Challenges and Strategies for Offshoring R&D to Emerging Countries: Evidence from Foreign MNCs’ R&D Subsidiaries in India

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LIST OF ABBREVIATIONS

AICTE- All India Council for Technical Education
BRIC- Brazil, Russia, China and India
CD- Cultural Distance
CEO- Chief Executive Officer
EU- European Union
E&T- Engineering and Technology
FDI- Foreign Direct Investment
GDP- Gross Domestic Product
GE- General Electric
GSM- Global System for Mobile communications
HC- Human Capital
HEI- Higher Education Institute
IB- International Business
ICN- Inventor Country
ICT- Information and Communications Technology
ID- Individualism Distance
IN- India
IP- Intellectual Property
IPR- Intellectual Property Regulations
ISD- Issue Date
IT- Information Technology
ITES- Information Technology Enabled Services
I-A- Industry-Academia
JV- Joint Venture
M&A- Mergers and Acquisitions
ME- Mobility Event
MNC- Multinational Corporation
MoU- Memorandum of Understanding
NCA- Non-Compete Agreement
NDA- Non-Disclosure Agreement
NSA- Non-Solicitation Agreement
PD- Power Distance
PG- Postgraduate
R&C- Research and Consultancy
R&D- Research and Development
RBV- Resource-Based View
RD- Regulatory Distance
RL- Rule of Law
RQ- Research Question
SC- Social Capital
STEM- Science Technology Engineering and Mathematics
TASK- Telangana Academy for Skill and Knowledge
TPO- Third-Party Organisations
UA- Uncertainty Avoidance
UG- Undergraduate
USA- United States of America
USPTO- United States Patent and Trademark Office
USTR- United States Trade Representative
VIF- Variable Inflation Factor
WCDMA- Wideband Code Division Multiple Access
ABSTRACT

This thesis studies two key challenges for offshoring R&D activities to emerging countries in terms of recruiting and retaining talent: low-quality of fresh Engineering graduates and high outward mobility of inventors and investigates firms’ strategies to overcome these challenges. This thesis is a collection of three research papers.

The first paper of this thesis presents research findings from an exploratory study of 12 firms in India to establish how these firms use teaching-focused collaboration strategies with universities to develop graduates with prerequisite skills for R&D positions and overcome the low talent quality challenge. By offering insights into how teaching-focused I-A collaborations are operationalised, and the drivers and challenges for universities and corporations participating in such alliances, this paper strengthens a much-neglected dimension of industry-academia (I-A) collaboration literature: the role of collaborative activities in teaching with industry. In addition, this paper contributes to the human capital theory by demonstrating the potential of teaching-focused I-A collaborations to provide an alternative to the traditional graduate recruitment and development model: ‘in-house on-the-job training’.

The second paper of this thesis further contributes to this line of research by exploring the HEI-level and institutional determinants of teaching-focused I-A collaborations using mixed methods. Based on 52 interviews and data collected from the websites of 2,224 HEIs, we show that, among institutional factors, academic discipline, government support, HEIs’ location, autonomy, and private ownership drive their involvement in teaching-focused collaborations with industry. Among HEI-level factors, HEIs’ size, quality, industrial and academic embeddedness influence HEIs’ collaboration with industry in teaching.

The third paper of this thesis aims at explaining the factors behind inventors’ high outward mobility in emerging countries. We claim that MNCs’ formal and informal institutional distance with the host countries positively impact the inventors’ outward mobility from subsidiaries. We also posit that experience plays a moderating role at both the micro level (i.e. at the individual inventor-level) and macro level (i.e. at the MNC-level). Our empirical analysis refers to foreign ICT MNCs in India, in the period 1996-2016, and adopts a novel methodology of tracking 1,421 inventors’ mobility on LinkedIn.
DECLARATION

I, Dhruba Jyoti Borah, declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

In addition, I declare that for the three papers which collectively form this thesis, I was in charge of developing the ideas, collecting and analysing data and drafting the papers.
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CHAPTER 1 INTRODUCTION

1.1 Offshoring of R&D to Emerging Countries

Evidence from recent studies (Lewin et al., 2009; Gerybadze and Merk, 2014; Zedtwitz and Gassmann, 2016) clearly show that for the last two decades, multinational companies (MNCs) have been increasingly offshoring substantial percentage of their global Research and Development (R&D) activities, which were earlier localised mainly in TRIAD regions- Japan, Western Europe and North America (Dunning, 1994; Patel and Pavitt, 1998), to emerging countries especially to the BRIC nations (Brazil, Russia, India and China). “Between 2000 and 2015, the number of MNC R&D centres in emerging countries grew by a factor of five, while in the countries this number merely doubled” (Zedtwitz and Gassmann, 2016, p.125). Offshoring refers to “organisation of tasks in a country different from where a firm’s headquarters are located” (Grossman and Rossi-Hansberg, 2011, p.3). Offshoring of R&D includes both ‘captive’ (where R&D is largely kept in-house through setting up subsidiaries abroad) and ‘outsourced R&D’ (where R&D is outsourced to an external partner located abroad) (Lewin et al., 2009). For the purpose of this thesis, we only focus on the captive part of offshoring. Gerybadze and Merk (2014) reported that researchers located in China and India constitute 63% of the global R&D staff of General Electric (GE). On the other hand, Cisco’s largest R&D laboratory outside the USA is set-up in India (Cisco, 2017). Figure 1.1 shows the locations of foreign R&D centres of US MNCs as of 2017. It can be observed that the BRIC nations are catching up with the TRIAD region in terms of foreign R&D investments from US MNCs.
Emerging countries evolved as attractive destinations for offshoring of R&D activities for several reasons. First, emerging countries with more than 40% share of the global population represent huge markets for MNCs. Since institutionally, these markets differ greatly from the TRIAD region, local R&D centres are necessary for modifying their existing products and technologies in line with the local needs and institutional norms. Such a strategy is termed as ‘home-base exploiting’ (Kuemmerle, 1997), i.e., exploitation of existing knowledge (knowledge that is produced in the home country) to fulfil market expectations in the host country. Thus, by setting up local R&D facilities in these countries, MNCs are able to offer support to their existing manufacturing operations in terms of quality development, cost reduction, capability enhancement, product portfolio extension and product development conforming to local specifications and needs with a ‘shorter R&D cycle time’ (Gassmann and Han, 2004). Products may fail if not appropriately adapted or modified based on the local institutional norms. For instance, Microsoft had to recall approximately 200,000 Windows 95 copies in India as
it portrayed an improper map of India\(^1\) (Khanna and Choudhury, 2007). Also, within the same country, due to the regional-level institutional differences, region-wise localisation of products could be necessary. For instance, Microsoft had to transform their products to match the regional language requirements in China and India. While in China, region-wise the use of ‘traditional’ versus ‘simplified’ Chinese varies (Khanna and Choudhury, 2007), in India, there are 22 officially recognised languages. Establishment of local R&D subsidiaries, therefore, may assist MNCs to understand the institutional differences with the host country and modify products accordingly.

Second, the abundant availability of science, technology, engineering and mathematics (STEM) talent in emerging countries appeared to be another motivating factor. MNCs are becoming concerned by the ageing population, and lack of interest among students in home countries to study science and engineering streams. Manning et al. (2008) reported that since the early 2000s USA and Western European countries experienced stagnation or decline in the number of nationals and permanent residents holding postgraduate degrees in science and engineering disciplines. On the other hand, during the same time period, emerging countries have enhanced their educational infrastructure to produce a large pool of graduates in the engineering and technology domains, which could help MNCs solve the talent shortage in their home countries. During the period 2000-2009, approximately 6.45 million students enrolled for engineering and technology (E&T) undergraduate (UG) programs in BRIC nations, which is 1.8 times more than the number of students enrolled for E&T courses in the USA, EU-27, South Korea, Japan and Australia combined in the same time period (Loyalka et al., 2014). A survey conducted by the Offshoring Research Network (ORN)

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\(^1\) Kashmir was portrayed to be a disputed region rather than an integrated territory of India (Khanna and Choudhury, 2007)
in 2006 reported the ‘access to qualified personnel’ as one of the top three factors driving
offshoring decisions with 68% of the surveyed firms considering it as ‘important’ or
‘very important’ (Manning et al., 2008). Most importantly, such graduates were available
to be employed at significantly lower wages than the MNCs’ home countries, offering
MNCs the opportunity to reduce the cost of R&D. In fact, Gassmann and Han (2004)
suggested that the human resource management costs in terms of salary paid to R&D
staff in China were, at that time, 75%-80% lower than that in the TRIAD regions.

Third, the technological capabilities of emerging countries have grown significantly over the past two decades. For instance, China’s patent applications have
increased by 38 folds from 25,000 applications in the year 2000 to 968,000 applications
in the year 2015 (Zedtwitz and Gassmann, 2016). R&D subsidiaries are also set up as a
part of a strategy called ‘home-base augmenting’ (Kuemmerle, 1997). Home-base
augmenting refers to the strategy of establishing R&D subsidiary in a host country with
the intention to acquire locally embedded knowledge or generate new knowledge. This
knowledge could be used to develop new products and technologies for the same host
country and/or any other unit from the MNC network. The sectoral specialisation of
emerging countries also led MNCs to offshore home-base augmenting projects in specific
sectors to specific emerging countries. For instance, India’s advanced capabilities in
Information Technology and Software, China and Taiwan in Communication Technology and Russia in Aerospace attracted most MNCs operating in these sectors to
invest in knowledge creation (Peng and Wang, 2000; Kenney et al., 2013).

Additionally, setting up local R&D subsidiaries is perceived by the policymakers
in emerging countries as an indication of their long-term investment plans and
commitment to contribute to the country’s growth from a ‘manufacturing economy’ to a
‘knowledge economy’ (Khanna and Choudhury, 2007). Having a R&D centre thus allow
MNCs to develop informal networks, also known as ‘GuanXi’ in China and trust with the local regulators, universities and research institutes, which could not only help MNCs to source the informal and locally embedded knowledge but also make them highly competitive to receive government support and financial incentives (Gassmann and Han, 2004).

1.2 Challenges for Offshoring R&D to Emerging Countries

With increased inward foreign investments in R&D to emerging countries, several institutional challenges have emerged for MNCs. Among these, the weak intellectual property regulations regimes and the inadequate infrastructure of emerging countries have been widely discussed (Barkema et al., 1997; Keupp et al., 2009; Yang et al., 2004; Yang et al., 2008; Brander et al., 2017). Most emerging countries fall into the list of countries with weak intellectual property rights (IPR) system (Park, 2008; Zhao, 2006). The weakness of IPR systems is evidenced by the abundance of infringement cases and the level of piracy present in these countries (USTR, 2015; Swike et al., 2008). In China, many small and medium enterprises are accused of ‘reverse engineering’ of branded products from foreign MNCs and selling them at a much cheaper price (Wang, 2004). This pirated products industry accounts for 8% of China’s GDP (Swike et al., 2008), which includes 94% piracy in software, the highest in the world (Zhao, 2006). IP right holders (both MNCs and domestic firms) in India lost 21.7% sales worth $11.9 billion because of trademark counterfeiting in the year 2012 (USTR, 2015). In 2005, the United States Trade Representative (USTR) started preparing ‘Special 301 watch list’, an

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2 Reverse engineering refers to the “process of taking something (a device, an electrical component, a software program, etc.) apart and analysing it in detail, usually with the intention of constructing a new similar but different or improved device or program that does the same thing without actually infringing any intellectual property from the original” (Minagawa et al., 2007, p.459)
3 ‘Special 301 reports’ takes account of the comments and experiences of US MNCs operating in these 31 countries during the evaluation process and thus the review appears to be very appropriate and updated
annual review of IPR systems of USA’s partner countries in trade (36 countries in the year 2018). Since 2006, India, China, and Russia have constantly featured in the ‘priority watch list’ of all 12 editions of the report, suggesting the inadequacy of the IPR regimes of these countries to protect innovations of foreign MNCs.

Substantial scholarly attention has also been paid to investigate foreign firms’ strategies to protect their intellectual property amidst weak institutional framework of emerging economies (Keupp et al., 2009; McGaughey et al., 2000; Yang et al., 2004; Yang et al., 2008). In fact, scholars (e.g., Keupp et al., 2009; Yang et al., 2008, etc.) show that the intellectual property (IP) protection strategies practiced by foreign firms in China are fundamentally different from the traditional ‘formal’ and ‘informal’ IP protection strategies (Hertzfeld et al., 2006; Olander et al., 2014) and Keupp et al. (2009) term them as ‘de-facto’ IP protection strategies. Among other challenges for offshoring R&D to emerging countries, infrastructural challenges have been well-acknowledged in the literature around the discussion on the importance of cluster policies in emerging countries in enticing foreign direct investments (FDI) in R&D. Due to the lack of financial spending power, governments in emerging countries mounted advanced infrastructure facilities including advanced communication and transportation systems, measure of strengths of IPR systems in emerging countries. (USTR, 2005;2018). The method of reviewing is based on five pillars: initiatives from respective governments to strengthen the IPR regimes (e.g., WTO-TRIPS agreement enforcement), number of cases of piracy and trademark counterfeiting experienced by US MNCs and policies that pose challenges for US MNCs to protect their IP and enter the markets (e.g., ‘indigenous innovation policies’ that provide more benefits to domestic firms and cases of inadequate trade secret protection etc.). The countries are classified into two main categories based on the strengths of their IPR systems: ‘priority watch list’ and ‘watch list’. Priority watch list reports the countries having weakest IPR systems, while ‘watch list’ indicates the countries which have made some positive progress in strengthening their IPR systems yet still far from having a standard IPR system.

4 Formal IP protection strategies include patents, trade secrets, copyrights, trademarks, and non-disclosure contracts while secrecy, complexity and lead time are examples of informal IP protection strategies (Olander et al., 2014).

5 De-facto IP protection strategies include internal and external guanxi (guanxi means connections in Chinese) which are two of the commonly used IP protection strategies by foreign MNCs in China. External guanxi refers to the maintenance of strong relationships with the judicial and political system of China which may help the MNCs in tackling IP infringement issues (Keupp et al., 2009). Internal guanxi strategy includes employee threatening strategy i.e., threaten to register lawsuits against employees if any violation of IP rights is observed, making them aware of the possible consequences of IP theft (Keupp et al., 2009).
and setting up of universities and research institutes in a finite number of locations in order to promote such locations as industrial clusters and R&D hubs. For instance, in China, Beijing, Shanghai and Shenzhen and in India, Bangalore and Hyderabad have been designated as R&D hubs, inviting MNCs to set-up R&D subsidiaries in these clusters (Huggins, 2008; Sun and Wen, 2007).

A strategically important challenge in offshoring R&D to emerging countries that has not enticed much scholarly attention is the recruitment and retention of talent in subsidiaries in emerging countries. This is surprising considering the fact that the availability of talent in emerging countries is one of the key determinants of MNCs’ R&D offshoring decisions to these countries. In line with Manning et al.’s (2008, p.41) definition of talent, we refer to talent as “personnel with proper skills and qualifications to engage in R&D activities”. Consistently with the resource-based view (RBV) of firms (Barney, 1991), talent is a critical resource because it contributes to the generation and application of knowledge to develop new products and technologies, which is considered as core competency of high-technology firms. Hence, particularly for firms in the high-technology sectors, inability to manage talent could negatively influence their R&D output, risking their competitive positions in the market.

In terms talent availability and recruitment, emerging countries have long been criticised for the limited number of high-quality universities, leading to the production of graduates that are inadequately skilled to undertake R&D tasks. Only 10 universities from the Brazil, Russia and India appeared in the top 500 world university ranking in 2017 compared to 135 from the USA alone (Shanghai Ranking, 2017), of which more than 75% graduates were recognised to be unemployable for R&D positions (Farrell et al., 2005; Aspiring Minds, 2016). Together with talent recruitment, the retention of employees also appeared as a concern for the MNCs operating in emerging countries.
“The challenge is not only to get the people in but to keep them in” (Joshi, 2007; quoted in Holtbrügge et al., 2010). Since the availability of high-quality personnel who could work for R&D function is limited (Farrell et al., 2005), the competition to recruit such personnel has become fierce. Further, substantial increase in R&D offshoring to emerging countries (Asakawa and Som, 2008; Lewin et al., 2009; Kenney et al., 2013) and rise of domestic national champions over the past decade (Buckley and Hashai, 2014), which has released substantial job opportunities for such a limited supply of market-ready employees, further escalated the difficulty in retaining talent. A previous study (Yang and Jiang, 2007) documents on average 15.4% labour mobility (including R&D employee mobility) rate among firms in emerging countries compared to 3% in the USA, while more recently, Lamin and Ramos (2016) suggested the mobility rate to be significantly higher (30-35%) within the knowledge-intensive industry in India.

Overall, inadequate attention has been paid to develop a detailed understanding of talent recruitment and development challenges. For instance, while it is clear that the quality of the majority of the E&T graduates produced by universities in emerging countries is poor, the literature lacks in-depth exploration of the effect of low-quality of E&T graduates on MNCs’ recruitment and graduate development strategies. On the other hand, while studies (e.g., Lamin and Ramos, 2016; Yang and Jiang, 2007) have documented skill-labour (including R&D employees) mobility rates in emerging economies to be considerably higher than in developed economies, none of them actually offers substantive empirical evidence on the factors explaining such mobility rates. Despite the availability of talent in emerging countries being one of the key factors driving R&D offshoring to these countries, the impact of challenges pertaining to the recruitment and retention of talent in R&D functions on firms and organisational strategies to overcome such challenges have remained underexplored. This research gap
may lead MNC managers considering emerging economies for greenfield R&D investments to overlook the importance of developing appropriate talent recruitment and retention strategies. To address these research gaps, we design the following overarching research question, whose investigation will not only strengthen the literature but also offer managerial implications to newcomer foreign MNCs to emerging countries.

**RQ.** *What are the talent recruitment and retention challenges for offshoring R&D to emerging countries, and what strategies do MNCs practice to eliminate such challenges?*

In the following sections, we dig deeper into the talent recruitment and retention challenges to formulate more specific sub-research questions, which will be addressed in the three research papers of this thesis.

### 1.2.1 Talent Recruitment Challenges in R&D

In the 1990s, MNCs found they had to compete for globally distributed graduates. The so-called ‘race for talent’ (Beechler and Woodward, 2009; Chambers et al., 1997; Lewin et al., 2009) started due to two main reasons: higher labour cost and un-availability of graduates in the home countries of MNCs. Ageing of the population (Economist, 2006), declining birth-rates and deteriorating interests to study STEM courses in industrialised economies (Rosenfeld, 2002) highlighted the graduate un-availability issue in developed countries. At the same time, graduates ‘drained’ from emerging to developed countries (Kenney et al., 2013; Qin, 2015; Yegorov, 2009) started receiving prominence amongst employers in developed countries due to quality of skills they had carried along (Chellaraj et al., 2008) and the fact that these drained graduates were ready to perform tasks at lower rates than their foreign counterparts (Salzman and Lowell, 2007). One-third of skilled professionals working in Silicon Valley in the year 2000 were
predominantly Asian born (Saxenian, 2005); few climbed up to the top positions in their respective organisations. In 2015, the CEOs of Microsoft and Google are Indian born engineers (The Hindu, 2014) who had left for the USA for higher education in the 1980s. It did not take long for MNCs to realise that it was essential to move their business operations to countries these graduates had come from. For MNCs, the race for graduates was assumed to be over when they started offshoring their business functions to emerging countries e.g., China and India, which in recent years have built up larger graduate inventories than any industrialised country (Asakawa and Som, 2008; Bruche, 2009).

When MNCs offshored R&D activities to emerging countries, although they could access a large pool of E&T graduates as they had expected (Loyalka et al., 2014) and graduates were eager to work for foreign firms (Zedtwitz, 2004), they experienced difficulties in recruiting suitable graduates for their R&D positions. “While statistics show high levels of unemployment among engineers (in emerging nations), many large companies complain of difficulty in finding qualified candidates” (Gereffi et al., 2008, p.20). The primary reason behind this paradox was that the majority of E&T graduates in emerging countries were not educated to the same quality level as E&T graduates in their home countries (Loyalka et al., 2014). “There is substantial dissatisfaction with the quality of graduates (in India). 64% of employers are only somewhat satisfied or worse with the current engineering graduate skills” (Blom and Saeki, 2011, p.26).

The quality issue arose particularly due to emerging countries’ predominant focus on expanding the size of the talent pool by setting up new Higher Education Institutes (HEIs) without paying much attention to the quality of these HEIs in the early 2000s. As a result, the number of non-elite HEIs and the number of students enrolling to such HEIs increased rapidly compared to the number of elite HEIs during the period 2003-2009 (Loyalka et al., 2014). Due to the lack of appropriate monitoring from the government,
such non-elite HEIs remained resource-constrained. They lack the necessary infrastructure, such as quality labs and libraries, up-to-date curriculum and faculty, to offer quality education (Ernst and Young, 2012). Teaching staff members are recruited without PhD degrees (Loyalka et al., 2014), which is considered a proxy for the quality standard for teachers (Liefner and Schiller, 2008). In non-elite HEIs in Brazil, China and India, the percentage of faculty with PhD holders were only 27%, 20% and 10% in 2009, while at the same time the share of faculty with PhD degree in elite HEIs in all three countries was 50%. Compared to elite HEIs, non-elite HEIs, particularly in Brazil and India bypass strict graduate admission procedures by enrolling students with limited science and mathematics scores for engineering programmes (Loyalka et al., 2014). Thus the quality of graduates greatly varies across the elite and non-elite HEIs in emerging countries. In fact, Loyalka et al. (2014) noted one surprising observation in the context of Brazil by stating “final-year students in non-elite engineering programs attain skill levels only slightly above those of first-year students in elite programs” (p.991) which perfectly summarises the difference in quality of education offered by elite and non-elite HEIs and also the preparedness of students graduating from non-elite HEIs for taking up R&D jobs in the industry.

Since the number of elite HEIs is limited in emerging countries, the graduates produced by such elite HEIs are not adequate to satisfy the demand for R&D positions in the industry. For instance, in Brazil, the number of enrolments in non-elite HEIs was approximately 350,000 while the same in elite HEIs was only 100,000 in 2009. The ratio of graduate enrolments in elite and non-elite HEIs is even poorer in India, with only 70,000 students were enrolled in elite HEIs compared to 1,400,000 enrolments in non-elite HEIs (Loyalka et al., 2014). The limited supply of high-quality graduates in emerging countries has further dropped due to excessive ‘brain drain’ (Qin, 2015;
Yegorov, 2009), the outward migration of high-quality graduates to developed countries for mainly for work and higher education purpose. Due to stiff competition for the remaining population of high-quality graduates in the industry in emerging countries, MNCs are left with no choice but to recruit the inadequately skilled or low-quality graduates from non-elite HEIs and to prepare them for R&D positions through ‘in-house on-the-job’ training, which require significant investment of on-the-job training resources in terms of the time and money. To reduce this cost, corporations have started to engage in teaching-focused collaborations with non-elite HEIs to offer courses/projects, train faculty and establish laboratories (labs), to transfer part of the on-the-job training to universities while students are still undergoing formal education, so that at the end of the formal education degree, the company receives industry-ready graduates. Many high-technology corporations such as Cisco, IBM, Huawei, Microsoft, and Texas Instruments are reaching out to academia with initiatives such as ‘Cisco Networking Academy’, ‘IBM academic initiative’, ‘Huawei ICT Academy’, ‘Microsoft IT Academy’, and ‘Texas Instruments University Program’ to form collaborations in teaching in emerging economies. We refer to these collaborations between industry and academia as ‘teaching-focused industry-academia (I-A) collaborations’ that are largely developed to address the primary mission of universities: teaching and educating students (Laredo, 2007).

Now the question that arises here is: to what extent such teaching-focused I-A collaborations have been studied in the extant literature? A detailed review of existing literature suggests that despite I-A collaborations have received extensive scholarly attention in the last two decades, most discussions have revolved around research and entrepreneurship-focused alliances. This leaves I-A collaborations tailored to enhance teaching activities of universities and thereby to develop skills for R&D jobs largely
unexplored. This finding synchronises with the statement made by Perkmann et al. (2008) that “the impact of academics’ engagement with industry on teaching is not clear and the question has not been addressed in the literature” (p.428). We address this research gap by presenting insights from India on how teaching-focused I-A collaborations occur, identifying drivers and challenges for universities and corporations participating in such alliances, illustrating how new modes of collaborations are operationalised and factors that may facilitate HEIs’ to participate in such collaborations with industry with the help of the following research questions. Specifically, we address the following research questions:

**RQ1A.** Are there different forms through which firms engage with E&T HEIs in teaching-focused I-A collaboration to develop E&T graduates for R&D functions?

**RQ1B.** What are the drivers and challenges for both firms and HEIs to engage in different forms of teaching-focused I-A collaborations?

**RQ1C.** What policy and managerial implications can be drawn from the analysis of teaching-focused I-A collaborations enhancing graduates’ employability for R&D functions?

**RQ1D.** What HEI-level and institutional factors influence HEIs’ participation in teaching-focused I-A collaborations?

### 1.2.2 Talent Retention Challenges in R&D

In line with the VRIN (valuable, rare, inimitable and non-substitutable) framework of RBV of firms (Barney, 1991), R&D employees can be termed as valuable and non-substitutable. R&D employees are valuable because they carry innovation-related information, which is often considered as a core competency of for technology-intensive corporations. They are non-substitutable because they are also very costly to replace
(Kochanski and Ledford, 2001); to bring other employees to the same level of technological know-how may require excessive training and time, which is likely to incur high costs to the company. The RBV of the firm suggests that corporations possessing such rare, valuable, and irreplaceable resources hold sustained competitive advantage over their competitors (Barney, 1991; Grant, 1996). Therefore, firms are concerned with protecting and retaining their R&D employees from the reach of their competitors.

“The best way to send information is to wrap it up in a person.” – J. Robert Oppenheimer (quoted in Agarwal et al., 2009, p.1349). When R&D employees move out and join competitors, the competitors may receive access to the R&D-related knowledge of the source firm. Such information may include the source firms’ capabilities, knowledge of innovation pipelines, knowledge pertaining to process innovations, client information, etc. (Kim, 1997; Somaya et al., 2008). Source firms’ trade secrets could also be in danger of getting leaked with the R&D employees’ outward mobility. Trade secrets usually refer to “chemical formulae, recipes, customer files, machinery designs, or one of many other types of information etc.” (Hannah, 2005, p.71), and loss of trade secrets to competitors would make it extremely difficult for the source firm to “recoup past investments in R&D, and future innovation may be compromised” (USTR, 2015, p.20).

As mentioned before, MNCs’ R&D subsidiaries in emerging countries not only participate in knowledge exploiting activities but also engage in knowledge augmenting process. Thus the knowledge produced by these subsidiaries could be highly critical to the MNCs’ business in the host (emerging country) as well as the global operations of the MNCs. During the knowledge exploitation and augmenting process, the subsidiaries in emerging countries are often required to collaborate with the MNCs’ headquarter and subsidiaries located in other countries. Thus, it is expected that during such collaborations with the global network of the MNC, R&D employees working for a subsidiary in an
emerging country will receive access to confidential innovation knowledge produced elsewhere in the MNC network. Hence, losing such employees from the subsidiary to competitors could put the source firms’ global R&D investments at risk.

Now the question arises that since R&D subsidiaries located in developed countries also possess critical knowledge of the global R&D investments of MNCs, why are the MNCs bothered by the outward mobility of R&D employees from those subsidiaries located in emerging countries only? In developed countries, labour mobility including mobility of R&D employees is significantly lower than emerging countries (see Yang and Jiang et al., 2007 for a comparison). Even if the R&D employees move out and join direct competitors in developed countries, MNCs are less likely to lose out confidential knowledge to the hiring firms. R&D employees are usually required to sign non-disclosure agreements which restrict them to share any confidential knowledge they possess about the source firm to the hiring firm. Victims of non-disclosure agreements may approach the judiciary system and seek monetary compensation or injunctive relief for breaching of the agreement. Such contracts are highly legally enforceable in developed countries because of the strong IPR regimes in these countries (Zhou and Poppo, 2010, p.865). Therefore, in developed countries, to avoid lawsuits, the hired R&D employees will be more reluctant to share confidential knowledge about the source firm to the hiring firm. On the other hand, the hiring firms, in particular, small and medium enterprises (SMEs) that do not possess financial resources to fight lawsuits in courts against large corporations, may show an unwillingness to build on the knowledge received from the hired R&D employee about the source firm (Agarwal et al., 2009).

However, in emerging countries, the enforcement of these IP protection agreements is difficult due to the weak IPR regime. Because of inappropriate resources and infrastructure, the IP disputes take more time to be resolved (Ginarte and Park, 1997)
incurring high legal costs to the involved firms. Also, the transparency in the handling of IPR cases is also an issue in most emerging countries. Local governments often prefer not to take legal action against the local firms that are accused of IP infringements (Swike et al., 2008) considering judgements passed against local firms a step backward towards indigenous technological development (USTR, 2015). Even if foreign MNCs succeed in securing a positive judgement (in Russia), it is not guaranteed that the judgement would be executed (against local firms) (Dyker, 2001, p. 863). Local governments’ preference towards local firms in emerging countries could be a worry for foreign MNCs as local firms are known to possess a free-riding attitude. And the weak IPR system and favourable policies towards local firms give them free license to rely on imitation of the technologies of MNCs as a catch-up strategy and to bridge the technological gap with the MNCs, earning the title of copycats (Luo et al., 2011). Hence, the risk of knowledge leakage to local firms is higher in emerging countries compared to that in developed economies. The hiring of R&D employees from foreign firms is a route that local firms predominantly take to access the advanced technologies brought in by MNCs and compete with them through creative imitation, duplication and reverse engineering (Blomström and Kokko, 1998; Luo et al., 2011).

Thus, it becomes clear that the risk of knowledge leakage to competitors via the outward mobility of R&D employees from MNC subsidiaries is higher in emerging countries compared to developed countries. It is, therefore, important from an MNC’s perspective to understanding the reasons behind high outward mobility of R&D employees from their subsidiaries in emerging countries. To date, the drivers of the outward mobility of skilled labour have been examined using the human capital theory lens (e.g., Crespi et al., 2007; Hoisl, 2007; Lenzi, 2009). Such drivers mostly include employees’ skills, education, experience, and relational capital inside and outside the
source firms (Mawdsley and Somaya, 2016). High levels and quality of skills, education and experience denote greater degree and quality of knowledge possessed by employees. In addition, such human assets are positively associated with promotion, enhancing the employees’ influence and importance within the organisations (Campbell et al., 2012; Castanias and Helfat, 2001). Such employees are highly sought after in the job market. The type of skillsets of the employees may also influence employees’ potential to find job opportunities in the industry. Employees with high-degree of ‘firm-specific human capital’ (Hashimoto, 1981), i.e., know-how that has limited application outside the source firm, may find it difficult to find suitable job opportunities in the industry (Hoisl, 2007).

The relational capital of individuals could be both internal and external. Internal relational capital refers to networks made by an employee with other employees within the same organisation. An employee possessing greater internal relational capital could be highly attractive for hiring firms as by recruiting him/her the firms may be able to contact and recruit other employees from the same source firm (Mawdsley and Somaya, 2016). External relational capital refers to the networks developed by employees outside the organisation, for instance with clients, suppliers and collaborators etc. Employees with high external relational capital possess greater awareness of the opportunities available outside the source firms and therefore are more likely to move out than those without (Mawdsley and Somaya, 2016).

However, while the human capital perspective explains fairly well why particular employees are more likely to move out than others, it does not relate the individual decisions of leaving a subsidiary to the organisation to explain why some subsidiaries experience higher outward mobility of employees compared to others in a specific host country, which is an issue of International Business (IB) scholars. Anchoring this question to institutional theory (North, 1991), and the influence of formal (regulatory)
and informal institutional (cultural) distance between MNCs’ home and host country on the R&D employees’ outward mobility from their subsidiary, our study aims to link individual-level explanations from human capital theory with firm-level institutional dynamics in a IB context.

Institutions, broadly classified as formal and informal institutions, are the “humanly devised constraints that structure political, economic and social interaction” (North, 1991, p.97) and institutional distance can be defined as the degree of dissimilarity across countries in terms of socio, political and economic structures. While formal institutions include the explicit legal, political and economic regulations of a particular country, informal institutions encompass more implicit normative and cognitive dimensions (North, 1991). With high institutional distance between home and host countries, MNCs struggle to understand the dynamics of the host market, to replicate its home country strategies with equal effectiveness due to emergence of unfamiliar challenges and costs (Bell et al., 2012), that is termed as the ‘liability of foreignness’ for MNCs in a host country (Zaheer, 1995). As a result, a high institutional distance may impede MNCs’ ability to prevent or limit the outward mobility of employees in the host country. Therefore, ‘institutional distance’ seems to be an appropriate theoretical lens to analyse the reasons behind the outward mobility of R&D employees from subsidiaries in the emerging countries. Focusing in particular on inventors, those R&D employees who are involved in the innovation of products and technologies, our study design the RQ2A.

Inventors are likely to have access to more confidential information than the general R&D personnel and therefore, their outward mobility could hurt the MNC more.

**RQ2A.** To what extent and how do formal and informal institutional distance between home and host country of MNCs influence the outward mobility of inventors from subsidiaries in emerging countries?
Now the question that arises here is: how could the impact of institutional distance on the outward mobility of inventors be mitigated? Focusing on individual-level and organisational-level cognitive learning processes, research shows that prior overseas experience of MNCs and individuals help to understand and anticipate the challenges that they may face in a distant institutional environment and enhance their immunity towards such challenges (Delioz and Henisz, 2003; Le and Kroll, 2017; Perkins, 2014). Through RQ2B, we examine the moderating role of micro (inventor-level) and macro (MNC-level) experience on the institutional distance that is whether the impact of formal and informal institutional distance on the outward mobility of inventors could be reduced by managing appropriate level of experience.

**RQ2B.** Does prior international experience of MNCs and inventors moderate the relationship between the formal and informal institutional distance between home and host country of MNCs and the outward mobility of inventors from subsidiaries in emerging countries?

### 1.3 Positioning and Outline of the Three Research Papers

To address the sub-research questions pertaining to specific talent management challenges, three different yet interconnected research papers have been developed, which collectively form this thesis. Research Paper-1 by addressing RQ1A, RQ1B and RQ1C, explores the organisation of teaching-focused I-A collaborations and associated challenges and drivers for both HEIs and firms to engage in different modes of collaborations. Research Paper-2 takes forward research on teaching-focused I-A collaborations by examining HEI-level and institutional determinants of these collaborations (RQ1D). Research Paper-1 and Research Paper-2 collectively contribute towards developing an understanding of the severity of talent recruitment challenges in
emerging countries and the viability of teaching-focused I-A strategies as a solution. Research Paper-3, through RQ2A and RQ2B, examines the institutional factors driving inventors’ outward mobility from MNC subsidiaries in emerging countries and their strategies to reduce the impact of such factors. Thus Research Paper-2 bridges the empirical research gap on the talent retention challenges in emerging countries. Figure 1.2 reports the positioning of the three research papers. Below, we also offer brief an outline of the three research papers.

**Figure 1.2** Positioning of the three research papers

1.3.1 **Research Paper-1**

**Title:** Are Engineering graduates ready for R&D jobs in Emerging Countries: Teaching-focused industry-academia collaboration strategies for training
Research Questions

*RQ1A.* Are there different forms through which firms engage with E&T HEIs in teaching-focused I-A collaboration to develop E&T graduates for R&D functions?

*RQ1B.* What are the drivers and challenges for both firms and HEIs to engage in different forms of teaching-focused I-A collaborations?

*RQ1C.* What policy and managerial implications can be drawn from the analysis of teaching-focused I-A collaborations enhancing graduates’ employability for R&D functions?

Key Results

- We identify three distinct modes of teaching-focused I-A collaborations: companies offering courses to students as a part of the HEI’s curriculum (Mode-1); companies offering ‘value-added’ courses to students outside the HEI’s curriculum (Mode-2); and companies offering dissertation projects to students (Mode-3).

- Under teaching-focused I-A collaborations, training programmes from firms are delivered to students through a) firms’ own employees, b) HEIs’ faculty, and c) third-party organisations.

- Companies can use such collaborations to train students not only with industry-specific skills, but also firm-specific skills, thus enabling companies to receive graduates that are not only industry-ready but also ready to work at the company, which can completely eliminate the need for offering in-house on-the-job training.

- Opportunities to improve crucial teaching resources such as curricula, library, faculty, labs and social capital in the industry drive HEIs’ decision to engage in teaching-focused I-A collaborations.
Key Contributions

- This paper establishes a new line of enquiry on ‘teaching-focused I-A collaborations’ so responding to Perkmann et al.’s (2013) call to investigate and understand this neglected dimension of I-A collaborations.

- This paper targets a critical yet under-researched policy challenge in emerging countries- the skill-gap among fresh graduates for R&D positions in the industry, and explains how teaching-focused I-A collaborations could contribute towards overcoming this challenge, which is likely to attract the attention of policy and management researchers and policymakers, not only in emerging economies but also in developed ones.

- Through this paper, we contribute to the human capital theory in the context of fresh graduate hiring, by demonstrating that teaching-focused collaborations can offer an alternative to the traditional graduate recruitment and development model of ‘in-house on-the-job training’.

1.3.2 Research Paper-2

Title: What are the determinants of teaching-focused industry-academia collaborations?

Evidence from Indian Higher Education Institutes

Research Questions

RQ1D. What HEI-level and institutional factors influence HEIs’ participation in teaching-focused I-A collaborations?

Key Results

- In this paper, we show that among institutional factors, discipline, government support in terms of establishing intermediary organisations, HEI’s location,
autonomy, and private governance of HEIs to be key for initiation of teaching-focused I-A collaborations.

- Among HEI-level factors, HEI’s size, quality, industrial and academic embeddedness are the determinants of HEI’s collaboration with industry in teaching.

**Key Contributions**

- Through this paper, we carry forward research on teaching-focused I-A collaborations.

- Through the identification of factors that facilitate and hinder HEI’s propensity to collaborate with industry in teaching, we offer implications to Indian policymakers in terms of how a favourable environment could be developed for encouraging HEI’s participation in teaching-focused collaborations with industry.

- The role of institutional support and policies in promoting I-A collaborations has been an understudied dimension (Perkmann et al., 2013) and through the discussion on government’s role in facilitating teaching-focused collaborations between industry and Indian HEIs in this paper, we contribute towards filling this research void.

1.3.3 Research Paper-3

**Title:** Why do inventors move out from MNC subsidiaries in emerging countries? The role of institutional distance and experience

**Research Questions**

*RQ2A.* To what extent and how formal and informal institutional distance between home and host country of MNCs influence the outward mobility of inventors from subsidiaries in emerging countries?
**RQ2B.** Does prior international experience of MNCs and inventors moderate the relationship between the formal and informal institutional distance between home and host country of MNCs and the outward mobility of inventors from subsidiaries in emerging countries?

**Key Results**

- Indian inventors are highly mobile considering their average tenure at MNC subsidiaries in India to be only three and a half years. Inventors move mostly between MNC subsidiaries then moving from MNC subsidiary to local firms and start-ups.

- The results demonstrate a positive relationship between a) regulatory distance between the home country and the host (emerging) country of the MNC and inventors’ outward mobility from subsidiary and b) cultural distance in terms of individualism and uncertainty avoidance between the home country and the host (emerging) country of the MNC and inventors’ outward mobility from subsidiary.

- MNCs’ prior experience in similar regulatory setting to the host country moderates the positive relationship between the regulatory distance between the home country and the host country of the MNC and inventors’ outward mobility from subsidiary.

- Inventors’ prior international experience moderates the positive relationship between cultural distance between the home country and the host country of the MNC and inventors’ outward mobility from subsidiary.

**Key Contributions**

- This study strengthens discussions around offshoring R&D to emerging countries by offering empirical insights into a widely mentioned yet empirically
underexplored risk of conducting R&D in emerging countries: high outward mobility of inventors from subsidiaries.

- To the best of our knowledge, this paper is one of the firsts to apply institutional distance perspective to identify reasons behind the outward mobility of inventors from MNCs’ subsidiaries in emerging markets and shows that institutional factors such as cultural and regulatory distance also influence inventors’ decision to leave MNC subsidiaries along with individual factors.

- This paper offers managerial implications in terms of how the effect of institutional distance on inventors’ outward mobility could be reduced (via application of MNC-level or inventor-level experience) and conceptually to contribute to the discourse on the application of individual-level and intra-MNC cognitive learning processes at organisational-level to mitigate the role of institutional distance in international business.

- From a methodological perspective, we utilise a novel approach which uses LinkedIn as a data source to track inventors’ mobility as an alternative to relying solely on the use of patents.

1.4 Structure of the Thesis

This thesis is organised in the following order. Chapter 2 describes the reasons behind the selection of India as the research context. Chapter 3, Chapter 4 and Chapter 5 discuss Research Paper-1, Research Paper-2 and Research Paper-3 respectively. Since this thesis exploits secondary sources, such as websites in Research Paper-2 and LinkedIn in Research Paper-3 for data collection, the inception of concerns regarding the validity and reliability of the data need to be addressed and clarified in depth. Therefore, this thesis includes appendices at the end of each research paper in order to elaborate on the data.
collection processes, in particular, the steps that have been undertaken to ensure proper validity and reliability of the data collected from the secondary sources. Chapter 6 summaries the key findings and highlights the future research avenues.
CHAPTER 2 RESEARCH CONTEXT

This thesis examines the talent recruitment and retention challenges for offshoring R&D to emerging countries in the context of India. This chapter offers a brief overview of R&D offshoring activities to India (in Section 2.1) and the Indian engineering and technology education system (in Section 2.2) and judicial system and relevant labour laws (in Section 2.3).

2.1 Offshoring of R&D to India

After the liberalisation of the Indian economy in 1991, which allowed 100% FDI in information technology (IT) and telecommunications, India experienced a sharp increase in FDI inflow, especially in IT. Foreign MNCs started offshoring of information technology enabled services (ITES) to India mainly to support primary functions in their home countries and subsidiaries located in advanced countries. For example, during the period 1996-2000, the central responsibility of GE’s Indian subsidiary was to assist GE’s headquarter in the USA and the subsidiaries in Europe with IT support (Zaheer et al., 2009). The Global Services Location Index from A. T. Kearney in 2004, 2005, 2007 and 2009 ranked India as the best offshoring location for high-technology services based on the attractiveness of the business environment, availability of human and financial resources (A. T. Kearney Global Services Location Index, 2005:2009). Availability of science and engineering talent, English fluency of manpower, lower costs of labour, suitable time zones with respect to the USA, and presence of people of Indian origin at the top positions of the foreign MNCs acted as the principal drivers for high FDI in ITES to India (Henley, 2006). At the same time, India’s development growth was also picking up. In 2007, India’s Gross Domestic Product (GDP) per capita annual growth reached
9.8% from 3.8% in 2003, further prompting MNCs to consider India as an attractive location to establish new subsidiaries. Following such upsurge in offshoring of white collar jobs, India was soon called the ‘back office of the world’ (Dossani and Kenney, 2003).

After the remarkable success of the Indian software outsourcing industry around the turn of the millennium and subsequent fast economic growth, India was initially able to develop its innovation capability in high technology sectors as well and was able to attract top MNCs in such sectors. A global leader in the semiconductor business, Texas Instruments established an R&D centre in Bangalore in 1985 (Gupta and Gupta, 2014) and became one of the firsts from Fortune 500 companies to establish an R&D centre in India. Keeping aside Texas Instruments, offshoring of R&D to India started gaining momentum in the late 1990s after MNCs realised the potential market size in India and other location-specific advantages, including advanced capabilities in IT and software, through their initial investments in ITES offshoring activities. IBM, SAP, and Sharp entered the Indian market with in-house R&D facilities in 1997 (Gerybadze and Merk, 2014). Within two years, the electronics goods industry (Daewoo Electronics, Mentor Graphics, Motorola, Sanyo and Sun Microsystems) and beverages industry (Pepsico, Seagram, and Unilever) too witnessed the establishment of some major foreign R&D facilities in India (Bowonder and Richardson, 2000). In the following years, more leading MNCs in respective industries such as GE (2000), Nokia (2001), ABB and HP (2002), Kyocera and General Motors (2003), Alcatel and Siemens (2004) and Du Pont and TRW (2008) set up their R&D centres in India (Gerybadze and Merk, 2014).

During the period 2000-2010, India saw an unprecedented rise in FDI in R&D. New R&D subsidiaries got established while the existing ones expanded their R&D facilities through more investments in product development, and talent recruitment and
training. For example, Japanese MNC Kyocera started its R&D subsidiary in India with only 30 employees in 2003 and, six years later, the number escalated to 600 with an annual growth of 64.8% (Gerybadze and Merk, 2014). As a result of such expansion, the patenting activities of these R&D centres also experienced positive growth. For instance, IBM’s patenting count grew from five patents in 2000 to 161 patents in a single year: 2011; GE’s patents increased from 11 in 2000 to 141 patents in the single year of 2011 (Krishna et al., 2012). Following such an increased interest from foreign MNCs to invest in R&D in India, India became the only emerging country to appear on the list of top 10 destinations for knowledge seeking German MNCs (Ambos and Ambos, 2011). For some MNCs, Indian R&D centre represented more than 50% of their foreign R&D activities. In 2010, every sixth R&D engineer from GE was based in India; subsidiaries established by Samsung and Cisco were recognised as the largest R&D units outside their home countries (Gerybadze and Merk, 2014; Krishna et al., 2012). By 2013, India became home to 1,031 R&D subsidiaries of foreign firms (see Zinnov, 2013 in Gupta and Gupta, 2014). During the period 2003-2009, US MNCs accounted for 20.3% share of the total inward FDI worth 76.26 billion USD, followed by the UK with 13.6% worth 47.61 billion USD (Mrinalini et al., 2013). India’s software and telecommunication industries have been the primary recipient of R&D activities. 62.7% of total R&D performed by MNCs in India is related to ICT while the same for healthcare and industrial equipment are 11.09% and 10.01% respectively (Krishna et al., 2012). In the semiconductor industry, 34 MNCs set up their R&D centres in India and registered 1,158 patents, compared to 22 R&D centres with 476 patents in China (Alnuaimi et al., 2012), giving tough competition to China in FDI in innovation (Bruche, 2009). Following such tremendous growth in FDI
in R&D to India, India was termed as the ‘innovation hub’ for western MNCs (Bruche, 2009) and an ‘emerging innovation giant’ (Forrester, 2008).

Considering the importance of the Indian market for global R&D activities of MNCs, India offers an appropriate research setting for studying the challenges for offshoring R&D to emerging countries. Below, we provide an overview of the structure and evolution of the Indian Engineering & Technical education system (in Section 2.2) and the judiciary system and relevant labour laws (in Section 2.3). We also explain why the education and judiciary systems in India are criticised to produce low-quality graduates and high labour mobility respectively.

2.2 India’s Engineering and Technical Education System

During the pre-economic reform period (1947-1991), India’s technical education sector was dominated by public-sector HEIs. At the backbone, Indian Institute of Technology (IITs) were set up following the Massachusetts Institute of Technology (MIT) model in the USA, HEIs that would specialise in offering engineering and technical education rather than operating as fully-fledged universities and offering courses in diverse disciplines (Varma and Kapur, 2010). India’s first Prime Minister Jawaharlal Nehru firmly backed IITs to form the backbone for the evolution of India from an underdeveloped economy with the minimum technological capability to a highly innovative and modern economy (Tharoor, 2003). The first IIT was established in Kharagpur in 1951. By 1991, Government of India set up another four IITs in Madras (later renamed as Chennai), Bombay (later renamed as Mumbai), Kanpur and Delhi.

During 1956-1970, Government of India launched a large number of industrial projects in various regions for ‘rapid Industrialisation’ (Planning Commission, 2019). To meet the requirement of human capital for such regional industrial projects, it became
imperative for the government to set up additional technical HEIs in the respective regions (Dubey et al., 2018). In 1959, the first regional technical HEI, known as the Regional Engineering College (REC), was established in Warangal to produce quality engineers for industrial projects started in the Southern region of India. Unlike IITs which operated under the central government, RECs were jointly controlled by the central and respective state government. By 1970, 15 RECs were set up. In terms of quality of education, IITs were deemed the best in the country while RECs to be the second-best HEIs in India (Saha and Ghosh, 2012). Alongside RECs, it was made sure that every state had at least one engineering college under the control of the state government to support the human capital required for the industrial projects launched by respective state governments.

Prior to market liberalisation, India’s engineering and technology education policies focused heavily on enhancing the quality of selected HEIs, mostly IITs and RECs (Dubey et al., 2018). With the tremendous growth in offshoring of R&D activities to India particularly in the ICT sector, Indian policymakers realised that the development of a considerably large pool of engineering and technology graduates is necessary to experience a sustained inward FDI. However, this required the establishment of a large number of new HEIs. In 1996, Mashelkar Committee, a committee formed by Government of India under renowned academic Ramesh Mashelkar, advised Government of India to upgrade the RECs in terms of funding, structure, and governance (Banerjee and Muley, 2007) in order to enhance the quality of education and increase the enrolment capacity. The committee also advocated for the establishment of an additional

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6 Once in every five years, the Government of India forms a committee under a renowned academic to evaluate the ongoing education policies and to suggest policy changes for the betterment of STEM education. India’s policies in STEM education usually follow the recommendations made by such committee reports (see Banerjee and Muley, 2007; Dubey et al., 2018; Saha and Ghosh, 2012).
number of IITs and RECs to support the growing need for technical manpower. This recommendation was put into action in 2002 when all RECs received National Institute of Technology (NIT) status and the ownership was transferred from state to central government (Saha and Ghosh, 2012). During the period 1991-2010, Government of India established 10 new IITs (Ratchford and Blanpied, 2008) and increased the total number of IITs to 23 by 2018. Additionally, new NITs were established in order to make sure that each of the 29 states in India has at least one NIT. As of 2018, 31 NITs have been set up. Further to meet the growing demand for technical manpower, state governments established new government engineering colleges as well as enhanced the enrolment capacity of the existing engineering colleges. Technical programmes were introduced in most central and state universities which used to offer mostly non-technical courses.

However, this was not enough to fulfil the escalating need of technical manpower in the country. In 2002-03, U.R. Rao Committee, a committee formed under the leadership of a renowned space scientist and academic Udupi Ramachandra Rao, came out with a radical suggestion of encouraging private investments in technical education (Dubey et al., 2018). Following the implementation of this suggestion, India saw an unprecedented rise in the number of institutes offering technical education. This resulted in unprecedented growth in the number of HEIs, from 678 in 2000-01 to 3,346 in 2013-14 (Choudhury, 2016). In 2008 alone, 1691 engineering colleges sought approval from University Grant Commission7 for establishment (Carnoy and Dossani, 2013). By early 2008, India’s yearly production of engineering graduates surpassed the USA. The private engineering HEIs, which contributed to only 15% of the graduate population in 1960 (Kapur and Mehta 2004), accounted for more than 75% of graduate population in 2008 (Banerjee and Muley, 2008). Private investments dominated even more in states such as

7 University Grant Commission is the national body that authorises establishment of new universities.
Maharashtra, and Andhra Pradesh where industrialisation was at the peak. In 2004, only 4.5% of total engineering colleges of Andhra Pradesh were public, rest 95.5% were private (Kapur and Mehta 2004).

Although private investments did help India to enhance the size of the talent pool, the growth was achieved “at the cost of declining quality of graduate education at least outside of a handful of elite universities” (Ernst, 2006, p. 9). The private HEIs have been accused of bypassing quality standards. While the public HEIs admit students through a highly competitive examination, the private HEIs are not obliged to admit students through such competitive examinations. A significant number of private HEIs enrol students based on donations that are made by the prospective student at the time of admission (Agarwal, 2007; Dubey et al., 2018). Thus, a significant number of private HEIs have been found to enrol students with little mathematics and science knowledge (Loyalka et al., 2014). Most private HEIs did not have the proper accreditation to provide degrees and specific courses (Agarwal, 2006) and they “lobby governments to be less stringent in applying regulations” (Loyalka et al., 2014, p.988).

On the other hand, Government of India could not enhance resources in the public HEIs. Although most public HEIs enhanced their enrolment capacity, the size of faculty did not grow at the same pace leading to 40% deficiency of academic staff in state government colleges (Ernst and Young, 2012). To solve the crisis for academic staff, faculty have been recruited without PhD degrees. In fact, in 2012, only 10% of faculty staff in most HEIs (both private and public) possessed PhD degrees (Loyalka et al., 2014). Also, the central and state government lacked financial resources to upgrade infrastructure including laboratories and libraries of public HEIs. Thus, concerns began to emerge regarding the quality of Indian engineering and technical graduates. A McKenzie report (Farrell et al., 2005) followed by a World Bank report (Blom and Saeki
documented the utter dissatisfaction among employers about the quality of the graduates produced in India.

As of 2018, India’s technical education system is structured as follows. Based on the ownership structure, India’s higher education system is mainly comprised of two types of HEIs: private and public. Based on the governance structure, the public HEIs could be operated under either the central government or the state government. Central government-run HEIs include ‘Central Universities’ and ‘Deemed Universities’. The basic difference between a ‘Central university’ and ‘Deemed University’ is that a Central University offers courses in diverse academic disciplines while a ‘Deemed Universities’ is likely to be specialised in a particular academic discipline. IITs and NITs are ‘Deemed Universities’ (Datta and Saad, 2011). State government-run HEIs include ‘State Universities’. Central Universities, Deemed Universities, State Universities, and Private universities possess academic freedom, i.e., they can design curriculum, assessment method and award degrees (Datta and Saad, 2011). The State Universities are also given responsibility to control and monitor smaller HEIs (both public and private) that do not have the necessary resources to operate as universities. These HEIs are required to follow the curriculum and assessment process designed by their parent State Universities. Also, degrees are awarded to the students of these HEIs by the parent State Universities.

2.3 India’s Judiciary System and Labour Laws

India’s judiciary system is built on a three-tier hierarchical structure. The judicial court which sits at the top of the hierarchy is called the ‘Supreme Court’ of India. The second and third tier of courts are called ‘High Courts’ (state-level court) and ‘District Courts’ (district-level) respectively (Chandra, 2018; Ghosh, 2018). As of 2018, India has 25 high courts and 672 district courts (NJDG, 2019). The judges of the Supreme Court are
appointed by the President of India after consulting with the Chief Justice of India (Chemin, 2010). On the other hand, while appointing the judges of high courts, consultation is also sought from the State Governor (Chandra, 2018). All judicial courts irrespective of their level in the hierarchical structure, are bound to follow the same rules and regulations outlined by the Code of Civil Procedure (Chemin, 2010; Ghosh, 2018). An individual or a company cannot directly appeal at the Supreme Court unless there has been a violation of fundamental rights. The appeal should be made to the court under which the jurisdiction comes (Chemin, 2010).

In order to restrict labour mobility and associated knowledge spillovers, firms enforce non-compete, non-solicitation and non-disclosure agreements (Marx, 2011; Marx et al., 2015). Non-compete agreements are signed between the employer and employees which put restrictions on employees to join or form employers’ direct competitors within a geographical location and/or industry for a definite period of time post-resignation (Marx et al., 2015). On the other hand, non-solicitation agreements, also known as no-poaching agreements, are signed between companies which restrict one party from approaching employees of the other (Demirbag et al., 2012; Rani, 2016). Non-disclosure agreements are used to prevent inventors from revealing confidential innovation knowledge about the source firms to external organisations (Hertzfeld et al., 2006; Keupp et al., 2009).

The Contract Act of India 1872 recognises those contracts as enforceable that place restrictions on employees during their employment tenures such as non-disclosure and non-solicitation agreements (Rani, 2016). However, the contract act discourages the practice of agreements that limit employees’ freedom to choose their post-employment professions. Thus, employees cannot be legally restricted from joining particular firms including competitors or starting own ventures. Hence, non-compete agreements are
generally invalid in India and have been termed as ‘void’ by the contract act (Sharma, 2012; Rani, 2016; Desai, 2018). The primary reason behind invalidating non-compete agreements is that it may lead to an anti-competitive environment and such an environment may stall the country’s economic progress (Rani, 2016). However, the contract act does allow practising of non-compete agreements under certain circumstances. The section 27 of Indian Contract Act 1872 states “One who sells the goodwill of a business may agree with the buyer to refrain from carrying on a similar business within specified local limits (i.e., signing non-compete contracts)......provided that such limits appear to the court reasonable” (Choudhury, 2019, p.10). Thus, firms can practice non-compete clause for employees that are engaged in selling goodwill (i.e., employees possessing intangible assets such as trade secrets). For instance, in 1967, Century Spinning and Manufacturing Company Limited, a company manufacturing company won a suit against one of its employees with whom it had entered into a non-compete agreement and the employee violated the agreement by joining a direct competitor (Choudhury, 2019; Desai, 2018). During the employee’s tenure, the employee had acquired knowledge about the manufacturing of tyre cord yarn which was considered by the company as a trade secret. Thus, the employee’s mobility to the competitor may lead to the transfer of this trade secret to the competitor. Hence, the Supreme Court of India ruled the judgement in favour of the company. Desai (2018) reports several other recent cases, where Indian courts have ruled non-compete agreements as legally binding on similar grounds.

Although non-solicitation, non-discourse and non-compete agreements (to a certain extent) agreements are valid in India, the enforceability of such contracts is a

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8 Goodwill in business refer to intangible assets, for instance, knowledge of trade secrets and R&D pipeline etc (Desai, 2018).
One of the main issues faced by companies in case of contract enforcement is the complications in receiving a timely outcome from court proceedings. As of March 2019, the total number of pending cases at Indian courts is 30.12 million among which, 8.6 million are civil and rest are criminal cases (NJDG, 2019; see Figure 2.1). Out of these 30.12 million cases, 32,922 cases have been running for more than 30 years (NJDG, 2019). One of the reasons for slow court proceeding is the inadequate number of courts and judges. As of March 2019, the total number of judges are 17,959 (NJDG, 2019). Thus, on average, 1,678 cases are pending against each judge. That is why the World Justice Project (2019) finds justice proceedings in India to be one of the slowest in the world.

Unlike other countries like China and Malaysia, India has not yet provided any provision for making the process of dispute resolution faster and reliable by means of allocating separate courts and judges having expertise in intellectual property (Palanissamy, 2011). Thus, firms need to wait a long period of time to receive judgement,
which incurs high costs to companies. Hence studies reported firms’ preference towards to settling cases outside the judiciary system in India (Lamin and Ramos, 2016). Also, the World Justice Project (2019) reports alternative dispute resolution mechanisms in India to be reasonably affordable and efficient.

Another reservation that MNCs possess about Indian regulators and the judiciary system is that India’s IP legislations and judicial system is biased towards local firms. For example, until 2005, there was no provision for firms to apply for product patents in India in pharmaceutical, agrochemicals and food industry under the Patent Act 1970. This legislation was introduced in order to ensure that foreign MNCs’ product patents do not displace domestic manufacturers (Chandran et al. 2005). This law stimulated reverse engineering of pharmaceutical drugs developed in the west (Mueller, 2005) by encouraging Indian firms to “make copies of the drugs by developing their own processes” (Chandran et al. 2005, p. 271). Such an indigenous R&D friendly patent act diminished the monopoly hold of foreign companies in the Indian pharmaceutical sector (Joshi et al., 1974). The Patent Act 1970 was amended in 2005 to allow product patents for pharmaceutical products with the condition that low quality or secondary patents would be denied. That means a patent would be rejected if the new invention does not result in a significant enhancement in the efficacy of the existing technology/product (Lee, 2008; Roderick and Pollock, 2012). Under this provision, Assistant Controller of Patents and Designs, India rejected Novartis application to patent Gleevec (drug for the treatment of chronic myeloid leukaemia), which had been granted a patent in the USA, saying that Gleevec “was only a modified version of an existing drug, Imatinib, and therefore that the drug was not innovative” (Gabble and Kohler, 2014, p. 1), does not enhance efficacy significantly and thus should not be awarded a patent (Roderick and Pollock, 2012). Novartis challenged this decision at the Supreme Court of India; however, the court ruled
the case against Novartis in 2013 (Barazza, 2013). Reports have termed such regulations and judgements to be pro-local and anti-foreign firms (USTR, 2018). Local firms may take advantage of such favourable policies to hire employees from foreign MNCs in India without facing any legal consequences.

Because of such issues, most policy and international business studies conducted in the context of India have termed India as a country with a weak institutional regime (Zhao, 2006, Park, 2008). India has been ranked 59th positions in the International Property Rights Index⁹ (2018) and 68th on the Rule of Law Index published by the World Justice Project (2019)¹⁰.

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⁹ The Intellectual property Index scores for a country are calculated based on the following dimensions: ‘strength of the legal and political system’, ‘protection of physical assets’ and ‘protection of intellectual property’ (Intellectual property Rights Index, 2018).

CHAPTER 3 RESEARCH PAPER-1

Are Engineering graduates ready for R&D jobs in emerging countries? Teaching-focused industry-academia collaboration strategies for training

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ABSTRACT

This paper investigates a critical but underexplored challenge for offshoring research and development (R&D) to emerging countries: high human capital development costs, particularly high on-the-job training costs in preparing fresh Engineering and Technology (E&T) graduates for R&D positions in corporations, since the majority of E&T graduates in emerging countries are not educated to the same quality level as E&T graduates in advanced countries. We present research findings from an exploratory study of firms based in India (both multinationals and local firms) to establish how these firms might address this challenge. The quest for reducing on-the-job training costs has pushed corporations to form teaching-focused collaborations with academia such that they can transfer a part of their on-the-job training to universities while students are still undergoing formal education, thereby enabling corporations to recruit industry-ready graduates for R&D positions at the end of the formal education degree. This paper contributes to human capital theory in the context of fresh graduate hiring for R&D positions by demonstrating the potential of teaching-focused industry-academia (I-A) collaborations to provide an alternative to the traditional graduate recruitment and development model: ‘in-house on-the-job training’. Additionally, through the exploration
of different forms of teaching-focused I-A collaborations, associated delivery mechanisms and challenges, this paper strengthens a much-neglected dimension of I-A collaboration literature: the role of collaborative activities with industry in university teaching.

**Keywords:** teaching, industry-academia collaboration, human capital, emerging economies, R&D

### 3.1 Introduction

In the 1990s, multinational corporations (MNCs) from industrialised countries began to experience difficulties in finding adequate numbers of Engineering and Technology (E&T) graduates in their home and other industrialised economies due to ageing of the population (Economist, 2006), declining birth-rates and declining interest among graduates in studying E&T courses (Jacobs et al., 2005). Since a significant fraction of research and development (R&D) positions in corporations are filled by E&T graduates, the scarcity of E&T graduates in developed countries stimulated MNCs to search for destinations to set up R&D subsidiaries in emerging economies, such as Brazil, Russia, India and China (BRIC), where E&T graduates were available in mass numbers and demanding much lower wage rates (Dossani and Kenney, 2006; Lewin et al., 2009). During the period 2000-2009, approximately 6.45 million students enrolled in E&T undergraduate (UG) programmes in BRIC nations, 1.8 times more than the number of students enrolled in E&T courses in the USA, EU-27, South Korea, Japan and Australia combined in the same time period (Loyalka et al., 2014).

When MNCs established their R&D subsidiaries in emerging countries, they could access a considerably large pool of E&T graduates; however, one major challenge
arose. MNCs found that the majority of E&T graduates in emerging countries were not educated to the same quality level as E&T graduates in their home countries (Loyalka et al., 2014). A McKenzie survey (Farrell et al., 2005) conducted among MNCs’ R&D managers in emerging countries reported that only 10% of Chinese and 25% of Indian E&T graduates satisfied the requirements for R&D roles. To reduce the substantial on-the-job training resources in terms of the time and money required to train such E&T graduates for R&D jobs in emerging countries, corporations have started to engage in teaching-focused collaborations with universities to offer courses/projects, train faculty and establish laboratories (labs). Many high-technology corporations such as Cisco, IBM, Huawei, Microsoft, and Texas Instruments are reaching out to academia with initiatives such as ‘Cisco Networking Academy’, ‘IBM academic initiative’, ‘Huawei ICT Academy’, ‘Microsoft IT Academy’, and ‘Texas Instruments University Program’ to form collaborations in teaching. We refer to these collaborations between industry and academia as ‘teaching-focused industry-academia (I-A) collaborations’ that are largely developed to address the primary mission of universities: teaching and educating students (Laredo, 2007). So far, however, most studies exploring the dynamics of I-A collaborations have concentrated discussions on research and entrepreneurship-focused alliances (Perkmann et al., 2013), leaving I-A collaborations tailored to develop skills for R&D jobs largely unexplored. We address this research gap by presenting insights into how such collaborations occur, identifying drivers and challenges for universities and corporations participating in such alliances, and illustrating how new modes of collaborations are operationalised. India, which is now home to R&D subsidiaries of many multinational firms and has been widely criticised for the lack of capacity of its HEIs to deliver the quantity and quality of E&T graduates desired by multinational firms, offers a unique setting to study teaching-focused I-A collaborations.
Based on original empirical evidence from 12 companies’ teaching-focused collaborations with Indian E&T Higher Education Institutes (HEI) for developing E&T graduates with the skills needed for R&D positions, complemented by data retrieved from the web pages of 2,224 Indian E&T HEIs, we identify three distinct modes of teaching-focused I-A collaborations: companies offering courses to students as a part of the HEI’s curriculum (Mode-1); companies offering ‘value-added’ courses to students outside the HEI’s curriculum (Mode-2); and companies offering dissertation projects to students (Mode-3). The three modes are distinguished from one another by the drivers for the partners to engage in collaborations and associated organisational and institutional challenges. Within each mode, we also discuss delivery alternatives, i.e., how the activities pertaining to the teaching collaboration could be carried out, suggesting key managerial and policy implications.

Throughout this paper, we intend to make three key contributions. First, we strengthen the literature through the exploration of the much-neglected dimension of teaching-focused I-A collaborations. Our qualitative approach assists in developing a detailed understanding of how university teaching resources and capabilities can be enhanced and subsequently graduates can be skilled and better prepared for R&D roles needed by industry. Second, in the contexts of fresh graduate hiring, we contribute to the human capital theory (Lepak and Snell, 1999; Schultz, 1961) by demonstrating that teaching-focused collaborations have the potential to replace the traditional graduate recruitment and development model of ‘in-house on-the-job training’ (Carayannis and Jorge, 1998). Lastly, we contribute to international management literature on talent management in emerging countries by exploring firms’ strategies in India to counter the shortage of high-quality E&T graduates.
3.2 Theoretical Foundations and Literature Review

3.2.1 The Need for Teaching-focused Collaborations

According to human capital theory (Becker, 1964; Lepak and Snell, 1999; Schultz, 1961), for fresh university graduates to be ready to perform workplace activities, companies usually offer ‘in-house’ on-the-job training to the graduates upon recruitment to equip graduates with firm-specific skills with the expectation that the graduates have already acquired the necessary level of industry-specific skills (theoretical know-how, operational and applied skills)\(^\text{11}\) during university education (see Figure 3.1).

![Figure 3.1 Skills needed for a student to become industry-ready and firm-ready in R&D](image)

The period of on-the-job training depends on the industry-specific skill-level of the graduates gathered through formal university education. Without the required level

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\(^{11}\) ‘Industry-specific technical know-how’ refers to the understanding of concepts/theories that have applications in the industry. ‘Industry-specific operational skills’ refer to the knowledge of the operation of tools that are used commonly in the industry, while ‘industry-specific applied skills’ refer to the application of the theoretical knowledge to develop a product/technology using industry-specific tools. The acquisition of these three industry-specific skills makes a student industry-ready. Graduates still require firm-specific skills (operational and applied) to be ready to undertake R&D tasks at the firm. ‘Firm-specific operational skills’ correspond to the knowledge of operating firm-specific tools and applied knowledge refers to the application of the theoretical knowledge to develop a product/technology using the firm-specific tools. Based on this categorisation, for a student in Computer Science, knowledge of Java programming (prog.) is an industry-specific theoretical know-how; Java prog. on commonly used mobile operating systems (OS) (e.g., Android) is an industry-specific operational skill; and application development with Java prog. on Android is an industry-specific operational. Additionally, knowledge of Java prog on the firm’s OS is a firm-specific operational skill and application development with Java prog. on the firm’s OS is a firm-specific applied skill.
of industry-specific skills, the firm cannot train students with firm-specific skills, and therefore, firms may be required to offer industry-specific skill training during in-house on-the-job training sessions, which is likely to increase the period of on-the-job training. With the increase in time to train graduates, both ‘direct costs’ (Rindfleisch and Heide, 1997) increase in terms of paying for resources including technologies, infrastructure and trainers, etc., needed for training, as well as ‘opportunity costs’ (Weber et al., 2017), because firms lose economic opportunities to use newly recruited graduates in revenue generating tasks such as developing new products/technologies. Because the skills gap is too large between the formal education outputs and needs of new graduates, the cost of on-the-job training increases for companies. If the costs reach a significantly high level, from transactional costs (Williamson, 1979) logic, firms will look for alternative strategies that could help them save costs on training, while still hiring graduates already trained in the required competencies. One such solution is collaborating with universities in teaching, to transfer part of the on-the-job training to universities while students are still undergoing formal education so that at the end of the formal education degree, the company receives industry-ready graduates. Such an action should reduce the time and costs associated with the in-house human capital development process for firms.

From the university’s perspective, such collaborations with industry could help the university to upgrade its key tangible teaching resources (Barney, 1991) such as faculty, curricula, library, and labs in line with industrial needs, which should ultimately assist the university to improve teaching performance. Universities in less-developed countries are usually resource-constrained: they often, lack an adequate number of quality teachers to teach students and are underfunded to upgrade labs and libraries in line with industrial needs, and operate with outdated curricula (Liefner and Schiller, 2008; Muriithi et al., 2018). Hence, teaching-focused collaborations with industry present
unique opportunities for universities in less-developed countries to overcome resource voids in teaching and to align their curricula with companies’ needs. Thus, teaching-focused I-A collaborations allow both partners to reap relational rent (Grimpe and Sofka, 2016). Firms will be able to reduce the internal costs involved in developing graduates by externalising some of the training programmes to universities, while at the same time, universities enhance their teaching using such training programmes and tools. Figure 3.2 illustrates the theoretical underpinning of I-A collaborations in teaching and how it can solve problems for both industry and academia.

3.2.2 Organisation of Teaching-focused I-A Collaborations: Do We Know Enough?

A literature search performed on Web of Science shows that over the past two decades, I-A collaborations have been extensively studied, with 453 articles published in Research Policy, the Journal of Technology Transfer, Technovation and R&D Management journals.\textsuperscript{12} To examine to what extent these studies discuss industry’s participation in

\textsuperscript{12} The search on Web of Science used the following keywords (adopted from Perkmann et al., 2013): TS=("joint research" AND "industry" AND "university") OR TS=("joint research" AND "industry" AND "academi") OR TS=("joint research" AND "industry" AND "facult") OR TS=("collaborative research" AND "industry" AND "university") OR TS=("collaborative research" AND "industry" AND "academi")
teaching-focused activities of the university, we used text-search in NVivo 10 using common teaching-related words such as ‘student/graduate training’, ‘teacher/faculty/academic training’, ‘curriculum development/design’ and ‘teaching performance/outcome’. Surprisingly, we found that of the 453 articles on I-A collaborations, only 37 articles (~8.17%) mentioned one of these words at least once. This demonstrates the degree to which teaching-focused I-A collaborations have been a neglected area of research. Next, to identify the types of teaching-focused I-A collaborations that have previously been recognised, if not explained, we dig deeper into two streams of literature on I-A collaborations: a) literature predominantly on teaching-focused I-A collaborations and b) literature on research and entrepreneurship-focused I-A collaborations that offers implications for universities’ teaching activities.

The training of students by industry has been extensively discussed with respect to their involvement as research assistants in joint/contract research projects conducted by industry at universities (Butcher and Jeffrey, 2007; Lee, 2000). Such projects could be jointly supervised by faculty and participating industry executives. Behrens and Gray (2001) report that when involved, students’ contribution to industrial R&D projects is significant and sometimes even surpasses faculty’s contribution. This suggests that through participation in such industrial projects, students can develop expertise and relevant experience working with real-world projects (Lee, 2000). In reality, however, the percentage of students recruited as research assistants compared to the overall student
population of a university is very small, which raises concerns about the extent to which the entire student community of the university actually benefits from the universities’ engagement in the industrial contract and joint research assignments. To address this problem, initiatives have been taken to make participation in industry-supervised projects mandatory for completing research degree programmes. For instance, in 1992, a four-year postgraduate studentship programme called the EngD programme was launched in the UK under the joint supervision of the staff of a participating company and university faculty that required students to spend 75% of the time in industry-related projects (Butcher and Jeffrey, 2007). Similarly, industrial PhD programmes in Denmark and France were designed to equip doctoral students with practical skills (Laredo, 2007); however, these programmes are designed only for postgraduates and PhD students. They do not address the practical industry-relevant skill voids of undergraduate students, who fill the majority of the entry-level R&D positions in industry (Jacobs et al., 2005).

An industry-relevant curriculum can equip students with industrial skills, introduce them to ‘real-world problems’ and help the university to ‘keep up with the ever-changing technological frontiers of industry’ (Bramwell and Wolfe, 2008; p.1181). To what extent such curriculum inputs are taken on-board and perceived as important by university management, however, remains unclear. For instance, one-third of the respondents in Ankrah et al. (2013) assert that industry collaborators give negative inputs to the curriculum. Industry can also participate in the delivery of the curriculum primarily through ‘guest lectures’ (Plewa et al., 2015), which may allow students to receive first-hand knowledge directly from industry executives and explore job and internship opportunities with the company. Engaging in the delivery process facilitates opportunities to identify graduates for recruitment, and makes a company attractive as a place to apply for jobs (Plewa et al., 2015).
Faculty productivity may increase due to collaborations with industry in research and entrepreneurship as such collaborations allow faculty to develop new ideas and assess the industrial applicability of their own theoretical research findings (Lee, 2000). The refined ideas could be translated into academic publications in terms of both quality and quantity (Banal-Estañol et al., 2015). Some studies confirm that temporary placement of faculty in industry and placement of industry people in universities can help faculty to acquire ideas about industrial applications and emerging technologies (Woolgar, 2007). Companies may also organise short-term knowledge sharing workshops for faculty. Such face to face interactions with industry personnel offer opportunities to the faculty to acquire ‘tacit’ knowledge. Thus, it is believed that faculty teaching performance is likely to bolster post involvement in research and entrepreneurship-focused collaborations with industry. The extant literature, however, presents some contrasting findings. Sánchez-Barrioluengo (2014) observes that faculty’s involvement in such activities negatively influences teaching productivity, possibly because the pressure of delivering industrial research assignments on time could divert faculty’s attention and time from teaching (Ankrah et al., 2013; Sánchez-Barrioluengo, 2014). Etzkowitz (2003) previously reported incidents of faculty lobbying to reduce and desert teaching responsibilities to pursue research agendas. Lee (2000) finds the contributions of I-A collaborations to teaching performance as ‘modest’, with only 38% of 140 academics engaging in research-focused I-A collaborations agreeing that they ‘benefitted substantially or considerably in acquiring practical knowledge useful for teaching’ (p.122). Such contrasting findings raise a critical question: to what extent can benefits retrieved by faculty through industry-oriented research entrepreneurship activities be translated to teaching in such a way that it can benefit the students?
Thus, we reiterate Perkmann’s (2013) statement that ‘the impact of academics’ engagement with industry on teaching is not clear and the question has not been addressed in the literature’ (p.428). The likely reason behind this research gap is that scholars have been trying to examine the effect on teaching as a by-product or ‘unintended consequences’ (Behrens and Gray, 2001) of research and entrepreneurship-focused I-A collaborations (as in Stephan, 2001; Lin and Bozeman, 2006) rather than acknowledging that a teaching-focused I-A collaboration may also exist in its own right and studying it as such. This long-pending research gap is one of our main motivations to undertake this research on teaching-focused I-A collaborations and to investigate three research questions. First, are there different forms through which firms engage with E&T (we narrow our focus to only Engineering & Technological institutes) HEIs in teaching-focused I-A collaboration to develop E&T graduates for R&D functions? Second, what are the drivers and challenges for both firms and HEIs to engage in different forms of teaching-focused I-A collaborations? Third, what policy and managerial implications can be drawn from the analysis of teaching-focused I-A collaborations enhancing graduates’ employability for R&D functions? In the process of probing these research questions, we contribute towards proposing a new research avenue: teaching-focused I-A collaborations between industry and academia to enhance universities’ primary mission: teaching.

3.3 Methodology

3.3.1 Research Settings

The empirical context for studying I-A teaching-focused collaborations is India, as this country has been identified by companies as an endless pool of E&T skilled workers. In reality the average quality may not be sufficiently high to allow immediate utilisation of
graduates, and new graduates from India employed by MNCs may need substantial on-the-job training to undertake R&D activities. Nevertheless, India offers a very large supply of skilled workers and graduates. This is the result of a number of government initiatives implemented over the past three decades.

Market liberalisation in 1991 led to a massive inflow of foreign direct investment (FDI) including FDI in R&D to India (Kumar and Aggarwal, 2005). Prior to market liberalisation, India’s E&T education policies focused heavily on enhancing the quality of selected E&T HEIs (henceforth, whenever we use the word ‘HEI’, we mean ‘E&T HEI’), mostly those with institutes of national importance status (Saha and Ghosh, 2012). In the 1990s, Indian policymakers realised that India would experience a sustained inward FDI in R&D only if it succeeded in developing a considerably large pool of E&T graduates, which would require the establishment of a large number of new HEIs. Because the government was not in a position to financially support the establishment of such a high number of new HEIs and given the urgent demand, Indian policymakers encouraged private investment in the higher education sector. This resulted in unprecedented growth in the number of HEIs, from 678 in 2000-01 to 3,346 in 2013-14 (Choudhury, 2016). By early 2008, India’s yearly production of engineering graduates surpassed the USA, but it came ‘at the cost of declining quality of graduate education at least outside of a handful of elite (high-quality) universities’ (Ernst, 2006, p.9). Thus, the push for higher enrolment in E&T education gave rise to a large number of non-elite (low-quality) HEIs.

Scholars (Ernst, 2006; Gereffi et al., 2008; Loyalka et al., 2014) have documented the sharp disparity in the quality of E&T education between elite and non-elite HEIs in India and have cited the following factors as responsible for the low-quality of E&T education in non-elite HEIs: low faculty to student ratio; low-quality of faculty; enrolling
students with little mathematics and science knowledge; and outdated curricula and labs. In fact, Agarwal (2006) reported that the majority of non-elite HEIs in India did not have proper accreditation to provide E&T degrees. Reports (Aspiring Minds, 2016; Farrell et al., 2005) presenting survey insights from R&D managers confirm that finding qualified graduates for R&D positions is a key challenge facing India, primarily because of the limited number of elite HEIs in the country, as well as the stern competition companies face when recruiting. Therefore, many companies must recruit graduates from non-elite HEIs, who are unlikely to be fully trained and equipped to work in R&D activities. Consequently, companies must sustain on-the-job training costs and in line with the theory, may consider establishing teaching-focused collaborations with HEIs in India.

3.3.2 Data Collection and Analysis

This paper uses multiple qualitative case studies to address the research questions. To identify the potential cases, first, we manually checked the websites of 2,224 E&T HEIs in India in order to retrieve first-hand information on companies and HEIs that engage in teaching-focused I-A collaborations. We define an I-A collaboration as teaching-focused if the HEI and company develop a formal agreement or memorandum of understanding (MoU) to enhance the HEI’s teaching activities, for instance, improving the quality of students directly by designing/delivering student training programmes or through improving HEIs’ teaching resources such as courses/curricula, library, labs, faculty and e-learning facilities, etc. In total, we found 925 HEIs (~ 41.6%) and 69 firms that engage in at least one teaching-focused I-A collaboration. Below, Figure 3.3 reports the locations of 925 HEIs across India.
It can be seen that HEIs across the majority of Indian states engage in teaching-focused collaborations with industry, suggesting the importance and penetration of such collaborations in Indian E&T education, which also justifies our selection of India as the research setting. The data retrieved from websites also helped to identify industry associations that are active in promoting such collaborations. As teaching-focused I-A

Figure 3.3 Heat map documenting the locations of 925 HEI with teaching-focused industrial collaborations across India (the colours blue, yellow and red denote low (10%), medium (100%) and high (200%) point density); created with eSpatial software.
collaborations are new to the literature, we performed a pilot study to determine if our definition of teaching-focused I-A collaboration is appropriate in the contexts of India. For the pilot study, we interviewed six senior executives from three industry associations covering three industries (IT, electronics & telecommunications and capital goods) during the period June-July 2016. Coding these interviews helped us to identify the abstract first, second and third order themes and to improve the questionnaire for the main study (case studies).

Out of these 69 firms that were found to be active in forming teaching-focused collaborations with academia based on the data retrieved from HEIs’ websites, just 15 firms contribute to 80% of the collaborations. Therefore, we decided to focus on only these 15 firms for conducting the case studies. Out of these 15 firms, 10 agreed to participate in the case studies. We further noticed that all these 10 firms are broadly from the information and communication technology (ICT) sector; and, therefore, we handpicked two firms from non-ICT sectors including one from the automobile industry (Firm-XI) and another (Firm-XII) from the electrical manufacturing industry, to bring industrial diversity to the case selection. For the main study, we first arranged the 12 companies (cases) in descending order of the number of their teaching-focused collaborations with a view that the cases with a higher number of collaborations should be interviewed first as they may offer more information than those with fewer collaborations, helping us to identify the themes earlier, while the latter cases could be used for validating the identified themes and finding alternative explanation (Yin, 2003) through cross-case analysis. However, all of the cases possess multiple teaching-focused collaborations, with a few holding over 100 teaching-focused collaborations; we were able to perform within-case analysis by asking the interviewees to give an account of the similarities and dissimilarities across different collaborations. The combination of
within-case and cross-case analyses contributed towards enhancing the richness and validity of data analyses (Eisenhardt, 1989).

For the interviews with companies, we contacted the Academic Programme Manager(s), who supervise activities pertaining to teaching-focused collaborations within each company. Most interviews were held face to face except a few that were performed over the phone. For some of the firms, we could not immediately identify the appropriate managers responsible for teaching-focused collaborations. Within such organisations, we used a ‘pyramiding technique’ (Von Hippel et al., 2009); i.e., we determined a starting point (an individual employee) within the firm; asked the subject for a referral and continued following the referrals until the person responsible for teaching-focused collaborations was found. For each case study; we interviewed at least one partner HEI and third-party organisation (TPO, if relevant). Interviews with HEI helped us to understand their side of the story and offered a balanced insight. Within the HEIs, we contacted the Director/Dean of the HEI, who then arranged focus group meetings involving faculty members that are actively involved in teaching-focused collaborations. Within the HEIs, we also interviewed current and former students who participated in the training programmes. In total, we conducted interviews with 52 participants (some of these provided information about more than one case, and therefore they add up to 73 respondents) for the main study during the period August 2016-January 2018 and used secondary data from multiple sources such as websites, MoUs, brochures, and press communications to reduce data collection biases (Eisenhardt, 1989; Yin, 2003). Table 3.1 offers a brief description of the 12 cases and the interviewees from each case.

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13 Academic Programme Managers (APM) are R&D Managers with added responsibilities of hiring and developing R&D graduates through academic collaborations

14 Not all teaching-focused I-A collaborations involve TPOs as a partner.
### Table 3.1 Brief introduction of the cases and respondents interviewed

<table>
<thead>
<tr>
<th>Cases</th>
<th>Brief description</th>
<th>Respondents</th>
<th>No. of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case/</td>
<td></td>
<td>Firm-APM; Partner HEI (1&lt;sup&gt;st&lt;/sup&gt;)-Focus group (Dean, and faculty members); Partner HEI (2&lt;sup&gt;nd&lt;/sup&gt;)-Former students</td>
<td>8</td>
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<tr>
<td>Firm-I</td>
<td>Firm-I is an Indian IT multinational and recruits over 10,000 fresh E&amp;T graduates every year for mainly development roles. Until 2017, it has developed teaching-focused collaborations with approximately 500 Indian HEIs in technological domains such as business intelligence, building enterprise applications, and mobile application development.</td>
<td>Firm-Former APM; Partner HEI-Dean and faculty members; Partner TPO-CEO</td>
<td>6</td>
</tr>
<tr>
<td>Case/</td>
<td>Firm-II is a leading US MNC specialising in telecommunication business and its Indian R&amp;D centre is largest outside the USA. In 2000, Firm-II started forming teaching-focused alliances with Indian HEIs to offer courses to UG/PG students in basic programming, network design and security. By 2017, this programme reached out to approximately 450 Indian HEIs.</td>
<td>Firm-APM; Partner HEI-Dean; Partner TPO -CEO and employees</td>
<td>11</td>
</tr>
<tr>
<td>Firm-II</td>
<td></td>
<td>Firm-APM; Partner HEI-Faculty, and former students; Partner TPO-CEO</td>
<td>7</td>
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<tr>
<td>Case/</td>
<td>Firm-III is a US multinational specialising in database management software. Its development centre in India has been operational since the 1990s. It has developed teaching-focused collaborations with approximately 400 HEIs by 2017 around database design and programming.</td>
<td>Firm-APM; Partner HEI-Faculty and former students; Partner TPO-CEO</td>
<td>7</td>
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<tr>
<td>Firm-IV</td>
<td>2017, it has developed teaching-focused collaborations with over 200 HEIs to set up labs and train faculty on analogue and embedded processing technologies.</td>
<td>Partner HEI-Dean; Partner TPO and R&amp;D Manager</td>
<td>11</td>
</tr>
<tr>
<td>Case/</td>
<td>Firm-V is a US multinational and was one of the first major global IT corporations to establish an R&amp;D subsidiary in India. By 2017, FIRM-V has developed teaching-focused collaborations with 155 Indian HEIs in four domains: big data, cloud computing, information security and mobile computing.</td>
<td>Partner HEI (1&lt;sup&gt;st&lt;/sup&gt;)- Focus group (Dean, faculty members and students); Partner HEI (2&lt;sup&gt;nd&lt;/sup&gt;)- Focus group (Director, Dean, and faculty members)</td>
<td>11</td>
</tr>
<tr>
<td>Firm-V</td>
<td></td>
<td>Firm-APM; Partner HEI-Faculty member and former students</td>
<td>6</td>
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<tr>
<td>Case/</td>
<td>Firm-VI is a US multinational specialising in semiconductors and its R&amp;D subsidiary in India has been operational since the late 1990s. Up to 2017, it has developed teaching-focused collaborations with 73 HEIs to set up labs in embedded systems.</td>
<td>Firm-APM; Partner HEI-Dean and faculty members; Partner TPO -CEO</td>
<td>7</td>
</tr>
<tr>
<td>Firm-VI</td>
<td></td>
<td>Firm-APM; Partner HEI-Faculty member and former students</td>
<td>6</td>
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<tr>
<td>Case/</td>
<td>Firm-VII is a European multinational specialising in telecommunications. As of 2017, it holds teaching-focused partnerships with 68 Indian HEIs for offering training to students on a range of topics including 2G, 3G, internet protocol, multimedia, GSM, WCDMA and value-added services.</td>
<td>Firm-APM; Partner HEI-Faculty member and former students</td>
<td>6</td>
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<tr>
<td>Firm-VII</td>
<td>Firm-VIII is an Indian IT multinational. In 2007, it started a programme to train faculty members of Indian HEIs on internet security. As of 2017, it holds teaching-focused collaborations with 55 HEIs.</td>
<td>Firm-APM; Partner HEI-Faculty member</td>
<td>4</td>
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<tr>
<td>Case/</td>
<td>Firm-V is a US multinational firm specialising in the development of customer-facing applications. By 2017, it has developed teaching-focused collaboration with 20 HEIs in mobile application development.</td>
<td>Firm-APM; Partner HEI- Focus group (Dean, faculty members and students)</td>
<td>7</td>
</tr>
<tr>
<td>Firm-IX</td>
<td>Firm-VII is a European multinational specialising in telecommunications. As of 2017, it holds teaching-focused partnerships with 68 Indian HEIs for offering training to students on a range of topics including 2G, 3G, internet protocol, multimedia, GSM, WCDMA and value-added services.</td>
<td>Partner HEI- Faculty members</td>
<td>4</td>
</tr>
<tr>
<td>Case/</td>
<td>Firm-X is a US multinational specialising in cyber security and its R&amp;D centre has been operational since the 1990s. As of 2017, it developed teaching-focused collaborations with 19 HEIs to set up labs and offer student and faculty training on cyber and network security.</td>
<td>Firm-APM; Partner HEI-Dean and faculty member</td>
<td>4</td>
</tr>
<tr>
<td>Firm-X</td>
<td>Firm X is an Indian multinational automotive parts manufacturer. In 2015, it entered into teaching-focused collaborations with two Indian HEIs located in Delhi NCR to co-develop and deliver curriculum, train faculty and set up labs in automobile engineering.</td>
<td>Firm-APM; Partner HEI-Dean and faculty member</td>
<td>4</td>
</tr>
<tr>
<td>Case/</td>
<td>Firm-XII is a domestic firm specialising in electrical equipment manufacturing. In 2015, it entered into a teaching-focused collaboration with HEI XII in Power Electronics. Firm-XII aims to develop multiple teaching-focused collaborations in the coming years.</td>
<td>Firm-APM; Partner HEI- Dean and faculty member</td>
<td>4</td>
</tr>
</tbody>
</table>
We followed the steps outlined by Attride-Stirling (2001) for interview coding and theme identification. The first author was responsible for interview coding and theme derivation, while the other two authors were responsible for checking if a) the codes were an appropriate representation of the interview data and b) the themes were appropriately derived from the codes. Joint meetings were organised for finalising the thematic networks (Attride-Stirling, 2001) which helped in achieving ‘researcher triangulation’ (Estrada et al., 2016). To facilitate an in-depth exploration of teaching-focused I-A collaborations, we continued coding the data beyond first and second order themes (Fereday and Muir-Cochrane, 2006) and added third, fourth, fifth and sixth order themes (see Figures A1, A2 and A3 in Appendix-A). We developed three thematic network maps for first-order themes: ‘organisation of teaching-focused I-A collaborations’, ‘drivers for teaching-focused I-A collaborations’ and ‘challenges for teaching-focused I-A collaborations’, addressing the research questions. The final thematic maps (with codes) were shared with the interviewees to ensure appropriate interpretation and representation of their interviews and the teaching-focused I-A collaborations in general. A point of saturation (Järvi et al., 2018) was achieved after eight cases as the next four cases did not result in the addition/deletion of themes and hence, we discontinued our main study at 12 cases.

3.4 Organisation of Teaching-focused I-A Collaborations

We identify three distinct modes of teaching-focused I-A collaborations: companies offering courses to students as a part of the HEI’s curriculum (Mode-1); companies offering ‘value-added’ courses to students outside the HEI’s curriculum (Mode-2); and companies offering dissertation projects to students (Mode-3). The three modes are distinguished in terms of the nature of skills developed by students, drivers for the
partners to engage in collaborations and associated challenges. Within each mode, we also discuss delivery alternatives.

3.4.1 Mode-1: Courses Offered to Students within HEI Curriculum by Firms

Organisation of Mode-1 Collaboration

In Mode-1, companies are involved in designing single/multiple courses as part of the UG/PG curriculum and offering these courses to students. For instance, in 2013, Firm-V collaborated with YY HEI\(^{15}\) to introduce a specialisation in ‘big data analytics’ within the UG programme in Computer Science. This specialisation contains seven IT courses (e.g., ‘Fundamentals of big data with Hadoop using Firm-V software’ and ‘essentials of Firm-V business intelligence administration’) spread across five semesters. At the end of the programme, on successful completion of all the courses pertaining to the specialisation, students receive a degree where the undertaken specialisation and the name of the company along with the HEI are clearly mentioned. Students must pay an additional fee to undertake courses from the company specialisations.\(^{16}\)

The curriculum development process takes place in the following stages:

- First, the focal courses are developed through intense face to face discussions between the faculty from the appropriate department and domain experts from the firm’s R&D department, and cover the course content as well as how the content will be conveyed to the students in terms of lectures, labs, books, timetable and assessments. Although initially the collaboration may target the development of few specific courses within a particular degree programme, the partners may be required

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\(^{15}\) In order to keep the HEI’s identity anonymous, we use YY as the pseudonym for all the HEIs interviewed.

\(^{16}\) For example, in YY HEI, 4-years’ course fees for the Computer Science and Engineering UG programme with Firm-V’s specialisation is approximately US$12,200; while course fee without Firm-V’s specialisation is approximately US$10,400.
to review the structure of all the courses that are taught within the degree programme, which is likely to prompt the improvement of other courses as well.

“We realised that books are still old; we asked them (the HEI) to order new books; books that are written by industrial people; who have seen the real thing. Now they have a better library and reading lists.” - Manager, Firm-XI.

“We first thought of introducing few elective courses such as ... in the fifth semester at YY institute. Due to the advanced nature of our electives, students without strong basic knowledge face difficulty to grasp our courses. So, we looked at the existing curriculum of the institute and the courses that are taught in the preceding semesters to understand if the students have the required basic knowledge. We identified that we cannot teach our electives unless and until the courses that are taught in the first four semesters, are updated. It led us to help them (the HEI) to change the content of other courses as well.” - Manager, Firm-XII.

- Second, the modified or newly introduced courses are reviewed by the ‘Board of Studies’ (BoS) of the HEI, who make the decision as to whether to introduce the amended course(s) to the curriculum. The involvement of the BoS ensures that the courses do not become overly firm-specific, which otherwise could reduce the graduates’ ability to seek jobs outside the company’s ecosystem (Hashimoto, 1981; Neal, 1995). Additionally, firms make it mandatory for the HEI to purchase at least a part of the necessary lab resources from the firm in order to facilitate the required practical component of the training. These lab resources involve products and technologies that are very firm-specific and allow students to acquire operational skills by familiarising themselves with the operation of firm-specific tools. The BoS,
however, may push for the procurement of tools that are used widely in the industry, not only in the specific firm.

“If our students become competent in technology that only one company uses, they won’t be recruited by others. Our responsibility is to create talent for the entire industry; not for one particular company. We therefore, do not induct companies’ programmes directly into our curriculum; we are open to co-developing curriculum.” – Dean, YY HEI.

- Finally, in case the HEI is autonomous, i.e., has the academic autonomy to design its own curricula; the decision made by the BoS is final. If the HEI is not autonomous, it must seek permission from its parent university to modify the existing curriculum. The parent university has its own BoS, which will then review the proposal and make the final decision.

The modified/new courses of the curriculum are usually entirely delivered by the faculty as it is their responsibility to teach courses that are part of the curriculum. Faculty are first trained by the partner firm’s R&D engineers on the relevant topic, tools and teaching methodologies. For instance, Firm-I’s faculty training programme is divided into five stages: a) subject training, where faculty are given training on specific topics; b) case studies and practitioner sessions, where faculty are taught about the application of concepts in the real-world business situations; c) tool exposure, where faculty are familiarised with advanced tools in software developing life cycles to facilitate firm-specific operational skills; d) hands-on, where faculty are first shown demonstrations of development and testing of applications using the tools and then offered assignments and projects using the same tools to facilitate firm-specific applied skills; and e) teaching methodologies, where faculty are given training on appropriate methods for structuring lectures, lab sessions, and student assessments. At the end of the training, faculty must
demonstrate how they would teach specific topics to students and the firm employees offer feedback. On successful completion of the training programme, faculty are offered a ‘trainer’ certificate. The length of training is contingent upon the quality of the faculty and the advanced nature of the skills that are to be imparted to the students, ranging from a few weeks to years. For instance, in the collaboration between Firm-V and YY HEI, since faculty were not familiar with the content of the newly introduced courses, Firm-V delivered via its own employees almost 100% of the lecture hours during the first year after the collaboration was announced (academic year: 2013-14), 50% of the lecture hours in 2014-15, and 20% in 2015-16. Faculty were given 2 weeks’ training before the start of each academic year and were additionally required to attend the lectures conducted by the employees of Firm-V.

Drivers for Firms and HEIs to Engage in Mode-1 Collaboration

Mode-1 enables firms to train students in theoretical and operational industry-specific and firm-specific operational skills. Training students in firm-specific operational skills helps the firm to develop the graduates not only for its own R&D positions but also at other organisations (e.g., clients) that use the firms’ products/technologies. This factor aids the firm in marketing its products and technologies.

“There is a marketing side to it. Let’s say we are developing ten thousand students every year on our software. That puts us in a strong position when dealing with potential clients. We can tell them (clients) that if you buy our software, we guarantee you ready-made graduates that are well-trained in our software and you won’t have to make any additional investment to train them (the graduates).”-Manager, Firm-V.
Courses taught in Mode-1 are part of the curriculum, and therefore compulsory for all students. Thus, companies are able to reach out to very high number of students. In Mode-1, firms do not need to involve their own employees in the course delivery process, which minimises the direct and opportunity costs, i.e., economic opportunities lost by firm employees, including research and development of new products and technologies due to their involvement in teaching courses to students. Additionally, the lab resources set up by firms as a part of the collaboration bring revenue to the firms both in the short term (via lab resource sales) and long-term (via upgrades and maintenance support). The cost of the lab resources is included by the firms in the fees to be paid by the students to attend the courses, which alleviates the pressure of arranging the funds from HEIs. In collaboration in Mode-1, in particular, the engagement in the joint curriculum design and approval process allows firms to develop cognitive social capital (Lee, 2009) about HEIs’ academic expertise and quality, and the faculty training process facilitates the development of relational social capital (Steinmo and Rasmussen, 2018) in firms through the establishment of personal relationships with faculty members. Such cognitive and relational social capital could be valuable for developing research and entrepreneurship-focused collaborations with academia in the future (Steinmo and Rasmussen, 2018).

**Challenges for Firms and HEIs to Engage in Mode-1 Collaboration**

In Mode-1, firms may lose control over the type of skills being imparted to students as the courses are developed through negotiation with faculty. Faculty may oppose the inclusion of overly firm-specific content and tools in the modified courses, which could limit the transfer of firm-specific skills to students. From the HEIs’ perspective, HEIs’
lack of autonomy to change curricula appears to be a strong challenge for developing Mode-1 collaborations, which can be termed as an ‘institutional rigidity’ (Schettkat, 2003).

“We were approached by ... to jointly develop courses in cloud computing within the Computer Science UG programme. Our Board of Studies wrote to YY University, our parent university seeking permission, but they rejected and we could not do it. In terms of academic independence to change curriculum, we are handicapped.” – Dean, YY HEI.

Another challenge appears regarding the delivery of the courses, namely, the suitability of faculty staff. Faculty may not have the adequate ‘potential and realised absorptive capacity’ (Cohen and Levinthal, 1990; Zahra and George, 2002), first to assimilate the knowledge from a few weeks of training, and then to deliver training to students with the required competency. Low-quality faculty might require firms to design long-term faculty training programmes, resulting in high direct and opportunity costs for the firm.

“Before initiating a partnership, we analyse their quality and ask questions. Are they able to learn our technologies in a couple of weeks’ of training and can they offer the same training with equivalent quality to the students? If we have concerns regarding the quality of the faculty, we tend not to proceed with the collaboration; because costs are also involved in training the academic staff. And

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17 India’s higher education system is mainly comprised of two types of HEIs: Universities and University-affiliated institutes. Universities include central universities, deemed universities, state universities and private universities, and have full autonomy in terms of academic and financial matters. State universities are given additional responsibilities to monitor and control institutes, both public and private in nature, that do not have the resources to reach ‘university’ status. Such institutes may include both autonomous and non-autonomous institutes and therefore are required to follow the curricula designed by their parent state universities. While non-autonomous institutes have neither academic nor financial autonomy, autonomous institutes are granted academic autonomy. Thus, non-autonomous HEIs struggle to partner with firms in Mode-1 collaborations and approximately 80% of the E&T HEIs in India are non-autonomous.
3.4.2 Mode-2: Value-added Courses Offered to Students by Firms

Organisation of Mode-2 Collaboration

In Mode-2, companies offer value-added courses, i.e., courses taught outside the regular curriculum. Participation in such courses is voluntary for students and the completion of these courses does not count towards the degree; however, students are awarded a post-completion certification from the firm. The HEIs offer the necessary infrastructure such as classroom and labs to organise the training at the HEIs’ premises. The courses are designed entirely by the firm. The inputs of the partner HEI’s BoS and the parent University (for non-autonomous HEIs) is not taken into consideration while designing the courses. Textbooks and learning materials are provided by the firm. Lab resources must be acquired by the HEI for delivering the courses. Students are required to pay for the courses taught in Mode-2.

There exist three delivery options for teaching the courses to the students: faculty, firm employees and third-party organisations (TPOs). In the case of delivery by faculty, they are initially trained by firm employees similarly to Mode-1. In addition to training the faculty on industry-specific and firm-specific skills, they are also given instructions on how a particular course is to be delivered in terms of assessment, lecture notes and assignments for lab classes. Faculty are not offered any flexibility to deviate from these instructions. They are also required to report regularly to the firm about the schedule, batch size, student progress, examination questions and examination scores so that it can keep track of the progress of the course delivery. It is expected that the courses will be taught weekly outside curriculum hours (often during the weekends) depending upon the
availability of faculty. If the faculty are unable to deliver the courses to students, the firms may hire TPOs, organisations that specialise in offering advanced vocational training. TPOs must also undergo training similar to the faculty before delivering the respective courses at HEIs. Firms are required to pay fees to the TPOs for their service. Thus, direct costs are still high for firms that opt for this delivery option; however, they can avoid opportunity costs by avoiding their own employees’ involvement in the course delivery to students.

In the absence of faculty and TPO, firms are likely to send employees from R&D functions that are experts in their respective disciplines and experienced in using specific technology domains to teach courses to students. To reduce costs, instead of delivering the courses throughout the semester, firm employees may choose to teach the courses through 2-3 days of intense training or offer a part of the course online via webinars and instructor-led virtual training classes. For instance, Firm-VII offers a full-year course on 2G, 3G, internet Protocols, Multimedia, GSM, WCDMA and value-added services at YY HEI by combining in-person and online training. The firm employees deliver introductory classes, conduct the practical sessions and take responsibility for assessment, while the online sessions are used for explaining theoretical concepts.

**Drivers for Firms and HEIs to Engage in Mode-2 Collaboration**

One of the key drivers for companies to engage in Mode-2 is the control that firms hold over the course design, allowing them to teach students courses that are highly firm-specific. It ultimately helps firms to develop students with the preferred level of firm-specific operational skills, which is not possible in Mode-1.
“We prefer not to engage in curriculum development. We can achieve the same target by certifying students outside the curriculum. And the institute cannot tell us what we can or cannot teach students.” - Manager, FIRM-I.

Such collaborations thus allow firms to both avoid the bureaucratic approval process that was required for Mode-1, and regularly modify the course content and structure.

“Companies need flexibility. The technologies are changing rapidly, so are skill requirements. We need to update the courses every year which is only possible if you teach outside the curriculum. If you try including these courses as curriculum, you cannot change the content for the next 4-5 years.” - Manager, Firm-X

Different factors may drive firms to use different delivery options in Mode-2. Delivery via faculty assists in reducing both direct and opportunity costs and helps to develop relational social capital with the faculty. Delivery via firm employees facilitates direct communication with the students, resulting in the transmission of ‘tacit knowledge’ from the employees to students, which includes the sharing of real-world R&D experience.

“Although academics might be well-trained in the coursework thanks to our well-designed faculty training programme; they do not have real-world experience of working in a company. They cannot help the students visualising the work environment in an R&D centre; how the technologies could be applied across different projects; if there arises a problem with the technology; how to fix it. For such knowledge, you need to involve people (R&D employees) who have actually developed such technologies.” - Manager, Firm-II.

Direct communications between the firms’ employees and students offer the opportunity to identify talent for recruitment (to firms) and explore internship and job opportunities (for students). While delivery via TPOs helps firms to reduce opportunity costs compared to delivery via own employees, neither the HEI nor the firm receives any additional
benefit. From the HEIs’ perspective, Mode-2 collaboration strengthens lab resources. Further, when the courses are delivered by faculty, faculty receiving training in the relevant industry and firm-specific skills and are able to develop relational social capital with the firms.

**Challenges for Firms and HEIs to Engage in Mode-2 Collaboration**

As the completion of value-added courses is not mandatory to receive a degree, students may show less willingness to undertake courses in Mode-2, which might restrict the firm from reaching out to a large pool of students. Similar to Mode-1, firms may opt not to involve faculty if their quality credentials are questionable. Additional challenges arise because courses under Mode-2 are external to the curriculum and faculty participation is therefore not mandatory to receive a salary. The absence of adequate incentive mechanisms may therefore discourage faculty participation. The only incentive that the faculty receive for their involvement in the delivery process is a trainer certificate, which is negligible compared to the financial incentives that can be gained via research and entrepreneurship-focused collaborations with industry (Debackere and Veugelers, 2005).

“Engineering colleges in India are already short of faculty. Thus, the existing faculty have high teaching loads. On the top of that you are asking me to teach these courses to students during the weekend. What’s my benefit? At max, I will get a certificate while they (companies) earn money through such courses. I would rather invest my time in doing consulting work with the industry, which guarantees some monetary returns.” - Faculty, YY HEI

While HEIs blame companies for not offering financial incentives to run these courses, firms suggest that faculty’s unwillingness to get trained in industrial technologies and
deliver these courses is partly due to a lack of competitive environment in the higher education sector, also termed as ‘peer pressure’ (Tartari et al., 2014).

“Particularly those faculty who are from government-run institutes: they are earning handsome salary each month, getting promoted without any pressure; there is no real competitive environment to pressurise them to learn new technologies. Without such pressure, they will never participate in such industrial partnerships for training.” - Manager, Firm-X.

Even if companies show interest in offering monetary incentives to faculty, institutional rigidity may appear, particularly in government-run HEIs, based on the acknowledgement of faculty participation in the industry-run programmes as a ‘conflict of interest’ and a threat to faculty’s ‘organisational loyalty’, which have previously been acknowledged as a barrier to faculty participation even in industry-oriented research (Lee, 1996). Additionally, the rigidity of faculty is also likely to emerge due to lack of ‘academic freedom’ (Azagra-Caro et al., 2006; Lee, 1996) in Mode-2, in terms of both design and delivery of courses. Academic freedom has two components: ‘academic choice’, i.e., the freedom to design the content of courses to be delivered to the students, and ‘academic dissemination choice’, i.e., the freedom of choosing the delivery mechanism (lectures), supporting resources (labs and books), and assessment mechanisms to support the course delivery (Davis et al., 2011). In Mode-2, the faculty has little flexibility to change the content or the delivery guidelines proposed by the firm.

“We are required to follow the course content prescribed by the company line by line and also report about almost everything: the schedule, batch size, examination questions and students’ examination scores to the company. We have zero flexibility, which is frustrating at times”. – Faculty, YY HEI.
Alternatively, the use of the firm’s own employees and TPOs as a delivery option can lead to high direct and opportunity costs and limit firms’ ability to develop relational capital with the HEIs.

3.4.3 Mode-3: Dissertation Projects Offered to Students by Firms

Organisation of Mode-3 Collaboration

In Mode-3, firms collaborate with HEIs to offer dissertation projects to students in order to enhance graduates’ firm-specific operational and applied skills. The projects are usually co-developed by students, faculty and the firms’ R&D employees. Projects could be group-based or individual projects depending upon the nature of the dissertation (undergraduate or master’s dissertation). The firm and faculty jointly decide the topics for the projects. While deciding topics, two criteria are used: a) the topic aligns with the company’s research themes and faculty’s area of interest as projects are entirely supervised by faculty; b) students have the required industry-specific theoretical know-how to learn the operational and applied skills necessary to perform the project. For instance, Firm-IX and YY HEI collaborated in Mode-3 to offer dissertation projects to UG students in Computer Science on mobile application development using the firms’ operating system (OS). Both partners agreed that to complete the project successfully, advanced knowledge of JAVA programming was required. Therefore, the faculty organised a screening of students to find those eligible based on Java programming skills. The selected candidates were then trained on Mobile Application Development on the firm’s OS through the faculty, who had previously undergone training at the development centre of Firm-IX in Noida. Faculty training takes place in a similar fashion to that of

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18 In India, an UG dissertation usually involves a group project, while a master’s dissertation is an individual project.
Mode-1 and Mode-2; however, the primary focus is strengthening the applied skills and the process of R&D project development.

“Apart from technical skills, we were also trained on project management training pertaining to R&D projects at the company. We were shown virtual demonstrations of the different stages of product development, what sort of activities takes place in each stage, the deliverables, etc., and we were expected to offer transfer the same knowledge to the students.”- Faculty, YY HEI.

Once the training is offered to students, students must form groups (for group-based projects) and come up with ideas for the dissertation project within the remit of topics proposed by the faculty and firm, for instance, the type of application to be developed in case of Firm-IX’s collaborations. Once the students have submitted their ideas to the faculty, the faculty then discuss these ideas with the firm to explore if they are implementable. The firm and faculty jointly decide the scope and boundary of each project. The faculty are required to report the progress to the firm and consultation is sought from the firm if a technical problem arises that the faculty are unable to solve. The final outcome of the project is usually assessed by both faculty and the company employee. The company may wish to commercialise the product by taking the collaboration to the entrepreneurial level. If the company comes up with multiple ideas from multiple collaborations, they screen the best ideas, usually via some prototype contests.

“As we speak, rapid prototype camping is happening in Bangalore. So, of the top 50 prototypes that have been churned out by students from our partner institutes, then we take these top 50 to our mentors at the corporate office. The students will be provided with entrepreneurial training by our incubators and accelerators and some of them will finally go to the market.”- Manager, Firm-VI.
Through participation in these projects, students are able to enhance their ‘problem-solving skills’, a must-have skill to succeed in R&D (Wang and Horng, 2002). For instance, in the case of Firm-IX’s collaborations, once a project reaches approximately an 80% readiness level, the application developed by the students is shared with the R&D staff of Firm-IX. The R&D staff then forwards the application to the quality department to find bugs. The bugs are sent back to the project team so they can check their algorithm and fix the bugs in order to stimulate a problem-solving attitude in the students.

Establishing a lab is optional for developing projects. If labs are not installed, students may have to visit the company’s corporate labs to use the required facilities, which is only feasible if the HEI and firm are located in close proximity. Company visits give the students unique insights into the functioning of the R&D department, product portfolio and project management process. Students may also be offered opportunities to participate in workshops, training sessions and meetings organised by the company for employees.

“I had the opportunity to participate in two workshops: the first one was on technology and network foresight activities organised by an external consultant and the second was on patenting.” - Student, YY HEI.

Certificates are issued by the firm on successful completion of the dissertation project. Students are not required to pay for undertaking the projects, however; if installed, the HEI is required to pay for the lab tools.

**Drivers for firms and HEIs to engage in Mode-3 Collaboration**

The primary driver for firms to collaborate in Mode-3 with HEIs is to train students with the applied component of firm-specific skills. These projects may lead to entrepreneurial
opportunities for the HEI and the firm, and publishing opportunities for the faculty as one faculty member shares the experience of writing several research papers based on the projects he supervises. Students show interest in completing the project as the completion of dissertation projects is mandatory to matriculate. The project leads to the development of relational and cognitive social capital between the partners.

**Challenges for firms and HEIs to engage in Mode-3 Collaboration**

The challenges for partnering in Mode-3 collaboration is similar to those experienced in joint R&D projects (see Bruneel et al., 2010). For instance, the partners may possess different expectations from the collaboration and preferences for different knowledge dissemination approaches. While firms are likely to push for prototypes and possibly patents, academics may be driven by opportunities for academic publications. Additionally, non-involvement of the firm’s employees, particularly during the initial implementation portion of the project, may give rise to products that do not fit firms’ existing business models and product ranges. Mode-3 collaborations are difficult to initiate if the students do not have the required industry-specific theoretical knowledge. Thus, to initiate Mode-3 collaborations, firms must either: a) enter in Mode-1 or Mode-2 collaborations to impart the students with industry-specific theoretical know-how; or b) collaborate with high-quality HEIs whose curricula are well aligned with current industrial needs. Thus, HEIs with outdated curricula are unlikely to be approached by firms to engage in Mode-3. On the other hand, building funds for purchasing lab resources could be a challenge for HEIs as students are not required by firms to pay fees to undertake the dissertation projects and therefore lab costs cannot be recovered from students.
Figure 3.4 reports how the three collaboration modes are operationalised using the delivery alternatives. Table 3.2 documents a comparison of the drivers and challenges for firms and HEIs to engage in the three modes of teaching-focused collaborations.

**Figure 3.4** Three modes of teaching-focused I-A collaborations and their respective delivery alternatives; ‘M’, ‘O’ and ‘FE’ refer to ‘mandatory’, ‘optional’ and ‘firms’ employees’ respectively.
### Table 3.2 Comparison of the drivers and challenges for firms and HEIs to engage in the three modes of teaching-focused I-A collaborations

<table>
<thead>
<tr>
<th>Drivers &amp; Challenges</th>
<th>Criteria</th>
<th>Mode-1</th>
<th>Mode-2</th>
<th>Mode-3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drivers for firms</strong></td>
<td><strong>Student training</strong></td>
<td>Training students with industry-specific skills (theoretical know-how and operational skills) and firm-specific skills (operational); reaching out to large number of students; seriousness of students</td>
<td>Training students with industry-specific skills (theoretical know-how and firm-specific skills (operational); control over skills imparted to students; transfer of tacit knowledge to students and identification of students for jobs/internships (when FE delivers)</td>
<td>Training students in firm-specific skills (operational and applied skills); seriousness of students to complete the projects</td>
</tr>
<tr>
<td></td>
<td><strong>Cost of student training</strong></td>
<td>Low direct and opportunity costs; revenue generation from lab establishment</td>
<td>Low direct and opportunity costs (when faculty delivers); low opportunity cost (when TPO delivers); revenue generation from lab establishment</td>
<td>Low direct and opportunity costs; revenue generation from lab establishment (if lab is set up)</td>
</tr>
<tr>
<td></td>
<td><strong>Other</strong></td>
<td>Cognitive and relational social capital with faculty</td>
<td>Relational social with faculty (when faculty delivers); avoidance of HEIs’ bureaucracy</td>
<td>Cognitive and relational social capital with faculty; ideas/prototypes for R&amp;D and commercialisation</td>
</tr>
<tr>
<td><strong>Drivers for HEIs</strong></td>
<td><strong>Student training</strong></td>
<td>Training of students, control over type of skills imparted to students</td>
<td>Training of students; students identify job/internship opportunities and (when FE delivers)</td>
<td>Training of students</td>
</tr>
<tr>
<td></td>
<td><strong>Development of resources</strong></td>
<td>Development of curriculum, faculty, library and lab resources</td>
<td>Development of faculty (when faculty delivers) and lab</td>
<td>Development of faculty; lab development (if lab is set up), publishing opportunities</td>
</tr>
<tr>
<td></td>
<td><strong>Other</strong></td>
<td>Structural, cognitive and relational social capital with industry</td>
<td>Relational social capital with industry (when faculty delivers); avoidance of HEIs’ bureaucracy</td>
<td>Cognitive and relational social capital with industry; ideas/prototypes for commercialisation</td>
</tr>
<tr>
<td><strong>Challenges for firms</strong></td>
<td><strong>Student training</strong></td>
<td>Limited control over the skills imparted to graduates resulting in limited firm-specific skills</td>
<td>Lack of interest and seriousness among students due to voluntary nature of courses</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td><strong>Cost of student training</strong></td>
<td>Direct and opportunity costs may increase if quality of faculty staff is low</td>
<td>High direct and opportunity costs (when FE delivers); high opportunity cost (when TPO delivers)</td>
<td>Direct and opportunity costs may increase if quality of faculty is low</td>
</tr>
<tr>
<td></td>
<td><strong>Other</strong></td>
<td>None</td>
<td>None</td>
<td>Conflict over type of project dissemination approaches and priorities</td>
</tr>
<tr>
<td><strong>Challenges for HEIs</strong></td>
<td><strong>Student training</strong></td>
<td>Limited control over the skills imparted to graduates resulting in limited industry-specific skills and more firm-specific skills</td>
<td>Limited control over the skills imparted to graduates resulting in limited industry-specific skills</td>
<td>Only students with high industry-specific know-how are able to participate</td>
</tr>
<tr>
<td></td>
<td><strong>Development of resources</strong></td>
<td>Lack of autonomy to modify curriculum; quality of faculty is too low to deliver the modified courses</td>
<td>Lack of curriculum and library development; lack of development of faculty (when FE or TPO delivers), faculty's participation may be seen as conflict of interest; lack of incentives for faculty to participate; quality is faculty is too low to participate; lack of academic freedom for faculty to participate</td>
<td>Lack of development of curriculum and library; quality of faculty is too low to participate</td>
</tr>
<tr>
<td></td>
<td><strong>Other</strong></td>
<td>None</td>
<td>None</td>
<td>Conflict over type of project dissemination approaches and priorities; organising funds for lab acquisition (if lab is set up)</td>
</tr>
</tbody>
</table>
3.5 Discussion and Conclusion

3.5.1 Implications for Research

Through this paper, we respond to Perkmann et al.’s (2013) call to investigate and understand the neglected dimension of I-A collaborations—the role of collaborative activities in universities’ teaching activities and we consider the discussion around the three modes of teaching-focused I-A collaborations with delivery alternatives as fresh contributions to the studies on I-A collaborations. Previous studies (Plewa et al., 2015), albeit not in detail, did recognise the existence of ‘curriculum co-development’ (similar to our Mode-1) between industry and academia. Co-development of curriculum for training students for R&D work in industry was limited to discussions on research-led degree programmes, e.g., doctoral programmes that are jointly supervised by firms and universities (Laredo, 2007). Not only PhD students join R&D departments of firms, however; a large number of fresh UG students join R&D functions too (Jacobs et al., 2005), yet the existing literature does not appear to address how corporations engage with HEIs to co-develop and deliver curriculum within the UG/PG education. By exploring three mechanisms to engage in Mode-1 teaching-focused I-A collaboration, we attempt to fill this research void. However, to the best of our knowledge, Mode-2 collaboration, i.e., offering value-added courses by companies to students of partner HEIs, has been largely overlooked by the preceding studies. Mode-3 collaborations, i.e., companies offering projects to students, have previously been discussed in the context of research-based I-A collaborations as a side or unintended benefit (Behrens and Gray, 2001). In this paper, we demonstrate a contrasting picture, where projects are offered to students at HEIs with student training as the intended benefit while research and entrepreneurial gains from such projects are unintended consequences. This finding also allows us to suggest that industry’s involvement in Mission-1 may contribute to Mission-2 and
Mission-3, as opposed to the negative relationship reported by Sánchez-Barrioluengo (2014). Further quantitative examination, however, is required to confirm the same.

From the resource-based view of universities, teaching-focused collaborations with firms assist in developing crucial teaching resources such as curricula, library, faculty, labs and social capital in the industry. While the improvement in faculty quality and knowledge as a result of industrial collaborations is well-acknowledged (Acworth, 2008; D’Este and Patel, 2007; Woolgar, 2007), how such knowledge is translated to teaching in such a way that it can benefit the students has been largely overlooked. Through discussions on using faculty as a delivery alternative, our paper highlights not only how faculty offer the training programmes of companies to students at HEIs but also the potential benefits and challenges that come along with the involvement of faculty in the delivery mechanism of the training programmes. Figure 3.5 proposes a conceptual framework, an upgrade to the framework conceptualised at the beginning of this paper (see Figure 3.2), on teaching-focused I-A collaborations through appropriate modes and delivery alternatives that reduces internal costs for developing fresh graduates, while simultaneously enhancing university resources.
Figure 3.5 Proposed theoretical framework on graduate development process using teaching-focused I-A collaborations; I refers to side-benefits; ‘SC’ refers to social capital; ‘T’, ‘O’ and ‘A’ skills refer to theoretical know-how, operational and applied skills
From an institutional perspective, technology-intensive sectors are often driven by rapidly changing technologies, which also drives the type of skill requirement (Consoli and Rentocchini, 2015). For instance, in less than two decades, the world moved from simple digitisation and automation skillsets to the internet of things, big data, artificial intelligence, and so on. For the industry to survive such technological changes, both firms and universities must possess the ‘dynamic capability’ (Teece et al., 1997) to adapt, integrate, and re-configure internal resources (curricula, libraries, labs and faculty) and external (industrial training programmes) resources to address rapidly changing skill requirements.

Through this paper, we also offer a critical theoretical contribution to the human capital theory. We believe that such teaching-focused I-A collaborations can challenge the existing human capital training and development models in two ways. Companies can use such collaborations to train students not only with industry-specific skills, but also firm-specific skills, thus enabling companies to receive graduates that are not only industry-ready, but also ready to work at the company, which can completely eliminate the need for offering in-house on-the-job training. In fact, one of the interviewees from Firm-X suggested that they have been able to reduce the requirement of in-house on-the-job training from 12 months to 45 days through such teaching collaborations. Eliminating the requirement for organising in-house on-the-job training does not necessarily mean that the cost of graduate training has reduced, however, particularly because large investments are required to design training programmes for organising the activities under teaching-focused collaborations with HEIs. Except for Mode-3, students are usually required to pay to take these special courses. Students show their willingness to pay for the training programmes as they see them as an opportunity to enhance their job prospects. Therefore, we argue that the investment that companies make in organising
the teaching-focused collaborations is fully or partially recovered from the students, suggesting companies can receive graduates with the needed skills at low (or no) cost. Another contribution in the context of human capital theory is that we observed rare evidence of students paying for obtaining firm-specific skill sets. By virtue of its definition, the prior understanding was that the company must pay for firm-specific training as ‘firm-specific’ skills are meant to enhance the trainee’s productivity within the company (Becker, 1964; Hashimoto, 1981; Neal, 1995; Stucki, 2016).

Lastly, our study strengthens international management literature on talent management in emerging countries by responding to the call of Lewin et al. (2009) to explore firms’ strategies in these countries, in particular China and India, to counter the shortage of high-quality science and engineering graduates in emerging countries.

3.5.2 Implication for Practice

From the policy perspective, for HEIs, graduate development alone should not be the main purpose of initiating such teaching-focused collaborations. HEIs and policymakers should ensure that HEIs are able to strengthen their teaching resources alongside graduates’ skill development, because in line with the resource-based view (Barney, 1991), enhancing teaching resources would guarantee the high teaching performance of HEIs in the long-term. While it is clear that there exist several challenges for HEIs to invest resources in such collaborations, which are institutional and organisational in nature, through appropriate policymaking and support from partner firms, such challenges could be eliminated. One such institutional challenge that hinders HEIs’ ability to jointly co-develop curricula with industry (Mode-1) is the lack of academic autonomy. In particular, non-autonomous HEIs share an ‘agent-principal relationship’ (Van der Meulen, 1998) with the parent state universities, where the HEIs (agents) must
follow curricula prescribed by the parent university (principal). To dissolve this institutional rigidity, we propose two solutions. First, policymakers should consider encouraging more academic autonomy for HEIs at least to the extent that HEIs can engage with industry in developing curricula. Second, companies should consider approaching government universities (principals) instead of HEIs (agents) for the inclusion of the training programmes in the university curricula. As the curriculum prescribed by a government university is followed by hundreds of its affiliated HEIs; by engaging in curriculum co-development with the universities, a wide-spread effect can be achieved.

Moreover, the rigidity and poor quality of the faculty appears to be a critical concern for involving faculty in the delivery of teaching-focused collaborations. Prior studies (e.g., Debackere and Veugelers, 2005; Tartari et al., 2014) have observed financial incentives and competitive environments among faculty to play a key role in persuading faculty to engage in industrial research, consulting and entrepreneurial activities. We therefore suggest both firms and HEIs work out appropriate incentive mechanisms in terms of salary supplements and/or percentages of revenue generated from student fees to acknowledge that faculty voluntarily participate in such collaborations. On the other hand, we observe that firms are less likely to invite faculty to deliver training programmes if the quality of faculty are poor, citing the concern that poor quality faculty do not possess the required potential and realised absorptive capacity to appropriately understand and transfer the training to students. An unintended outcome of firms’ deciding not to involve faculty in teaching-focused collaborations, however, could result in the ‘Matthew effect’ (Azoulay et al., 2013), i.e., the quality of poor faculty will grow poorer due to non-exposure to industrial technologies. The capabilities of HEIs
with such faculty will never improve and the problem of low employability of graduates for R&D functions will persist.

In terms of financial arrangements, such collaborations are operating quite effectively as far as the firms and HEIs are concerned, since the burden of paying for special courses rests on the students. In a country such as India, it is clear that a significant percentage of the students would not be able to pay for such courses. Whether policymakers can or should intervene and ensure that the financial burden of receiving additional skills does not solely rest on the students’ shoulders is a question that must be addressed.

3.5.3 Limitations and Future Research Directions

This study possesses some limitations particularly related to context-specificity. First, the study is based on one country setting: India. We believe that our findings are relevant to other emerging countries, however, where the employability of E&T graduates for R&D functions is a concern (Farrell et al., 2005). Oracle has already made teaching-focused collaborations with 737 HEIs in China, 123 HEIs in Brazil and 71 Russian HEIs (Oracle, 2018), while EMC has entered similar collaborations with 487 HEIs in China, 164 HEIs in Brazil and 84 HEIs in Russia (Emc2, 2018). Such secondary evidence also highlights the need and relevance for exploring the dynamics of teaching-focused I-A collaborations in other emerging countries. Insights from different institutional environments will help in examining the validity of the typology that we presented here. Additionally, we do not see why teaching-focused collaborations cannot be established in developed countries. Recent reports (Bédard-Maltais, 2017; Geissbauer et al., 2016) in the context of developed countries show the mismatch of technology-intensive skills between industry’s requirements and university output as one of the primary barriers to practising
Industry 4.0 technologies, offering the opportunity for the emergence of teaching-focused collaborations between industry and academia. Another limitation of this paper is that we have restricted our investigation of teaching-focused collaborations to E&T HEIs only.

Future research could study the occurrence of such teaching-focused collaborations in the broader STEM disciplines. To inform HEIs, corporations and policymakers, on how to develop a favourable environment for implementing each collaboration mode, future research could also use large-scale data to examine firm-level, HEI-level and institutional level factors that could hinder or facilitate the occurrence of each type of teaching-focused I-A collaboration. Last but not least, future research could examine the effectiveness of these I-A collaborations in improving graduate readiness for R&D jobs and to what extent each of the collaboration modes actually increases the quality of graduates.

References


**Appendix-A**

**Interview questionnaire for company managers (excluding the impromptu questions)**

1. To what extent is the quality of fresh university graduates an issue for your firm and the industry, in general, for recruiting graduates for R&D positions? If this is an issue, how do you overcome it?

2. Do you collaborate with HEIs in teaching to enhance the quality of students and develop them for R&D positions? How do these collaborations enhance the employability of graduates for R&D positions?

3. Could you please explain how such collaborations are operationalised?

4. I have seen on your website that you have collaborations with XX number of HEIs in teaching. Are all these collaborations practised in the same way and initiated with the same objective? Could you please go through some of these collaborations and elaborate on the objectives of initiating the collaborations and how are they practised?
5. Could you please elaborate on the type and level of knowledge and skills that you intend to develop in students through such collaborations? What kinds of additional benefits could be availed by students from these collaborations? How do you encourage students’ participation in such collaborations?

6. How do these collaborations enhance the quality of the faculty at partner HEIs? Could you please elaborate on the type and level of knowledge and skills that you intend to develop in faculty through such collaborations? What kinds of additional benefits could be availed by faculty from these collaborations? How do you encourage faculty’s participation in such collaborations?

7. How do these collaborations enhance other teaching resources of the partner HEIs such as curriculum, library and labs etc.?

8. What are the additional drivers for your firm to engage in teaching collaborations with HEIs? Do the benefits from teaching collaborations depend on how they are operationalised?

9. What are the challenges or risks for your firm to engage in teaching collaborations with HEIs? Do these challenges or risks depend on how they are operationalised?

10. How do HEIs benefit from teaching collaborations? Do the benefits depend on how they are operationalised?

11. What are the challenges or risks for HEIs to engage in such collaborations in teaching with industry? Do these challenges or risks depend on how they are operationalised?

12. Is there any other HEI-level, firm-level and institutional-level challenge to participate in such teaching collaborations with HEIs?
13. Is there any institutional support available to facilitate teaching collaborations between industry and academia? If yes, could you please explain the type and level of support available?

14. How do you see the performance of such teaching-focused collaborations with respect to your organisation, partner HEIs and the industry? What could be done to enhance the effectiveness of these collaborations?

15. To what extent and how the following factors affect the occurrence of teaching-focused industry-academia collaborations:
   - HEI’s size
   - HEI’s quality
   - HEI’s academic research
   - HEI’s industrial embeddedness in terms of R&C projects, entrepreneurship, industry-affiliated trustees and alumni who hold top positions in the industry
   - Government support in terms of financial incentives, and intermediary organisations
   - Location of the HEIs
   - Discipline

16. Can you think of any other HEI-level or institutional factor that may affect teaching-focused industry-academia collaborations? If yes, could you please explain how such factors affect these collaborations?
Interview questionnaire for academics (excluding the impromptu questions)

1. Do you have any collaboration with companies to develop your teaching resources such as faculty, library, labs, and curriculum etc. and student training? If yes, could you please explain why and how such collaborations are operationalised?

2. I have seen from your website that you have collaborations with XX number of companies in teaching. Are these all collaborations practised in the same way and initiated with the same objective? Could you please go through each of these collaborations and elaborate on the objectives of initiating the collaborations and how are they practised?

3. Could you please elaborate on the type and level of knowledge and skills that you intend to develop in students through such collaborations? What kinds of additional benefits could be availed by students from these collaborations? How do you encourage students’ participation in such collaborations?

4. How do these collaborations enhance the quality of the faculty? Could you please elaborate on the type and level of knowledge and skills that you intend to develop in faculty through such collaborations? What kinds of additional benefits could be availed by faculty from these collaborations? How do you encourage faculty’s participation in such collaborations?

5. How do these collaborations enhance other teaching resources of you HEI such as curriculum, library and labs etc.?

6. What are the additional drivers for your HEI to engage in such teaching collaborations with firms? Do the benefits from such collaborations depend on how they are operationalised?
7. What are the challenges or risks for your HEI to engage in teaching collaborations with firms? Do these challenges or risks depend on how they are operationalised?

8. How do firms benefit from teaching collaborations? Do the benefits depend on how they are operationalised?

9. What are the challenges or risks for firms to engage in such collaborations in teaching with industry? Do these challenges or risks depend on how they are operationalised?

10. Is there any other HEI-level, firm-level and institutional-level challenge to participate in teaching collaborations with firms?

11. Is there any institutional support available to facilitate teaching collaborations between industry and academia? If yes, could you please explain the type and level of support available?

12. How do you see the performance of such teaching-focused collaborations with respect to your HEI, partner firms and the industry? What could be done to enhance the effectiveness of these collaborations?

13. To what extent and how the following factors affect the occurrence of teaching-focused industry-academia collaborations:
   - HEI’s size
   - HEI’s quality
   - HEI’s academic research
   - HEI’s industrial embeddedness in terms of R&C projects, entrepreneurship, industry-affiliated trustees and alumni who hold top positions in the industry
   - Government support in terms of financial incentives, and intermediary organisations
• Location of the HEIs
• Discipline

14. Can you think of any other HEI-level or institutional factor that may affect teaching-focused industry-academia collaborations? If yes, could you please explain how such factors affect these collaborations?
Figure A1 Thematic network first order theme: Organisation of teaching-focused I-A collaborations
Figure A2 Thematic network first order theme: Drivers for practising teaching-focused I-A collaborations
Figure A3 Thematic network first order theme: Challenges for practising teaching-focused I-A collaborations
CHAPTER 4 RESEARCH PAPER-2

What are the determinants of teaching-focused industry-academia collaborations? Evidence from Indian Higher Education Institutes

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ABSTRACT

Despite teaching being the main mission of most universities, Industry-academia (I-A) collaborations for teaching have remained under-researched compared to I-A collaborations for research and entrepreneurship. This paper explores the university-level and institutional determinants of teaching-focused I-A collaborations in India via a mixed methods approach. First, due to a lack of prior research on teaching-focused collaborations between industry and academia, we developed a list of HEI-level and institutional determinants of I-A collaborations and conducted 52 interviews with Indian Higher Education Institutes (HEIs), companies and intermediary organisations to identify the extent to which these factors also drive teaching-focused I-A collaborations. We then collected data from the websites of 2,224 HEIs and estimate zero-inflated negative binomial regression models to examine quantitatively the influence of the factors identified by the interviewees on HEI’s propensity to engage in teaching-focused collaborations with industry. We show that, among institutional factors, academic discipline, government support in terms of establishing intermediary organisations, HEI’s location, autonomy, and ownership type are key for engaging in teaching-focused collaborations.
I-A collaborations. Among HEI-level factors, HEI’s size, quality, industrial and academic embeddedness are the determinants of teaching-focused I-A collaborations.

**Keywords:** teaching, industry academia collaboration, India, mixed methods

### 4.1 Introduction

Despite teaching being the main mission of most universities, Industry-academia (I-A) collaborations for teaching have remained under-researched compared to I-A collaborations for research and entrepreneurship (Laredo, 2007; Perkmann et al., 2013). Recently this area has been investigated by Borah et al. (2018), who in the context of India identified three modes of teaching-focused collaborations between industry and academia with associated delivery alternatives and explained how such collaborations are utilised to develop Engineering and Technology (E&T) graduates for research and development (R&D) positions in the industry. Teaching-focused I-A partnerships enable universities to strengthen critical resources such as curriculum, faculty, and laboratories (labs) which could enhance the teaching performance of universities in the long-term. On the other hand, from the industry’s perspectives, such collaborations allow firms to receive R&D-ready graduates at the end of their university education which could reduce on-the-job training costs. For policymakers, I-A collaborations in teaching help in strengthening human capital for innovation and by bridging skill mismatches in graduates. Thus, teaching-focused I-A collaborations can bring a number of benefits to the participating firms, universities, and local, national or regional innovation systems. It is, therefore, important to investigate the determinants of such teaching-focused I-A collaborations so that necessary inputs could be offered to universities, industries, and
policymakers and favourable policies can be designed for promoting industries’ and universities’ participation with such collaborations around teaching.

In the last two decades, a significant amount of scholarly attention has been devoted to understanding the predictors of research, consulting (R&C) and entrepreneurship-focused I-A collaborations (Perkmann et al., 2013) using varied theoretical lens such as the institutional theory (Hemmert et al., 2014; Hong and Su, 2013; Owen-Smith et al., 2002), resource-based view (Giuliani et al., 2010), ambidexterity (Sengupta and Ray, 2017), and absorptive capacity (Segarra-Blasco and Arauzo-Carod, 2008) and aggregating firm-level, university-level and individual academic-level data. While the list of such determinants of I-A collaborations in R&C and entrepreneurship is extensive, the extent to which these predictors also drive teaching-focused I-A partnerships is still unknown particularly because teaching-focused collaborations between industry and academia is a recent proposition and lacks explorations of predictors. This study, designed in the context of India, aims to investigate the factors influencing universities’ propensity to form teaching-focused I-A collaborations. This paper uses mixed methods by collating data from qualitative interviews and quantitative data from 2,224 Indian Engineering and Technological (E&T) Higher Education Institutions (HEIs). First, we reviewed the extant literature on teaching-focused I-A collaborations and the HEI-level and institutional predictors of HEI’s involvement in research, consultancy and entrepreneurship-focused industrial collaborations and then conducted 52 interviews in India to identify if the factors that were identified as drivers of I-A collaborations in R&C and entrepreneurship also influence HEI’s engagement in teaching-focused collaborations with industry and also to uncover the existence of additional unknown factors. Then, we test these factors using data from the websites of 2,224 Indian HEIs. We show that, among institutional factors, academic discipline,
government support, HEI’s location, autonomy, and ownership type of HEIs influence HEI’s engagement in teaching-focused industrial collaborations. Among HEI-level factors, HEI’s size, quality, industrial and academic embeddedness determine HEI’s collaboration with industry in teaching. By examining factors influencing teaching-focused I-A collaborations, this paper not only contributes to the growing research on I-A collaborations for teaching but also offer recommendations to policymakers, HEIs and firms on how to develop a favourable environment for teaching-focused I-A collaborations.

Emerging countries like India present a more appropriate research setting for exploring teaching-focused collaborations because, in these countries, most universities are teaching-only universities (Liefner and Schiller, 2008; Shin and Jung, 2014) unlike advanced countries, where universities are expected to invest substantial time and resources in the other two missions: research and entrepreneurship. Therefore, universities in emerging countries are likely to prefer developing teaching-focused collaborations over industrial collaborations for research and entrepreneurship. Furthermore, Perkmann et al. (2013) recognise the USA and European countries as the most commonly chosen country-settings in studies exploring I-A collaborations and term the contributions covering other geographic contexts to be ‘rare’. By investigating the predictors of I-A collaborations in teaching at Indian HEIs, we contribute to the I-A literature by offering some geographic diversity.

The rest of the paper is organised in the following order. Section 4.2 discusses literature on teaching-focused I-A collaborations and the determinants of I-A collaborations. Section 4.3 offers insights into the methods used for data collection and analysis for testing the effect of the determinants of I-A collaborations specifically on
teaching-focused I-A collaborations. Section 4.4 shows the results and Section 4.5 discusses the implications of the results to research and practice.

4.2 Conceptual Background and Literature Review

4.2.1 Teaching-focused I-A Collaborations

In this section, we recall the definition of teaching-focused I-A collaboration and briefly highlight the collaboration modes. Teaching-focused I-A collaborations are those partnerships between universities and firms that are targeted towards strengthening the first and foremost mission of universities, i.e., teaching (Borah et al., 2018; see also Laredo, 2007). Borah et al. (2018) studied teaching-focused I-A collaborations in India and identified three modes in which, I-A collaborations in teaching usually take place: Mode-1: firms offering courses to students as a part of the curriculum; Mode-2: firms offering courses to students external to the curriculum; and Mode-3: firms offering projects to students. These three different modes of teaching-focused collaborations with industry bring diverse benefits to HEIs. In Mode-1 collaboration, HEIs upgrade curriculum to match the industry’s needs and train students with the updated curriculum. Through Mode-2 collaboration, HEIs are able to train graduates in corporate R&D skills that are external to the curriculum. In Mode-3 collaborations, HEIs benefit from dissertation projects that are performed by students with the firms in terms of opportunities to commercialise the outputs of the projects and generate publications. Borah et al. (2018) show that the activities could be delivered through three actors: HEI’s faculty; companies’ own employees, or third-party trainers.

Delivery of industrial training programmes to students by faculty is done in two steps. In the first step, faculty get trained by the partner company in respective technologies and then the faculty train the students and/or set up and operate the
Universities. In this process, HEIs are able to develop the quality of the faculty required by the partnership, which becomes a critical ‘resource’ (Barney, 1991). By teaching-focused I-A collaboration, Borah et al. (2018) refer to only those collaborations that require formal agreements (Schartinger et al., 2002) between the university and the company. Therefore, informal collaborations such as faculty’s attendance in industry-organised seminars and workshops and ‘personal contractual collaborations’ (Freitas et al., 2013) which include interactions between industry employees and academics for training students via guest lecturers and student internships are not considered as a teaching-focused I-A collaboration. Since the decision to engage in teaching-focused collaboration with companies requires an HEI-level decision rather than the individual academic decision, it would be expected that mostly HEI-level and institutional factors will determine HEI’s engagement in teaching-focused industrial collaborations rather than individual factors.

The following section offers an overview of the HEI-level and institutional factors that have been conceptually or empirically identified in prior studies as the predictors of HEI’s engagement in R&C and entrepreneurship-focused collaborations with industry, which are then used as references in setting questions for the interviews to explore which of these factors could also potentially influence HEI’s propensity to engage in teaching-focused industrial collaborations and how.

4.2.2 Determinants of I-A collaborations

The resource-based view- RBV of the firms (Barney, 1991) and universities (Powers and McDougall, 2005) and institutional theory (North, 1991) are the two theoretical lenses that have been widely used in the study of predictors of I-A collaborations (Giuliani et al., 2010). Drawing on RBV, scholars have explained the influence of resources and
capabilities of the involved partners i.e., the individual academic researcher (Boardman and Ponomariov, 2009; Giuliani et al., 2010; Perkmann et al., 2011), the university (D’Este and Patel, 2007; Muscio et al., 2013; Ponomariov, 2008) or the firm (Santoro and Chakrabarti, 2002; Segarra-Blasco and Arauzo-Carod, 2008). On the other hand, scholars grounding research on the institutional theory, tend to focus on studying the effect of formal institutional settings in the geographical location of the focal organisations, government support in the form of subsidies, grants, the establishment of intermediary boundary organisations, competition and academic disciplines (Bekkers and Freitas, 2008; Martinelli et al., 2008; Owen-Smith et al., 2002), and informal institutions such as culture (Hemmert et al., 2014) in facilitating I-A collaborations for R&C and entrepreneurship.

**HEI-level determinants of I-A collaborations**

Among HEI-level factors, the size of the department/HEI has been established as a key determinant of I-A collaborations in R&C. Schartinger et al. (2001) report a U-shaped relationship between department’s size and its propensity to develop industrial collaborations with small and large departments being more likely to engage in industrial collaborations compared to the medium-sized ones. Large departments usually possess the required physical resources such as technology transfer offices, and laboratories as well as tacit resources such as knowledge and experience that are critical to initiate and sustain industrial collaborations. Also, large departments are able to balance out excess teaching and publishing activities even if some academics are involved in industrial research and consultancy (Schartinger et al., 2001). Additionally, large departments/universities possess a better diversity of subject-areas and faculty, higher visibility and social capital within the industry (Muscio et al., 2013) which may attract
firms for possible collaborations. On the other hand, small departments may exhibit a high degree of specialisation in a niche research domain which might be attractive for firms interested in that specific domain (Schartinger et al., 2001).

The effect of HEI’s/departments’ quality on the probability of the HEI/department to form industrial collaboration shows mixed results. Muscio et al. (2013) identify scientific excellence as a prerequisite for I-A collaboration stating that high-quality academics are more likely to identify commercialisation opportunities in the market. The presence of ‘star scientists’ in a department could also help to attract private funding, particularly within the physical and engineering science disciplines (Perkmann et al., 2011). From a collaborating firm’s perspective, high-quality universities are able to offer capabilities and resources to achieve the objectives of an industrial project. That is why, R&D intensive firms with relatively higher absorptive capacity seem to prefer collaborating with high-quality universities, even if they have located abroad (Laursen et al., 2011). However, the positive effect of departmental/university quality on the university's propensity to collaborate with industry may only hold for specific types of I-A collaborations. Researchers from high-quality universities tend to have high ambition and ability to pursue highly advanced research and may prefer engaging in joint research with industry, while researchers from low-quality universities may prefer involving in consulting collaborations which require only problem-solving skills (Giuliani and Arza, 2009). Other studies (e.g., D’Este and Patel, 2007; Ponomariov, 2008) show a negative correlation between the departmental quality and their propensity to collaborate with industry citing two key reasons. First, academics from high-quality universities may perceive time spent in industrial R&C and entrepreneurial initiatives as the time lost to publish peer-reviewed articles. Second, high-quality universities are less likely to be solely dependent on industrial funding due to access to public funding, particularly in
countries where public funds are allotted competitively based on the quality of research undertaken by universities. However, for low-quality universities, in the absence of public funds, private funding could be a ‘necessity’ (Giuliani and Arza, 2009).

Scholars also argue that universities’ or departments’ industrial embeddedness i.e., prior experience of engaging with industry in R&C and entrepreneurship collaborations also enhances universities’ probability of forming future relationships with industry. Prior experience of I-A collaboration can be seen as a "critical determinant of success and failures of subsequent alliance" (Bruneel et al., 2010, p.860) since both organisations (firms and universities) belong to different ‘institutional logic’ (Townley, 1997), possess different expectations from the alliance, work at a different pace and possess different research priorities (Bruneel et al., 2010). While a university may be interested in academic publications from the collaborative project, the industry partner is driven by commercialisation and financial incentives and prefers confidentiality and protection of data (Looy et al., 2003). Prior experience in collaborating with industry may facilitate establishing trust with the industrial partners and vice versa (Hong and Su, 2018; Petruzzelli, 2011), overcoming conflicts arising from the differences in institutional logic (Bruneel et al., 2010). Indeed, Petruzzelli (2011) finds evidence of a positive association between prior ties with industry and universities’ joint innovation value creation. Moreover, prior experience of collaborating with industry allows academics to develop extensive networks in the industry (Giuliani et al., 2010; Landry et al., 2006) in terms of ‘relational social capital’ (Moran, 2005) which may be valuable to form industrial collaborations (Steinmo and Rasmussen, 2018). Also, often there exists a communication gap between the industry and universities; firms are unaware of universities’ activities and if such activities could be of any value to them and vice versa (Schartinger et al., 2001). Universities’ experience in collaborating with firms in R&C and
commercialisation activities may bridge this communication gap and may initiate further collaborations with industry. The information gap between industry and universities can also be bridged through trustees and university alumni that are active in the industry. Mathies and Slaughter (2013) observe that trustees in American private research universities act as a channel between states and university and reports that universities with trustees that hold important positions in the industry receive more industrial and federal funding than universities without industry-affiliated trustees.

**Institutional determinants of I-A collaborations**

The role of institutions has been recognised as a central factor in I-A collaborations. Institutional support may come in the form of funding, subsidy and incentives for joint projects between industry and academia (Park and Leydesdorff, 2010; Segarra-Blasco and Arauzo-Carod, 2008; Szücs, 2018), through the establishment of intermediary structures such as research parks (Cox et al., 2000) and boundary organisation such as consortia (Johnson, 2008; Perkmann and Schildt, 2015), university research centres (Ponomariov and Boardman, 2010), incubation centres that organise boot camps, elevators pitches and business plan etc. (Hayter, 2016) to bring industrial and academic organisations closer. Federal funding often acts as the facilitator of I-A collaborations. For instance, due to the existence of Wine Industry Network of Expertise and Technology, a funding organisation that sponsors applied research on wine, the propensity to pursue joint applied research with industry has increased considerably among South African universities (Giuliani et al., 2010). On the other hand, Ponomariov and Boardman (2010) show that academics with affiliation to university research centers are more likely to collaborate with industry than those without.
The influence of academic discipline on I-A collaborations has been well-acknowledged by prior studies. Research shows the propensity to collaborate with industry to be highest among scholars from applied disciplines, in particular, engineering and technological disciplines (Bekkers and Freitas, 2008; Martinelli et al., 2008; Lee, 1996). Based on a study conducted in Austria, Schartinger et al. (2002) report a positive association between the employment dynamics and firms’ propensity to engage in knowledge interactions with universities, in particular, technological innovation-driven sectors that are characterised by frequent changes in technology, require novel technological ideas and skills also bound to change (Desjardins and Rubenson, 2011; Vona and Consoli, 2014) which may motivate universities to involve in knowledge interactions with industry. The specialisation of countries, regions and universities in a specific field of research may also prompt companies to engage in collaborations in specific domains. That is why, in the contexts of Kenyan universities, Muriithi et al. (2018) observe the propensity to collaborate with industry to be higher among academics from agricultural science and natural science than engineering disciplines, due to the extensive experience of Kenyan universities in agriculture-related research. In addition, the use of knowledge transfer channels in I-A collaborations could vary across disciplines. Bekkers and Freitas (2008) find ‘scientific output, students and informal contacts’, ‘collaborative and contract research’ and ‘patents and licensing’ as key channels for transferring knowledge from university to firms in I-A collaborations taking place in biomedical, chemical engineering and computer science disciplines (except patents and licensing) while for material science, the preferred knowledge transfer channel is patents and licensing.

The geographical positioning of HEIs also plays a vital role in developing R&C and entrepreneurship-focused I-A linkages (Youtie and Shapira, 2008). Close geographical
proximity allows face to face meetings between the partner HEI and firms, which is a prerequisite for the exchange of tacit knowledge (Vasileiadou and Vliegenthart. 2009). Studies on clusters and regional innovations systems report universities as the “prime sources of locally sticky knowledge and the hubs of local social networks” (De’Este et al., 2012, p.541). Thus, firms that are new to clusters tend to collaborate with universities to access universities’ rich local knowledge and social network. Additionally, in the case of entrepreneurship-focused collaborations, finding an investor becomes easier for university spin-outs if the university is located in an industrial cluster (Storey and Tether, 1998). Also, geographical proximity offers necessary continuous and frequent interactions between the involved partners, enabling the partners to develop trust, overcome the barriers posed by differences in institutional logic (Llopis and D’Este, 2016).

4.2.3 Summary of Literature Review

From the above discussion of the literature on predictors of I-A collaborations, discipline, university’s location, government support in terms of funding, incentives and establishment of intermediary boundary organisations are identified to be influential institutional factors for universities’ participation in industrial R&C and entrepreneurial projects. Among HEI-level factors, department/university size, quality, and industrial embeddedness measured in terms of prior experience of working with industry, links with industry through trustees, alumni holding the top positions in the firms, are recognised as the determinants of HEI’s participation in industrial R&C and entrepreneurship-focused projects. In the following sections, we examine if these university-level and institutional predictors of I-A collaborations in R&C and
entrepreneurship also drive HEI’s involvement in teaching-focused industrial partnerships.

4.3 Research Design and Methods

This paper uses ‘complimentary mixed method’ (Greene et al., 1989) to explore the HEI-level and institutional determinants of teaching-focused I-A collaborations at Indian E&T HEIs (therein HEIs). Data collection is developed in two stages. In the first stage, we used existing literature on the predictors of I-A collaborations in R&C and entrepreneurship to develop a list of HEI-level and institutional variables that may also influence HEI’s participation in teaching-focused industrial collaborations. Then we conducted 52 interviews among HEIs, corporations and policy organisations to identify which of these factors actually drive teaching-focused I-A collaborations and how. Once the factors have been identified, we develop our testable model (Figure 4.1) outlining the expected relationship between the HEI-level and institutional factors and HEI’s propensity to form teaching-focused collaborations with industry. The model is then tested through the estimation of zero-inflated negative binomial regression models on data gathered from the websites of 2,224 Indian HEIs.

4.3.1 Stage-1: Finalisation of Independent Variables and Testable Model

We interviewed 12 private companies and nine public and private HEIs that actively engage in teaching-focused I-A collaborations (see Appendix-A for interview questionnaire and Appendix-B for interviewee details). In total, 52 interviews were performed. The interviewees were asked both ‘semi-structured’ and ‘open-ended questions’. The semi-structured questions helped us to understand to what extent and how the determinants of R&C and entrepreneurship-focused I-A collaborations also
drive collaborations between industry and HEIs in teaching. The interviewees identified four HEI-level factors- size, quality, academic research, and industrial embeddedness, and three institutional factors- discipline, location, and availability of government support, as the primary determinants of teaching-focused I-A collaborations. The majority of the interviewees suggested that trustees and alumni of HEIs hardly contribute to the initiation of teaching-focused collaborations with industry. On the other hand, open-ended questions were asked to explore if any other HEI-level and institutional factor facilitate or hinder the initiation of teaching-focused I-A collaboration. This led us to identify an additional HEI-level factor- HEI’s academic embeddedness and two institutional factors as the predictors of teaching-focused collaborations: HEI’s academic autonomy and ownership type. The interviewees’ responses are documented in Table 4.1.

**Table 4.1** HEI-level and institutional factors recognised based on interviews to facilitate/inhibit HEI’s engagement in teaching-focused I-A collaboration\(^{19}\)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Effect on occurrence of I-A collaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEI-level determinants</strong></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>17</td>
</tr>
<tr>
<td>Quality</td>
<td>9</td>
</tr>
<tr>
<td>Engagement in academic research</td>
<td>9</td>
</tr>
<tr>
<td>Engagement in terms of engagement in industrial R&amp;C</td>
<td>31</td>
</tr>
<tr>
<td>Industrial embeddedness in terms of engagement in entrepreneurship</td>
<td>22</td>
</tr>
<tr>
<td>Industrial embeddedness in terms of trustees who hold top positions in the industry</td>
<td>3</td>
</tr>
<tr>
<td>Industrial embeddedness in terms of alumni who hold top positions in the industry</td>
<td>1</td>
</tr>
<tr>
<td>Academic embeddedness (linkages with other HEIs)</td>
<td>19</td>
</tr>
<tr>
<td><strong>Institutional determinants</strong></td>
<td></td>
</tr>
<tr>
<td>Location (in industrial cluster)</td>
<td>38</td>
</tr>
<tr>
<td>Discipline variety</td>
<td>23</td>
</tr>
<tr>
<td>Government support (establishment of intermediary organisations)</td>
<td>22</td>
</tr>
<tr>
<td>Public ownership of HEIs</td>
<td>0</td>
</tr>
<tr>
<td>Academic autonomy</td>
<td>29</td>
</tr>
</tbody>
</table>

\(^{19}\) In total 52 interviews were conducted. In Table 4.1, we only document those responses, where factors are acknowledged to be enabler or inhibitor of teaching-focused I-A collaboration and the responses that did not acknowledge any influence of these factors have been excluded.
Identifying HEI-level determinants of I-A collaborations from interviews

**HEI’s size**

Interviewees from firms suggested that collaborations with larger HEIs allow them to reach out to a higher number of students and to train them with little marginal cost. Additionally, in large HEIs, the faculty size is likely to be bigger and so are the cumulative networks and contacts in the industry, which could be leveraged to develop collaborations with industry in teaching. Further, HEIs with large-sized faculty are able to share the load of teaching regular courses alongside industrial training programmes.

“We have collaborations with five companies offering in total approximately 20 courses to students. These courses are taught outside the curriculum hours to students by our faculty. We could not have run 20 courses if we had a few academics. The faculty need to attend regular training from the companies. If few of them go for industrial training, the others cover up for their regular teaching activities”—Director, HEI-IV.

Following such arguments, we anticipate the role of HEI’s size to be a facilitator to teaching-focused I-A collaborations.

**HEI’s quality**

We received mixed responses to the question- whether HEI’s quality acts as a facilitator or inhibitor to teaching-focused I-A collaborations. Firms may prefer collaborating with high-quality HEIs because faculty from high-quality HEIs possess the required ‘absorptive capacity’ to first assimilate the industrial training programmes and then to offer them to students with the required quality. On the other hand, the role of HEI’s quality could be an inhibitor to teaching-focused industrial collaborations for two reasons. First, considering recruiting graduates from high-quality HEIs to be highly

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20 These reasons are given by the interviewees.
competitive and costly, firms could opt for collaborating with low-quality HEIs in teaching, developing the skill sets of students through such collaborations and then recruiting these students by paying a significantly lower salary than that they would have to pay for hiring graduates from high-quality HEIs. Second, high-quality HEIs usually possess up-to-date curricula, well-resourced labs, and high-quality faculty. Therefore, they may not feel the need to seek industrial support to strengthen their resources for teaching activities. Such strong reasoning drives us to anticipate the role of HEI’s quality as an inhibitor rather than a facilitator to HEI’s participation in teaching-focused collaborations with industry.

**HEI’s involvement in academic research**

We received a mixed response to the question of whether HEI’s involvement in academic research facilitates or hinder its engagement in teaching-focused collaborations with firms. Research-focused HEIs may show interest in developing teaching collaborations with industry in order to get access to advanced lab resources and industrial technologies, which could be utilised to generate academic research productivity. Additionally, the existence of attractive industrial labs on campus could bolster an HEI’s chances of attracting high-quality postgraduate researchers.

> “While most of the software and hardware we offer in the laboratories that we establish in the universities are designed to skill undergraduate and postgraduate students with practical hands-on experience, we also expect that such resources will be used by faculty and postgraduate researchers for their research projects”- Manager, Firm-III.

On the other hand, lack of interest to participate in teaching-focused collaborations with industry may arise among research-focused HEIs particularly because teaching-focused collaborations require a significant amount of time investment
from faculty which may negatively influence their research productivity. Prior studies (e.g., Marsh, 1984) also suggest a negative relationship between research and teaching because the time devoted to teaching is time lost to research. This, combined with interviewees’ argument leads us to assume a negative relationship between HEI’s involvement in academic research and its propensity to engage in teaching-focused collaborations with industry.

**HEI's industrial embeddedness**

Interviewees from Firm-IX highlighted that the starting point of collaborating with several HEIs was mostly joint R&D, consultancy and technology commercialisation projects. Such engagements allowed the company to involve UG and PG students in the research projects and therefore to understand the skill-gaps that the students may experience as a result of the outdated curriculum and labs. This ultimately led Firm-IX to guide the development of curriculum, labs, and libraries through the initiation of teaching-focused collaborations. Also, collaborations in industrial R&C and entrepreneurship allow companies to involve in frequent discussions with the partner HEI’s faculty and vice versa. Such discussions may include the possibilities for partnering for teaching activities e.g., establishing laboratories, and modifying curriculum by themselves or to offer suggestions on possible firms that can be contacted to collaborate in teaching activities. Therefore, we expect that HEI’s involvement in industrial R&C and/or entrepreneurship will be positively correlated with HEI’s propensity to develop teaching-focused industrial collaborations.

**HEI's academic embeddedness**

In India, often a particular business group establishes several private HEIs in different Indian states. Since such HEIs are controlled by the same group (or owner), they share active linkages with each other, facilitating a high degree of information sharing.
Therefore, it is highly likely that if one HEI from a group develops teaching-focused partnerships with companies and benefits from such partnerships, other HEIs from the same group may also seek to develop similar collaborations. Additionally, from the firms’ perspective, HEIs with group affiliation are preferred because by collaborating with one member institute, the company receives access to a number of other HEIs to offer their training programmes. Hence, we expect that the likelihood of developing teaching-focused I-A collaborations increases for an HEI if it shares active linkages with other HEIs.

**Identifying institutional determinants of I-A collaborations from interviews**

**Discipline**

The discipline variety of HEI’s may also drive teaching-focused I-A collaborations. HEIs offering courses in non-E&T disciplines alongside E&T disciplines are preferred partners for teaching-focused alliances because collaboration with such HEIs allows firms to address interdisciplinary skill needs. For instance, the skill requirements for industry 4.0 technologies are highly interdisciplinary, with applications in a wide range of sectors from engineering to banking, and healthcare (Manogaran et al., 2017). Therefore, firms may prefer to develop teaching-focused collaborations with HEIs that offer courses in diverse disciplines.

“Clients for our big data and cloud computing solutions also include financial organisations and healthcare organisations. We have developed different courses on big data for students studying engineering and other domains such as economics and medicine etc. Obviously, we would prefer collaborating with colleges or universities that offer these courses alongside engineering courses so
that we can address the skill shortage in multiple areas at one go”. - Manager, Firm-V.

HEI's academic autonomy

Practicing Mode-1 collaboration i.e., co-development of curriculum with the industry, is difficult for HEIs possessing very limited academic autonomy to modify curricula (Borah et al., 2018). Academics from HEI-III revealed that they were approached by Firm-V to co-develop and co-deliver several electives in big data analytics within the undergraduate programme in Computer Science and Engineering. Although the HEI was very willing to modify the curriculum to include the electives suggested by the company, they did not receive approval from their parent state university. We, therefore, anticipate a negative relationship between the lack of academic autonomy of HEIs and their engagement in Mode-1 collaboration.

HEI's location

The location of HEIs plays a crucial role in facilitating I-A collaborations in teaching particularly because being in an industrial cluster allows HEIs to reach out to a large number of firms to develop teaching-focused collaborations. In order to sustain a teaching collaboration, firms may need to send employees to partner HEIs to jointly develop curricula with HEIs’ faculty (in Mode-1 collaborations); train faculty and students (in Mode-2 collaborations), and design student projects for supervision (in Mode-3 collaborations). The time and cost of performing such activities for firms reduce when the partner HEI is located in an industrial cluster with sound transportation connectivity. For instance, firms with subsidiaries located in all major industrial clusters in India are able to develop and maintain teaching-focused collaborations with HEIs through subsidiaries located in the same cluster as that of the partner HEIs. Additionally, being located in industrial clusters also offers HEIs access to third-party organisations,
which can be used to offer training programmes from partner firms to students without the involvement of faculty. Therefore, we expect a positive relationship between HEIs’ location in industrial clusters and their propensity to form teaching-focused collaborations with industry.

**HEI’s ownership**

HEI’s ownership (public versus private) is a crucial factor for companies to decide if they want to pursue collaborative activities in teaching. According to the interviewees from industry, collaborating with public HEIs requires firms to undergo a great deal of paperwork and bureaucracy, which can be avoided while collaborating with private HEIs. Therefore, it is likely that firms will show more willingness to collaborating with private HEIs in teaching. Further, public HEIs may not allow faculty to get involved in the delivery of for-profit industrial training programmes owing to ‘conflict of interest’ (Borah et al., 2018), which could limit firms’ options to deliver training programmes to students at public HEIs. Therefore, we envisage that public HEIs will be less likely to engage with industry in teaching-focused collaborations.

**Government support: setting up intermediary organisations**

While the Central Government of India has not made any initiative to promote teaching-focused I-A collaborations, state governments have been found to be very active in this regard. For instance, Telangana Academy for Skill and Knowledge (TASK), a skill enhancement initiative from the State Government of Telangana was launched in the year 2013 to facilitate teaching-focused collaborations between HEIs located in the state of Telangana with local and multinational firms. Few of the primary activities that TASK does for promoting teaching-focused I-A collaborations is developing partnerships with for firms, developing awareness about industrial training programs and laboratory equipment from the partnering firms among HEIs through workshops and roadshows,
and also help the interested HEI in choosing the appropriate delivery mechanism through which the training programs from the companies to the students of the HEI. TASK has also its own trainers, who have undergone ‘train the trainer’ training and are qualified to deliver the training programs to students at HEIs. Therefore, HEIs that are could use TASK’s trainers to deliver the training from the companies to their students instead of their faculty. Also, such training programs and laboratory equipment offered to TASK’s member HEIs at a highly subsidised rate compared to the market price. Therefore, we assume that HEIs with access to such government initiatives that are organised to enhance I-A collaborations in teaching activities are more likely to collaborate in teaching with firms.

Figure 4.1 visualises the expected HEI-level and institutional determinants of HEI’s participation in teaching-focused I-A collaborations.

### Figure 4.1 The expected HEI-level and institutional determinants of teaching-focused industrial collaborations

<table>
<thead>
<tr>
<th>HEI-level factors</th>
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<tbody>
<tr>
<td>• HEI’s size (+)</td>
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<tr>
<td>• HEI’s quality (-)</td>
</tr>
<tr>
<td>• HEI’s involvement in academic research (-)</td>
</tr>
<tr>
<td>• HEI’s academic embeddedness (+)</td>
</tr>
<tr>
<td>• HEI’s industrial embeddedness (+)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HEI’s academic autonomy (+)</td>
</tr>
<tr>
<td>• Discipline variety (+)</td>
</tr>
<tr>
<td>• Location (+)</td>
</tr>
<tr>
<td>• Government support (+)</td>
</tr>
<tr>
<td>• HEI’s public ownership (-)</td>
</tr>
</tbody>
</table>

HEI’s propensity to engage in teaching-focused collaborations with industry
- in Mode-1
- in Mode-2
- in Mode-3

4.3.2 Stage-2: Validation of the Testable Model

We collected data from the websites of 2,224 Indian HEIs and estimated zero-inflated negative binomial regression model to investigate if the HEI-level and institutional factors identified by the interviewees do affect the HEIs’ propensity to form industrial
collaborations in teaching. The list of Indian HEIs was extracted from the All India Council for Technical Education’s (AICTE) approved list of higher education HEIs published on the website of AICTE in the year 2016-2017. AICTE is a national-level public statutory body and is responsible for accrediting undergraduate and postgraduate programmes in Indian HEIs. The criterions used to select the relevant HEIs for conducting the analysis for this paper are offering undergraduate-level ‘Engineering and Technology’ programmes. The search resulted in 3,013 HEIs. The next step included screening the websites of each of the 3,013 HEIs. However, the websites of 594 HEIs were either non-existent or seems incomplete (do not contain basic information such as courses offered, disciplines, and the number of enrolled students etc.) and therefore, were not considered. Additionally, 91 HEIs were not considered for analysis due to the outdated nature of the websites. Moreover, few years are required to develop networks in the industry and to initiate collaborations capitalising on such networks. Hence, HEIs that are less than 3 years’ old (104 HEIs) were not considered for further analysis. The final sample comprises 2,224 HEIs. Figure 4.2 visualises the sample selection process.

A website is termed as outdated if the website has not been updated in the 12 months prior to the date of data collection. We look for ‘last updated date’ which usually appears on the home page of the website. In the absence of such a date, we check if any new material has been uploaded on the website during the past 12 months.
Websites are public platforms, offering insights into organisations’ ‘activities, strategies and identity’ (Pina and Tether, 2016), meant to be used as a communication channel to facilitate the flow of information from the organisation to the outside world including potential clients. The information released in the websites is usually ‘controlled’ in nature, mostly stresses on those features that the organisation wants to communicate externally and could be attractive from a marketing perspective (Pina and Tether, 2016). HEIs are expected to showcase their industrial collaborations in teaching as this can enhance their image to prospective students and faculty. Students could be interested in

Figure 4.2 Sample selection process

Extract list of E&T HEIs from AICTE database

Does the HEI have a website?

YES

Is the HEI’s website complete?

NO

NO

Eliminate the HEI from the sample

YES

Is the HEI’s website up-to-date?

NO

YES

Is the HEI at least 3 years old?

NO

NO

Final Sample: 2,224 HEIs

NO
joining an HEI that offers industrial training programmes as a part or outside the curriculum in order to enhance employability for R&D positions in the industry. Also, such collaborations may entice prospective faculty to join the HEI because by participating in such teaching-focused collaborations with industry, faculty would be able to gain competence in new industrial technologies and develop relational social capital in the industry for future industrial research and entrepreneurial endeavours (Borah et al., 2018). The information shown on the websites is likely to be reliable as it contains the names of the partner firms and the partner firms may object if misinformation is conveyed through the website.

A typical HEI website has the following webpages ‘Home’, ‘About’, ‘Admissions/Courses Offered’, ‘Departments’, ‘Research’, ‘Infrastructure/Facilities’, ‘Collaborations/MoUs/Partnerships’, ‘Training & Placements’ and ‘Contact Us’ webpages. We checked each webpage for the needed information using both ‘human and computer-based methods’ (Pina and Tether, 2016). A number of HEIs had inbuilt search engines, letting us search directly for the required information. Further, we analysed the attachments in the form of documents and spreadsheets which include the HEI’s syllabi, vision document, training and placement event list, and academic brochure. Also, we followed the outgoing hyperlinks (Heimeriks et al., 2008) from the HEI website to see if the teaching collaboration activities of the HEI have found mention in outer sources such as news reports and the partner firms’ website etc., achieving ‘triangulation’

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22 ‘About’ webpage usually contains information history, organisation, governance structure and mechanism, and vision of the HEI. ‘Admissions/Courses Offered’ webpage includes information on the student enrolment numbers, admission procedure, academic committees, fee structure, academic calendar, and rules and regulations of the HEI. ‘Departments’ webpage reveals departmental level information including faculty details. ‘Research’ webpage contains information about academic and industrial research conducted by the HEI. ‘Infrastructure/Facilities’ webpage contains information about various infrastructure available on campus including labs, library, accommodation, fitness and sports facilities, research centres and entrepreneurship cells. ‘Collaborations/MoUs/Partnerships’ includes information about the HEI’s partnerships with external industrial and academic organisations. ‘Training & Placements’ webpage comprises information about student placement statistics, job/internship, and industrial training opportunities.
(Eisenhardt, 1989) i.e., to cross-validate the information retrieved from the HEIs’ websites.

**Operationalisation and measurements of dependent variables**

The websites of the 2,224 Indian HEIs have been analysed to count the number of teaching-focused I-A collaboration that the HEIs has made until the data collection date and through which of the three modes, such collaborations have been practiced. The process of identifying different modes of collaborations from the information provided on websites is discussed in Appendix-B (see Tables B5, B6 and B7).

**Operationalisation and measurements of independent variables**

**HEI Size**

The size of an HEI is measured by the number of enrolled students.

**HEI’s quality**

This variable measures if particular HEIs are regarded as elite or non-elite HEIs in India. For selecting elite HEIs in India used by Loyalka et al. (2014) that define elite HEIs as highly selective admitting admit students only through the Joint Entrance Examination. Based on this criterion, we consider 169 HEIs (7.59%) as elite HEIs.

**HEI's engagement in academic research**

This variable can be defined as the extent of HEI’s involvement in academic research, measured by a) the HEI offers PhD programmes, b) the HEI’s research publication intensity. We retrieved data on research publications of HEIs from Scopus database by inserting their names as ‘affiliation name’. Research publication intensity of an HEI is calculated by dividing the total number of papers published by the HEI until the year
2016 by the age of the HEI until 2016. On the other hand, ‘offering of PhD programmes’ is a binary variable. 351 HEIs (15.78%) are found to be offering PhD programmes.

**HEI’s academic embeddedness**

This variable measures the degree of HEIs’ embeddedness in the academic community. If an HEI belongs to a group of HEIs, we consider the HEI to be possessing active linkage with other HEIs and highly embedded in the academic community. We found 341 HEIs (15.38%) to be academically embedded.

**HEI’s industrial embeddedness**

This variable measures the degree of HEIs’ embeddedness in the industrial community, measured using two sub-variables- HEI’s engagement in industrial R&C and HEI’s engagement in entrepreneurship. An HEI is assumed to have engaged in industrial research and consultancy and entrepreneurship if the HEI has dedicated structures for handling these activities such as a ‘technology transfer office’, ‘industrial R&C centre’, and ‘entrepreneurship development cell’ etc. (see Tables in Appendix-B for examples of such infrastructure developed by Indian HEIs for industrial R&C and entrepreneurial activities). Based on this criterion, we found that 337 HEIs (15.15%) engage in industrial R&C and 383 HEIs (17.22%) participate in entrepreneurship.

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23 A dedicated infrastructure for industrial R&C act as an intermediary organisation between industry and HEIs; possess full-time employees responsible for organising networking events with firms, screening technologies developed within the HEI that can be patented and commercialised, work as ‘one-stop destination’ (Woolgar, 2007) for firms to find appropriate faculty members for collaboration, drafting proposals for external funding and developing joint research contracts, consultancy contracts and licensing agreements between the HEI and external organisations (Kenney and Patton, 2009; Perkmann et al., 2013). Similarly, a dedicated infrastructure for entrepreneurship assists in organising entrepreneurial training to students, offering platforms to students and faculty to showcase their prototypes and through organising boot camps, elevator pitches and business plan competition in the presence of venture capitalists and other financial organisations (Hayter, 2016; Mian, 1997; Wright et al., 2006). Such a structure may also allow external start-ups to access office space, library, and intellectual support available on-campus (Jacob et al., 2003).
Government support: setting up of intermediary organisations

The variable measures if the HEI has access to government-supported intermediary organisations which promote the development of teaching-focused I-A collaborations.

TASK is the only intermediary organisation that has been found to be active in these initiatives. As the operations of TASK is only limited to the state of Telangana out of 29 states in India, we consider an HEI to have access to TASK if it is located in the state of Telangana. In total, 217 HEIs (10.7%) have access to the support that TASK offers for teaching-focused I-A collaborations.

HEI’s location

This variable measures if an HEI is located in an industrial cluster. In line with Sharma et al. (2012), this paper considers Bangalore, Chennai, Delhi NCR, Hyderabad, Kolkata, Mumbai, and Pune as the industrial clusters in India. 441 HEIs (19.83%) are found to be situated in one of these seven industrial clusters.

HEI’s ownership type

This variable measures whether an HEI is owned and managed by government or by private entities. In our sample, 1,986 HEIs are private (89.3%) while 238 (10.7%) are owned and managed by the government.

HEI’s academic autonomy

This variable measures if an HEI has academic autonomy to design own curricula. India’s higher education system is mainly comprised of two types of HEIs: universities and university-affiliated HEIs. Universities include ‘deemed universities’ (public), ‘central universities’ (public), ‘state universities’ (public) and ‘private universities’. Universities possess the required academic autonomy to design their curriculum. On the other hand,
university-affiliated HEIs (unless given the ‘autonomous status’\textsuperscript{24}), which are controlled and monitored by the state universities, are required to follow the curriculum designed by the State Universities and therefore do not possess academic autonomy. We assume an HEI to possess academic autonomy if it is either a University or an autonomous university-affiliated HEI. Among 2,224 HEIs, only 274 HEIs (12.32\%) have academic autonomy.

**HEI's discipline variety**

This variable measures the extent of variety present in the HEI’s disciplines. We consider an HEI to be diverse in the disciplines if it offers courses outside the mainstream E&T disciplines, for instance, courses in humanities, science, and mathematics.

Table 4.2 reports a summary of the definition and measurement of the independent, dependent and control variables alongside summary statistics.

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\textsuperscript{24} ‘Autonomous’ status is granted by the University Grant Commission, India to university-affiliated HEIs based on their experience and performance. These autonomous HEIs while possess academic autonomy, are still controlled by state universities in financial matters.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Measurement</th>
<th>Mean</th>
<th>St. Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI’s size</td>
<td>Size of the HEI</td>
<td>Total number of enrolled students in the year 2016</td>
<td>2171.59</td>
<td>1335.25</td>
<td>230</td>
<td>18400</td>
</tr>
<tr>
<td>HEI’s quality</td>
<td>Quality of enrolled students</td>
<td>‘1’ for elite HEIs, ‘0’ otherwise</td>
<td>0.08</td>
<td>0.26</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s involvement in academic research</td>
<td>Availability of PhD programmes in the HEI</td>
<td>‘1’ if the HEI offers PhD programme, ‘0’ otherwise</td>
<td>0.16</td>
<td>0.36</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s involvement in academic research</td>
<td>Intensity of involvement in academic research</td>
<td>Number of research publications per year (=number of publications until 2016 divided by HEI’s age until 2016)</td>
<td>26.88</td>
<td>110.84</td>
<td>0</td>
<td>1,849.7</td>
</tr>
<tr>
<td>HEI’s academic embeddedness</td>
<td>Degree of linkages with other HEIs</td>
<td>‘1’ if the HEI is a member of a HEI group, ‘0’ otherwise</td>
<td>0.15</td>
<td>0.36</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s industrial embeddedness</td>
<td>Degree of HEI’s involvement in industrial R&amp;C</td>
<td>‘1’ if the HEI possess dedicated infrastructure for handling industrial R&amp;C activities, ‘0’ otherwise</td>
<td>0.15</td>
<td>0.36</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Degree of HEI’s involvement in entrepreneurship</td>
<td>‘1’ if the HEI possess dedicated infrastructure for handling entrepreneurial activities, ‘0’ otherwise</td>
<td>0.17</td>
<td>0.38</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s academic autonomy</td>
<td>Degree of academic autonomy of the HEI</td>
<td>‘1’ for autonomous HEIs, ‘0’ otherwise</td>
<td>0.12</td>
<td>0.33</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s location</td>
<td>Location of the HEI</td>
<td>1’ if the HEI is located in an industrial cluster (i.e., Delhi NCR, Bangalore, Chennai, Hyderabad, Kolkata, Mumbai and Pune), ‘0’ for private HEIs</td>
<td>0.20</td>
<td>0.40</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s ownership</td>
<td>Ownership type of the HEI</td>
<td>‘1’ if the HEI is a public HEI, ‘0’ for private HEIs</td>
<td>0.11</td>
<td>0.31</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Government support</td>
<td>Availability of government support for teaching-focused I-A collaborations</td>
<td>‘1’ if the HEI has access to the facilities offered by TASK, ‘0’ otherwise</td>
<td>0.10</td>
<td>0.30</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s discipline variety</td>
<td>Degree of variety in the disciplines of the HEI</td>
<td>‘1’ if the HEI offers courses in at least one non-E&amp;T discipline, ‘0’ otherwise</td>
<td>0.43</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s age</td>
<td>Age of the HEI</td>
<td>The difference between the year 2017, in which the data collection process was carried out, and the year in which the HEI was established</td>
<td>16.81</td>
<td>15.45</td>
<td>3</td>
<td>163</td>
</tr>
<tr>
<td>HEI’s gender</td>
<td>Gender of students enrolled to the HEI</td>
<td>‘1’ if the HEI enrol only women students and ‘0’ if the HEI enrol both male and female students</td>
<td>0.03</td>
<td>0.18</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HEI’s engagement in teaching-focused industrial collaborations</td>
<td>Number of teaching-focused industrial collaborations developed by the HEI until 2016</td>
<td>0.98</td>
<td>1.71</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>HEI’s engagement in teaching-focused industrial collaborations in Mode-1</td>
<td>Number of teaching-focused industrial collaborations developed by the HEI until 2016 in Mode-1</td>
<td>0.05</td>
<td>0.27</td>
<td>0</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>HEI’s engagement in teaching-focused industrial collaborations in Mode-2</td>
<td>Number of teaching-focused industrial collaborations developed by the HEI until 2016 in Mode-2</td>
<td>0.45</td>
<td>1.40</td>
<td>0</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>HEI’s engagement in teaching-focused industrial collaborations in Mode-3</td>
<td>Number of teaching-focused industrial collaborations developed by the HEI until 2016 in Mode-3</td>
<td>0.08</td>
<td>0.56</td>
<td>0</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Operationalisation and Measurements of Control Variables

We include three control variables: HEI’s age, gender, and the type of knowledge developed through the teaching collaborations.

**HEI’s age**

It is highly likely that comparatively older HEIs are likely to possess higher social capital in the industry than newer ones, which is a prerequisite for most I-A collaborations (Hong and Su, 2013). We, therefore, consider age as a control variable and calculate HEI’s age as the difference between the year 2017, in which the data collection process was carried out, and the year in which the HEI was established. We found 1,028 HEIs (46.22%) to be newly established HEIs with equal to or less than 10 years of age.

**HEI’s gender**

In India, a number of HEIs enrol only women students. In comparison to male academics, female academics’ engagement with industry in research-focused collaborations is not common (Tartari and Salter, 2015), suggesting that gender has a role to play in I-A collaborations. Based on this argument, we expect that firms may show less willingness to engage with women HEIs in teaching collaborations we well. Hence, HEI’s gender is controlled here. We found that 77 HEIs (3.46%) enrol only female students while the remaining HEIs enrol mixed gender.

**Type of knowledge developed through the collaborations**

We also control for the type of knowledge that is developed through the collaborations: Information Communication and Technology (ICT) knowledge and non-ICT knowledge. The type of knowledge is dependent upon the partner company’s industry affiliation. We consider a collaboration to be developing ICT knowledge if the partner company belongs to the ICT industry and non-ICT knowledge if the partner company belongs to non-ICT sectors, which may include electrical, mechanical, automobile, civil engineering,
chemical, and biomedical industries. In total, we found that 1,989 teaching-focused I-A collaborations have taken place at 897 HEIs to develop ICT knowledge, among which 96 collaborations are Mode-1 collaborations, 1,755 are Mode-2 collaborations and 138 are Mode-3 collaborations (see Figure 4.3 and Figure 4.4). On the other hand, 127 HEIs have developed 187 teaching-focused industrial collaborations for imparting non-ICT knowledge in students, among which 14 have taken place in Mode-1, 134 in Mode-2 and 39 in Mode-3.

![Figure 4.3](image-url) **Figure 4.3** Number of teaching-focused collaborations (TC) in different modes developing ICT and non-ICT knowledge in students

![Figure 4.4](image-url) **Figure 4.4** Number of HEIs with teaching-focused collaborations (TC) in different modes developing ICT and non-ICT knowledge in students
4.3.3 Model and Estimation

We use the zero-inflated negative binomial model to test the effects of HEI-level and institutional factors on HEIs’ participation in teaching-focused collaborations with industry. Because our dependent variable is a count variable, i.e., positive integer starting from 0, usually both Poisson and negative binomial models are suitable for analysis (Greene, 2008). However, in this paper we choose the negative binomial model over the Poisson model due to ‘overdispersion’ of our dependent variable i.e., variance (2.91) is significantly greater than mean (0.97). The negative binomial model is a more appropriate model than Poisson for analysing dependent variables that are overly dispersed (Ramaciotti and Rizzo, 2015). The zero-inflated model was preferred over the standard negative binomial model because our dependent variable contains a substantial number of zeroes. The median of our dependent variable is 0 which confirms the presence of a significant number of zeros in the dependent variable. Moreover, we performed the Vuong test to assess if the zero-inflated model is appropriate to analyse our data. We found significant Vuong statistics (p-value<0.01) which suggest that the zero-inflated negative binomial model is a better fit to our data than the standard negative binomial model (Banerjee and Siebert, 2017; Ramaciotti and Rizzo, 2015).

The zero-inflated negative binomial model runs analysis in two stages. The first stage of the model operates as a logit model on a ‘binary distribution’ i.e., it considers all values of the dependent variable that are greater than ‘1’ as ‘1’. This stage helps to identify those independent variables, also known as ‘inflated variables’, which contribute to the achievement of a ‘certain zero’ in the dependent variable. In our case, this stage of zero-inflated negative binomial model facilitated the recognition of factors that hinder

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25 We run robustness tests with the Poisson model and found the results to be consistent with that obtained with the negative binomial model.
the occurrence of teaching-focused collaborations at HEIs. We included ‘HEI’s public ownership’ as an inflate variable based on the argument that firms show lack of interest in forming teaching-focused collaborations with public HEIs due to a high degree of bureaucracy present in such HEIs. Additionally, we inserted ‘HEI’s academic autonomy’ as an inflate variable for the dependent variable ‘Mode-1 collaborations’ considering the restrictions imposed on non-autonomous HEIs in designing own curricula.

The second stage of the zero-inflated negative binomial model operates as a negative binomial regression model on a ‘binomial distribution’, i.e., it considers the original distribution of the dependent variable in the count data form. This stage helps to identify the independent variables that lead to a higher frequency of events. In our case, the second stage the model allowed us to understand factors that decide the number of teaching-focused an HEI develop.

4.4 Results

4.4.1 Empirical Findings

Table 4.3 reports the descriptive statistics and correlation among the variables. Most correlations are low with values within the range \{-0.4, 0.4\}. To check collinearity among predictor variables, we further performed the variance inflation factor (VIF) test. We found the range of VIF scores of our independent variables to be between 1.02 and 1.71, which falls within the permissible limit, indicating the absence of collinearity among these variables.
The results from the zero-inflated negative binomial model are reported in Table 4.4. To control for the type of knowledge developed through the teaching-focused collaborations, we performed the regression separately for collaborations enhancing ICT knowledge and non-ICT knowledge and the results have been reported in models (2) and (3) respectively. The results for the three modes of collaborations are reported separately in models (1a), (1b) and (1c).

Among HEI-level factors, the coefficient of HEI’s size is positive and significant (coefficient=0.0002, p-value<0.01) for teaching-focused collaborations. Therefore, the
expected positive relationship between HEI’s size and HEI’s propensity to engage in teaching-focused industrial collaborations is supported, particularly for Mode-2 and Mode-3 collaborations.

Overall, the coefficient of HEI’s quality is not significant for teaching-focused collaborations. However, the coefficient is negative and significant (coefficient=-0.45, p-value<0.1) for Mode-1 collaborations, suggesting that non-elite HEIs are more likely to engage in curriculum co-development with industry than elite HEIs.

The coefficient of HEI’s involvement in academic research in terms of offering PhD programmes and research publications are not significant, indicating no support to our anticipation that research-focused HEIs will show less propensity to collaborate with industry in teaching.

The coefficient of inter-HEI linkage is positive and significant (coefficient=0.73, p-value<0.001), suggesting that academically embedded HEIs are more likely to form teaching-focused I-A collaborations with industry particularly in Mode-2 and Mode-3.

Both the coefficients of HEI’s involvement in industrial R&C (coefficient=0.46; p-value<0.01) and entrepreneurship are positive and significant (coefficient=0.42; p-value<0.01) with HEI’s engagement in teaching-focused industrial collaborations. In terms of the effect on specific collaboration modes, we found that HEI’s involvement in industrial R&C increases HEI’s probability to form Mode-1 and Mode-2 collaborations while involvement in entrepreneurship improves the HEI’s propensity to collaborate in teaching across all three modes.

Amongst the institutional factors, results show that HEI’s location in industrial clusters holds a positive and statistically significant coefficient (coefficient=0.45, p-value<0.01) for teaching-focused collaborations across all three collaboration modes. The results are the same for teaching-focused collaborations addressing both ICT and
non-ICT knowledge. It thus validates our assumption that HEIs located in industrial clusters are likely to engage in a higher number of teaching-focused collaborations with industry than those situated elsewhere.

Variety in HEI’s disciplines shares a positive and significant relationship (coefficient=0.27, p-value<0.01) with HEIs’ propensity to engage in teaching-focused collaborations particularly for developing ICT knowledge, suggesting firms’ preference to collaborate in teaching with HEIs that offer courses in non-E&T disciplines alongside E&T disciplines.

The coefficient of availability of government support is positive and significant for teaching-focused collaborations imparting ICT knowledge (coefficient=0.29, p-value<0.05) to students in Mode-2. Therefore, our assumption regarding the availability of government support positively driving HEIs to collaborate with industry in teaching is confirmed only in the context of ICT disciplines.

Among the institutional factors included in the ‘inflate’ component of the regression model, HEI’s academic autonomy shares a statistically negative and significant correlation (coefficient=-6.23, p-value<0.01) with HEI’s non-involvement in Mode-1 teaching-focused collaborations with industry, offering support to our presumption that non-autonomous HEIs are less likely to engage in curriculum co-development activities with industry.

On the other hand, the coefficient of governance mechanism is positive and significant for Mode-1 (coefficient=4.67, p-value<0.01), suggesting that public HEIs are less likely to participate in teaching-focused industrial collaborations in Mode-1.

Among the control variables, we find HEI’s age to be a predictor of HEI’s engagement only in Mode-3 teaching collaboration. Finally, as expected, HEI’s gender possesses a negative and significant relationship with teaching-focused collaborations.
developing ICT knowledge in students, confirming a gender bias against female students in (E&T) teaching collaborations.
### Table 4.4 Predictors of teaching-focused I-A collaborations (Model: Zero-inflated negative binomial regression)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Teaching-focused I-A collaboration</th>
<th>Mode of teaching-focused I-A collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Entire sample</td>
<td>(2) ICT knowledge</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HEI-level factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s size</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
</tr>
<tr>
<td>HEI’s quality</td>
<td>0.06 (0.13)</td>
<td>0.05 (0.13)</td>
</tr>
<tr>
<td>HEI’s involvement in academic research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offering of PhD programmes</td>
<td>0.07 (0.10)</td>
<td>0.06 (0.10)</td>
</tr>
<tr>
<td>Number of research publications</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td><strong>HEI’s academic embeddedness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter-HEI linkage</td>
<td>0.73 (0.08)***</td>
<td>0.75 (0.08)***</td>
</tr>
<tr>
<td><strong>HEI’s industrial embeddedness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s involvement in industrial R&amp;C</td>
<td>0.46 (0.10)***</td>
<td>0.51 (0.10)***</td>
</tr>
<tr>
<td>HEI’s involvement in entrepreneurship</td>
<td>0.42 (0.09)***</td>
<td>0.41 (0.09)***</td>
</tr>
<tr>
<td><strong>Institutional factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s location</td>
<td>0.45 (0.08)***</td>
<td>0.43 (0.08)***</td>
</tr>
<tr>
<td>Availability of government support</td>
<td>0.24 (0.10)**</td>
<td>0.29 (0.10)**</td>
</tr>
<tr>
<td>Discipline</td>
<td>0.26 (0.07)***</td>
<td>0.27 (0.07)***</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s age</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>HEI’s gender</td>
<td>-0.66 (0.23)***</td>
<td>-0.58 (0.23)**</td>
</tr>
<tr>
<td>_cons</td>
<td>-1.17 (0.08)***</td>
<td>-1.23 (0.08)***</td>
</tr>
<tr>
<td><strong>Inflate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Institutional factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s governance mechanism</td>
<td>17.78 (876.89)</td>
<td>18.42 (1,184.50)</td>
</tr>
<tr>
<td>HEI’s academic autonomy</td>
<td>-0.84 (0.50)*</td>
<td>-0.65 (0.49)</td>
</tr>
<tr>
<td>_cons</td>
<td>-17.60 (876.89)</td>
<td>-18.25 (1,184.50)</td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>2,224</td>
<td>2,224</td>
</tr>
<tr>
<td>LR chi2</td>
<td>424.13</td>
<td>405.73</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* if p<0.1, ** if p<0.05 and *** if p<0.01
Table 4.5 Predictors of teaching-focused I-A collaborations (Model: Zero-inflated Poisson regression)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Teaching-focused I-A collaboration</th>
<th>Mode of teaching-focused I-A collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(7) Entire sample</td>
<td>(8) ICT knowledge</td>
</tr>
<tr>
<td>HEI’s size</td>
<td>0.01 (0.00)**</td>
<td>0.01 (0.00)**</td>
</tr>
<tr>
<td>HEI’s quality</td>
<td>-0.01 (0.07)</td>
<td>0.01 (0.08)</td>
</tr>
<tr>
<td>HEI’s involvement in academic research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offering of PhD programmes</td>
<td>0.00 (0.07)</td>
<td>-0.03 (0.07)</td>
</tr>
<tr>
<td>Number of research publications</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>HEI’s academic embeddedness</td>
<td>0.36 (0.05)**</td>
<td>0.38 (0.06)**</td>
</tr>
<tr>
<td>Inter-HEI linkage</td>
<td>0.25 (0.07)**</td>
<td>0.31 (0.07)**</td>
</tr>
<tr>
<td>HEI’s involvement in industrial R&amp;C</td>
<td>0.47 (0.06)**</td>
<td>0.45 (0.07)**</td>
</tr>
<tr>
<td>HEI’s involvement in entrepreneurship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s location</td>
<td>0.29 (0.05)**</td>
<td>0.27 (0.05)**</td>
</tr>
<tr>
<td>Availability of government support</td>
<td>0.19 (0.07)**</td>
<td>0.23 (0.07)**</td>
</tr>
<tr>
<td>Discipline</td>
<td>0.24 (0.05)**</td>
<td>0.24 (0.06)**</td>
</tr>
<tr>
<td>HEI’s age</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>HEI’s gender</td>
<td>-0.61 (0.21)**</td>
<td>-0.53 (0.21)**</td>
</tr>
<tr>
<td>_cons</td>
<td>-0.13 (0.07)**</td>
<td>-0.22 (0.07)**</td>
</tr>
<tr>
<td>Inflation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s governance mechanism</td>
<td>1.95 (0.24)**</td>
<td>2.04 (0.25)**</td>
</tr>
<tr>
<td>HEI’s academic autonomy</td>
<td>-1.90 (0.25)**</td>
<td>-1.90 (0.26)**</td>
</tr>
<tr>
<td>_cons</td>
<td>-0.36 (0.09)**</td>
<td>-0.41 (0.10)**</td>
</tr>
<tr>
<td>Number of observations</td>
<td>2.224</td>
<td>2.224</td>
</tr>
<tr>
<td>LR chi2</td>
<td>347.77</td>
<td>316.31</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* if p<0.1, ** if p<0.05 and *** if p<0.01
4.4.2 Robustness Check

For robustness check, we performed analyses on the same data using zero-inflated Poisson model and compared the results with those obtained from the zero-inflated negative binomial model. The results from the zero-inflated negative binomial regression are reported in Table 4.5. The results are consistent between the zero-inflated negative binomial and zero-inflated Poisson model. For additional robustness check, we also analysed the data using the standard negative binomial model (see Table B8 in Appendix-B). Results from both zero-inflated and standard negative binomial models confirm HEI’s size, academic embeddedness, and industrial embeddedness in terms of engagement in industrial R&C and entrepreneurship as the HEI-level determinants and HEI’s location, availability of government support, HEI’s discipline variety and autonomy as the institutional determinants of teaching-focused I-A collaborations. The only difference observed between the two models is that in the negative binomial model, HEI’s public ownership holds negative and statistically significant coefficient for teaching-focused collaborations taking place across both ICT and non-ICT disciplines in all three modes of collaborations, while in the zero-inflated model, we found the same relationship only for Mode-1 collaborations. This difference appears because in the zero-inflated model, public ownership variable is inserted as an inflate variable and in the negative binomial regression, it is considered as a count variable. Both results have different interpretations. The negative relationship between public ownership of HEIs and Mode-1 collaboration shown in the results from the zero-inflated negative binomial model suggests that public HEIs are unlikely to initiate Mode-1 collaborations with industry. On the other hand, the negative relationship between public ownership of HEIs and teaching-focused collaboration demonstrated in the results from the negative
A binomial model suggests that public HEIs tend to engage in a lower number of teaching collaborations with industry.

In addition, for the variable ‘HEI’s industrial embeddedness’, we assumed that if an HEI is involved in industrial R&G and entrepreneurship, it will have dedicated structures or departments for handling industrial R&G and entrepreneurial activities. However, one criticism of such an assumption could be that small HEIs may not have the necessary funds or scale to set-up dedicated infrastructure for these activities, yet they may still engage with industry in R&G and entrepreneurship. On the other hand, large HEIs are likely to possess the resources to set up such infrastructure which may lead to teaching-focused collaborations. Therefore, it is essential to understand if the positive relationship observed between the HEI’s industrial embeddedness and HEI’s involvement in teaching-focused industrial collaborations for the entire sample also holds when only large HEIs are considered. To analyse this issue, we estimated separate zero-inflated negative binomial models for small and large HEIs. An HEI is considered as ‘small’ if its student enrolment number is less than the mean student enrolment number across the 2,224 HEIs; ‘large’ otherwise. Based on this criterion, 824 HEIs are considered as small HEIs and 1,400 HEIs as large HEIs. The coefficients of HEI’s involvement in industrial R&G and HEI’s involvement in entrepreneurship are positive and significant for large HEIs (see Table B9 in Appendix-B), consistent with the results obtained for the full sample.

Another issue is that the information retrieved from websites does not reveal when the teaching-focused collaborations were formed. Since some of the independent variables, in particular, HEI’s industrial embeddedness, are time-variant, it was difficult to understand if HEI’s industrial embeddedness in terms of industrial R&G and entrepreneurship share a causal relationship with HEI’s propensity to engage in teaching-
focused industrial collaborations or they have coevolved. To address this concern, we estimated zero-inflated negative binomial models separately for HEIs that were established before and after the year 2000. The main thought behind splitting up the sample is that most teaching-focused collaborations must have occurred after the year 2000 since the majority of these collaborations have been formed by foreign MNCs and MNCs started setting up their R&D subsidiaries in India predominantly after the year 2000 (Gerybadze and Merk, 2014; Zedtwitz and Gassmann, 2016). For newer HEIs that were established post-2000 (1,522 HEIs), it is possible that these HEIs’ involvement in industrial R&C and entrepreneurship has coevolved with teaching-focused industrial collaborations. On the other hand, for older HEIs, which were established before 2000 (702 HEIs), it is possible that such HEIs’ involvement in industrial R&C and entrepreneurship started prior to their engagement in teaching-focused collaborations. Thus, the relationship between HEI’s industrial embeddedness in terms of industrial R&C and entrepreneurship and HEI’s engagement in teaching-focused industrial collaborations is likely to be a causal-effect relationship for older HEIs. Therefore, it is essential to understand if the positive relationship observed between the two variables for the entire sample also holds when only older HEIs are considered. The coefficients of HEI’s engagement industrial R&C and entrepreneurship are positive and significant for older HEIs (see Table B9 in Appendix-B), suggesting the existence of a positive causal relationship between HEI’s industrial embeddedness and propensity to collaborate in teaching with industry.

Lastly, to measure the quality of HEIs, we used the ranking of HEIs published by national Institutional Ranking Framework, Ministry of Human Resource Development of India. The ranking publishes a list of top 200 HEIs based on performance in five dimensions: teaching resources, research productivity, graduation outcomes, outreach
and inclusivity, and perception among employers and academic peers. We considered these 200 HEIs as elite HEIs and the remaining 2,024 HEIs as non-elite HEIs. However, the results were found to be consistent with those reported in Table 4.4.

4.5 Discussion

4.5.1 HEI-level Determinants of Teaching-focused I-A Collaborations

The analysis of factors affecting teaching-focused I-A collaborations shows that, among HEI-level factors, HEI’s size, quality, academic embeddedness, and industrial embeddedness are the main drivers. Similar to I-A collaborations in R&C (Schartinger et al., 2001), large HEIs show high propensity to develop industrial collaborations in teaching as well. There could be three explanations for this result. First, collaborating with large HEIs allow firms to roll out their training programmes to a large number of students at a lower marginal cost. Second, large HEIs because of large faculty size are able to balance excess teaching load (Schartinger et al., 2001) that may arise from several faculty members’ involvement in the teaching-focused industrial collaborations. Third, large HEIs are likely to possess greater visibility and networks in the industry (Muscio et al., 2013), attracting firms to discuss opportunities for teaching collaborations.

We observed that non-elite HEIs show higher propensity to form industrial collaborations in Mode-1 for curriculum co-development and delivery. Elite HEIs participate less in Mode-1 collaboration possibly because they mostly perceive upgrading curricula in line with industrial needs as ‘unnecessary’ as the students enrolled in these HEIs are of high-quality. However, such a perception could lead to a serious implication for the HEIs’ reputation in the long-term. Elite HEIs should realise that although students enrolled in elite HEIs are of high-quality, these students when graduated may not be skilled in par with industry’s requirement if the curricula are not aligned to industry’s
needs. Thus, graduates from even elite HEIs may find difficulty in getting employed, jeopardising these HEIs’ reputation among employers and prospective students. On the other hand, on a positive note, non-elite HEIs have been found to be actively participating in curricula development with industry which is a positive sign for Indian higher education system, where non-elite HEIs are often criticised for operating with outdated curricula (Loyalka et al., 2014). As the graduates from non-elite HEIs form the majority of the graduate pool in India, improvement in skills of the graduates from non-elite HEIs will help to reduce the negative perception about the quality of Indian graduate pool to a large extent which may lead to increased foreign direct investments (FDI) in R&D.

Our results show that high academic embeddedness of HEIs attracts corporations for teaching-focused collaborations. A possible reason could be that collaborating with HEIs with high academic embeddedness offer firms with structural social capital (Lee, 2009) in the academic community, which could be exploited to establish teaching-focused collaborations with multiple HEIs and thus to reach out to more number of students. On the other hand, in order to deliver training in Mode-1, Mode-2, and Mode-3, HEIs need to set-up labs to allow companies to integrate company-specific components to the training offered to students (Borah et al., 2018). However, HEIs may find it difficult to raise funds to pay for the lab tools. If a particular HEI (say HEI-A) is able to access the labs established by the particular company at a nearby HEI (say HEI-B), the students of HEI-A could attend the training programs offered by the company at HEI-B. Therefore, having good relationships with nearby institutes could help a particular HEI to overcome the resource constraints for teaching collaborations with industry. As mentioned earlier, joining a group of institutes allows developing further

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26 Studies (Lewin et al., 2009; Manning et al., 2008) show that talent availability in host countries drives MNCs’ R&D offshoring decisions.
27 Structural social capital of an organisation refers to the size and density of the social networks it holds.
inter-HEI linkages. Alternatively, HEIs may also create linkages with other academic institutions by collaborating in joint research (Jonkers and Cruz-Castro, 2013) and faculty exchange/mobility initiatives (Edler et al., 2011; Horta et al., 2010), which will not only assist them in enhancing research productivity and skills of faculty but also make the HEI an attractive destination for industry to pursue teaching-focused I-A collaborations.

We found that HEI’s industrial embeddedness in terms of industrial R&C and entrepreneurship projects facilitates teaching-focused I-A collaborations. The possible reason behind this result is that prior experience with HEIs through R&C and entrepreneurship collaborations could help to develop cognitive and relational social capital (Steinmo and Rasmussen, 2018) between the company and HEI. Within cognitive social capital, prior entrepreneurial and industrial R&C engagements assist HEIs to understand the industrial technologies and skills that are in demand and identify opportunities to collaborate with industry to upgrade labs, curriculum and to train faculty so that the students can be equipped with the necessary skill-sets. Also, through collaborations in R&C and entrepreneurship, firms receive a first-hand idea of HEI’s institutional environment including bureaucracy, autonomy, and leadership, which as our results show, may affect HEI’s engagement with industry in teaching-focused collaborations. On the other hand, industrial R&C and entrepreneurial initiatives with HEIs could allow the firm to develop relational social capital with HEIs in terms of personalised linkages with faculty, their capabilities and to decide if these faculty members could be used as delivery channels for any future teaching-focused collaboration. So, HEI’s industrial R&C and entrepreneurship activities can be seen as

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28 Cognitive social capital refers to the shared cognitive elements such as values, beliefs and norms present in a network required for a successful exploitation of the network benefits; whereas relational social capital refers to the quality of personal relationships such as trust developed within a social network (Nahapiet and Ghoshal, 1998).
the channels through which the information and communication gap, which usually exists between industry and academia (Schartinger et al., 2001) is bridged, leading to the development of teaching-focused collaborations.

Another perspective to see this result is that universities’ engagement in mission-2 (industrial R&C) and mission-3(entrepreneurship) strengthens mission-1 (teaching). The existing understanding, while limited, of the effect of I-A collaborations in university mission-2 and mission-3 on mission-1 is inconclusive. While studies (Acworth, 2008; D’Este and Patel, 2007) have observed I-A collaborations in mission-2 and mission-3 to benefit teaching activities through infrequent industry contributions to the teaching processes such as guest lectures and occasional curriculum inputs, whereas Sánchez-Barrioluengo (2014) empirically documented a negative correlation between teaching and the other two missions of universities. Our study provides a pivotal contribution to this debate by showing a positive association between HEIs’ engagement with industry in research and entrepreneurship and collaborations for teaching. The disparity in results between our study and Sánchez-Barrioluengo’s (2014) is primarily due to the difference in the measurement operationalisation techniques used by the two studies for teaching activities. We assumed industry-organised practices for enhancing the teaching quality as a measurement of teaching while Sánchez-Barrioluengo (2014) considered the magnitude of teaching activities (e.g., student numbers and teaching revenue) as a measurement of teaching. We argue that only students’ numbers and teaching revenues do not fully cover all aspects of teaching and future researchers should also consider university’s engagement in industrial training programmes also as a measure of mission-1 of universities.
4.5.2 Institutional Determinants of Teaching-focused I-A Collaborations

Among institutional factors, we found discipline, location, HEI’s academic autonomy and availability of government support to be the determinants of teaching-focused I-A collaborations while HEI’s public ownership inhibits such collaborations.

The number of teaching-focused I-A collaborations taking place at Indian HEIs for imparting ICT knowledge to students overshadows those addressing non-ICT knowledge. We offer two justifications to explain this result. First, considering India’s specialisation and the large agglomeration of MNCs and domestic firms in the ICT sector (Kenney et al., 2013), the demand for talent in ICT domains is likely to be higher and the strong competition for talent might have pushed corporations to use teaching-focused collaborations with HEIs as a strategy to identify and recruit graduates. Second, teaching-focused collaborations with HEIs could be a response from the industry to the urgent need for developing R&D manpower in emerging fields of ICT sector such as internet of things (IoT), cloud computing and big data. This is in line with the argument that firms in high-tech sectors tend to be more ‘committed’ to collaborate with universities in R&D activities (Hanel and St-Pierre, 2006). We also found that firms imparting ICT knowledge through teaching collaborations show more willingness to form such collaborations with HEIs that offer courses in diverse disciplines. This is possibly due to the emergence of Industry 4.0, which has resulted in great demand for ICT knowledge across disciplines (Benešová and Tupa, 2017).

In line with previous studies (Youtie and Shapira, 2008) on the role of the geographical location of HEIs on R&C and entrepreneurship-focused I-A linkages, this paper also recognizes the geographical location of HEIs in clusters as a key factor for teaching-focused collaborations. It thus points to the possibility that HEIs located in clusters have high visibility (Muscio et al., 2013) and therefore are able to find industrial
collaborators more easily than those located elsewhere. Being located in industrial clusters offers opportunities to HEIs and firms to network with each other, leading the HEIs to develop more social capital in the industrial community and vice versa. On the other hand, even if HEIs decide not to involve faculty as the delivery channel, the companies can partner with third-party organisations (Borah et al., 2018) which can be found in abundance around industrial clusters to deliver the activities pertaining to teaching-focused collaborations.

Our results suggest that government support in the form of establishing intermediary organisations such as TASK is influential for teaching-focused I-A collaborations. In India, TASK is the sole government initiative that aims to develop collaborations between industry and academia. For HEIs participating in teaching-focused industrial collaborations, TASK offers subsidy and for the partner firms, TASK offers human resources that advertise the companies’ training programs and if required, deliver the training programs to students. In a triple helix structure, considering the responsibility of an intermediary organisation is to provide economic benefits to industry and university in the form of reducing transaction costs (Leydesdorff, 2000), we believe TASK’s operation aptly fits the definition of an intermediary organisation. The role of institutional support and policies in promoting I-A collaborations has been an understudied dimension (Perkmann et al., 2013) and the discussion on TASK’s role in facilitating teaching-focused collaborations between industry and Indian HEIs, contributes to filling this research void. As of 2018, TASK operates only in the state of Telangana and promotes collaborations between HEIs located in the state of Telangana and mainly ICT firms. It suggests that HEIs in other states will benefit immensely from the existence of such policy initiatives. However, at present TASK focuses on building ICT knowledge only. Non-ICT knowledge of graduates also needs to be developed in
order to enhance human capital and technological capability across sectors. Thus, intermediary organisations like TASK should be given responsibilities to develop teaching-focused I-A collaborations in non-ICT disciplines as well.

While we find government support to be influential for initiating I-A collaborations in teaching, we also found that public HEIs are less likely to collaborate with industry in teaching. Public ownership is a challenge particularly for Mode-1 collaborations i.e., curriculum co-development with industry. The curriculum design process requires a number of approvals from different authorities in India (see Borah et al., 2018). In a public HEI, the process tends to be slow due to high bureaucracy, which discourages firms to engage in Mode-1. Similar results were also reported by Muriithi et al. (2018) for Kenyan universities, who stated that, among other institutional factors, the bureaucratic structure acts as a barrier to I-A collaborations because of the sheer number of approvals required to release funds, creating problems in fulfilling the collaboration objectives on time.

Another institutional factor that limits HEIs involvement in forming collaborations for curriculum co-development (Mode-1) is lack of autonomy, confirming Borah et al.’s (2018) observation. This is a serious issue considering approximately 88% of the total number of HEIs present in India that does not hold the academic autonomy to incorporate such industry inputs in their curriculum. Collaboration in curriculum co-development is necessary not only to align the curriculum to the industrial needs but it requires updating labs and libraries accordingly. As Borah et al. (2018) suggest, firms approaching the parent universities who design the curriculum for the non-autonomous HEIs could be a solution worth considering. On the other hand, policymakers should grant some academic autonomy to the currently non-autonomous HEIs to an extent that
allows HEIs to introduce some changes to the existing curriculum as per the industry’s needs.

### 4.6 Conclusion

Through this paper, we carry forward research on teaching-focused I-A collaborations. We identified four HEI-level factors- HEI’s quality, size, industrial and academic embeddedness and five institutional factors- discipline, HEI’s academic autonomy, private ownership, location and availability of government support as the key predictors of teaching-focused I-A collaborations. Through the identification of factors that facilitate and hinder HEI’s propensity to collaborate with industry in teaching, we not only strengthen the literature on I-A collaborations but also offer implications to Indian policymakers in terms of how a favourable environment could be developed for encouraging HEI’s participation in teaching-focused collaborations with industry.

This paper presents some limitations. First, data collected from websites are constrained by the ‘controlled’ nature of the information available on the website and the possibility of some human error. Collection of data through survey could have helped to avoid such limitations although it would have covered a sample of the 2,224 HEIs considered in this study. Alternatively, advanced text mining tools and/or website crawlers could be used to minimise human errors in data collection. Second, we did not study the firm-level determinants of teaching-focused I-A collaborations. Prior studies (e.g., Fontana et al., 2006; Giuliani et al., 2010; Santoro and Chakrabarti, 2002; Segarra-Blasco and Arauzo-Carod, 2008) have shown, in the context of research collaborations, that a number of firm-level factors such as firm size, experience, openness to the external environment and innovation orientation (product versus process innovations) etc. can influence the occurrence of I-A collaborations. In addition, Borah et al. (2018) mention that firms’
involvement in specific teaching collaboration modes could be driven by motivations to reduce transaction costs. Hence, investigation of firm-level determinants of teaching-focused I-A collaborations alongside our findings regarding the institutional and HEI-level determinants could inform researchers and policymakers on the factors that need to be taken into consideration in a triple helix system in order to develop a favourable ambience for teaching-focused I-A to take place. Third, the occurrence of teaching-focused collaborations could be affected by faculty-level individual factors such as personal motivations, productivity, demographics, and career trajectory etc., which have been previously found as influential predictors of faculty’s involvement in research collaborations with industry (as in Boardman and Ponomariov, 2009; Giuliani et al., 2010; Perkmann et al., 2011). We were restricted by our data, which were collected from the websites of the HEIs, to extract such micro-level information and thus constitute a possible line of enquiry for future studies.

Last but not least, context specificity is a limitation. The study is based on one country setting and therefore generalisability of the findings could be a concern. In particular, the institutional factors identified as predictors of HEI’s participation in teaching-focused collaborations may vary across countries due to institutional differences. Teaching-focused I-A collaborations are becoming increasingly popular in other emerging countries as well. In fact, in May 2018, the President of Incheon National University in South Korea announced that it has entered into collaborations with around 50 firms to help the university out with curriculum design and to select the lecturers who would be given responsibility to teach the amended courses from the amended curriculum (Times Higher Education, 2018). Additionally, Borah et al. (2018) report that companies such as Cisco, EMC, and Oracle have been developing similar collaborations with hundreds of universities in most emerging countries including Brazil, Russia, and China;

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suggested the growing importance of teaching-focused collaborations for managers and policymakers. Hence exploration of determinants of teaching-focused collaborations in institutional settings other than that of India will not only allow verification of our results but also will contribute towards guiding HEIs, policymakers and company managers towards establishing a favourable environment for teaching-focused I-A collaborations to take place.

References


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## Appendix-B

### Table B1 List of interviewed companies

<table>
<thead>
<tr>
<th>Interviewed company</th>
<th>Company Descriptions</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm-I</td>
<td>Firm-I is an Indian IT multinational and recruits over 10,000 fresh E&amp;T graduates every year for mainly development roles. Until 2017, it has developed teaching-focused collaborations with approximately 500 Indian HEIs in technological domains such as business intelligence, building enterprise applications, and mobile application development.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-II</td>
<td>Firm-II is a leading US MNC specialising in telecommunication business and its Indian R&amp;D centre is largest outside the USA. In 2000, Firm-II started forming teaching-focused alliances with Indian HEIs to offer courses to UG/PG students in basic programming, network design and security. By 2017, this programme reached out to approximately 450 Indian HEIs.</td>
<td>Former Academic Programme Manager; CEO of TPO</td>
</tr>
<tr>
<td>Firm-III</td>
<td>Firm-III is a US multinational specialising in database management software. Its development centre in India has been operational since the 1990s. It has developed teaching-focused collaborations with approximately 400 HEIs by 2017 around database design and programming.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-IV</td>
<td>Firm-IV is a US multinational firm specialising in semiconductors and integrated circuits. By 2017, it has developed teaching-focused collaborations with over 200 HEIs to set up labs and train faculty on analogue and embedded processing technologies.</td>
<td>Academic Programme Manager; CEO of TPO</td>
</tr>
<tr>
<td>Firm-V</td>
<td>Firm-V is a US multinational and was one of the first major global IT corporations to establish an R&amp;D subsidiary in India. By 2017, Firm-V has developed teaching-focused collaborations with 155 Indian HEIs in four domains: big data, cloud computing, information security and mobile computing.</td>
<td>Academic Programme Manager and R&amp;D Manager</td>
</tr>
<tr>
<td>Firm-VI</td>
<td>Firm-VI is a US multinational specialising in semiconductors and its R&amp;D subsidiary in India has been operational since the late 1990s. Up to 2017, it has developed teaching-focused collaborations with 73 HEIs to set up labs in embedded systems.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-VII</td>
<td>Firm-VII is a European multinational specialising in telecommunications. As of 2017, it holds teaching-focused partnerships with 68 Indian HEIs for offering training to students on a range of topics including 2G, 3G, internet protocol, multimedia, GSM, WCDMA and value-added services.</td>
<td>R&amp;D Manager</td>
</tr>
<tr>
<td>Firm-VIII</td>
<td>Firm-VIII is an Indian IT multinational. In 2007, it started a programme to train faculty members of Indian HEIs on internet security. As of 2017, it holds teaching-focused collaborations with 55 HEIs.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-IX</td>
<td>Firm-IX is a US multinational firm specialising in the development of customer-facing applications. By 2017, it has developed teaching-focused collaboration with 20 HEIs in mobile application development.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-X</td>
<td>Firm-X is a US multinational specialising in cyber security and its R&amp;D centre has been operational since the 1990s. As of 2017, it developed teaching-focused collaborations with 19 HEIs to set up labs and offer student and faculty training on cyber and network security.</td>
<td>Former Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-XI</td>
<td>Firm XI is an Indian multinational automotive parts manufacturer. In 2015, it entered into teaching-focused collaborations with two Indian HEIs located in Delhi NCR to co-develop and deliver curriculum, train faculty and set up labs in automobile engineering.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>Firm-XII</td>
<td>Firm-X is a domestic firm specialising in electrical equipment manufacturing. In 2015, it entered into a teaching-focused collaboration with HEI X in Power Electronics. Firm-X aims to develop multiple teaching-focused collaborations in the coming years.</td>
<td>Academic Programme Manager</td>
</tr>
<tr>
<td>HEI</td>
<td>HEI description</td>
<td>Respondents interviewed</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>HEI-I</td>
<td>HEI-I is a privately-owned autonomous HEI which was established in 1997 in Delhi NCR region. It offers UG, PG and PhD programmes in wide range of disciplines including biotechnology, and humanities alongside E&amp;T programmes. HEI-I has over 10 teaching-focused collaborations.</td>
<td>Dean (Academic), Dean (Training &amp; Placement), and faculty member</td>
</tr>
<tr>
<td>HEI-II</td>
<td>HEI-II is a privately-owned autonomous HEI which was established in 2002 in Rajasthan. It offers UG, PG and PhD programmes in E&amp;T disciplines only. HEI-II has three teaching-focused collaborations.</td>
<td>Focus Group: Director, Dean, and faculty member</td>
</tr>
<tr>
<td>HEI-III</td>
<td>HEI-III is a privately-owned non-autonomous HEI which was established in 2000 in Rajasthan. It offers MBA programmes alongside UG and PG programmes in E&amp;T disciplines. HEI-III has five teaching-focused collaborations.</td>
<td>Focus Group: Dean, (four) faculty members and current student</td>
</tr>
<tr>
<td>HEI-IV</td>
<td>HEI-IV is a privately-owned non-autonomous HEI which was established in 2011 in Rajasthan. It offers MBA programmes alongside UG, PG and PhD programmes in E&amp;T disciplines. HEI-IV has five teaching-focused collaborations.</td>
<td>Director</td>
</tr>
<tr>
<td>HEI-V</td>
<td>HEI-V is a privately-owned non-autonomous HEI which was established in 2006 in Delhi NCR region. It offers MBA programmes alongside UG and PG programmes in E&amp;T disciplines. HEI-V has a teaching-focused collaboration.</td>
<td>Director, Dean and (two) faculty members</td>
</tr>
<tr>
<td>HEI-VI</td>
<td>HEI-VI is a privately-owned autonomous HEI which was established in 1997 in Delhi NCR region. It offers UG, PG and PhD programmes in wide range of disciplines including basic science, mathematics, humanities alongside E&amp;T programmes. HEI-VI has three teaching-focused collaborations.</td>
<td>Dean and faculty member</td>
</tr>
<tr>
<td>HEI-VII</td>
<td>HEI-VII is a public autonomous HEI which was established in 2011 in Delhi NCR region. It offers UG and PG programmes in humanities and E&amp;T disciplines. HEI-VII has a teaching-focused collaboration with four firms.</td>
<td>Dean</td>
</tr>
<tr>
<td>HEI-VIII</td>
<td>HEI-VIII is a privately-owned autonomous HEI which was established in 2010 in Rajasthan. It offers UG, PG and PhD programmes in wide range of disciplines including basic science, mathematics, humanities alongside E&amp;T programmes. HEI-VIII has two teaching-focused collaborations.</td>
<td>Dean</td>
</tr>
<tr>
<td>HEI-IX</td>
<td>HEI-IX is a public HEI which was established in 1977 in North-East India. It offers MBA programmes alongside UG, PG and PhD programmes in E&amp;T disciplines. HEI-IX has two teaching-focused collaborations.</td>
<td>Faculty member and (three) former students</td>
</tr>
</tbody>
</table>

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### Table B3 Examples of infrastructures at Indian HEIs for organising industrial R&C

<table>
<thead>
<tr>
<th>HEI</th>
<th>Term used for the dedicated infrastructure for industrial consultancy &amp; consultancy</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Institute of Technology Bombay</td>
<td>Industrial Research and Consultancy Centre (IRCC)</td>
<td>“IRCC co-ordinates sponsored research and industrial consultancy projects at IIT Bombay. Through such projects, researchers at IIT Bombay solve problems arising in industry and conduct basic and applied research.”</td>
</tr>
<tr>
<td>National Institute of Engineering Mysuru</td>
<td>Centre for Research and Consultancy (CRC)</td>
<td>Major objectives of CRC are to provide technical assistance to industries and user organisations; promote research and develop appropriate technology; promote exchange programmes between industries and the institution; support short-term courses/seminars/workshops for effective knowledge dissemination; establish testing/consultancy centres in various fields of engineering.</td>
</tr>
<tr>
<td>Indian Institute of Technology Delhi</td>
<td>Industrial Research and Development</td>
<td>“The Industrial Research &amp; Development (IRD) Unit was specifically set up in the Institute to provide specialised administrative and managerial support for the operation of Sponsored Research Projects, Consultancy Jobs and other related R&amp;D activities. Over the years, the institute has set up many modern labs and is continuously supporting infrastructure through these projects.”</td>
</tr>
<tr>
<td>MIT-College of Engineering</td>
<td>Centre of Excellence for Machine Intelligence and High-Performance Computing</td>
<td>“This centre has been set-up to develop an internationally recognised research body in the following areas based on special interest groups: database, data mining, machine learning, image processing, information security computer networks, mobile/cloud computing, wireless sensor networks; to support institute-industry collaboration (e.g. consultancy and technology/knowledge transfer) with domestic and international companies; to form industrial advisory groups to bridge the gap between academics and industry.”</td>
</tr>
<tr>
<td>Vardhaman College of Engineering</td>
<td>Centre for Nanotechnology</td>
<td>“It has a well-equipped lab housing synthesis and electrical property studies equipment. The centre has research projects sponsored by Defence Research Development Organisation (DRDO) and Board of Research on Nuclear Sciences (BRNS) and BARC. The research projects have produced a number of high impact publications and attract significant industrial input.”</td>
</tr>
<tr>
<td>Indian Institute of Engineering Science and Technology Shibpur</td>
<td>Research and Consultancy Cell</td>
<td>“In order to enhance the level of intellectual productivity and efficacy, the University has established a “Research and Consultancy Cell (RACC)” of which the principal objective is to facilitate - on behalf of the university, coordination in administration, managerial, liaison, monitoring etc. of sponsored research and consultancy work within the ambit of the administrative framework of the University. This allows research workers to devote more time to research proper without bothering much on not-too-technical but no-less-important other aspects of the projects undertaken.”</td>
</tr>
<tr>
<td>HEI</td>
<td>Term used for the dedicated infrastructure for entrepreneurship</td>
<td>Text</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LNMIIT</td>
<td>Centre for Technology Business Incubation &amp; Entrepreneurial Leadership</td>
<td>“This centre aims a providing a platform for faculty, staff, students and alumni for innovation, incubation and entrepreneurial leadership; enabling technology-based solutions to problems that might be being faced by the campus, society, state and the nation; providing business assistance and mentoring, accelerate emerging companies' development by providing hands-on assistance during the vulnerable start-up years.”</td>
</tr>
<tr>
<td>Manav Rachna International University</td>
<td>Manav Rachna Research Innovation and Incubation Centre</td>
<td>“The centre is instrumental in coordinating entrepreneurial education so that they develop necessary background to take up viable and feasible start-up ventures. The Centre regularly organizes business plan competitions through which meritorious projects are identified and selected for direct support.”</td>
</tr>
<tr>
<td>IIIT Hyderabad</td>
<td>Centre for Innovation and Entrepreneurship (CIE)</td>
<td>“The CIE plays a role along the entire process from identifying technologies, packaging them and supporting the beneficiaries in customer development. Beneficiaries vary from large industry players to sole entrepreneurs, and engagement models include equity participation, royalty and upfront payments.”</td>
</tr>
<tr>
<td>College of Engineering Pune</td>
<td>Bhau's Entrepreneurship Cell</td>
<td>“Since its inception, this cell has been primarily responsible for stimulating, sustaining and supporting entrepreneurial endeavours within the campus, providing them with necessary assistance and resources. With dedicated and full-fledged support from Bhau Institute of Entrepreneurship (BIE), the cell firmly believes in harvesting innovative ideas and intends to nurture them. The club is also associated with National Entrepreneur Network, who helps us build an effective and a vibrant entrepreneurship ecosystem on campus.”</td>
</tr>
<tr>
<td>Thiagarajar College of Engineering</td>
<td>Maker Space</td>
<td>“Maker Space in TCE was established with the objectives to enable the students to innovate, design, experiment and build prototype of their ideas that have been conceived in engineering, science and other disciplines.”</td>
</tr>
<tr>
<td>Manipal Institute of Technology</td>
<td>MIT Innovation Centre</td>
<td>“The MIT Innovation Centre nurtures innovation, and encourages entrepreneurial talent among students, faculty and people of the region. It facilitates inter-disciplinary research and provides incubation facilities to start-ups and budding entrepreneurs. The objectives are to encourage students and faculty for innovation, idea generation and product development; provides seed fund to transform an idea into a product; arrange workshops for students and faculty in the field of entrepreneurship; help with the patenting process and generate 10 patentable ideas every year.”</td>
</tr>
</tbody>
</table>

**Identification of Mode-1 collaborations from websites**

Mode-1 teaching-focused I-A collaborations refer to the collaborations between HEIs and firms for the co-development of curriculum and delivery. To identify Mode-1 collaborations, we looked for explicit texts if the HEI has collaborated with any corporation to develop the curriculum/syllabus of one or multiple courses. Table B5
reports few examples on how Mode-1 collaborations were identified from the information available on HEIs’ websites.

Table B5 Examples of texts that helped identifying Mode-1 teaching-focused I-A collaboration

<table>
<thead>
<tr>
<th>Partner HEI</th>
<th>Partner firm</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galgotias University</td>
<td>JBM</td>
<td>“Galgotias University in Collaboration with JBM Cadmium offers an Industry Integrated B. Tech In Mechanical Engineering. This is a four-year mechanical engineering degree course.”</td>
</tr>
<tr>
<td>JIS College of Engineering</td>
<td>Infosys</td>
<td>“Infosys is willing to extend the relationship with our college by collaboratively designing a new industry elective in CS/IT/B.Sc (IT)/M.Sc.(IT)/MBA(IT/IS) curriculum Building Enterprise Applications - a practitioners perspective of software engineering.”</td>
</tr>
<tr>
<td>Coimbatore Institute of Technology (CIT)</td>
<td>IBM</td>
<td>“The collaboration serves the following purposes: .... Introduction of a post graduate programme, curriculum jointly developed by IBM and CIT.”</td>
</tr>
<tr>
<td>Dr. MGR Educational and Research Institute</td>
<td>REETER Group</td>
<td>“Signed memorandum of understanding with REETER Group USA., to impart Digital Industry 4.0 (4th Industrial Revolution) concept in our academic curriculum.”</td>
</tr>
<tr>
<td>Manav Rachna International University</td>
<td>Sukam</td>
<td>“B.Tech in Electrical Engineering programme with specialisation in Power Electronics is jointly offered with Su-Kam.”</td>
</tr>
</tbody>
</table>

Identification of Mode-2 collaborations from websites

Mode-2 teaching-focused I-A collaborations refer to the collaborations between HEIs and firms for delivering industrial training programmes to students outside curricula. To identify Mode-2 collaborations, we looked at explicit texts if the HEI has collaborated with any corporation to offer training to students outside the curriculum. We assume a student training programme to be delivered in Mode-2 collaboration if there is no indication that the training programme is a part of the curriculum. Table B6 reports few examples on how Mode-2 collaborations were identified from the information available on HEIs’ websites.
Table B6: Examples of texts that helped identifying Mode-2 teaching-focused I-A collaboration

<table>
<thead>
<tr>
<th>Partner HEI</th>
<th>Partner firm</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPR Institute Engineering Technology</td>
<td>EMC and Oracle</td>
<td>“To equip with the state-of-the-art technology, the students are offered with value added courses in Data Science and Big data analytics by Dell EMC, and Oracle.”</td>
</tr>
<tr>
<td>Manav Rachna International University</td>
<td>Reliance</td>
<td>“MoU signed between Manav Rachna and Reliance Jio Infocomm Limited, the Institutions of Manav Rachna can look forward to a digitised campus and short programs of varying durations that would enable students to be tech-savvy in a digitised world.”</td>
</tr>
<tr>
<td>Trident Academy of Technology</td>
<td>HP</td>
<td>“Trident has signed up an Operational Arrangement with RCPL, the sole HP partners in India for providing summer training programmes (to students).”</td>
</tr>
<tr>
<td>Gurgaon Institute of Technology &amp; Management</td>
<td>D-Link</td>
<td>“The establishment of D-Link academy in GITM, Gurgaon will benefit the students who want to enhance their knowledge in networking field. The following courses will be started at GITM: DCS-Switching Program and DCS-Wireless Program.”</td>
</tr>
<tr>
<td>CMR Institute of Technology</td>
<td>IBM</td>
<td>“IBM RAD Workshop” was conducted between 15th February to 18th February 2011 by Mr. Chinmay Saraswat. Around 68 Students from Department of MCA had been trained.”</td>
</tr>
</tbody>
</table>

Identification of Mode-3 collaborations from websites

Mode-3 teaching-focused I-A collaborations refer to the collaborations between firms and HEIs for offering dissertation projects to students. To identify Mode-3 collaborations, we looked at explicit texts if the HEI has collaborated with any corporation to offer projects to students. Table B7 documents few examples on how Mode-3 collaborations were identified from the information available on HEIs’ websites.
### Table B7 Examples of texts that helped identifying Mode-3 teaching-focused I-A collaboration

<table>
<thead>
<tr>
<th>Partner HEI</th>
<th>Partner firm</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alva’s Institute of Engineering &amp; Technology</td>
<td>Apple</td>
<td>“Currently VI Sem CSE, ECE, ISE and VIII Students are working App projects under the guidance of faculty members. At the end of the semester on successful competition of App projects, the students are honoured with Apple Developer Certificates.”</td>
</tr>
<tr>
<td>NMAM Institute of Technology</td>
<td>Intel</td>
<td>“Introduction of Audit course on Internet of Things (IoT) UG projects on Embedded systems and IoT Application (with Intel).”</td>
</tr>
<tr>
<td>PSG Institute of Technology and Applied Research</td>
<td>Nexmoo Solutions</td>
<td>“Students will be able to do projects under the guidance of Nexmoo personnel based on which placements of final year students would be done with the same company.”</td>
</tr>
<tr>
<td>Ballari Institute of Technology &amp; Management</td>
<td>Wipro</td>
<td>“Each project batch consists of students from CSE, ISE, ECE, and EEE. Each batch will develop collaborative project. In the first batch of MTLC seven projects are certified by Wipro out of total 10 projects.”</td>
</tr>
<tr>
<td>KIIT University</td>
<td>Siemens</td>
<td>“Established in the School of Mechanical Engineering, its objective is to impart project-based training of PLM Software tools for cutting-edge technology enabled solutions”</td>
</tr>
<tr>
<td>Maharishi Arvind Institute of Engineering &amp; Technology</td>
<td>Novell</td>
<td>“After Successful Training Novell will provide Live Projects to the Students.”</td>
</tr>
<tr>
<td>Trident Academy of Technology</td>
<td>Sankalp Semiconductor</td>
<td>“Trident has a MoU signed with Sankalp Semiconductor primarily to provide project assistance to students &amp; also provide lectures &amp; conduct seminars on the latest technologies.”</td>
</tr>
</tbody>
</table>
Table B8 Predictors of teaching-focused I-A collaborations (Model: Negative binomial regression)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Teaching-focused I-A collaboration</th>
<th>Type of teaching-focused I-A collaboration mode (entire sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(13)</td>
<td>(14)</td>
</tr>
<tr>
<td></td>
<td>Entire sample</td>
<td>ICT knowledge</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s level factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s size</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
</tr>
<tr>
<td>HEI’s quality</td>
<td>0.08 (0.13)***</td>
<td>0.04 (0.13)***</td>
</tr>
<tr>
<td>HEI’s involvement in academic research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offering of PhD programmes</td>
<td>0.09 (0.10)***</td>
<td>0.07 (0.10)***</td>
</tr>
<tr>
<td>Number of research publications</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
</tr>
<tr>
<td>HEI’s academic embeddedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter-HEI linkage</td>
<td>0.72 (0.08)***</td>
<td>0.74 (0.08)***</td>
</tr>
<tr>
<td>HEI’s industrial embeddedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s involvement in industrial R&amp;C</td>
<td>0.44 (0.10)***</td>
<td>0.48 (0.10)***</td>
</tr>
<tr>
<td>HEI’s involvement in entrepreneurship</td>
<td>0.42 (0.09)***</td>
<td>0.40 (0.09)***</td>
</tr>
<tr>
<td>Institutional factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s location</td>
<td>0.40 (0.08)***</td>
<td>0.38 (0.08)***</td>
</tr>
<tr>
<td>Availability of government support</td>
<td>0.25 (0.10)***</td>
<td>0.29 (0.10)***</td>
</tr>
<tr>
<td>HEI’s governance mechanism</td>
<td>-1.21 (0.15)***</td>
<td>-1.22 (0.15)***</td>
</tr>
<tr>
<td>HEI’s academic autonomy</td>
<td>0.26 (0.11)**</td>
<td>0.28 (0.11)***</td>
</tr>
<tr>
<td>Discipline</td>
<td>0.25 (0.07)***</td>
<td>0.26 (0.07)***</td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI’s age</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
</tr>
<tr>
<td>HEI’s gender</td>
<td>-0.67 (0.23)***</td>
<td>-0.58 (0.22)***</td>
</tr>
<tr>
<td>_cons</td>
<td>-1.13 (0.08)***</td>
<td>-1.20 (0.08)***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>2,224</td>
<td>2,224</td>
</tr>
<tr>
<td>LR chi2</td>
<td>567.06</td>
<td>562.21</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td>0.09</td>
<td>0.10</td>
</tr>
</tbody>
</table>

* if p<0.1, ** if p<0.05 and *** if p<0.01
Table B9 Robustness checks using split-model analysis for predictors of teaching-focused I-A collaborations (Model: Zero-inflated negative binomial regression)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of teaching-focused I-A collaboration</th>
<th>(19)</th>
<th>(20)</th>
<th>(21)</th>
<th>(22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large HEIs</td>
<td>Small HEIs</td>
<td>Old HEIs</td>
<td>New HEIs</td>
<td></td>
</tr>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HEI-level factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI's size</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
<td>0.00 (0.00)***</td>
<td></td>
</tr>
<tr>
<td>HEI's quality</td>
<td>-0.01 (0.13)</td>
<td>0.54 (0.26)**</td>
<td>0.12 (0.15)</td>
<td>0.18 (0.20)</td>
<td></td>
</tr>
<tr>
<td>HEI's involvement in academic research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offering of PhD programmes</td>
<td>0.19 (0.11)*</td>
<td>-0.20 (0.20)</td>
<td>0.08 (0.13)</td>
<td>0.09 (0.15)</td>
<td></td>
</tr>
<tr>
<td>Number of research publications</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td></td>
</tr>
<tr>
<td>HEI's academic embeddedness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter-HEI linkage</td>
<td>0.41 (0.09)**</td>
<td>1.02 (0.12)***</td>
<td>0.46 (0.14)***</td>
<td>0.73 (0.10)***</td>
<td></td>
</tr>
<tr>
<td>HEI's industrial embeddedness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI's involvement in industrial R&amp;C</td>
<td>0.24 (0.11)**</td>
<td>0.84 (0.17)***</td>
<td>0.51 (0.15)***</td>
<td>0.49 (0.13)***</td>
<td></td>
</tr>
<tr>
<td>HEI's involvement in entrepreneurship</td>
<td>0.42 (0.11)***</td>
<td>0.49 (0.15)***</td>
<td>0.28 (0.14)**</td>
<td>0.53 (0.12)***</td>
<td></td>
</tr>
<tr>
<td>Institutional factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI's location</td>
<td>0.27 (0.09)**</td>
<td>0.73 (0.13)***</td>
<td>0.55 (0.11)***</td>
<td>0.29 (0.11)***</td>
<td></td>
</tr>
<tr>
<td>Availability of government support</td>
<td>0.06 (0.11)</td>
<td>0.37 (0.18)**</td>
<td>0.17 (0.16)</td>
<td>0.24 (0.13)*</td>
<td></td>
</tr>
<tr>
<td>Discipline variety</td>
<td>0.18 (0.09)**</td>
<td>0.26 (0.10)**</td>
<td>0.29 (0.12)***</td>
<td>0.21 (0.09)**</td>
<td></td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI's age</td>
<td>0.00 (0.00)</td>
<td>0.01 (0.00)*</td>
<td>0.00 (0.00)*</td>
<td>0.06 (0.01)***</td>
<td></td>
</tr>
<tr>
<td>HEI's gender</td>
<td>-0.49 (0.34)</td>
<td>-0.75 (0.32)**</td>
<td>-1.11 (0.67)*</td>
<td>-0.57 (0.24)**</td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>-0.41 (0.12)**</td>
<td>-1.91 (0.22)***</td>
<td>-0.63 (0.14)***</td>
<td>-1.79 (0.15)***</td>
<td></td>
</tr>
<tr>
<td><strong>Inflate Institutional factors</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HEI's public ownership</td>
<td>14.84 (491.56)</td>
<td>16.69 (584.94)</td>
<td>15.36 (875.91)</td>
<td>17.27 (457.68)</td>
<td></td>
</tr>
<tr>
<td>HEI's academic autonomy</td>
<td>-0.56 (0.69)</td>
<td>-0.18 (0.78)</td>
<td>-1.29 (0.62)**</td>
<td>0.755 (0.88)</td>
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<tr>
<td>_cons</td>
<td>-15.18 (491.56)</td>
<td>-16.30 (584.94)</td>
<td>-16.51 (875.91)</td>
<td>-17.15 (457.68)</td>
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*p<0.1, **p<0.05 and ***p<0.01
CHAPTER 5 RESEARCH PAPER-3

Why do inventors move out from MNC subsidiaries in emerging countries? The role of institutional distance and experience

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ABSTRACT

Inventors’ outward mobility from Multinational Corporation’s (MNCs) subsidiaries is a concern to MNCs because it often leads to knowledge spillovers to competitors and could jeopardise MNCs’ global R&D investments and their competitive advantage. In order to explain inventors’ outward mobility in foreign countries, we rely on institutional theory and focus on the role of formal and informal institutional distance between the host and the MNC’s home country. We also claim that experience plays a moderating role, both at the micro level (i.e. at the individual inventor-level) and at the macro level (i.e. at the MNC-level). Our empirical analysis refers to foreign MNCs in the ICT sector in India, in the period 1996-2016, and adopts the emerging methodology of tracking 1,421 inventors’ mobility on their LinkedIn profiles. Our econometric findings confirm the role of institutional distance on inventors’ departure as well as the moderating role of experience. However, and interestingly, we find that the inventors’ experience moderates only the impact of informal distance, while the international experience of the MNC moderates the impact of formal institutional distance.
Keywords: inventor mobility, institutional distance, cultural distance, emerging economies, LinkedIn

5.1 Introduction

On March 7th, 2007, Apple’s CEO Steve Jobs wrote an email to his counterpart Eric Schmidt in Google ‘I would be very pleased if your recruiting department would stop doing this (referring to Google’s recruitment of an inventor from Apple)’ (CNET, 2015).

Considering inventors as the repositories of innovation-related knowledge, the outward mobility of host country inventors (therein inventors) from a host country subsidiary (therein subsidiary) may lead to outward knowledge spillovers, i.e. unwanted leakages of confidential subsidiary-level and/or company-level innovation knowledge to other foreign subsidiaries or local firms (Poole, 2013; Singh, 2007), which may jeopardise their subsidiary-level and global R&D investments. Therefore, explaining the factors behind inventors’ outward mobility is vital to manage and reduce this risk for MNCs. The human capital and innovation literature (e.g., Breschi and Lissoni, 2009; Hoisl, 2007) has suggested that individual inventor-level factors, such as education, prior experience, networks and productivity, play a role in explaining inventors’ outward mobility. However, while the human capital perspective explains fairly well why particular inventors are more likely to move out than others, it does not relate the individual decisions of leaving a subsidiary to the organisation to explain why some firms (e.g., the subsidiary of some MNCs) experience higher outward mobility of inventors compared to others in a specific host country, which is of interest to IB scholars. Anchoring this question to institutional theory (North, 1991), this paper aims to comprehend the influence of formal (regulatory) and informal institutional (cultural) distance between the host and MNC’s home country on the inventors’ outward mobility.
from their subsidiary, thus linking individual-level explanations from human capital
theory with firm-level institutional dynamics in IB context. We also claim that micro
(inventor-level) and macro (MNC-level) experience moderate the impact of institutional
distance on the outward mobility of inventors, offering insights to researchers and MNC
managers on whether the impact of institutional distance on inventors’ outward mobility
could be reduced by the appropriate level of experience.

We test our hypotheses on an original database that combines patent data and
LinkedIn profiles of 1,421 inventors in the Indian subsidiaries of 678 foreign MNCs in
the Information and Communication Technologies (ICT) sector. India is one of the main
destinations for R&D offshoring, particularly in the ICT industry, which hosts a large
number of R&D subsidiaries and headquarters (Kenney et al., 2013; Lewin et al., 2009),
suggesting that the knowledge produced in Indian subsidiaries is highly valuable for their
global R&D operations and needs to be protected. This makes the Indian context
particularly appropriate to study factors influencing inventors’ outward mobility.

We believe this paper makes several contributions. First, this paper contributes to
the offshoring of innovation activities literature by explaining institutional factors
affecting the outward mobility of inventors from MNC subsidiaries, thus bringing a fresh
perspective to this phenomenon. Second, the examination of moderation of inventor-
level and MNC-level experience on the impact of formal and informal institutional
distance on inventors’ outward mobility allows us to contribute to the conversation on
the application of cognitive learning at both individual-level and intra-MNC level to
mitigate the role of institutional distance in international business (Delioz and Henisz,
2003; Le and Kroll, 2017; Perkins, 2014). Third, by choosing India as the research setting,
this study addresses a widely mentioned yet relatively underexplored challenge for
offshoring R&D to emerging economies: talent retention. While a number of studies (e.g.,
Lamin and Ramos, 2016; Yang and Jiang, 2007) have documented skill-labour (including inventors) mobility rates in emerging economies to be considerably higher than in developed economies, none of them actually offers substantive empirical evidence on the factors explaining such mobility rates. Our paper addresses this empirical gap. Fourth, from a methodological perspective, we utilise a novel approach which uses LinkedIn as a data source to track inventors’ mobility as an alternative to relying solely on the use of patents (see Hoisl, 2007; Singh, 2007; Singh and Agrawal, 2011, among the others). Thus our contributions, in terms of using LinkedIn for tracing inter-firm mobility events and offering insight into the process leading to the identification of mobility events, will be of great value to scholars aiming to use LinkedIn profiles as a data source for management research.

5.2 Conceptual Background and Hypotheses Development

5.2.1 Inventors’ Outward Mobility in MNCs’ Foreign Subsidiaries

When employees leave a firm to move to a competing firm, the innovation and organisational knowledge that is embodied in these individuals will benefit the new employer. The influence of inventors’ mobility on knowledge spillovers from former employers to hiring firms has been documented in a number of studies (Breschi and Lissoni, 2009; Mariotti et al., 2010; Singh, 2007; Singh and Agrawal, 2011). Normally using patent citation data, these studies reported noticeable growths in the number of citations made by hiring firms’ patents to source firms’ patents after the transfer of inventors. The knowledge transferred from the source to the hiring firm may include source firm’ capabilities, knowledge about innovation pipelines, knowledge pertaining to process innovations, and client information, etc. (Kim, 1997; Somaya et al., 2008). In the context of a host country, MNCs may be concerned about knowledge leakages
through inventors moving to established local firms, starting their own ventures or joining subsidiaries of other MNCs located in the same host country.

Innovation often originates from the combination and recombination of different streams of knowledge (Kogut and Zander, 1992). This is especially the case in the context of local firms in host (emerging) countries which can benefit from borrowing or imitating knowledge from other firms and are often seen as free-riders (Lamin and Ramos, 2016). Indeed, searching for quick technology catch-up, local firms in emerging countries look for opportunities to take advantage of the knowledge and superior technology possessed by MNCs (Kumaraswamy et al., 2012). Kale and Little (2007) bring evidence from India, where the entire domestic pharmaceutical industry grew via ‘duplicative and creative imitation’ and ‘reverse engineering’ of foreign firms’ technologies and products. Likewise, Buckley et al. (2002) revealed a strong positive correlation between inward FDI to China and Chinese firms’ enhanced productivity, development of high-technology products and access to the global market. The hiring of inventors from foreign firms is a route that local firms predominantly take to access the advanced technologies brought in by MNCs and compete with them (Blomström and Kokko, 1998; Luo et al., 2011). Hence, spillovers of knowledge to local firms via inventors’ mobility might negatively influence MNCs’ business in the host country and deplete the technology advantage that MNCs hold over local firms.

MNCs are also vulnerable to lose out inventors to the subsidiary of other MNCs in the same host country. Specifically, technology leader MNCs are more concerned about knowledge leakages to other MNCs, rather than to local firms (Alcácer, 2006; Livanis and Lamin, 2016), as the latter do not possess normally the needed absorptive capacity to identify useful knowledge in the external environment (Cohen and Levinthal, 1990) and capabilities to utilise that knowledge (Salomon and Jin, 2010). From the point
of view of the hiring MNC, accessing new knowledge through recruiting inventors from fellow foreign firms in a host country fits well with a strategy to establish ‘technological gatekeepers’ (Spencer, 2003) to track technological growths in foreign countries and to absorb knowledge from the external environment, including other MNC subsidiaries and bring it back to the headquarter. While local firms may look only for knowledge about the local operations of the MNC subsidiary, if an inventor is hired by another MNC, the hiring MNC may benefit from the incoming inventor’s knowledge about the global operations of the source MNC as well. If information regarding the global operation of the source MNC is retrieved through the mobility of inventors, the information is not only useful for the hiring subsidiary itself but could also be immensely valuable for the headquarters or subsidiaries located elsewhere. At the same time, leakages of headquarter-related information to competitors may put source MNCs’ global R&D investments and strategies at risk.

Therefore, we claim that inventors’ mobility from subsidiaries in host countries (in particular, emerging economies) is a serious concern for MNCs. Below, we discuss why, among the factors that affect inventors’ mobility in MNCs’ foreign subsidiaries, institutional distance is likely to play a primary role.

5.2.2 (Formal and Informal) Institutional Distance and Inventors’ Outward Mobility from MNC Subsidiaries in Foreign Countries

Institutions have been defined as the “humanly devised constraints that structure political, economic and social interaction” (North, 1991, p.97). In IB studies, institutional distance can be defined as the degree of dissimilarity across countries in terms of socio, political and economic structures, clearly plays a very important role (Kogut and Singh, 1988; van Hoorn and Maseland, 2016). Institutions have been
classified as formal and informal. Formal institutions include explicit legal/regulatory (therein regulatory), political and economic rules of a particular country; informal institutions encompass more implicit normative and cognitive dimensions (North, 1991). When there is a high institutional distance between the home and host country, MNCs face ‘liability of foreignness’ (Zaheer, 1995) because of the unfamiliarity to the host country’s market dynamics, norms, business practices and sources of costs (Bell et al., 2012), which may result in failure to design and implement practices that synchronise with the host country’s institutional environment. Working in such an MNC may result in high ‘cognitive dissonance’ in inventors, because the MNC’s norms and practices, which are not designed in line with the host country’s institutional environment, may seem foreign and unfamiliar to them, creating an ambiance of stress and discomfort, leading them to quit the MNC. Hence, a high institutional distance may, in general, impede MNCs’ ability to prevent or limit inventors’ outward mobility.

As far as formal institutions (e.g., political, economic, legal, etc.), we focus on those dimensions that are most relevant to our study that is regulatory institutions because the strength of a regulatory system often influences the design and implementation of IP protection strategies (Keupp et al., 2009), which is important to inventions, and subsequently to inventors. MNCs from strong regulatory regimes are likely to implement formal IP protection strategies, such as contracts, because these contracts are highly enforceable in strong regulatory regimes. In order to restrict inventors’ outward mobility and the associated knowledge spillover, companies in strong regulatory regimes require scientists and researchers to sign non-compete, non-solicitation and non-disclosure

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29 Cognitive dissonance refers to the discomfort experienced by individuals when they are exposed to two contradicting beliefs. Every individual has ‘schemas’ i.e., understanding of how to go about things in daily life for instance, how to drive a car or a truck, which is developed based on the individual’s prior experience (Endicott et al., 2003). Cognitive dissonance arises when they experience new or contradictory events, practices, and experience that are foreign to the existing schemas.
agreements (Marx, 2011; Marx et al., 2015). Non-compete agreements (NCA) and non-solicitation agreements (NSA) put restrictions on inventors to join or form employers’ direct competitors, and vertical and horizontal collaborators respectively within a particular geographical location and/or industry for a definite period of time post-resignation (Marx et al., 2015); whereas, non-disclosure agreements (NDA) are used to prevent inventors from revealing confidential innovation knowledge about the source firms to external organisations (Hertzfeld et al., 2006; Keupp et al., 2009). In the case of a contract breach, companies tend to approach the judiciary system and pursue legal cases against the inventors. In countries with a strong regulatory system, such IP contracts are perceived to be highly legally enforceable\textsuperscript{30} as strong regulatory regimes offer high “legal recourse for victims of opportunistic conducts or for preference reversals that negate the original terms of the agreement” (Zhou and Poppo, 2010, p.865).

In contrast, weak regulatory regimes offer a number of challenges for enforcing IP contracts. First, in a weak regulatory regime, the judiciary system presents little remedy to opportunistic behaviour and fails to impose heavy sanctions towards the contract violator. Second, in countries with weak regulatory systems, due to the dearth of fully-fledged legal infrastructure, the judiciary system tends to be slow in resolving disputes. Interviews conducted with MNC executives by Lamin and Ramos (2016) quote “it takes 30 years to settle a case (in India)” (p.608) due to deficiency of separate courts for handling intellectual property violation cases (Swike et al., 2008). Cases stretching over a long period of time incur high litigation costs for companies involved, inducing firms towards informal mechanisms for dispute resolution, such as course settlements.

\textsuperscript{30} The high effectiveness of NCAs/NSAs in strong regulatory environment is evident, for instance, engineers in the USA, where there is a strong judicial system, who have signed such contracts do join unrelated technological fields, industry, and companies after resigning from companies to avoid possible lawsuits from their source companies (Marx, 2011).
outside courts (Zhou and Xu, 2012). Keupp et al. (2009) find that the development of relationships with the judiciary system is an effective measure to enforce contracts in China. Others suggest trust to be a substitute for contracts in countries with weak regulatory systems (Zhou and Poppo, 2010).

When an MNC from a home country with a strong regulatory regime sets up a subsidiary in a host country with a weak regulatory regime, the MNC will lack understanding of the problems associated with enforcing contracts in the host country and capabilities to pursue informal IP protection strategies to mitigate the outward mobility of inventors and the associated knowledge spillover. Likewise, MNCs from weak regulatory regimes establishing operations in a country with a strong regulatory regime will experience a dearth of understanding and capabilities to design adequate IP contracts in the host country in terms of the term specificity, contingency adaptability and compliance of contracts (Luo, 2005). Also, such MNCs may not possess the competences to pursue legal cases inside the courts and may be unaware of the legal costs involved in the process since they are used to settling cases bypassing the judicial systems in their home countries (Lamin and Ramos, 2016). Thus, due to regulatory distance, MNCs may struggle to modify the IP protection strategies inherited from their home country in line with the host country’s regulatory environment.

Now, the MNC’s inability to adopt IP protection strategies that suit the host country’s regulatory environment is likely to result in cognitive dissonance in inventors working at these MNCs. Inventors from a host country with weak regulatory regime when working for an MNC from a strong regulatory regime may experience cognitive dissonance because of the requirement to sign and follow formal IP protection practices. Inventors may perceive the requirement to sign IP contracts as control tools and it may induce a feeling of not being trusted by the firm, as often “control comes into play only
when adequate trust is not present” (Das and Teng, 1998, p.495). Further, such contracts may develop a sense of fear and panic in inventors as they may not fully comprehend the functioning of such contracts, for instance, the extent and type of knowledge not to be shared as per the NDA and type of organisations that they are not supposed to join as per the NCA and NSA. On the other hand, inventors from a strong regulatory regime when working for an MNC from a home country with weak regulatory regime may experience cognitive dissonance because of the non-availability of formal IP protection strategies to protect their knowledge. For instance, not being able to sign any NCA/NSA may lead to concerns in inventors regarding their job stability and value within the firm, whereas not being able to sign NDA may create anxieties regarding the potential safety of their knowledge, and the MNC’s ability and willingness to follow appropriate and ‘fair’ procedure, such as fighting litigation cases in courts, if the inventor’s knowledge is stolen (Zhou and Poppo, 2010).

To summarise, a high regulatory distance to host country can affect the MNCs’ ability to design and implement IP protection strategies that best suit the regulatory environment of the host country. As a result, inventors working for MNCs face cognitive dissonance as they are required to work with IP protection strategies that are foreign and unfamiliar to them. A high degree of cognitive dissonance in inventors may ultimately result in their outward mobility. Therefore, our first hypothesis concerns the positive association between regulatory distance and the inventors’ outward mobility (from a subsidiary).

31 Inventors from strong regulatory regimes may consider fighting court cases to protect IP as a ‘fair’ strategy (Zhou and Poppo, 2010); however, the views of inventors from weak regulatory regimes may differ.
**Hypothesis 1 (H1):** The greater the formal institutional (regulatory) distance between the home and host country of an MNC, the higher the inventors’ outward mobility of the MNC’s subsidiary.

As far as informal institutions are concerned, previous studies have extensively used national culture as a representation of a country’s normative and cognitive institutions (Jensen and Szulanski, 2004). Likewise, in this paper, we focus on cultural distance as the emissary of informal institutional distance. Different cultural dimensions, such as power distance, individualism, uncertainty avoidance, masculinity and long-term orientation, have been observed to have different influence on organisational strategies (as in Choi and Contractor, 2016; David et al., 1997) supporting Shenkar’s (2001) argument that each cultural construct should be studied independently. In particular, power distance, individualism and uncertainty avoidance have been demonstrated to be relevant to innovation processes (e.g., Shane, 1993; Taylor and Wilson, 2012) and, consequently, to the inventors.

Power distance is defined as “the degree to which members of a society expect and agree that power should be stratified and concentrated at higher levels of a society, an organisation, or an institution” (Jiang et al., 2015, p.336). In high power distance societies, companies retain the power to make decisions within their higher authorities. Instead of involving subordinates in the decision-making process, instructions are conveyed to the concerned stakeholders, in the case of R&D activities, inventors or sub-units, on what to invent and how (Shane, 1993).

Individualism refers to the prioritisation of individual interest and personal values over that of groups and interpersonal relationships (Efrat, 2014). In individualistic societies, companies organise individual-oriented practices that facilitate a sense of autonomy among individuals, allow them to realise their own potential, and create an
individual-oriented competitive mindset in the organisation (Morris et al., 1993; Taylor and Wilson, 2012), while in collectivist societies, companies tend to encourage employees to consider group needs over their own. Uncertainty avoidance is the “extent to which the members of a culture feel threatened by uncertain or unknown situations” (Hofstede, 1991, p.113).

Uncertainty-avoiding and uncertainty-accepting societies differ in tolerance toward uncertainty and risk. In uncertainty-avoiding societies, companies encourage inventors to work within the prescribed organisational routines and procedures so that risks associated with innovating a new product can be negated (Shane, 1995), whereas in uncertainty-accepting societies, companies allow bypassing of organisational routines and procedures to maximise innovation output even though doing so may increase the risk of failure.

When an MNC moves into culturally distant host country in terms of power distance, individualism and uncertainty avoidance, unfamiliarity to the cultural norms and beliefs of the host country could limit their ability to develop the cultural practices of their subsidiary in consonance with the host country’s cultural environment. For instance, when an MNC from an uncertainty accepting society moves into an uncertainty avoiding society, it may lack knowledge and capabilities to design and implement formal organisational routines and procedures for innovation processes. On the other hand, MNCs from an uncertainty avoiding society moving into an uncertainty accepting society could struggle to promote practices that allow the circumvention of organisational routines in innovation processes. MNCs’ failure to organise their organisational practices according to the cultural environment of the host country could lead to cognitive dissonance in the inventors they hire in the host country.
Inventors from a low power distance host country, when working for an MNC from a high power distance home country, may experience cognitive dissonance in terms of tensions arising from the bureaucracy embedded in the high power distance culture of the MNC that restricts the inventors from discussing their innovative ideas with their supervisors and pursuing such ideas. Similarly, inventors from high power distance host countries may feel uncomfortable in an MNC from a low power distance home country due to the expectation of participation and engagement in the decision making processes and contributing with own research ideas.

In terms of individualism, a sense of dissonance may arise among inventors from an individualistic host country while working for MNCs from a collectivist home country particularly due to the restriction that the collectivist culture of the MNCs may put on pursuing projects that the inventors individually are particularly interested about. Additional anguish may arise when the inventor’s performance is overshadowed by the group’s performance. Likewise, inventors from a collectivist host country, who are used to work in teams, may feel subdued when asked to work in isolation and be devoid of learning opportunities. Also, the introduction to an individual-based competitive environment to an inventor who has always worked in a group-based competitive environment could create a sense of panic and pressure.

Inventors from uncertainty-accepting host countries may feel demoralised when working for MNCs from uncertainty-avoiding home countries due to the perception that working within strict procedures could suppress their creativity. Likewise, inventors from an uncertainty-accepting host country, who are used to inventing following standard operating procedures, may struggle to invent in MNCs from uncertainty-accepting home countries, due to the lack of procedures for engaging in developing or utilising technologies or products in which they have limited experience of working.
To summarise, a high cultural distance hinders MNCs’ ability to design and implement organisational practices harmonious with the norms embedded in the cultural milieu of the host country. As a result, inventors working for MNCs will face cognitive dissonance as they are required to work in a culture that is foreign and unfamiliar to them. The discomfort, anxiety, and tension resulting from the cognitive dissonance may sway their inventors’ decision to consider alternative job options. Therefore, our second hypothesis concerns the positive association between cultural distance and the inventors’ outward mobility (from a subsidiary).

**Hypothesis 2 (H2):** The greater the cultural distance in terms of power distance (H2a), individualism (H2b) and uncertainty avoidance (H2c) between the home and the host country of an MNC, the higher the outward mobility of inventors from the MNC’s subsidiary.

### 5.2.3 The Moderating Effect of MNCs’ International Experience

Research based on organisational learning suggests that MNCs are able to learn from the diverse range of experience they gather from their overseas investments (Lord and Ranft, 2000; Zhao and Luo, 2005), enhancing their familiarity with distant regulatory and cultural milieu. Particularly, the experience developed in host countries with similar institutional settings can help an MNC understand and anticipate the challenges that they may face in a new host country and enhance their immunity towards such challenges (Delioz and Henisz, 2003; Perkins, 2014). For instance, experience in a weak regulatory environment could help MNCs from a strong regulatory regime to understand the difficulties in enforcing contracts and develop capabilities in pursuing informal IP protection strategies. On the other hand, MNCs from weak regulatory regimes having experience in countries with strong regulatory systems will be able to develop capabilities
in designing and enforcing IP contracts in a host country with stronger regulatory systems. Similarly, prior experience of operating in countries with similar national culture to the host country could help the company managers to strengthen their cognitions with the cultural norms of the host country, the cultural preference and sensitivity of the inventors, and to anticipate inventors’ behaviour in varied circumstances (Cho and Padmanabhan, 2005). Thus through sourcing the knowledge and capabilities of subsidiaries located in countries with similar institutional environment to the target host country, MNCs’ managers will be able to convert their dissonant cognitions regarding the cultural and regulatory norms and practices in the host country to consonant ones. This will lead MNCs to design strategies and organisational practices that are harmonised with the regulatory and cultural environment of the host country and allow MNCs to prevent inventor-level cognitive dissonance from occurring. As a result, the outward mobility of inventors from subsidiaries may decrease. Therefore, our third hypothesis concerns the moderation effect of MNC’s international experience on the positive association between regulatory and cultural distance and the inventors’ outward mobility (from its subsidiary).

**Hypothesis 3a (H3a):** The positive relationship between regulatory distance between the home and host country and inventors’ outward mobility from MNCs’ subsidiaries will be weaker for MNCs with prior experience in similar regulatory environment to the host country.

**Hypothesis 3b (H3b):** The positive relationship between cultural distance (in terms of power distance, individualism and uncertainty avoidance) between the home and host country and inventors’ outward mobility from the MNCs’ subsidiaries will be weaker for MNCs with prior experience in similar cultural environment to the host country.
5.2.4 The Moderating Effect of Inventors’ International Experience

The degree of cognitive dissonance is a factor combining the magnitude of dissonant cognitions and the importance of dissonant cognitions (Wicklund and Brehm, 2013). Therefore, the cognitive dissonance can be broadly mitigated in two ways: first, by reducing the magnitude of dissonant cognitions so that the cognition becomes fully consonant, and second, by reducing the importance of dissonant cognitions. Experience helps individuals to acquire cognitive (or mental) schemas in diverse areas, catalysing the conversion of dissonant cognitions to consonant ones. In particular, international experience could help inventors to acquire schemas in foreign regulatory practices and culture, which will become activated as a consonant cognition in the memory of the inventor when exposed to such or similar environment again. The practices adopted by institutionally distant MNC will look no longer unfamiliar to the inventors who, therefore, will be less likely to experience a regulatory and ‘cultural shock’ (Oberg, 1960). In addition to that, international experience may require an inventor to work in multicultural teams, assisting the inventor to develop an understanding of how people and organisations from a different culture and regulatory regimes work and the capability to foresee the differences the inventor might face when required to work at an institutionally distant MNC. Such a prior understanding may not completely eliminate the dissonant cognitions; however, it may reduce the magnitude of the dissonant cognitions resulting in weaker cognitive dissonance. Lastly, through experience of working in multicultural teams, inventors may also develop positive perceptions about working in institutionally different work environment, such as positive impact of diversity on idea creation (Østergaard et al., 2011), which will reduce the importance of dissonant cognitions arising from institutional distance, resulting in weaker cognitive dissonance. Thus, inventors with international experience are less likely to experience strong cognitive
dissonance due to cultural and regulatory distance. Therefore, our fourth hypothesis states as follows:

**Hypothesis 4a (H4a).** The positive relationship between regulatory distance between the home and host country and inventors’ outward mobility from MNCs’ subsidiaries will be weaker for inventors with prior international experience.

**Hypothesis 4b (H4b).** The positive relationship between cultural distance (in terms of power distance, individualism and uncertainty avoidance) between the home and host country and inventors’ outward mobility from the MNCs’ subsidiaries will be weaker for inventors with prior international experience.

Figure 5.1 visualises the hypotheses.

![Figure 5.1 Hypotheses Model](image-url)
5.3 Methodology

5.3.1 Data and Sample

The host country in this study is India. We define host country (Indian) inventors as the inventors, who have been granted at least one USPTO patent while working for foreign MNCs’ subsidiaries in India. The selection of USPTO patents to identify inventors is driven by the fact that most inventions with potential global applications are usually patented in the USA first (Alnuaimi et al., 2012). We used the following criteria for screening USPTO patents that were granted to Indian inventors in the year 2016: ICN (inventor country)/IN (India) AND ISD (issue date)/1/1/2016-31/12/2016. We then narrowed down our focus to the patents that were granted to the Indian subsidiaries of ICT MNCs and these patents were manually checked to develop a list of Indian inventors. We then checked the LinkedIn profiles of each inventor manually to track their mobility events throughout their professional career.

Figure 5.2 reports the flowchart followed to screen the inventors and their outward mobility events from MNC subsidiaries in India. While retrieving information from LinkedIn, we used the following criteria: the inventor has a clear and complete LinkedIn profile AND the inventor is an Indian national AND the inventor is mobile32. We recorded 426 inventors as immobile33. Additionally, we consider only those mobility events that took place within India AND occurred from MNC subsidiaries to subsidiaries of other MNCs, local firms or start-ups34 AND the mobility event occurred not due to a

32 Inventors who have changed at least one job until the end of the year 2016.
33 Inventors who have not changed job until the end of the year 2016.
34 Inventors may also move to public research institutes and universities; however, such organisations are usually perceived as non-competitors to private firms (Livanis and Lamin, 2016) and subsequently, knowledge leakage linked with the mobility of inventors to such organisations may not concern the MNCs. Hence, the outward mobility of inventors to research institutes and universities are not examined in this paper.
merger or acquisition (M&A) activity between the source and the hiring firm\textsuperscript{35} AND the mobility event occurred not as a result of an end to a temporary/contractual position\textsuperscript{36}. In total, we identified 3,022 mobility events (observations) and 426 non-mobility events during the period 1996-2016 from 1,847 inventors working for 678 foreign MNCs’ Indian subsidiaries. Details about the step-wise data collection process from LinkedIn are presented in the Appendix-C.

\textsuperscript{35} In case the hiring Firm X acquires or merges with Firm Y and an inventor’s employer name changes from Firm X (or Firm Y) to Firm Y (or Firm X) during the same time period, we do not consider it as a mobility event.

\textsuperscript{36} Mobility events involving only permanent and full-time positions are considered. Temporary/part-time positions include internships, trainees and any position where it is clearly mentioned that the inventor was on a temporary and/or part-time contract. This allowed us to eliminate ‘forced’ mobility events.
Check USPTO granted patents in 2016 to identify Indian inventors

Inventors selected; now screen their LinkedIn profiles

YES

Inventor has a complete LinkedIn profile

YES

Inventor is an Indian national

YES

Inventor is mobile

YES

Inventors' LinkedIn profiles selected; now select mobility events (ME)

NO

Eliminate the LinkedIn profile from sample

NO

ME is not a result of M&A

YES

ME is from a MNC in India to other firms in India

NO

ME is not a result of end of a temporary position

YES

Eliminate the ME from sample

Non-mobility events (NME)

NO

3,022 ME and 426 NME selected

Figure 5.2 Flowchart diagram of data collection process from patents and LinkedIn
The majority of prior studies on inventor mobility (e.g., Hoisl, 2007; Singh, 2007; Singh and Agrawal, 2011 etc.) have used patenting activities of inventors to track their mobility. The inventor mobility identification method used in these studies recognises a mobility event if an inventor files patents under two different organisations in two separate years. However, this method has several flaws. First, this method cannot accurately distinguish between mobility and collaboration. Second, this method cannot identify mobility events, where an inventor fails to obtain a patent. Third, patents cannot indicate the exact month and year in which the inventor changes jobs. These limitations could be overcome using LinkedIn data. Moreover, LinkedIn facilitates additional information such as the permanent and temporary nature of the employment, allowing to control for voluntary and forced mobility events. Ge et al. (2016) find the use of LinkedIn as a more reliable source for tracking movement of employees than patents based on triangulated information received from patents, LinkedIn and employee survey. Recent studies (e.g., Breschi et al., 2018) used information from LinkedIn to track mobility of inventors across national borders, which has further encouraged us to use LinkedIn as a data source to track inter-firm mobility of inventors.

5.3.2 Dependent Variable
The degree of outward mobility of inventors is contingent upon how frequently an inventor moves out. Therefore, the time taken by inventors to move out from MNC subsidiaries is considered as the dependent variable and is measured as number of months an inventor stays in MNC subsidiary before moving out to other MNC subsidiaries, local firms or start-ups. Figure 5.3 using a Kaplan-Meyer failure curve reports that about 50% of outward mobility events occur within just 30 months.
Figure 5.3 Kaplan-Meyer failure curve for mobility events of inventors from MNC subsidiaries in India

Table 5.1 reports the distribution of the mobility events and time taken by inventors to move out from MNC subsidiaries from 40 different home countries considered in the sample.
<table>
<thead>
<tr>
<th>Home Country</th>
<th>No. of MNCs</th>
<th>No. of Obs.</th>
<th>Mean time to move out from subsidiary</th>
<th>Min time to move out from subsidiary</th>
<th>Max time to move out from subsidiary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>7</td>
<td>7</td>
<td>16.85</td>
<td>6</td>
<td>35</td>
</tr>
<tr>
<td>Austria</td>
<td>2</td>
<td>2</td>
<td>31</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Barbados</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Belgium</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Bermuda</td>
<td>4</td>
<td>21</td>
<td>41.43</td>
<td>10</td>
<td>84</td>
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<tr>
<td>Brazil</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>1</td>
<td>1</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Canada</td>
<td>14</td>
<td>29</td>
<td>35.38</td>
<td>4</td>
<td>132</td>
</tr>
<tr>
<td>China</td>
<td>2</td>
<td>14</td>
<td>23</td>
<td>3</td>
<td>66</td>
</tr>
<tr>
<td>Croatia</td>
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<td>76</td>
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<td>76</td>
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<tr>
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<td>1</td>
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<td>15</td>
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<tr>
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<td>49.71</td>
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<td>132</td>
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<td>82</td>
<td>44.31</td>
<td>6</td>
<td>168</td>
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<td>13</td>
<td>74</td>
<td>36.82</td>
<td>4</td>
<td>192</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>2</td>
<td>4</td>
<td>26</td>
<td>9</td>
<td>54</td>
</tr>
<tr>
<td>Ireland</td>
<td>6</td>
<td>18</td>
<td>29</td>
<td>4</td>
<td>132</td>
</tr>
<tr>
<td>Israel</td>
<td>5</td>
<td>6</td>
<td>18.33</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Japan</td>
<td>21</td>
<td>39</td>
<td>34.50</td>
<td>8</td>
<td>112</td>
</tr>
<tr>
<td>Kenya</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1</td>
<td>1</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1</td>
<td>1</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Netherlands</td>
<td>7</td>
<td>53</td>
<td>41.21</td>
<td>6</td>
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<tr>
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<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Norway</td>
<td>3</td>
<td>3</td>
<td>18.33</td>
<td>15</td>
<td>24</td>
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<tr>
<td>Oman</td>
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<td>1</td>
<td>17</td>
<td>17</td>
<td>17</td>
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<td>Panama</td>
<td>1</td>
<td>2</td>
<td>19.5</td>
<td>19</td>
<td>20</td>
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<tr>
<td>Philippines</td>
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<td>1</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Poland</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Russia</td>
<td>2</td>
<td>2</td>
<td>16</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Singapore</td>
<td>8</td>
<td>15</td>
<td>19.93</td>
<td>7</td>
<td>72</td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>South Korea</td>
<td>3</td>
<td>98</td>
<td>43.76</td>
<td>2</td>
<td>156</td>
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<tr>
<td>Spain</td>
<td>3</td>
<td>5</td>
<td>15.8</td>
<td>7</td>
<td>23</td>
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<td>61.98</td>
<td>5</td>
<td>204</td>
</tr>
<tr>
<td>Taiwan</td>
<td>5</td>
<td>8</td>
<td>24.25</td>
<td>7</td>
<td>56</td>
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<tr>
<td>Thailand</td>
<td>1</td>
<td>1</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>UAE</td>
<td>5</td>
<td>5</td>
<td>20.2</td>
<td>4</td>
<td>36</td>
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<tr>
<td>UK</td>
<td>43</td>
<td>66</td>
<td>27.76</td>
<td>4</td>
<td>125</td>
</tr>
<tr>
<td>USA</td>
<td>476</td>
<td>2,275</td>
<td>43.31</td>
<td>3</td>
<td>228</td>
</tr>
</tbody>
</table>
5.3.3 Explanatory Variables

**Formal Institutional Distance (Regulatory Distance)**

As a proxy for regulatory distance, we use the difference in rule of law score between MNCs’ home country and India. The rule of law indicator measures the effectiveness of a national judicial system, police and intellectual property rights and has widely been used for measuring the regulatory distance between countries (e.g., Choi and Contractor, 2016; van Hoorn and Maseland, 2016). The rule of law scores are taken from the *Worldwide Governance Indicators*. For measuring regulatory distance, we use the following equation which is similar to the one proposed by Kogut and Singh (1988):

\[
RD_{HOME-INDIA} = \frac{(RL_{HOME} - RL_{INDIA})^2}{V_t}
\]

Here, \(RD_{HOME-INDIA}\) refers to regulatory distance between the home country and India in the year \(t\). \(RL_{HOME}\) and \(RL_{INDIA}\) denote the rule of law scores for the home country and India respectively and \(V_t\) refers to the variance in rule of law scores of all the nations in the year \(t\).

**Informal Institutional Distance (Cultural Distance)**

To compute the cultural distance variable between MNCs’ home country and India, we use Hofstede’s scores and the following equation:

\[
CD_{HOME-INDIA_x} = \frac{(C_{HOME_x} - C_{INDIA_x})^2}{V_x}
\]

Here, \(CD_{HOME-INDIA_x}\) refers to cultural distance between the home country and India for the \(x^{th}\) cultural dimension (power distance-PD, individualism-ID and uncertainty avoidance-UA). \(C_{HOME_x}\) and \(C_{INDIA_x}\) denote the scores of the home country
and India respectively for the \( x^{th} \) cultural dimension\(^37\) and \( V_x \) represents the variance among the scores of all the nations for the \( x^{th} \) cultural dimension.

### 5.3.4 Moderating Factors

We consider MNCs’ prior experience in a similar institutional environment to the host country as a moderator of the relationship between MNCs’ institutional distance and inventors’ outward mobility from the subsidiary. We assume a country’s (i) regulatory and cultural environment to be similar to India, if the regulatory distance \( RD_{it-INDIA_t} \) and cultural distance \( CD_{ix-INDIAx} \) between \( i \) and India is less than or equal to the mean of India’s distances with all other nations \( n \). The following equations are constructed:

\[
RD_{it-INDIA_t} \leq \frac{\sum_{i=1}^{n}(RD_{it-INDIA_t})}{n}
\]
\[
CD_{ix-INDIAx} \leq \frac{\sum_{i=1}^{n}(ED_{ix-INDIAx})}{n}
\]

The experience of an MNC in similar institutional environment to India until a given year, in which the inventor joins the subsidiary, is computed by counting the maximum number of years the MNC’s subsidiaries are active in any country that has similar institutional environment to India. The orbis database is used to gather information on the establishment years of subsidiaries.

The second moderator is prior international experience of inventors. We record international experience if the inventor has previously studied/worked in a foreign country or has worked for a foreign MNC subsidiary in India. The location of employment/education information available on LinkedIn profiles is used to recognise the inventors’ experience abroad.

\(^37\) 11 observations were dropped due to missing information.
5.3.5 Control Variables

We control for several firm-level and inventor-level institutional factors that may influence inventors’ outward mobility from subsidiaries. Among the institutional factors, ‘industry innovation intensity’ is controlled for because in an innovation intense industry the competition for hiring inventors could be fierce, leading to an overall growth in inventors’ outward mobility. The innovation intensity of the Indian ICT industry in a given year is calculated as the ratio of the number of USPTO patent applications made by the Indian ICT industry to the total number of USPTO patent applications made across all industries.

We additionally control for ‘MNCs’ economic distance’ with the host country. Economic distance usually refers to the difference in the economic growth of the home and host country (Berry et al., 2010). In line with the institutional distance literature, foreign firms, particularly in a host country that is economically distant from the home country, may struggle to understand and develop compensation strategies to satisfy the wage expectations of inventors, including salaries, increments and welfare benefits, which could ultimately result in the departure of the inventors from MNC subsidiary. Following prior studies (e.g., Tsang and Yip, 2007), we consider the difference in GDP per capita between MNCs’ home country and India as the proxy for economic distance. The economic distance variable is then developed using the following equation:

\[ ED_{HOME-INDIA_t} = \frac{(GDP_{HOME_t}-GDP_{INDIA_t})^2}{V_t} \]

Here, \( ED_{HOME-INDIA_t} \) refers to economic distance between the home country and India in the year \( t \). \( GDP_{HOME_t} \) and \( GDP_{INDIA_t} \) denote the GDP per capita scores for the home country and India respectively and \( V_t \) refers to variance among the GDP per capita scores of all the nations in the year \( t \).
Among firm-level factors, we control for ‘MNC knowledge stock’ and ‘subsidiary knowledge stock’; measured by their USPTO patents, because firms with large knowledge stock may be able to offer diverse learning opportunities to the inventors and thus may be less susceptible to inventors’ outward mobility. We also control for ‘subsidiary age’ because older subsidiaries are less likely to be affected by the institutional distance due to their experience and embeddedness in the host country (Cho and Padmanabhan, 2005).

Concerning inventor-level controls, we included ‘inventor education qualification’, proxied by three dummy variables for Bachelor, Masters and PhD (or higher) qualification, as inventors possessing higher education qualifications are more likely to move than those without (Hoisl, 2007). Likewise, ‘Inventor gender’ is controlled as prior studies (Keith and McWilliams, 1999) show that women employees are less mobile than their male counterparts. ‘Inventor industry experience’ is controlled and measured by aggregating the total months of experience before the inventor joins the focal firm. Additionally, we control for the ‘inventor knowledge stock’ by aggregating the number of USPTO patents granted to the inventor because inventors with greater knowledge stock could be attractive targets for competing knowledge-seeking firms.

Finally, we exclude the outward mobility events to start-ups\textsuperscript{38} from the sample as inventors may also be driven by individual factors e.g., independence, desire to contribute to the society and egoistic passion when they start own ventures (Shane et al., 2003) which could overshadow the roles that informal and formal institutional distance play on their outward mobility from subsidiary.

Table 5.2 reports the list and operationalisation of all variables.

\textsuperscript{38} 32 observations were dropped.
<table>
<thead>
<tr>
<th>Variable name</th>
<th>Definition and measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
</tr>
<tr>
<td>Time to move out from subsidiary</td>
<td>Number of months spent by an inventor at a subsidiary before he/she moves out to join a local firm or start-up or subsidiary of another MNC.</td>
</tr>
<tr>
<td><strong>Explanatory variables</strong></td>
<td></td>
</tr>
<tr>
<td>Regulatory distance</td>
<td>Regulatory differences between the MNC’s home country $k$ and India, measured using rule of law scores from the Worldwide Governance Indicators database.</td>
</tr>
<tr>
<td>Power distance</td>
<td>Cultural differences with respect to power distance between the MNC’s home country $k$ and India, measured using Hofstede’s scores.</td>
</tr>
<tr>
<td>Individualism distance</td>
<td>Cultural differences with respect to individualism between the MNC’s home country $k$ and India, measured using Hofstede’s scores.</td>
</tr>
<tr>
<td>Uncertainty avoidance distance</td>
<td>Cultural differences with respect to uncertainty avoidance between the MNC’s home country $k$ and India, measured using Hofstede’s scores.</td>
</tr>
<tr>
<td><strong>Moderators</strong></td>
<td></td>
</tr>
<tr>
<td>MNC experience in similar institutional environment to the host country (India)</td>
<td>Experience of an MNC in similar institutional environments to India until a given year, in which the inventor joins the subsidiary, is computed by counting the maximum number of years the MNC’s subsidiaries have been active in any country that has a similar institutional environment to India.</td>
</tr>
<tr>
<td>Inventor’s international experience</td>
<td>We identify international experience if the inventor has previously studied/worked in a foreign country or have worked for a foreign MNC subsidiary in India. The location of employment and education information available on LinkedIn profiles is used to recognise the inventors’ experience abroad.</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
</tr>
<tr>
<td>Industry innovation intensity</td>
<td>Ratio of the number of USPTO patent applications made by the Indian ICT industry to the total number of USPTO patent applications by Indian organisations across all industries in the year in which the inventor joins the subsidiary.</td>
</tr>
<tr>
<td>Economic distance</td>
<td>Economic differences between the home country and India, measured using GDP per capita scores from the World Bank database.</td>
</tr>
<tr>
<td>MNC knowledge stock</td>
<td>Total number of USPTO patents granted to the MNC until the year in which the inventor joins the subsidiary. Four dummy variables are developed: ‘0’ for ‘no patents’, ‘1’ for ‘1-100 patents’, ‘2’ for ‘100-500 patents’, ‘3’ for ‘500-1,000 patents’ and ‘4’ for ‘&gt;1,000 patents’.</td>
</tr>
<tr>
<td>Subsidiary knowledge stock</td>
<td>Total number of USPTO patents granted to the subsidiary until the year in which the inventor joins the subsidiary. Four dummy variables are developed: ‘0’ for ‘no patents’, ‘1’ for ‘1-100 patents’, ‘2’ for ‘100-500 patents’, ‘3’ for ‘500-1,000 patents’ and ‘4’ for ‘&gt;1,000 patents’.</td>
</tr>
<tr>
<td>Subsidiary age</td>
<td>Age of the MNC subsidiary until the year in which the inventor joins it, measured in years.</td>
</tr>
<tr>
<td>Inventor’s gender</td>
<td>Dummy variable. ‘0’ if female and ‘1’ if male.</td>
</tr>
<tr>
<td>Inventor’s education qualification</td>
<td>Highest education degree held by the inventor until the year in which he/she joins subsidiary, measured using three dummy variables- ‘1’ for ‘undergraduate’ and below, ‘2’ for ‘master’ and ‘3’ for ‘PhD and above’.</td>
</tr>
<tr>
<td>Inventor’s age</td>
<td>Age of the inventor until the year in which he/she joins the subsidiary.</td>
</tr>
<tr>
<td>Inventor’s industry experience</td>
<td>Number of months of industrial experience of the inventor until the year in which he/she joins the subsidiary.</td>
</tr>
<tr>
<td>Inventor’s knowledge stock</td>
<td>Number of USPTO patents granted to the inventor until the year in which he/she joins the subsidiary.</td>
</tr>
</tbody>
</table>
5.3.6 Model and Estimate

We used survival analysis, in particular, Cox Proportional Hazard Model (CPHM) model for estimating the model as it fits the data and the objective of this study, it helps identifying the explanatory factors that determine how fast an event is likely to occur. In our study, the event is the outward mobility of inventors from MNC subsidiaries. We code all the mobility events as ‘1’ and the non-mobility events (if an inventor does not change job until the end of the year 2016) as ‘0’. In total, 3,022 mobility events and 426 non-mobility events were recorded. A simplified CPHM model can be expressed as:

\[ H(t) = H_0(t) \times \exp\{x_\beta\} \]

Where \( H_0(t) \) is the baseline hazard function representing the risk of outward mobility of inventors from subsidiaries at time \( t \) when \( x_i = 0 \). \( \exp\{x_\beta\} \) describes a relative risk, which can grow or shrink depending upon the change in \( x_i \), i.e., the independent variables, which include regulatory distance, PD distance, ID distance and UA distance, and the control variables. The full model is given below-

\[ H(t) = H_0(t) \times \exp\{\beta_1(\text{Regulatory distance}) + \beta_2(\text{PD distance}) + \beta_3(\text{ID distance}) + \beta_4(\text{UA distance}) + \beta_5(\text{inventor age}) + \beta_6(\text{inventor work experience}) + \beta_7(\text{inventor gender}) + \beta_8(\text{inventor education qualification}) + \beta_9(\text{inventor knowledge stock}) + \beta_{10}(\text{MNC knowledge stock}) + \beta_{11}(\text{subsidiary knowledge stock}) + \beta_{12}(\text{subsidiary age}) + \beta_{13}(\text{economic distance}) + \beta_{14}(\text{industry innovation intensity})\} \]

5.4 Results

5.4.1 Descriptive Statistics

Table 5.3 reports the descriptive statistics and correlations among the variables, along with means and standard deviations. The correlation matrix reports collinearity between inventor age and inventor industry experience, which is not surprising; while no strong
correlation is observed between other variables. To check for any multicollinearity problem that could affect our regression results, we performed variance-inflation-factor (VIF) test for the predictor variables. The maximum observed VIF is 5.10, which is well below the limit for multicollinearity\(^{39}\). Therefore, based on VIF test, multicollinearity does not seem to be a problem in our analysis.

Table 5.3 Descriptive statistics and correlation among variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>S.dev</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inventor gender</td>
<td>0.96</td>
<td>0.19</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Inventor age</td>
<td>27.38</td>
<td>5.05</td>
<td>0.04</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3. Inventor edu. qualification</td>
<td>1.43</td>
<td>0.58</td>
<td>-0.02</td>
<td>0.29</td>
<td>1</td>
<td></td>
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<td></td>
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<td></td>
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<td>4. Inventor industry experience</td>
<td>46.66</td>
<td>52.95</td>
<td>0.05</td>
<td>0.81</td>
<td>0.01</td>
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<td></td>
<td></td>
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<tr>
<td>5. Inventor know. stock</td>
<td>1.25</td>
<td>3.31</td>
<td>0</td>
<td>0.11</td>
<td>0.13</td>
<td>0.06</td>
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<td></td>
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<tr>
<td>6. MNC know. stock</td>
<td>2.38</td>
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<td>-0.03</td>
<td>0.03</td>
<td>0.05</td>
<td>0</td>
<td>0.14</td>
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<tr>
<td>7. Subsidiary know. stock</td>
<td>0.58</td>
<td>0.71</td>
<td>-0.04</td>
<td>0.1</td>
<td>0.07</td>
<td>0.07</td>
<td>0.12</td>
<td>0.65</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8. Subsidiary age</td>
<td>8.14</td>
<td>9.6</td>
<td>-0.03</td>
<td>0.03</td>
<td>0</td>
<td>0.02</td>
<td>0.05</td>
<td>0.52</td>
<td>0.43</td>
<td>1</td>
</tr>
<tr>
<td>9. Industry innovation intensity</td>
<td>5.74</td>
<td>2.36</td>
<td>0</td>
<td>-0.14</td>
<td>0.01</td>
<td>-0.16</td>
<td>0.01</td>
<td>-0.13</td>
<td>-0.11</td>
<td>-0.12</td>
</tr>
<tr>
<td>10. Economic distance</td>
<td>2.13</td>
<td>0.65</td>
<td>-0.03</td>
<td>0.28</td>
<td>-0.02</td>
<td>0.3</td>
<td>0.04</td>
<td>0.14</td>
<td>0.31</td>
<td>0.26</td>
</tr>
<tr>
<td>11. Regulatory distance</td>
<td>3.05</td>
<td>0.98</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.01</td>
<td>-0.05</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>12. Power distance</td>
<td>2.79</td>
<td>0.97</td>
<td>0.01</td>
<td>0.05</td>
<td>0.02</td>
<td>0.05</td>
<td>0.03</td>
<td>-0.12</td>
<td>0.1</td>
<td>-0.17</td>
</tr>
<tr>
<td>13. Individualism distance</td>
<td>0.48</td>
<td>1.14</td>
<td>-0.01</td>
<td>-0.03</td>
<td>0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.14</td>
<td>-0.1</td>
<td>0.03</td>
</tr>
<tr>
<td>14. Uncertainty avoidance distance</td>
<td>-0.01</td>
<td>-0.37</td>
<td>-0.36</td>
<td>-0.64</td>
<td>-0.68</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Time to move out from an MNC subsidiary</td>
<td>42.23</td>
<td>33.93</td>
<td>-0.03</td>
<td>-0.06</td>
<td>0.06</td>
<td>-0.09</td>
<td>0.4</td>
<td>0.2</td>
<td>0.09</td>
<td>0.05</td>
</tr>
</tbody>
</table>

\(^{39}\) VIF value of 10 is usually considered as the limit for multicollinearity (Hair et al., 1992)
We find that on average inventors spend only 42.23 months at ICT MNC subsidiary in India before moving out. In terms of the type of organisations that inventors prefer joining after moving out from a MNC subsidiary, we observe that out of 3,022 outward mobility events, in 2,765 (91.5%) of them, the inventors moved to another MNC subsidiary; in 225 (7.4%) cases, the inventors moved from MNC subsidiary to a local firm and in only 32 (1.1%) outward mobility events, the inventors moved out of MNC subsidiary to create own ventures (see Figure 5.4).

**Figure 5.4** Where do the inventors go after having worked in the Indian subsidiary of MNCs?

### 5.4.2 Empirical Findings

Table 5.4 reports the models designed to test H1 and H2. Namely model (1) documents the results for the full sample. The coefficient of regulatory distance (coefficient=0.14, p-value<0.01) is positive and significant, offering support to H1, i.e., inventors’ outward mobility from subsidiaries increases with increase in formal institutional distance. In terms of the effect of cultural distance on inventors’ outward mobility, the coefficients of power distance, individualism and uncertainty avoidance are non-significant. As some studies (Shenkar, 2001; Zaheer et al., 2012) argue for results to be analysed further by
taking into account ‘direction of distance’, we split the sample into two sub-samples based on whether the distance between the MNC’s home country and India is positive or negative\(^{40}\) respectively in models (2) to (4) and models (5) to (7). We find positive and significant coefficient for regulatory distance (coefficient=0.19, p-value<0.01) when the direction of regulatory distance is positive, suggesting that an MNC experiences higher outward mobility of inventors from the subsidiary when the home country’s regulatory strength is higher than India’s. The coefficients of individualism (coefficient=0.19, p-value<0.01) and uncertainty avoidance distance (coefficient=0.11, p-value<0.05) are positive and significant when the corresponding direction of distance is positive, indicating that MNCs face higher outward mobility of inventors from the Indian subsidiary when the home country’s individualism and uncertainty avoidance values are stronger compared to India’s. Thus, we found support for H1 and H2 (except in case of power distance) when the appropriate directions of the formal and informal institutional distance are taken into account.

\(^{40}\) Direction of regulatory, power distance, collectivism and uncertainty distance between the home and India is positive when the home country has stronger regulatory, power distance, individualism and uncertainty avoidance norms or scores than India and negative otherwise.
Table 5.4 Relationship between MNCs’ regulatory and cultural distance and inventors’ outward mobility from subsidiary (Model- CPHM)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Full sample</th>
<th>Negative distance between the home and host country of MNC</th>
<th>Positive distance between home and host country of MNC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PD (1)</td>
<td>ID (2)</td>
</tr>
<tr>
<td>Inventor gender</td>
<td>0.09 (0.10)</td>
<td>0.09 (0.10)</td>
<td>0.46 (0.40)</td>
</tr>
<tr>
<td>Inventor education</td>
<td>0.01 (0.04)</td>
<td>0.02 (0.04)</td>
<td>0.05 (0.16)</td>
</tr>
<tr>
<td>Inventor age</td>
<td>0.01 (0.01)</td>
<td>0.01 (0.01)</td>
<td>-0.02 (0.04)</td>
</tr>
<tr>
<td>Inventor experience</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Inventor know. stock</td>
<td>0.12 (0.01)***</td>
<td>0.12 (0.01)***</td>
<td>-0.12 (0.08)*</td>
</tr>
<tr>
<td>MNC know. stock</td>
<td>-0.13 (0.02)***</td>
<td>-0.13 (0.02)***</td>
<td>-0.12 (0.08)*</td>
</tr>
<tr>
<td>Subsidiary know. stock</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.01 (0.02)</td>
</tr>
<tr>
<td>Industry inno. intensity</td>
<td>0.46 (0.17)***</td>
<td>0.33 (0.18)***</td>
<td>1.90</td>
</tr>
<tr>
<td>Economic distance</td>
<td>-0.03 (0.01)**</td>
<td>-0.02 (0.01)**</td>
<td>0.04 (0.06)</td>
</tr>
<tr>
<td>Regulatory distance (RD)</td>
<td>0.14 (0.05)***</td>
<td>0.19 (0.06)***</td>
<td>0.05 (0.26)</td>
</tr>
<tr>
<td>Power distance (PD)</td>
<td>0.00 (0.04)</td>
<td>0.05 (0.04)</td>
<td>-0.08 (0.20)</td>
</tr>
<tr>
<td>Individualism distance (ID)</td>
<td>0.03 (0.04)</td>
<td>0.03 (0.04)</td>
<td>0.05</td>
</tr>
<tr>
<td>Uncertainty avoidance</td>
<td>530.13</td>
<td>525.48</td>
<td>49.86</td>
</tr>
<tr>
<td>Total obs.</td>
<td>3,415</td>
<td>3,386</td>
<td>217</td>
</tr>
<tr>
<td>No. of failures</td>
<td>2,987</td>
<td>2,962</td>
<td>194</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-20969</td>
<td>-20767.4</td>
<td>-826</td>
</tr>
<tr>
<td>LR chi2</td>
<td>350.13</td>
<td>525.48</td>
<td>49.86</td>
</tr>
</tbody>
</table>

* If p<0.1, ** if p<0.05 and *** if p<0.01; standard errors in parentheses; RD, PD, ID and UAD refers to regulatory, power distance, individualism and uncertainty avoidance distance respectively. Analysis could not be conducted for negative regulatory distance and positive power distance due to insufficiency of data.

In order to examine the moderation effect of ‘MNC-level’ and ‘inventor-level’ international experience on the influence of formal and informal institutional distance on the outward mobility of an inventor from an MNC subsidiary, we used the ‘split-sample method’. The split-sample technique for moderation analysis requires splitting a sample according to the ‘high’ and ‘low’ values of the moderators to test for the existence the

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41 Mean value is considered as the baseline. Values lower than mean is considered as ‘low’ and values greater than mean are considered as ‘high’.

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moderation on a positive relationship if the coefficient of the predictor variable decreases and remains significant for the high values of the moderator compared to the low values of the moderator (Greene, 2010). Models (8) to (11) report the results for MNCs with low experience and models (12) to (15) show the results for MNCs with high experience in a similar institutional environment to India. Comparing models (8) and (12), we observe that while the coefficients of regulatory distance are significant in both models, the magnitude of the coefficient (0.14) is lower in model (12) than in model (8) (0.22), implying that the effect of regulatory distance on an inventor’s outward mobility from a subsidiary is weaker for MNCs with high experience in similar regulatory environments to the host country. This supports H3a. In contrast, the coefficients of power distance and uncertainty avoidance are negative and non-significant in models (9) and (11) and positive and significant in models (13) and (15). The coefficient of individualism is negative and significant in model (10) and positive and significant in model (14). Thus, we do not observe any evidence of weaker effect of cultural distance on an inventor’s outward mobility from a subsidiary for MNCs with high experience in similar cultural environments to the host country. Hence, H3b is not supported.
Table 5.5 Relationship between MNCs’ regulatory and cultural distance and inventors’ outward mobility from subsidiary moderated by MNCs’ and inventors’ international experience (Model- CPHM)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Low MNC experience in similar</th>
<th>High MNC experience in similar</th>
<th>Inventors’ international experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RLE (8) PE (9) IE (10) UAE (11)</td>
<td>RLE (12) PE (13) IE (14) UAE (15)</td>
<td>≤ 2 years (16) &gt; 2 years (17)</td>
</tr>
<tr>
<td>Inventor gender</td>
<td>-0.02 (0.14) -0.07 (0.13) 0.01 (0.13) 0.08 (0.13)</td>
<td>0.14 (0.14) 0.25 (0.15)** 0.20 (0.15) 0.11 (0.15) 0.07 (0.11) 0.20 (0.19)</td>
<td></td>
</tr>
<tr>
<td>Inventor edu. qualification</td>
<td>-0.10 (0.05)* -0.06 (0.05) -0.07 (0.05) -0.04 (0.05)</td>
<td>0.10 (0.06)* 0.10 (0.06)* 0.14 (0.06)** 0.12 (0.06)* 0.00 (0.05) 0.08 (0.06)</td>
<td></td>
</tr>
<tr>
<td>Inventor age</td>
<td>0.02 (0.01)** 0.02 (0.01)** 0.02 (0.01)* 0.01 (0.01)</td>
<td>-0.01 (0.01) -0.02 (0.01) -0.02 (0.01) -0.01 (0.01) 0.00 (0.01) 0.02 (0.01)*</td>
<td></td>
</tr>
<tr>
<td>Inventor experience</td>
<td>0.00 (0.00) 0.00 (0.00) 0.00 (0.00) 0.00 (0.00)</td>
<td>0.00 (0.00) 0.00 (0.00) 0.00 (0.00) 0.00 (0.00) 0.00 (0.00)</td>
<td></td>
</tr>
<tr>
<td>Inventor know. stock</td>
<td>-0.12 (0.00)** -0.13 (0.00)** -0.13 (0.00)** -0.13 (0.00)**</td>
<td>-0.12 (0.01)** -0.11 (0.01)** -0.11 (0.01)** -0.11 (0.01)**</td>
<td></td>
</tr>
<tr>
<td>MNC know. stock</td>
<td>-0.07 (0.01)** -0.07 (0.01)** -0.08 (0.01)** -0.09 (0.01)**</td>
<td>-0.11 (0.01)** -0.08 (0.01)** -0.05 (0.01)** -0.06 (0.04) -0.14 (0.02)** -0.09 (0.03)**</td>
<td></td>
</tr>
<tr>
<td>Subsidiary know. stock</td>
<td>0.00 (0.08) -0.05 (0.07) 0.04 (0.06) 0.08 (0.06)</td>
<td>0.03 (0.05) 0.03 (0.05) 0.06 (0.04) -0.08 (0.07) -0.11 (0.07) -0.02 (0.05) -0.04 (0.06)</td>
<td></td>
</tr>
<tr>
<td>Subsidiary age</td>
<td>-0.04 (0.01)** -0.02 (0.01)** -0.02 (0.01)** -0.02 (0.01)**</td>
<td>0.00 (0.00)* 0.01 (0.00) 0.00 (0.00) 0.00 (0.00) 0.00 (0.00) 0.00 (0.00)</td>
<td></td>
</tr>
<tr>
<td>Industry inno. intensity</td>
<td>0.02 (0.22) 0.09 (0.21) 0.12 (0.20) 0.18 (0.20)</td>
<td>0.11 (0.00) 0.83 (0.00) 1.03 (0.00)* 1.15 (0.00) 0.25 (0.21) 1.51 (0.33)**</td>
<td></td>
</tr>
<tr>
<td>Economic distance</td>
<td>-0.01 (0.01) -0.01 (0.01) -0.01 (0.01) -0.01 (0.01)</td>
<td>-0.07 (0.02)** -0.06 (0.02)** -0.05 (0.02)** -0.04 (0.02)**</td>
<td></td>
</tr>
<tr>
<td>Regulatory distance (RD)</td>
<td>0.22 (0.07)*** 0.14 (0.08)*</td>
<td>0.29 (0.13)** 0.18 (0.09)** 0.05 (0.05) -0.13 (0.06)*</td>
<td></td>
</tr>
<tr>
<td>Power distance (PD)</td>
<td>-0.06 (0.04)</td>
<td>-0.14 (0.05)*** -0.02 (0.05)</td>
<td></td>
</tr>
<tr>
<td>Individualism distance (ID)</td>
<td>-0.14 (0.05)***</td>
<td>-0.02 (0.05)</td>
<td></td>
</tr>
<tr>
<td>Unc. avoidance distance (UAD)</td>
<td>0.29 (0.13)**</td>
<td>0.18 (0.09)** 0.24 (0.14)* 0.05 (0.05) -0.06 (0.07)</td>
<td></td>
</tr>
<tr>
<td>Total obs.</td>
<td>1,923 2,163 2,204 2,256 1,492 1,252 1,211 1,159 2,104 2,131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of failures</td>
<td>1,666 1,903 1,930 1,966 1,321 1,084 1,057 1,021 1,824 1,163</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of survivors</td>
<td>257 260 274 290 171 168 154 138 280 148</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-10780 -12541 -12746 -13049 -8138.47 -6479 -6273 -6011 -11867 -7045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LR chi2</td>
<td>259.38 296.7 317.72 291.9 296.84 233.05 241.15 247.87 403.13 255.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* If p<0.1, ** if p<0.05 and *** if p<0.01; standard errors in parentheses. RLE, PE, IE and UAE refer to regulatory environment, power distance environment, individualism environment and uncertainty avoidance environment.
Models (16) and (17) show the results obtained for inventors with ≤2 years and >2 years of international experience\(^{42}\) respectively. The coefficient of regulatory distance is non-significant in model (16); however, the coefficient is significant with a higher magnitude in model (17), offering no support to H4a. The coefficients of power distance and uncertainty avoidance, while lower in magnitude in model (17) than in models (16), remain non-significant. On the other hand, the coefficients of individualism distance is significant and lower in model (17) than in model (16), respectively -0.13 and 0.05 respectively. This result suggests that inventors’ international experience moderates the influence of individualism distance on the inventor’s mobility from a subsidiary. Hence, H4b is supported with respect to individualism distance only.

To visualise the moderation effects of MNC-level and inventor-level international experience on the positive relationship between MNCs’ institutional distance with the host country and inventors’ outward mobility from subsidiary, we plotted the hazard ratios of regulatory, power distance, individualism and uncertainty avoidance distance separately for low and high degree of MNC-level international experience in Figure 5.5 and for low and high degree of inventor-level international experience in Figure 5.6. Figure 5.5 reveals that with increase in MNCs’ international experience, the hazard of inventors’ outward mobility decreases due to regulatory distance, whereas the hazard increases due to cultural distance. This shows the negative moderating effect of MNCs’ international experience on the positive relationship between formal institutional distance and inventors’ outward mobility from MNC’s subsidiary.

\(^{42}\)The mean of inventors’ international experience is 2.39 and hence rounded off to 2 years. For robustness we also estimated separate CPHM for inventors with ≤ 3 years and >3 years of international experience and the results are consistent.
Figure 5.6 shows that the hazard of inventors’ outward mobility from subsidiaries decreases due to cultural distance with increase in inventors’ international experience, while the hazard increases due to regulatory distance with inventors’ international experience. This corroborates the negative moderation of inventors’ international experience on the positive relationship between informal institutional distance and inventors’ outward mobility from MNC’s subsidiary.
Among the control variables, the coefficient of industrial innovation intensity is positive and significant, suggesting that inventors’ outward mobility increases with increase in innovation intensity in the industry. We observe a negative and significant relationship between inventors’ knowledge stock and inventors’ mobility which imply that inventors with high knowledge stock are likely to be less mobile. Also, the negative correlation between MNC knowledge stock and inventors’ outward mobility suggests that inventors are likely to stay longer at knowledge intensive MNCs.

### 5.4.3 Robustness Checks

For robustness checks on the results obtained for H1, we used IPR scores from IPR Index (2007:2016) as an alternative measure of regulatory distance in model (18) (see Table C9 in Appendix-C). As IPR scores are available only from the year 2007, for analysis, we considered only those mobility and non-mobility events (N=1,955) that took...
place during the period 2007-2016. The coefficient for regulatory distance is positive and significant, showing the consistency between the results in models (1) and (18).

For examining the robustness of results reported for H2, we used Globe’s practice scores (House et al., 2004) as an alternative cultural distance measure (see Table C9 in Appendix-C) and found consistent results. The only difference between the results based on Hofstede’s and Globe’s cultural scores is observed in the case of the coefficient of uncertainty avoidance. Using Hofstede’s scores, we find positive and significant coefficient for uncertainty avoidance distance (see model (1) in Table 5.4), whereas the coefficient of uncertainty avoidance distance is negative and significant for Globe’s scores (see Table C9 in Appendix-C). This difference in results could be due to the negative correlation between Hofstede’s scores and Globe’s practice scores on uncertainty avoidance (Venaik and Brewer, 2010). To control for the direction of distance, we conducted separate analyses for positive and negative institutional distance and we found the results to be similar to the ones reported in Table 5.4.

The robustness checks conducted for examining the moderation of inventor-level and MNC-level international experience on inventors’ outward mobility from subsidiaries are reported in Table C10 (see Appendix-C). For examining the moderation of inventors’ international experience, we split the sample into inventors with <=3 years and >3 years international experience and found the results to be consistent with those based on 2 years’ experience. For examining the moderation of MNCs’ international experience, we used a tighter scale to determine a country’s institutional similarity to that the host country (India). Here, we assumed a country’s institutional environment to be similar to India if the corresponding distance between the home country and India is less than or equal to half of the mean of the distance that India possesses with all other nations. The results obtained are similar to the ones reported in Table 5.5. Additional robustness
checks were also conducted by assuming the ‘median’ value of experience as the baseline and values above and below the median are considered as ‘high’ and ‘low’ values, which also show consistency with our main results.

5.5 Discussion and Conclusion

Our study addressed the influence of institutional distance between home and host country on the outward mobility of inventors from MNC subsidiaries in India. The results suggest that MNCs from distant countries in terms of regulatory strength face high outward mobility of inventors mainly for two reasons. First, MNCs from strong regulatory regimes may find it difficult to design and enforce non-compete and non-solicitation agreements in countries with weak regulatory systems, like India (Zhou and Poppo, 2010) and inventors in such countries take advantage of the weak institutional regime to violate such contracts and join competing organisations. MNCs from distant regulatory regime may also lack capabilities or may not realise the need to develop alternative informal strategies that could prevent inventors’ outward mobility, such as strategic human resource (HR) policies (Bhatnagar, 2007). Second, MNCs’ over-reliance on formal regulatory practices such as IP contracts could incur cognitive dissonance in inventors who are used to work in environments with informal regulatory practices, and such cognitive dissonance may ultimately lead to leaving the subsidiary.

In terms of the effect of cultural distance on the outward mobility of inventors from a subsidiary, separate investigation of the cultural constructs reveals that individualism and uncertainty avoidance distance lead to higher outward mobility of inventors. Controlling for the direction of distance show that Indian inventors tend to display higher outward mobility from MNCs with highly individualistic and uncertainty avoiding culture. Considering that collectivism and uncertainty avoidance norms are
highly valued in Indian society, Indian inventors are likely to experience cognitive dissonance when the inventors are required to work in individualistic and uncertainty avoiding cultures. This result also allows us to argue that individuals may not experience cognitive dissonance just because there exists a cultural distance at the workplace, as argued previously (Le and Kroll, 2017); rather it may be experienced by individuals only when the cultural distance intensifies in a particular direction. This finding also allows us to answer to and reiterate the quest by Shenkar (2001) and Zaheer et al. (2012) for considering the direction in institutional distance studies.

On the other hand, we obtained mixed yet interesting results for the moderation of macro and micro experience on institutional distance. We found that while macro (MNC-level) experience moderates the formal component of institutional distance, micro (inventor-level) experience moderates the informal component. Macro experience in similar a regulatory environment to the host country helps the MNCs to familiarise with the challenges pertaining to enforcing non-compete and non-solicitation agreements, which enables MNCs to become competent in designing appropriate contracts and be effective in enforcing such contracts in the host country and subsequently succeeds in reducing outward mobility of inventors from the subsidiary. This result points at the significance of intra-MNC learning (Zhao and Luo, 2005) sharing of practices and knowledge pertaining to the design and enforcement of contracts among the MNC units that are located in similar economies in terms of the regulatory environment. Contrary to our expected results and findings from prior studies (e.g., Dikova and Sahib, 2013) that observed positive influence of MNCs’ prior experience in reducing the negative effect of cultural distance in the contexts of cross-border acquisitions, we find that prior experience of cultural norms and inventors’ cultural sensitivity in countries that are culturally similar to the host country, does not seem to influence the impact of cultural
distance on the inventors’ outward mobility from the subsidiary. A possible explanation is that MNCs get locked into their organisational culture, which also defines the MNC’s identity and carries the traits of their home country culture. Culture is a more sensitive and complex issue than regulatory and compensation strategies, and therefore assimilation of prior learning from other countries to modify the cultural profile of the subsidiary is not a simple process. Another explanation could be that MNCs strive for implementing a universal set of corporate cultural culture values in order to ease communication and integration among business units located globally (Yip et al., 1997), and therefore this may overshadow the use of prior learning to alter the cultural profile of the subsidiary, although doing so may help the MNC to control the outward mobility of inventors.

The negative moderation of micro experience on inventors’ outward mobility suggests that, unlike organisations, individuals’ adaptability and cognitive consonance to different culture increases with international experience. International experience helps inventors to reduce cognitive dissonance by allowing them to acquire schemas in the foreign culture and convert the dissonant cognition to consonant cognition, to foresee the possible cultural distance they may face at workplace and reduce the magnitude of dissonant cognition, to enhance the perceived benefits of cultural distance and reduce the importance of dissonant cognition. We thus contribute to the growing literature on the significance of micro international experience in reducing cultural distance in international business (Le and Kroll, 2017). However, we found that micro experience does not moderate formal institutional distance. The mostl likely reason behind this result could be that inventors do not experience a cognitive dissonance that is high enough to lead to outward mobility when asked to work in a foreign regulatory environment. The degree of cognitive dissonance depends on two factors: the magnitude of the dissonant
cognition and the importance of the dissonant cognition (Wicklund and Brehm, 2013). When Indian inventors are required to work with formal IP protection strategies in an institutional distant MNC, they do recognise the dissonance yet the importance of this dissonant cognition (i.e., IP contracts) is likely to be low as they are aware that the MNC will struggle to enforce these contracts due to India’s weak regulatory system, and therefore fear of consequences of violating an IP contract would not be extreme.

Lastly, this study strengthens discussions around offshoring R&D to emerging countries by offering empirical insights into a widely mentioned (e.g., Kumaraswamy et al., 2012; Lamin and Ramos, 2016; Livanis and Lamin, 2016) yet empirically underexplored risk of conducting R&D in emerging countries: high outward mobility of inventors from subsidiaries. In the context of India, we show that MNC subsidiaries are more likely to lose out inventors to the subsidiaries of other MNCs than to local firms, which is surprising considering the large population of local firms within the Indian ICT sector (Kenney et al., 2013), and inventors’ preference towards working in the host country culture which the local firms embrace43. This finding offers empirical support to Lamin and Ramos’ (2016) remark about local firms’ incapability to free-ride off the presence of foreign firms in emerging countries. Inventors’ outward mobility to competing MNCs is a concern, as the latter compete in the global market. Knowledge leakages from an Indian subsidiary may benefit the competitors in the home and the overseas markets and jeopardise the source firm’s global R&D investments.

43 We perceive that there could be two reasons behind inventors’ preference towards joining MNCs over the local firms. Firstly, as Spencer (2008) indicates, in the contexts of emerging countries, MNCs are likely to offer better working conditions including higher wages than the local firms. Secondly, considering the existence of high technological distance between the foreign firms and the local firms in emerging countries (Singh, 2007), employment in the subsidiaries of foreign firms could offer inventors the opportunities to work with more advanced technologies and this could be a motivational factor for inventors to join foreign firms over the local firms.
Our results provide some managerial implications. To reduce institutional distance and subsequently inventors’ outward mobility from subsidiaries, consideration of the appropriate level of experience is vital. To reduce regulatory distance with the host country, MNCs need to develop strategies at the organisational level by facilitating learning from other units that are located in countries whose regulatory system is similar to the host country. Such a practice could assist the MNC in developing capability in designing and enforcing non-compete and non-solicitation agreements in line with the host country’s regulatory needs, and therefore control the outward mobility of inventors from subsidiaries. In contrast, to reduce cultural distance with the host country, MNCs should rather design strategies at the micro level, e.g., when recruiting inventors, selecting those with international experience at the subsidiary of foreign MNCs and/or overseas jobs/education.

On a more optimistic note, in emerging countries, while MNCs are likely to lose out inventors to competing firms, primarily to subsidiaries of other MNCs, they can also benefit from the inward mobility of other MNCs’ inventors. However, a subsidiary must find a positive balance between inventors’ inward and outward mobility to maintain a healthy net knowledge flow, which is crucial for sustaining competitive advantage (Mariotti et al., 2010). A subsidiary’s inability to sustain a balance between inward and outward knowledge flow could also give rise to tensions within the MNC network regarding knowledge control, resulting in the subsidiary losing its bargaining power within the network (Mudambi and Navarra, 2004).

5.6 Limitations and Future Research Avenues
As usual, this study is not immune from limitations. Firstly, our findings are based on inventor data in only one host country (India) and one industry (ICT). Future works could
examine the validity of our findings in the contexts of other host countries and other high-technology industries, where inventors’ mobility may jeopardise knowledge advantages. Secondly, although we adopted a series of steps to ensure the reliability of data collected from LinkedIn, there still exist limitations with this data. Uploading of information on LinkedIn entirely rests on the individuals themselves and therefore, concerns lie with the accuracy of the self-provided information. This issue could be eliminated by considering the ‘recommendations’ written by fellow colleagues; however, not all profiles include recommendations. Also, there is no comparable data source available to validate the information received from LinkedIn.

In terms of future research directions, more could be explored in terms of the bright side of inventors’ mobility in emerging countries. Namely, we propose the following research questions: to what extent do knowledge spillovers (i.e. losing and hiring inventors from other MNCs’ subsidiaries) impact the innovation performance of the subsidiary at the local and global level? Since MNCs from strong regulatory regimes are unable to recruit inventors from direct competitors in the home country, can they follow an alternative route to acquire some of the competitors’ knowledge by hiring an inventor from the competitors at the subsidiary-level in emerging countries and then relocate them to home country units? On the other hand, from a policy perspective it is clear that local firms in emerging countries hardly benefit from the outward mobility of inventors from MNCs. What strategies could local firms and governments adopt to attract inventors from MNC subsidiaries? Lastly, in terms of methodology, recently LinkedIn has appeared to be an attractive data source to track the movement of individuals and immigration in policy studies in the context of brain drain and brain circulation (e.g., Breschi et al., 2018). We contribute to this emerging methodology by using LinkedIn to determine inter-firm mobility events and offer insights into the steps taken to ensure
validity and reliability of the data collected from LinkedIn regarding the identification of outward mobility events from firms. We envisage that IB studies will greatly benefit from using LinkedIn data particularly in the context of human mobility across and within MNC networks.

References


Dikova, D. and Sahib, P. R., 2013. Is cultural distance a bane or a boon for cross-border acquisition performance?. *Journal of World Business, 48*(1), 77-86.


Appendix-C

Data Collection from LinkedIn

*Step-1: Identification of Indian inventors*

We define host country (Indian) inventors as the inventors who have been granted at least one United States Patent & Trademark Office (USPTO) patent while working for an MNC subsidiary in India. The selection of USPTO patents to identify inventors is driven by the fact that most inventions with potential global applications are usually patented in the USA first (Alnuaimi et al., 2012). We used the following criteria for screening USPTO patents that were granted to the Indian inventors in the year 2016- ICN (inventor country)/IN (India) AND ISD (issue date)/1/1/2016->31/12/2016. We then narrowed down our focus to the patents that were granted to the Indian subsidiaries of ICT MNCs, and then these patents were manually checked to develop a list of 2,934 Indian inventors who have been granted at least one USPTO patent while working for ICT MNCs Indian subsidiaries.

*Step-2: Selection of LinkedIn profiles of Indian inventors*

Once the list of 2,934 Indian inventors was compiled, we checked the LinkedIn profiles of each inventor manually to track their mobility events throughout their professional career. LinkedIn is a social networking website exclusively designed for professionals to promote their career trajectories and developing professional contacts (Sigfusson and Chetty, 2013). LinkedIn profiles of individuals usually include information about their educational background, history of work experience with names of employers and employment dates and sometimes details of the projects they had worked (Patriotta et al., 2013). Considering that India is currently ranked second after USA in the number of LinkedIn users (STATISTA, 2018), it can be expected that many Indian inventors would maintain complete and up-to-date LinkedIn profiles. In a special editorial of Research
Policy journal, Feldman et al. (2015) stated that ‘the editors believe this (LinkedIn) provides intriguing new possibilities for career studies’ (p. 1630). It is worth mentioning, in the past, studies (e.g., Dietz and Bozeman, 2005; Youtie et al., 2013 etc.) have used data from curriculum vitae (CV) of academics to examine the influence of job rotations on productivity. In this regard, LinkedIn profiles of inventors could also be considered as their CVs. We logged into LinkedIn as a premium user (on paid subscription) to manually access the profiles of the inventors. The premium subscription allowed us to access not only the ‘public profiles’ but also the ‘private profiles’.

We used three criteria to select LinkedIn profiles for analysis. First, only inventors with ‘complete’ LinkedIn profiles are considered. We establish a link between the name mentioned as an inventor in the USPTO patent and name on the LinkedIn profile if there exists a match between the first name and surname AND the LinkedIn profile shows the inventor’s employment with the company (assignee) around the date when the patent application was made (similar to Breschi et al., 2018). Thus, inventors with no LinkedIn profile were eliminated from the sample. In case of multiple LinkedIn profiles appearing for the same inventor name and company, we checked all the appeared LinkedIn profiles for any mention of USPTO granted patents to identify the true inventor. In case of no mention of patents, the inventor name was not considered for the analysis.

A LinkedIn profile is considered as ‘complete’ if names of employers, locations of employments (at least the country) and periods of employments are clearly mentioned AND names of academic alma mater (at least from the undergraduate level) and period of study are clearly mentioned AND there is no discontinuity in the career history for more than a year (in case of more than a year of discontinuity, we accept profiles only if the reasons for discontinuity is clearly mentioned for instance maternity or sabbatical etc.)
AND the profile is updated until December 31st, 2016. Below, we offer some examples of rejected LinkedIn profiles and reasons behind rejections:

a] Profile of Inventor-I (see Table C1) was rejected because of missing education information including education level and the year of graduation. This information is necessary to calculate the age of the inventor at the time of starting employment career at different companies (which is a control variable in our regression model). Therefore, the profile was rejected despite the employment information is complete.

**Table C1** Example of an incomplete LinkedIn profile (reason: missing education information)

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/ education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>IIT Delhi, India</td>
<td>M.Sc.</td>
<td>Not indicated</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Employment-1</td>
<td>ITI Ltd</td>
<td>Assistant Engineer</td>
<td>1998-1999</td>
<td>14</td>
</tr>
<tr>
<td>Employment-3</td>
<td>Motorola</td>
<td>Senior Design Engineer</td>
<td>2000-2004</td>
<td>45</td>
</tr>
<tr>
<td>Employment-4</td>
<td>NXP</td>
<td>Design Manager</td>
<td>2004-present (as of Dec’2016)</td>
<td>--</td>
</tr>
</tbody>
</table>

b] Profile of Inventor-II (see Table C2) was rejected because of missing employment information. His profile shows no information regarding his employment during the period 2011- December 2016.

**Table C2** Example of an incomplete LinkedIn profile (reason: missing employment information)

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/ education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>YMCA University of Science and Tech., India</td>
<td>B.Sc.</td>
<td>2002-2006</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>HCL</td>
<td>Design Engineer</td>
<td>2005-2006</td>
<td>12</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Freescale</td>
<td>Design Engineer</td>
<td>2008-2011</td>
<td>38</td>
</tr>
</tbody>
</table>

c] Profile of Inventor-III (see Table C3) was rejected because of confusing information regarding the third and fourth employment. The inventor was found to be working in parallel for two firms Microchip Technology and Cadence during the period 2015-2016
which is confusing considering no merger or acquisition activity happened between Microchip Technology and Cadence during the mentioned time period.

Table C3 Example of an incomplete LinkedIn profile (reason: parallel employments)

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>M.M.M.E. Gorakhpur, India</td>
<td>B.Sc.</td>
<td>2000-2004</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>STMicroelectronics</td>
<td>Project Intern</td>
<td>2005-2006</td>
<td>12</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Freescale</td>
<td>Lead Design Engineer</td>
<td>2006-2013</td>
<td>84</td>
</tr>
<tr>
<td>Employment-3</td>
<td>Microchip Technology</td>
<td>Lead Engineer</td>
<td>2013-present (as of Dec’2016)</td>
<td>--</td>
</tr>
<tr>
<td>Employment-4</td>
<td>Cadence</td>
<td>Principal Engineer</td>
<td>2015-present (as of Dec’2016)</td>
<td>--</td>
</tr>
</tbody>
</table>

Second, only inventors of Indian nationality are considered. Identifying the nationality of inventors and eliminating foreign nationals from our final sample is important because, compared to Indian nationals, foreign nationals may be less affected by cultural distance while working for a foreign MNC. As LinkedIn profiles do not show the nationality of individuals, we relied on education information shared in the profiles to decide whether the inventor is Indian national (similar to the process adopted by Breschi et al., 2018). We assumed an inventor to be of Indian nationality if the first-level of education mentioned in the LinkedIn profile is obtained in India. For instance, Inventor-IV (see Table C4) was eliminated because the first-level of education (Bachelor in Computer Science) mentioned in the LinkedIn profile was obtained in Japan (Osaka University).

Table C4 Example of identification of foreign nationals

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Osaka University, Japan</td>
<td>B.Sc.</td>
<td>2005-2009</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>Canon</td>
<td>Software Engineer</td>
<td>2009-present (as of Dec’2016)</td>
<td>12</td>
</tr>
</tbody>
</table>
Third, only mobile inventors are considered. An inventor is considered as mobile if the inventor changes jobs at least once during his/her career. Following the applications of these skeleton criteria, LinkedIn profiles of 1,562 inventors were identified for the next step.

**Step-3: Selection of mobility events from the LinkedIn profiles of Indian inventors**

Once the 1,562 LinkedIn profiles of inventors are extracted, we applied three criteria to select appropriate mobility events for the analysis, as our unit of analysis is mobility events. First, only those mobility events which occurred from a MNC subsidiary to other firms in India were considered. We eliminated mobility events that occurred a) from local firms and start-ups to other organisations including MNCs, b) from MNCs to academic organisations and c) outside India.

a) Mobility events from local firms and start-ups were discarded as the objective of this study is to develop an understanding of the reasons behind the outward mobility of inventors from foreign MNCs in India only.

b) Mobility events involving academic organisations such as universities and research institutes as hiring organisation are eliminated because the decision to join academia for an inventor may be driven by factors other than institutional distance. For instance, Inventor-V worked in four different companies during the period 2004-2016 (see Table C5). After Employment-2 (Kodiak Networks), the inventor took a break from the professional career to join academia (University of Texas at Dallas, USA) as a PG student. Therefore, the transition from Employment-2→ Education-2 or Employment-3 is not considered as mobility.
Table C5: Elimination of mobility events to academia

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education-1</td>
<td>R.V College of Engineering</td>
<td>B.Sc.</td>
<td>2000-2004</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>Huawei</td>
<td>Associate Software Engineer</td>
<td>2004-2005</td>
<td>13</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Kodiak Networks</td>
<td>Design Engineer</td>
<td>2005-2007</td>
<td>30</td>
</tr>
<tr>
<td>Education-2</td>
<td>University of Texas at Dallas</td>
<td>MSc</td>
<td>2008-2009</td>
<td>12</td>
</tr>
<tr>
<td>Employment-3</td>
<td>Qualcomm</td>
<td>Senior Engineer</td>
<td>2010-2014</td>
<td>53</td>
</tr>
<tr>
<td>Employment-4</td>
<td>Intel</td>
<td>System Engineer</td>
<td>2014-present (as of Dec'2016)</td>
<td>--</td>
</tr>
</tbody>
</table>

C) Mobility events are considered only if they have occurred within the geographical border of India because the influence of institutional factors will change for mobility events occurring outside India. We consider a mobility event to have occurred outside India if the job locations of both source firm and hiring firm are foreign locations. For instance, Inventor-VI (see Table C6) underwent six mobility events during the period 1994-2016. Out of the six mobility events, we considered only two mobility events: from Employment-1→Employment-2 and Employment-2→Employment-3 for our analysis because in case of the remaining mobility events, which occurred after employment-3, job locations of source firms and hiring firms are overseas locations.

Table C6: Example of mobility events occurring abroad

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>GB Pant Krishi Evam Praudyogik Vishwavidyala, India</td>
<td>B.Sc</td>
<td>1990-1994</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>Central Electronics Engineering Research Institute (Location- Pilani, India)</td>
<td>Scientist</td>
<td>1994-1996</td>
<td>21</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Johnson Controls (Location- Delhi, India)</td>
<td>Senior Software Engineer</td>
<td>1996-1997</td>
<td>17</td>
</tr>
<tr>
<td>Employment-3</td>
<td>AT&amp;T (Location- NY, USA)</td>
<td>System Analyst Architect</td>
<td>1997-2000</td>
<td>36</td>
</tr>
<tr>
<td>Employment-4</td>
<td>Lante (Location- NY, USA)</td>
<td>System Analyst Architect</td>
<td>2000-2002</td>
<td>24</td>
</tr>
<tr>
<td>Employment-5</td>
<td>Dell (Location- Austin, USA)</td>
<td>Software Architect</td>
<td>2002-2004</td>
<td>24</td>
</tr>
<tr>
<td>Employment-6</td>
<td>Inventes (Location- Austin, USA)</td>
<td>President</td>
<td>2005-2008</td>
<td>38</td>
</tr>
<tr>
<td>Employment-7</td>
<td>Inxero (Location- Austin, USA)</td>
<td>Founder &amp; CEO</td>
<td>2008-present (as of Dec'2016)</td>
<td>--</td>
</tr>
</tbody>
</table>
Mobility events that occurred as a result of merger or acquisition (M&A) between the hiring and source firm were not considered as cases of mobility. To ensure that a change in employer due to M&A is not counted as an event of mobility, we checked the relationship between the source and the hiring firm in the year in which the inventor changes the job. If the employer name changes for an inventor from Employer X to Employer Y because of acquisition of Employer X by Employer Y, the event is not considered as a mobility event. For instance, Inventor-VII changed four jobs during his professional career during 1996-2016 (see Table C7). However, the job-change from Sun Microsystem to Oracle in 2011 happened possibly because of the acquisition of Sun Microsystem by Oracle in 2010 and therefore, this job change was not counted as a mobility event.

Table C7: Example of identification of mobility events caused by mergers and acquisitions between the source and hiring firm

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/ university name</th>
<th>Position/ education level</th>
<th>Employment/ education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>University of Mysore, India</td>
<td>B.Sc.</td>
<td>1992-1996</td>
<td>48</td>
</tr>
<tr>
<td>Employment-1</td>
<td>Hinditron Informatics</td>
<td>Software Engineer</td>
<td>1996-1997</td>
<td>8</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Novell</td>
<td>Software Consultant</td>
<td>1997-2000</td>
<td>38</td>
</tr>
<tr>
<td>Employment-3</td>
<td>Sun Microsystem</td>
<td>Staff Engineer</td>
<td>2000-2011</td>
<td>127</td>
</tr>
<tr>
<td>Employment-4</td>
<td>Oracle</td>
<td>Principal Software Engineer</td>
<td>2011-present (as of Dec'2016)</td>
<td>--</td>
</tr>
</tbody>
</table>

Lastly, mobility events involving only permanent and full-time positions are considered. Temporary/part-time positions include internships, trainees and any position where it is clearly mentioned that the inventor was on a temporary and/or part-time contract. For instance, Inventor-IX worked as an Engineer Trainee at Genesis Microchip before moving to Freescale (see Table C8). Therefore, although during the professional career between 2008 and December 2016, the inventor registered two mobility events: one from Genesis Microchip to Freescale and the other from Freescale to Texas Instruments; we only consider the latter because the first mobility could have been a ‘forced mobility’ due to the end of the traineeship contract.
**Table C8** Example of identification of forced mobility events

<table>
<thead>
<tr>
<th>Employment/education history</th>
<th>Company/university name</th>
<th>Position/education level</th>
<th>Employment/education period</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>BITS Pilani, India</td>
<td>M.Sc.</td>
<td>2006-2008</td>
<td>24</td>
</tr>
<tr>
<td>Employment-1</td>
<td>Genesis Microchip</td>
<td>Engineer Trainee</td>
<td>2008-2008</td>
<td>8</td>
</tr>
<tr>
<td>Employment-2</td>
<td>Freescale</td>
<td>Design Engineer</td>
<td>2008-2015</td>
<td>38</td>
</tr>
<tr>
<td>Employment-3</td>
<td>Texas Instruments</td>
<td>Design Engineer</td>
<td>2015-present (as of Dec'2016)</td>
<td>--</td>
</tr>
</tbody>
</table>

**Additional Results**

Tables C9 and C10 illustrate the results for different tests performed for checking the robustness of our main results.
Table C9 Relationships between regulatory and cultural distance and inventors’ outward mobility from subsidiary based on the positive and negative direction of distance (Model: CPHM)

<table>
<thead>
<tr>
<th>Variables</th>
<th>RLD measured using IPR scores</th>
<th>CD measured using Globe’s scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full sample</td>
<td>Positive RL distance</td>
</tr>
<tr>
<td></td>
<td>(18)</td>
<td>(19)</td>
</tr>
<tr>
<td>Inventor gender</td>
<td>0.12 (0.12)</td>
<td>0.12 (0.13)</td>
</tr>
<tr>
<td>Inventor edu qualification</td>
<td>0.03 (0.05)</td>
<td>0.03 (0.05)</td>
</tr>
<tr>
<td>Inventor age</td>
<td>0.02 (0.01)</td>
<td>0.02 (0.01)</td>
</tr>
<tr>
<td>Inventor experience</td>
<td>0.00 (0.00)*</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Inventor know. stock</td>
<td>-0.13 (0.01)***</td>
<td>-0.13 (0.01)***</td>
</tr>
<tr>
<td>MNC know. stock</td>
<td>-0.07 (0.02)***</td>
<td>-0.07 (0.02)***</td>
</tr>
<tr>
<td>Subsidiary kno. stock</td>
<td>-0.04 (0.05)</td>
<td>-0.05 (0.05)</td>
</tr>
<tr>
<td>Subsidiary age</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Industry inno. intensity</td>
<td>-1.56 (0.75)**</td>
<td>-1.49 (0.75)**</td>
</tr>
<tr>
<td>Economic distance</td>
<td>-0.11 (0.02)***</td>
<td>-0.10 (0.02)***</td>
</tr>
<tr>
<td>RL distance</td>
<td>0.30 (0.06)***</td>
<td>0.31 (0.06)***</td>
</tr>
<tr>
<td>PD distance</td>
<td>-0.03 (0.03)</td>
<td>-0.03 (0.03)</td>
</tr>
<tr>
<td>ID distance</td>
<td>0.07 (0.02)***</td>
<td>0.07 (0.02)***</td>
</tr>
<tr>
<td>UA distance</td>
<td>-0.15 (0.16)</td>
<td>-0.15 (0.16)</td>
</tr>
<tr>
<td>Total obs.</td>
<td>1,955</td>
<td>1,945</td>
</tr>
<tr>
<td>No. of failures</td>
<td>1,527</td>
<td>1,519</td>
</tr>
<tr>
<td>No. of survivals</td>
<td>428</td>
<td>426</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-9815</td>
<td>-9757</td>
</tr>
<tr>
<td>LR chi2</td>
<td>263.63</td>
<td>258.22</td>
</tr>
</tbody>
</table>

* If p<0.1, ** if p<0.05 and *** if p<0.01; standard errors in parentheses; RL, PD, CL and UA refer to regulatory, power distance, collectivism and uncertainty avoidance respectively. Analysis could not be done for negative RL and positive PD distance due to insufficiency of data.
### Table C10: Relationship between MNCs' regulatory and cultural distance and inventors' outward mobility from subsidiary moderated by MNCs' and inventors' international experience - Robustness check (Model: CPHM)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Low MNC experience in similar</th>
<th>High MNC experience in similar</th>
<th>Inventors' international experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RLE (26)</td>
<td>PDE (27)</td>
<td>IDE (28)</td>
</tr>
<tr>
<td></td>
<td>UAE (29)</td>
<td>RLE (30)</td>
<td>PDE (31)</td>
</tr>
<tr>
<td></td>
<td>IDE (32)</td>
<td>UAE (33)</td>
<td>≤ 3 years (34)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 3 years (35)</td>
</tr>
<tr>
<td>Inventor gender</td>
<td>-0.02 (0.13)</td>
<td>-0.05 (0.13)</td>
<td>0.03 (0.13)</td>
</tr>
<tr>
<td>Inventor education qualification</td>
<td>-0.07 (0.05)</td>
<td>-0.03 (0.05)</td>
<td>-0.06 (0.05)</td>
</tr>
<tr>
<td>Inventor age</td>
<td>0.02 (0.01)</td>
<td>0.01 (0.01)</td>
<td>0.02 (0.01)**</td>
</tr>
<tr>
<td>Inventor experience</td>
<td>0.00 (0.00)**</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Inventor know. stock</td>
<td>(0.01)**</td>
<td>(0.01)**</td>
<td>(0.01)**</td>
</tr>
<tr>
<td></td>
<td>(0.01)**</td>
<td>(0.01)**</td>
<td>(0.01)**</td>
</tr>
<tr>
<td>MNC know. stock</td>
<td>-0.09 (0.13)</td>
<td>-0.14 (0.13)</td>
<td>-0.13 (0.13)</td>
</tr>
<tr>
<td>Subsidiary know. stock</td>
<td>0.06 (0.07)</td>
<td>0.05 (0.07)</td>
<td>0.02 (0.06)</td>
</tr>
<tr>
<td>Subsidiary age</td>
<td>-0.03 (0.01)</td>
<td>-0.03 (0.01)</td>
<td>-0.02 (0.01)**</td>
</tr>
<tr>
<td>Industry int. intensity</td>
<td>0.07 (0.14)</td>
<td>0.14 (0.20)</td>
<td>0.24 (0.20)</td>
</tr>
<tr>
<td>Economic distance</td>
<td>-0.01 (0.21)</td>
<td>-0.01 (0.01)</td>
<td>0.00 (0.01)</td>
</tr>
<tr>
<td>Regulatory distance</td>
<td>0.19 (0.07)</td>
<td>0.14 (0.08)</td>
<td>0.06 (0.10)</td>
</tr>
<tr>
<td>PD distance</td>
<td>-0.05 (0.05)</td>
<td>-0.04 (0.05)</td>
<td>-0.02 (0.05)</td>
</tr>
<tr>
<td>ID distance</td>
<td>-0.02 (0.05)</td>
<td>-0.02 (0.05)</td>
<td>-0.02 (0.05)</td>
</tr>
<tr>
<td>UA distance</td>
<td>Total obs.</td>
<td>2,072</td>
<td>2,264</td>
</tr>
<tr>
<td>No. of failures</td>
<td>1,810</td>
<td>2,014</td>
<td>1,986</td>
</tr>
<tr>
<td>No. of survivals</td>
<td>262</td>
<td>250</td>
<td>290</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-11,834</td>
<td>-13,360</td>
<td>-13,190</td>
</tr>
<tr>
<td>LR chi2</td>
<td>301,81</td>
<td>333,45</td>
<td>291,91</td>
</tr>
</tbody>
</table>

* If p<0.1, ** if p<0.05 and *** if p<0.01; standard errors in parentheses; RLE, PDE, IDE and UAE refer to regulatory environment; power distance environment, individualism environment and uncertainty avoidance environment.
Appendix-specific References


CHAPTER 6 CONCLUSION

This chapter summarises the key findings of this thesis and discusses limitations and future research avenues. The chapter is organised in the following order. First, it recalls the two key talent management challenges for offshoring R&D to emerging countries: talent recruitment challenges due to the low-quality of E&T graduates and talent retention challenges due to the high mobility of inventors, introduced in Chapter-1 of this thesis and explains how the three research papers collectively extend our understanding of the said challenges as well as the strategies of firms to address them. Next, in Section 6.2, we highlight the contributions to research made by this thesis in terms of extending the extant literature and theories and proposing new methodologies. The following section (Section 6.3) discusses the implications to practitioners including firm managers, HEIs and policymakers. The chapter closes with Section 6.4 which offers a discourse on the future research avenues that can be pursued as extensions to the research conducted in this thesis.

6.1 Summary of Findings

This thesis addressed the following overarching research question: What are the talent recruitment and retention challenges for offshoring R&D to emerging countries and what strategies do MNCs practice to address such challenges? Through the first two papers (Research Paper-1 and Research Paper-2) of this thesis, we focused on the talent recruitment challenges experienced by MNCs in an emerging country-India due to the difficulty in finding high-quality E&T graduates for R&D positions. In Research Paper-3, we studied the talent retention challenges experienced by MNCs pertaining to the high
mobility of inventors. Below, we briefly summarise the findings for each talent management challenge separately.

6.1.1 Summary of Findings: Talent Recruitment Challenges in R&D

Based on empirical evidence from 12 cases studies, Research Paper-1 argues that low-quality of E&T graduates is a challenge for foreign MNCs domestic firms operating in emerging countries in the context of high on-the-job costs involved in training such graduates for R&D positions. Training graduates to a satisfactory level for undertaking R&D tasks requires usually about 12 months of on-the-job training, which incurs high ‘direct’ and ‘opportunity’ costs to the companies. To overcome this challenge, firms form teaching-focused I-A collaborations with HEIs so that a part of the on-the-job training could be transferred to HEIs with an aim to educate students with the type and level of knowledge and skills needed by the firms during formal education. These collaborations allow firms to impart ‘industry-specific’ and ‘firm-specific’ skillsets to graduates thereby reducing the requirement of offering on-the-job training to make them R&D-ready. Moreover, by asking the participating students from partner HEIs to pay for the training programmes organised under teaching-focused collaborations, firms are able to transfer the cost onto them and reduce the investments needed to initiate and sustain such collaborations significantly. Teaching collaborations between firms and HEIs are practised in three modes: firms jointly developing curriculum with HEIs (Mode-1), firms offering ‘value added’ courses to students outside the curriculum (Mode-2) and firms offering dissertation projects to students (Mode-3). Training programmes under teaching collaborations can be delivered to students through faculty of the partner HEIs, employees of the partner firm and third-party organisations.

Using mixed methods derived from 52 interviews among HEIs, policymakers and firms in India and the websites of 2,224 Indian HEIs, Research Paper-2 identifies the
HEI-level and institutional determinants of teaching-focused I-A collaborations. Among HEI-level factors, HEI's size, industrial embeddedness in terms of engagement in industrial R&C and entrepreneurship and academic embeddedness in terms of linkages with other HEIs were found to be the main determinants and HEI's quality is the barrier to I-A collaborations in teaching. Among institutional factors, HEI's discipline diversity, location in industrial clusters, and government support in terms of establishment of intermediary organisations facilitate teaching-focused I-A collaborations while HEI's lack of autonomy and government ownership hinder the occurrence of such collaborations.

6.1.2 Summary of Findings: Talent Retention Challenges in R&D

Drawing on 3,022 outward mobility events of 1,421 Indian inventors during the period 1996-2016, Research Paper-3 finds inventors’ mobility in India to be rather high as inventors spend on average only 42 months at MNC subsidiaries in India. Results reveal that the likelihood of the outgoing inventors joining subsidiaries of other MNCs is significantly higher than joining local firms and start-ups, indicating critical vulnerability of losing out important and confidential innovation knowledge to competing MNC subsidiaries via inventors’ mobility than to local firms and start-ups in India. Using institutional distance perspective of the institutional theory, we find that MNCs with high regulatory distance to India experience high outward mobility of inventors. On the other hand, inventors are likely to move out more frequently when they are required to work for MNCs with a culture that is more individualistic and uncertainty avoiding than that of India. This is possibly because of cognitive dissonance faced by inventors due to distant regulatory and cultural norms in MNC subsidiaries.

Results also reveal that MNCs’ experience in countries with a similar regulatory environment to that of India moderates the relationship between regulatory distance and
inventors’ outward mobility from subsidiaries. Macro experience in a similar regulatory environment to the host country helps the MNCs improve MNCs’ capability of designing and enforcing appropriate and effective contracts in the host country. This is likely to bring success in reducing the outward mobility of inventors from subsidiaries. On the other hand, the relationship between cultural distance and inventors’ outward mobility from subsidiaries is moderated by micro (inventors’) international experience. This is possibly because inventors with foreign experience do not feel cognitive dissonance due to cultural distance while working for an MNC subsidiary and therefore, are less likely to move out.

6.2 Implications for Research
Through Research Paper-1 and Research Paper-2, we established a new line of inquiry within the I-A collaboration literature: ‘teaching-focused I-A collaborations’. In I-A collaboration literature, teaching outcome has mostly been studied as a ‘by-product’ or ‘unintended outcome’, whereas research and entrepreneurial gains have been regarded as the ‘main products’ (Perkmann et al., 2013). This suggests negligence towards understanding the dynamics of industrial collaborations that are targeted towards enhancing teaching performance compared to the other two missions of universities—research and entrepreneurship. This is unfortunate considering that most universities in less-developed countries, including India, are teaching universities and ‘teaching’ is still the sole function/mission of these universities (Laredo, 2007; Liefner and Schiller, 2008). Through exploring teaching-focused I-A collaborations in India, we fill this important research void. Research Paper-1 contributes to human capital theory (Lepak and Snell, 1999) by suggesting the potential of such teaching-focused collaborations with academia to replace the traditional on-the-job training model for developing new graduates for
R&D positions. Paper-2 further extends this line of research by investigating the HEI-level and institutional determinants of teaching-focused I-A collaborations. Selection of India as the geographical context in both Research Paper-1 and Research Paper-2 also allowed us to bring a geographical diversity to the discussions on industry-academia collaborations. Developed countries have been the prevailing contexts in prior studies on I-A collaborations (Perkmann et al., 2013).

Research Paper-3 offers empirical insights talent retention challenges in emerging countries (Kumaraswamy et al., 2012; Lamin and Ramos, 2016; Livanis and Lamin, 2016). Based on strong empirical evidence, we show that inventor mobility is a concern for MNC subsidiaries in emerging countries. Research Paper-3 helps to understand the determinants of inventors’ mobility from an institutional perspective using the institutional distance logic, contributing simultaneously to IB and innovation literature. Prior literature had mostly studied the issue from an individual perspective using human capital theory. In addition, to the best of our knowledge, Research Paper-3 is one of the first studies to examine the multi-level moderation via MNCs’ international experience (organisational level) and inventor’s (individual) international experience on the impact of institutional distance. Research Paper-3 also makes methodological contributions by proposing LinkedIn as a data source to track inventors’ mobility.

6.3 Implications for Practice

The benefits of teaching-focused collaborations go beyond the individual benefits to the participating firms and HEIs. These collaborations could prove to be crucial for industrial growth and stimulating inward FDI in emerging economies. Technology-intensive sectors are often driven by rapidly changing technologies, which also drives the type of skill requirement (Consoli and Rentocchini, 2015). For the industry to survive such
technological changes, universities must possess the dynamic capability to develop graduates in line with the rapidly changing skill requirements. Collaborations with industry in teaching could help universities to achieve this dynamic capability. On the other hand, teaching-focused I-A collaborations contribute to the expansion in the size of the high-quality talent pool in a country by enhancing the employability of fresh graduates for R&D positions in the industry. Since R&D offshoring decisions from MNCs are often driven by the availability of talent in the destination country (Lewin et al., 2009; Manning et al., 2008), the presence of a high number of teaching-focused I-A collaborations may thus attract high inward FDI in R&D. Hence, universities, firms, and policymakers, the three helices of the innovation system (Etzkowitz and Leydesdorff, 2000) should work together towards overcoming the challenges of teaching-focused I-A collaborations. Additionally, policymakers should continue to extend the initiatives that have been successful in fostering teaching-focused collaborations between industry and academia e.g., the setting up of intermediary organisations (e.g., TASK).

Research Paper-3 offers implications mainly to MNC managers in India by exploring the institutional determinants of inventors’ outward mobility of inventors from Indian subsidiaries of MNCs and how the effect of institutional distance could be reduced. Our results suggest that MNC managers can control the outward mobility of inventors using two strategies. First, in order to reduce regulatory distance with a host country, MNCs could use the learning from subsidiaries that are in countries sharing a similar regulatory environment with the host country. Such learning will enable MNCs to design effective non-compete and non-solicitation agreements in line with the host country’s regulatory norms. Second, in order to reduce cultural distance with the host country, MNCs should design strategies more at the micro level. Firms should recruit inventors with experience at subsidiaries of foreign MNCs and/or overseas jobs/education. Our
results show that inventors with high international experience are less likely to be affected by high cultural distance.

In a nutshell, this thesis enhances understanding of new-comer MNC subsidiaries about the gravity of talent recruitment and retention challenges in emerging countries, particularly in India, and informs about the strategies that their peer MNCs and domestic firms are or could be practicing to overcome these talent management challenges.

6.4 Future Research Directions

In order to develop favourable policies for teaching-focused I-A collaborations to take place, it is important to identify the firm-specific factor that may influence firms’ decision to engage in teaching-focused I-A collaborations. Additionally, future research should evaluate the performance of different modes of teaching-focused collaborations in terms of employability of graduates trained under these collaborations. Despite we argue that teaching-focused I-A collaborations present mostly a win-win situation for the partner HEIs and firms, it is important to explore if there exist any downside of teaching-focused I-A collaborations. Future studies should also explore the viability of teaching-focused I-A collaborations in other emerging economies and developed economies.

From the host emerging country-perspective, inventors’ incoming mobility to local firms and start-ups from the subsidiaries of foreign MNCs could contribute to the development of indigenous technological capability through knowledge spill-over (Singh, 2007). Hence, it is also important to recognise the factors that may drive inventors working for foreign MNCs to join local firms and start-ups. Cross-country studies could be helpful in recognising such factors. From the source MNCs’ perspective, reducing the outward mobility of inventors is a priority to prevent any unwanted knowledge spill-over. As MNCs find it difficult to enforce non-compete and non-solicitation agreements in
India due to the weak IPR enforcement system, MNCs are more likely to resort to strategic talent retention strategies to retain inventors. The question that emerges here is: are these inventor retention strategies similar to those traditional retention strategies implemented for non-inventors? Last but not least while we used LinkedIn primarily to measure the inter-firm mobility of inventors; during the data collection phase, we also learned about a few other possible uses of LinkedIn in academic research. First, LinkedIn data can be used to identify R&D collaborations. While analysing the LinkedIn profiles of inventors, on several occasions, we observed cases of inventors to be working for organisations different to the patent applicant company in the patent application year, pointing towards R&D collaborations between the patent applicants and the employers of the inventors. Second, LinkedIn data can also contribute to the measurement of diversity in inventors’ groups, especially in International Business research. LinkedIn offers distinct and transparent data on explicit human capital indicators of diversity such as ethnicity, the position of employees, education qualification, and experience etc. Also, through profile matching, data could be extracted from other social media platforms such as Twitter, Facebook and Quora etc. to measure diversity in tacit dimensions such as political, linguistic and religious orientations etc. We believe that these are all interesting directions for future research.
This list only includes references for Chapter-1, Chapter-2 and Chapter-6 only as the reference lists for the Chapter-3, Chapter-4 and Chapter-5 have been included in the respective chapters.


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