8.47)	(8.53)
SIZE	0.000008***	0.000008***	0.000008***	0.000009***	0.000008***
	(5.44)	(5.67)	(5.52)	(5.92)	(5.36)
DISTECH	0.210102***	0.206366***	0.208309***	0.208330***	0.206113***
	(5.22)	(5.14)	(5.18)	(5.17)	(5.13)
EMTECH	0.009900*	0.009814*	0.009956*	0.010024*	0.009834*
	(1.70)	(1.68)	(1.70)	(1.71)	(1.68)
EXPOINT	0.005963***	0.005923**	0.006300***	0.006338***	0.006145***
	(2.58)	(2.56)	(2.73)	(2.75)	(2.66)
PROFIT	0.000218	0.000218	0.000218	0.000218	0.000218
	(1.19)	(1.18)	(1.19)	(1.19)	(1.18)
FDUM	0.588634***	0.591469***	0.584445***	0.592261***	0.583326***

contd...

Independent variables	*Coefficients (Robust z-value)*				
	Total	*Regional Dimension of OFDI*		*Ownership Structure of OFDI*	
		Developed	*Developing*	*JV*	*WOS*
	(7.83)	(7.88)	(7.78)	(7.88)	(7.77)
LIBDUM1	-1.701759***	-1.677325***	-1.705345***	-1.717994***	-1.679823***
	(7.64)	(7.48)	(7.66)	(7.69)	(7.49)
LIBDUM2	-0.178399**	-0.179292**	-0.183778**	-0.188279***	-0.180178**
	(2.48)	(2.49)	(2.56)	(2.62)	(2.50)
ACOM_DUM	-0.534678***	-0.552484***	-0.541749***	-0.524817***	-0.562660***
	(5.58)	(5.81)	(5.65)	(5.39)	(5.92)
OFDINT_L2	0.175519***				
	(3.67)				
OFDINT_DL2		0.274548***			
		(3.01)			
OFDINT_DLL2			0.159813***		
			(2.85)		
OFDINT_JVL2				0.219356***	
				(3.29)	
OFDINT_WOSL2					0.128607**
					(2.21)
Constant	-0.679598***	-0.65551***	-0.668941***	-0.682922***	-0.646257***
	(5.47)	(5.33)	(5.38)	(5.45)	(5.27)
Log-likelihood	-2795.6354	-2797.6909	-2796.9405	-2796.3878	-2798.3601
Wald chi2(11)	421.13	426.16	403.18	406.82	410.90
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Observations with firms doing R&D	1067	1067	1067	1067	1067
Observations with firms without R&D	1812	1812	1812	1812	1812
Cragg & Uhler's R^2	0.139	0.137	0.138	0.138	0.137

Note: Robust z statistics in parentheses; JV- joint ventures; WOS- Wholly owned subsidiaries; * significant at 10%; ** significant at 5%; *** significant at 1%.

The presented empirical findings on lagged OFDI intensities corroborate that Indian automotive firms appear to enjoy a special advantage in conducting in-house R&D when they enhance the magnitude of their OFDI operation. OFDINT_L1 (one year lagged OFDI intensity) and OFDINT_L2 (two year lagged OFDI intensity) came up with significantly positive impacts in their respective estimations. Their impact was consistent across different regressions over host regions and level of equity participation in OFDI projects. Therefore, it is not just OFDI presence in foreign countries that is encouraging R&D intensity of Indian automotive firms, but also the degree of their OFDI involvement is an important conducive factor.

The performances of other predictors like AGE, SIZE, DISTECH, EXPOINT, PROFIT, LIBDUM1, LIBDUM2 and ACOM_DUM across these estimations are generally in line with the findings obtained in the case of estimations involving OFDI dummy variable. Inferences drawn on these independent variables while discussing results in the case of estimations with OFDI dummy variables remain largely valid in the case of estimations involving OFDI intensities. EMTECH is an exception with sensitivity over different specifications. While it has largely an insignificant negative coefficient in regressions with OFDI dummy variable, it has an insignificant positive coefficient and a moderately (10 per cent) positive coefficient in regressions with one year lagged and two year lagged OFDI intensities respectively.

5. Concluding Remarks

The Indian automotive sector has been experiencing a phase of rapid growth and capability formation in recent years. With the government policy regimes on industry, inward FDI, technology and trade evolving from a restrictive phase in pre-1990s to a facilitative one in 1990s and then to a more strategic one in 2000s, both Indian vehicle and component manufacturers have been rapidly upgrading their competitive prowess. Concurrently these Indian automotive firms are also aggressively transnationalizing their business through strategic alliances, exports and outward FDI. The phenomena of rising outward investment (both greenfield and acquisitions) from Indian automotive sector present an interesting case of cross-border knowledge flows led by developing country enterprises.

The case studies of Tata and Amtek groups clearly show that these groups are engaged in in-house knowledge creation and are seeking external complementary technical and value-adding manufacturing assets. When these groups undertake greenfield OFDI and strategic acquisitions, they become a source as well as recipients of cross-border knowledge flows.

The empirical findings strongly support the postulation that OFDI is an important determinant of domestic R&D performance of Indian automotive firms. With OFDI the Indian automotive firms appear to be gaining access to technological and market information in foreign countries which motivates them to undertake higher R&D. The favourable effect of OFDI on R&D is found for both developed and developing host regions, interestingly stronger in case of the former. OFDI in the form of joint venture as well as wholly-owned subsidiary tends to encourage R&D at home, relatively more in the case of joint venture. Other significant explanatory variables that positively affect R&D intensity of Indian automotive firms are firm age, size, purchase of disembodied technologies, export intensity, foreign ownership and liberalization. Auto component producers have lower R&D intensity as compared to vehicle manufacturers.

A number of policy observations and lessons can be deduced from this study. Given the fact that outward FDI operations of firms (both greenfield and brownfield forms) tend to be instrumental in improving their domestic R&D, a strategic OFDI policy should be adopted by the home developing countries. The government should particularly facilitate the strategic-asset seeking OFDI, as is being done in China.[23] While the OFDI regulations have been liberalized in India, a focused policy is required to strengthen the multinational operations of Indian firms, with targeted national champions being supported through information, finance and other support services (Pradhan, 2008b). Earlier Singh (2007) recommends that the government needs to support and encourage outward FDI (even the setting up of overseas R&D centres), say through special investment tax credit scheme for business fixed investment abroad in plant & equipment and buildings, also for acquisitions. We may add that the 150% weighted average deduction of R&D expenses from the taxable income of automotive firms in India should also be extended to their initial capital expenses for setting up/acquiring overseas R&D/technical/engineering centres. Encouraging such overseas centres and R&D collaborations, with or without manufacturing abroad, would add to the augmentation of strategic assets. It is also important to create a collaborative platform involving both the automotive industry associations SIAM and ACMA to synergise OFDI by vehicle and auto component producers from India.

The R&D by the Indian automotive firms can also be encouraged by facilitating the firms' access to foreign technical collaborations and enhancing export-supporting infrastructure.[24] Also since the size variable has a positive impact on R&D intensity, and the Indian automotive firms are relatively small by international standard, measures to mitigate small size disadvantage like clusters upgradation and common testing facilities could be very helpful in pushing up automotive R&D.

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[23] In China there is a strong support for the firms' globalization in general—starting with the Chinese government 'go-global' strategy announced in October 2000—and for them to acquire the strategic assets in particular (Deng, 2007; Rui and Yip, 2008); the targeted State-owned enterprises are encouraged to engage in overseas FDI and are offered the tax benefits, investment insurance and subsidized loans from State financial institutions. There is an intense domestic competition between the foreign and domestic firms in certain sectors. The Chinese firms view the foreign acquisitions as a fast way of obtaining a complete set of new capabilities.

[24] Under its 2004 Auto Policy, China has imposed 'minimum stipulated size R&D facility' and technical cooperation conditions for inward FDI into vehicle and automotive engine sectors.

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Appendix

Table-A1
R&D Investment Growth Rate of Selected Indian Automotive Firms by Segments during 2000–2007

Company Name	*R&D growth rate*	*Product*	*Remark*
Automobile ancillaries			
Rane T R W Steering Systems Ltd.	415.0	Steering gears	Consistently doing R&D activities since 1994. Its R&D expenses have grown from Rs. 2.1 million in 1994 to Rs. 49 million in 2007. However, in terms of R&D intensity, such expenses account for about 1 per cent or less.
Subros Ltd.	356.0	Automobile ancillaries, nec	Its sporadic R&D investment started in early 1990s and assumed a consistent trend since 1999. The absolute R&D investment of the company, which was less than Rs. 1 million in 1995, has gone up to Rs. 112 million in 2005 and Rs. 84 million in 2007. Its R&D intensity for last four years varies in the range of 1–1.5 per cent.
Banco Products (India) Ltd.	173.1	Automobile engine parts	Banco's R&D that began in 1995 with Rs. 0.7 million investments has gone up to Rs. 37 million in 2007. However, its R&D intensity reached the 1 per cent level only in 2007.
Bharat Forge Ltd.	134.5	Automobile ancillaries, nec	Its R&D expenses have increased from Rs. 5.6 million in 1996 to Rs. 69 million in 2008. Like most other ancillary firms, its R&D intensity is yet to reach 1 per cent level.
Bosch Chassis Systems India Ltd.	109.4	Suspension & braking parts	From Rs. 0.8 million of R&D investments in 1993, Bosch achieved Rs. 62 million R&D investment in 2007. For recent years, its R&D expenses account for about 1 per cent of sales.
Ucal Fuel Systems Ltd.	85.1	Carburettors	Its R&D has increased from Rs. 13 million in 1996 to Rs. 155.5 million in 2007. It is amongst the most aggressive R&D-oriented firms with R&D accounting for about 3–4 percent of sales in recent years.
Pricol Ltd.	84.8	Automobile equipment	A consistently outperforming R&D-intensive firm with R&D going up from Rs. 14 million in 1993 to Rs. 239 million in 2008. Its R&D intensity is about 3 per cent for majority of years during 1993–2008.
Wheels India Ltd.	74.1	Wheels for automobiles	Consistently allocating resources for R&D. From Rs. 5.2 million in 1992, its R&D has grown to Rs.

contd...

Company Name	*R&D growth rate*	*Product*	*Remark*
			103 million in 2008. Its average R&D intensity is about 1 per cent.
Automobile Corpn. Of Goa Ltd.	72.2	Other Automobile ancillaries, nec	It has a consistent record of R&D activities since 1993 but allocated resources for R&D rarely reaches 1 per cent.
Harita Seating Systems Ltd.	71.0	Auto seating systems	Its R&D has grown smartly from Rs. 0.7 million in 1994 to reach Rs. 19 million in 2008. Its average R&D intensity is at about 1 per cent level.
Sharda Motor Inds. Ltd.	64.0	Automobile ancillaries, nec	A recent entrant to R&D in 2001 with Rs. 21 million. In 2006, its R&D investment is estimated to be Rs. 25.7 million. It has an average R&D intensity of 1 per cent for recent years
Shriram Pistons & Rings Ltd.	62.8	Pistons	From a modest R&D beginning of Rs. 5.8 million in 1993, it has invested about Rs. 95.7 million in 2007. From 2002 onwards, its R&D intensity has been consistently above 1 per cent level.
India Nippon Electricals Ltd.	57.2	Flywheel magnetos	Started R&D investment in 1998. Its average R&D intensity is about 1 per cent of sales.
Minda Industries Ltd.	55.6	Automobile equipment	Its R&D intensity is ranging from 3–7 per cent during 1998–2008. From Rs. 12 million in 1998, its R&D investment has increased to Rs. 150 million in 2008.
Hindustan Composites Ltd.	54.4	Brake linings	Its R&D activities started in 1996 with Rs. 2.9 million worth of investment. In 2007, it spent Rs. 10.4 million on in-house R&D. On an average, the company has spent about 1 per cent of its sales in R&D during 1996–2007.
Sona Koyo Steering Systems Ltd.	53.1	Drive transmission & steering parts	Its average R&D intensity is just 0.5 per cent over 1997–2008. In absolute terms, its R&D investment has increased from Rs. 4.3 in 1997 million to Rs. 21.3 million in 2007.
Lucas-TVS Ltd.	52.7	Electrical automobile parts	Doing in-house R&D from 1997 onwards with investment grown from Rs. 95.7 million in 1997 to 239.2 million in 2007. The company has shown an average R&D intensity of 2 per cent level.
Sundram Fasteners Ltd.	51.7	Automobile ancillaries	The company didn't have a consistent R&D strategy prior to 2002. Some sporadic R&D expenses were undertaken in 1994, 1995 and 2000. From Rs. 11.7 million R&D spending in 2002, it has opted for a continuous R&D activity. However, its R&D intensity is yet to reach 1 per cent mark.
Brakes India Ltd.	47.4	Suspension & braking parts	An early entrant into R&D since 1992. Its R&D has grown from Rs.28.5 million in 1992 to Rs. 196

contd…

Company Name	R&D growth rate	Product	Remark
			million in 2007. As a percentage of sales, R&D investment consistently accounted for more than 1 per cent level.
K S Diesels Ltd.	45.6	Automobile engine parts	Doing consistent R&D from 2000 onwards, but in small amounts. In terms of sales, R&D is not even 1 per cent level.
Commercial vehicles			
Ashok Leyland Ltd.	122	Heavy commercial vehicles	Although its in-house R&D investment can be detected in 1991, a consistent pattern can be observed from 1994 onwards. During 1994–1999, its R&D investment fell below 1 per cent level of sales. After reaching about 1 per cent in 2001, its R&D intensity has gone up to 2.2 per cent in 2008.
Tata Motors Ltd.	108	Heavy commercial vehicles	Its R&D investment has grown from Rs. 753 million in 1995 to Rs. 11960 million in 2008. During 1995–2004, its R&D accounted for more than 1 per cent of sales. After reaching 1.9 per cent in 2005, its R&D intensity has consistently risen to 3.7 per cent in 2008.
Force Motors Ltd.	90	Light commercial vehicles	It has been pursuing a consistent R&D strategy since 1993. The size of R&D investment undertook by the company has grown from Rs. 70.2 million in 1993 to Rs. 119.9 million in 1996 and then to Rs. 401 million in 2007. Its R&D intensity, which was averaged to about 2 per cent during 1993–2000, reached 5.2 per cent in 2006.
Swaraj Mazda Ltd.	28	Light commercial vehicles	Started R&D in 1997 and continued during 1999–2008. However, it is yet to reach 1 per cent level of its R&D intensity.
Eicher Motors Ltd.	28	Light commercial vehicles	Recently started R&D from 2002 onwards. Within this short period it has impressively spent about 2 per cent of sales on R&D.
Passenger cars & multi utility vehicles			
Ford India Pvt. Ltd.	640	Passenger cars	Its R&D investment has gone up from just Rs. 1.7 million in 2000 to Rs. 205 million in 2005. Its average R&D intensity falls below 1 per cent.
Hyundai Motor India Ltd.	438	Passenger cars	From Rs. 1.1 million R&D spending in 2000, it has increased R&D to Rs. 61.6 million in 2007. In terms of sales, R&D is just 0.1 per cent.
Mahindra & Mahindra Ltd.	54	Utility Vehicles incl. jeeps	It has a sporadic R&D behaviour in the 1990s but adopted a consistent innovation strategy since 2002. The period 2002–2008 has witnessed

contd...

Company Name	*R&D growth rate*	*Product*	*Remark*
			significant growth of its R&D expenses from Rs. 690 million to 2174 million which accounted for above 1 per cent of its sales in various years.
Honda Siel Cars India Ltd.	40	Passenger cars	It has conducted consistent R&D during 1999–2005, but no R&D spending can be detected over 2006–2007. As with other passenger car manufacturers, its R&D intensity is less than 1 per cent mark.
Maruti Suzuki India Ltd.	26	Passenger cars	Consistently a R&D performing firm since 1995. Its R&D investment has gone up from Rs. 97 million in 1995 to Rs. 639 million in 2007. Its average R&D is only 0.3 per cent.
Hindustan Motors Ltd.	-39	Passenger cars	It has been doing consistent R&D from 1989 onwards. Its R&D investment has grown from Rs. 20 million in 1989 to Rs. 105.7 million in 1999 and since then has shown a declining trend. Its average R&D intensity is about 0.5 per cent.
Two & three wheelers			
T V S Motor Co. Ltd.	84	Two wheelers	It has been a R&D focused company since 1992. Its R&D investment has increased from Rs. 8 million in 1992 to Rs. 150 million in 2000. The period 2001–2008 has seen significant expansion in its R&D spending from Rs. 161 million in 2001 to Rs. 703.5 million in 2008. The average R&D intensity of the company has gone up from 0.9 per cent in 1992–2000 to 1.8 per cent in 2001–2008.
Hero Honda Motors Ltd.	63	Motorcycles	Since starting R&D activities in 1995, it has adopted a continuous R&D strategy. Its R&D investment has grown from Rs. 13.7 million in 1995 to Rs. 259.6 million in 2007. However, its average R&D intensity is just about 0.3 per cent.
Kinetic Motor Co. Ltd.	33	Scooters	It has been incurring R&D expenditure since 1995. The value of its R&D investment has grown from Rs. 3.2 million in 1995 to Rs. 54.2 million in 2007. As a proportion to sales, R&D accounted for 0.3 per cent in 1995–2000 and then 3.1 per cent in 2001–2007.
Scooters India Ltd.	-12	Three wheelers	The company started R&D only in 2002 and is yet to incur substantial amount on it. The size of its R&D investment has reduced from 4.5 million in 2002 to Rs. 2.6 million in 2007. The average value of its R&D intensity is just 0.26 per cent.
L M L Ltd.	-39	Scooters	It has an aggressive R&D strategy in place since

contd...

Company Name	*R&D growth rate*	*Product*	*Remark*
			1994. Its R&D investment has consistently grown from Rs. 6.7 million in 1994 to Rs. 126.7 million in 2003 and then declined to 14.1 million in 2007. In spite of the slowdown in the absolute size of R&D investment, as a proportion of sales, it has increased from 1 per cent during 1994–2003 to 2 per cent in 2004–2007.
Kinetic Engineering Ltd.	-46	Mopeds	It has started R&D activities in 1993 by incurring Rs. 7.6 million. During 1995–2001, the company aggressively invested in R&D an aggregate investment of Rs. 364.7 million averaging to 2.2 per cent of sales. However, its R&D investment has been consistently falling since 2002 and average R&D intensity reduced to 1.4 per cent in 2002–2007.
Majestic Auto Ltd.	-71	Mopeds	It has a consistent R&D strategy beginning from 1994. However, the amount spent is not very large and has sharply fallen since 2002. Its average R&D intensity is 0.5 per cent during 1994–2007.

Note: The growth rate has been obtained from the semi-log regression model of the form: LogY=a+bt, where growth rate = (antilog b-1)*100. R&D investment is measured in terms of Indian Rs. Million at current prices.

Source: Based on Prowess database, version 3.1.

Table-A2
Top 25 Indian Automotive Firms based on Average Disembodied Technological Spending Intensity, 1991–2007

Company Name	*Royalties and technical know-how fees as a per cent of sales*	*Products*
Man Force Trucks Pvt. Ltd.	11.37828	Commercial vehicles
Super Shock Absorbers Ltd.	6.5	Automobile ancillaries
High Technology Transmission Systems (India) Pvt. Ltd.	6.277416	Automobile ancillaries
Hi-Tech Arai Ltd.	4.781014	Automobile ancillaries
T R W Rane Occupant Restraints Ltd.	3.908629	Automobile ancillaries
Mercedes-Benz India Pvt. Ltd.	3.74397	Passenger cars & multi utility vehicles
Luk India Pvt. Ltd.	3.653406	Automobile ancillaries
Honda Siel Cars India Ltd.	3.557843	Passenger cars & multi utility vehicles
Motherson Pudenz Fuses Ltd. [Merged]	3.306973	Automobile ancillaries
Valeo Friction Materials India Ltd.	3.198463	Automobile ancillaries
Tata Auto Plastic Systems Ltd.	3.149386	Automobile ancillaries
I P Rings Ltd.	2.951389	Automobile ancillaries
Haldex India Ltd.	2.942799	Automobile ancillaries
Tata Yazaki Autocomp Ltd.	2.839469	Automobile ancillaries
Hyundai Motor India Ltd.	2.768985	Passenger cars & multi utility vehicles
India Japan Lighting Ltd.	2.644032	Automobile ancillaries
Climate System India Ltd.	2.624899	Automobile ancillaries
Ucal Fuel Systems Ltd.	2.587164	Automobile ancillaries
Trelleborg Automotive India Pvt. Ltd.	2.530934	Automobile ancillaries
Harita-Grammer Ltd. [Merged]	2.38	Automobile ancillaries
Yamaha Motor India Pvt. Ltd.	2.356203	Two & three wheelers
Denso India Ltd.	2.233484	Automobile ancillaries
Kinetic Motor Co. Ltd.	2.227915	Two & three wheelers
T C Springs Ltd.	2.219292	Automobile ancillaries
Rane N S K Steering Systems Ltd.	2.132896	Automobile ancillaries

Source: Based on Prowess database, version 3.1.

Table-A3
Indian Auto Component Exports, Imports and Turnover: 2002–03 to 2007–08

Indicators	*2002—03*	*2003—04*	*2004—05*	*2005—06*	*2006—07*	*2007—08 (est.)*	*5-year p.a. % Growth*
Exports ($ million)	760	1274	1692	2469	2873	3615	36.6
Turnover[a] ($ million)	5430	6730	8700	12000	15000	18000	27.09
Ratio of Exports to Turnover (%)	14	18.93	19.45	20.58	19.15	20.08	
Auto Component Imports ($ million)	740	1428	1902	2482	3328	4938	46.17
Ratio of Imports to total Domestic Demand[b] (%)	13.68	20.74	21.35	20.66	21.53	25.56	

Note: a–The figures for 2002–03, 2003–04 and 2004–05 are for production; b–The total domestic demand for auto components is estimated as the turnover plus net imports.

Source: Compiled from ACMA (2008:23) and other ACMA sources.

Table-A4
Indian Exports and Production of Automobiles: 2002–03 to 2007–08

Indicators	*2002—03*	*2003—04*	*2004—05*	*2005—06*	*2006—07*	*2007—08*	*5-year Average Growth p.a. (%)*
Exports (No.)							
Passenger Vehicles	72,005	1,29,291	1,66,402	1,75,572	1,98,452	2,18,418	24.85
Commercial Vehicles	12,255	17,432	29,940	40,600	49,537	58,999	36.93
Three Wheelers	43,366	68,144	66,795	76,881	1,43,896	1,41,235	26.64
Two Wheelers	1,79,682	2,65,052	3,66,407	5,13,169	6,19,644	8,19,847	35.47
Production (No.)							
Passenger Vehicles	7,23,330	9,89,560	12,09,876	13,09,300	15,45,223	17,62,131	19
Commercial Vehicles	2,03,697	2,75,040	3,53,703	3,91,083	5,19,982	5,45,176	21.76
Three Wheelers	2,76,719	3,56,223	3,74,445	4,34,423	5,56,126	5,00,592	12.59
Two Wheelers	50,76,221	56,22,741	65,29,829	76,08,697	84,66,666	80,26,049	9.6
Ratio of Exports to Production (%)							
Passenger Vehicles	9.95	13.07	13.75	13.41	12.84	12.4	
Commercial Vehicles	6.02	6.34	8.46	10.38	9.53	10.82	
Three Wheelers	15.67	19.13	17.84	17.7	25.87	28.21	
Two Wheelers	3.54	4.71	5.61	6.74	7.32	10.21	
Turnover (Rs. billion)	NA	936.7	1121.45	1240.57	1403.32	1489.62*	12.30**
Exports (Rs. billion)	NA	64.76	88.09	102.61	117.38	138.36*	20.90**
Ratio of Exports to Turnover (%)		6.91	7.85	8.27	8.36	9.3	

Note: Passenger vehicles here refer to passenger cars and utility vehicles; *- Provisional; ** 2003–04 to 2007–08 period.

Source: SIAM; the turnover and export values are from www.dayafterindia.com.

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Institute for Studies in Industrial Development
4, Institutional Area, Vasant Kunj, New Delhi - 110 070, India
Phone: +91 11 2689 1111; *Fax:* +91 11 2612 2448
E-mail: info@isid.org.in; *Website:* <http://isid.org.in>

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