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RESEARCH ARTICLE

From Arbitrage to Global Innovation: Evolution of Multinational R&D in Emerging Markets

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Abstract Our inductive study of nine European multinational enterprises (MNEs) and their R&D units in India uncovers a distinct trajectory of overseas R&D evolution in emerging markets. In contrast to the well-established trajectory of foreign R&D evolution that begins by adapting existing MNE products to the local market, this alternative trajectory begins by leveraging cost arbitrage and progresses through three unique configurations towards a global product mandate. Our study also unravels how the R&D units build embeddedness within the MNE network and with the local ecosystem, and how such embeddedness influences the evolution of their R&D mandate. We present a stylized taxonomy of R&D configurations and integrate this into an evolutionary model of emerging market R&D and suggest that research on MNE R&D in emerging markets must shift from focusing on the macro environment to exploring the dynamics of embeddedness. The study also provides useful insights to practitioners on managing R&D in emerging markets.

Keywords Multinational R&D · Emerging markets · Innovation · Embeddedness · Cost arbitrage · Competence creation

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1 Introduction

Multinational enterprises (MNEs) engage in overseas R&D for one of two dominant reasons: Either to adapt products to meet the unique requirements of attractive foreign markets, or to leverage geographically embedded sophisticated technical know-how (Cantwell and Mudambi 2005; Gerybadze and Reger 1999; Kuemmerle 1999). However, when the host country is an emerging market, MNEs are faced with problems on both these fronts. Demand tends to be mostly in price-sensitive mass market, technological ecosystems are underdeveloped, and intellectual property regimes are weak (Govindarajan and Ramamurti 2011; Zhao 2006). The observation in the literature is that MNE R&D in these markets is of low value or narrow in scope, and mainly driven by cost arbitrage (Demirbag and Glaister 2010; Kumar 2001; Reddy 1997; Zhao 2006). However, in recent years MNEs such as GE, Microsoft, and IBM have been announcing large-scale R&D investments in countries like China and India (Businessweek 2010; Economist 2010). Recent field studies in these countries suggest that these are not just low-cost R&D locations, although they may have started as one, and that there is a new dynamic that seems to be driving the growth of R&D here (Govindarajan and Trimble 2012; Jha et al. 2016; Kumar and Puranam 2012; Yip and McKern 2016). Our study explores this dynamic with the research question: *How does an MNE's R&D evolve in an emerging market?*

While our research question is timely and critical, this is still a relatively new phenomenon and due to the sensitivity associated with R&D, available empirical data is limited. So, we pursue an inductive theory-building exercise, using multiple in-depth case studies (Eisenhardt 1989; Yin 2009) as appropriate for exploratory work. The research setting is India, a hub of MNE R&D activity among emerging economies (UNCTAD 2005). India's sustained importance as an R&D destination for over a decade makes it a suitable context to study the MNE R&D pattern unfolding in emerging markets. We employ a nested design, focusing on three firms in each of three most R&D intensive sectors in India, namely, automotive, information and communication technology (ICT), and pharmaceutical industry (Yin 2009). Drawing on strategy process research, we analyze how these R&D units have evolved over the years, and identify significant triggers that drive this evolution (Doz 1996; Mirabeau and Maguire 2014; Vaara and Lamberg 2016).

Our model maps out the evolutionary path of R&D units in emerging countries that typically start with an arbitrage motive, and isolate the mechanisms that drive their evolution. We build on the insight that embeddedness drives legitimacy, knowledge and resources within MNE networks (Andersson et al. 2001, 2002; Dhanaraj et al. 2004). We distinguish between different types of embeddedness—internal and business embeddedness—analyze the process of their formation, and relate how each of these dimensions impacts the R&D unit's evolution. We analyze these movements to develop testable propositions and integrate them into an evolutionary framework.

Our study makes two distinct contributions. First, our evolutionary framework uncovers an alternative trajectory of R&D evolution predominantly found

in emerging markets, which starts with a 'cost arbitrage' motive and progressively moves towards a higher competence-creating role. This trajectory is different from the trajectory of evolution prevalent in developed markets and noted in extant view that begins with a dominant 'adaptation' motive. Second, we unpack 'embeddedness' and isolate the underlying processes that create embeddedness within organizational units. Complementing previous work that has explored the antecedents and consequences of embeddedness of an MNE subsidiary (Andersson et al. 2001, 2007; Frost et al. 2002), we bring forth 'how' different types of embeddedness are created and its implication for competence-creating roles. These findings, grounded in R&D evolution in emerging markets, also inform the broader internationalization theories.

2 A Short Survey of R&D Evolution Literature

Vernon's (1966) product life cycle theory provides the anchor for early MNE R&D literature suggesting that as demand for a firm's product rises in foreign markets, its functions—first marketing, and eventually production and associated functions such as R&D—would relocate there. These foreign R&D units were established with an *adaptation* motive i.e., to adapt existing MNE products to foreign markets by supporting local production, making minor modifications to suit the local needs and providing technical services to local customers (Ronstadt 1978; De Meyer and Mizushima 1989). Essentially, foreign R&D was market-driven or demand-driven and the R&D units acted as a vehicle to transfer firm's technology from the home country to the foreign production location.

Subsequent studies posited that the R&D units set up to support production gradually took on a more creative role, first innovating for the local market and then adding value beyond their local market (Ronstadt 1978; Roth and Morrison 1992; Birkinshaw et al. 1998; Pearce 1999; Kuemmerle 1999; Cantwell and Mudambi 2005; Hayashi and Serapio 2006). Some of them emerged as centers of excellence for certain technologies (Frost et al. 2002) while others took on product mandate for global markets (Roth and Morrison 1992).

This progress was shaped by two forces—unique and sophisticated demand from the local market (Vernon 1979); and rapidly advancing national innovation systems that offered learning opportunities (Nelson 1993; Porter 1990). With this, the motivation for foreign R&D was not just demand-driven but also knowledge-driven i.e., to leverage strategic knowledge assets in multiple locations and integrate them into global products (Gassmann and von Zedtwitz 1999; Granstrand et al. 1993; Hedlund 1986, Kogut and Zander 1993; Kuemmerle 1999; Veliyath and Sambharya 2011). In general, foreign R&D units evolved from being competence-exploiting units that take existing MNE products to the local market to being competence-creating units that leverage the local knowledge to add value to the global market (Cantwell and Mudambi 2005).

The evolution of an R&D unit is not only impacted by changes in the external environment but is also shaped by the unit's own strategic choice (Birkinshaw and Hood 1998). With the MNE R&D being conceptualized as a heterarchy (Hedlund

1986)—a network of relatively autonomous but interdependent R&D units—the role of subsidiary strategy in steering its evolution has gained traction. In this vein, the literature on 'relational embeddedness', which delves into subsidiaries' strategy regarding who they interact with, the intensity of the interaction, and the resources they can access and control as a consequence of those interactions, provides useful insights into the evolution of R&D units.

Relational embeddedness (henceforth, simply embeddedness) can be defined as closeness in a relationship (Andersson et al. 2002) and captures the intensity of information flow and mutual adaptation between two actors. Embeddedness plays a crucial role in the activities and outcomes of individuals, organizations and organizational sub-units such as MNE subsidiaries (Andersson et al. 2001, 2002; Polanyi 1957; Granovetter 1985; Uzzi 1996, 1997). In MNE subsidiaries, it has been found that external embeddedness i.e., the relationship of the subsidiary with local suppliers and customers, has a positive impact on its performance as well as competence creation for the MNE (Andersson and Forsgren 2000; Andersson et al. 2001, 2002, 2007). On the other hand, internal embeddedness i.e., the relationship of the subsidiary with the corporate headquarters, does not directly impact competence development or innovation-related business performance (Ciabuschi et al. 2011; Yamin and Andersson 2011). However, it indirectly improves performance by strengthening the subsidiary's influence within the MNE which enables it to secure resources needed for innovative projects (Ciabuschi et al. 2014). Further, subsidiaries that simultaneously have a high degree of internal and external embeddedness are more innovative. In other words, dual embeddedness positively impacts competence creation (Figueiredo 2011; Achcaoucaou et al. 2014; Athreye et al. 2014).

The survey of literature on R&D evolution, and embeddedness as a key enabler of that evolution, reveals two gaps. First, the trajectory of R&D evolution has been developed based on observations in developed countries and does not account for the MNE R&D phenomenon unfolding in emerging markets. We know little about how R&D units in emerging countries like India, which were setup to leverage *cost arbitrage* for efficient R&D (Reddy and Sigurdson 1994; Reddy 1997; OECD 2008), are evolving into innovation hubs for MNEs (D'Agostino and Santangelo 2012; Jha et al. 2016). A second gap is in our understanding of the process of embeddedness. While embeddedness is accepted as an effective strategy for subsidiary evolution into a competence-creating role, the literature is silent on the process through which an R&D subsidiary might achieve embeddedness. Embeddedness evolves over time, from arms-length to more intense (Andersson et al. 2002), but exactly how, is unexplored. We hope to address both these gaps through our study.

3 Research Design

Our research question is exploratory in nature and aspires to unravel a nascent and underexplored phenomenon. MNE R&D in emerging country context has received limited attention because it is a recent phenomenon (UNCTAD 2005) and data from this context is sparse (Khan et al. 2011). Even though there are hundreds of R&D units in place now (Zinnov 2012), there are very few that have a history that we

can theorize on. The purpose of our study is to explore the contours of the changes in MNE R&D in emerging markets and lay down the key definitions, concepts and processes, which can lay a strong foundation for future confirmatory research. Given the nature of the phenomenon and the exploratory and process-focused (i.e., addressing a 'how' question) nature of our research, an inductive method based on multiple, in-depth case studies is appropriate (Eisenhardt and Graebner 2007; Miles and Huberman 1994; Yin 2009). We draw on strategy process research that has progressed steadily over the years providing new ways to capture dynamic processes (Chakravarthy and Doz 1992; Doz 1996; Doz et al. 2000; Mirabeau and Maguire 2014; Vaara and Lamberg 2016).

3.1 Research Setting

India is the context of our study and serves as an ideal setting for two reasons. First, India has witnessed sustained MNE R&D activity since the mid-1990s. The number of MNE R&D centers has grown steadily, from 162 in 2000 to over 700 in 2010 (Zinnov 2012). R&D investment by US MNEs alone has gone up from $22M in 1997 to $582M in 2008 (Basant and Mani 2012). This makes India a 'leading indicator' of MNE R&D among emerging countries and gives us a large enough window to study evolutionary dynamics. Second, it is a country that has embraced the free-market economy route towards development (Patibandla 2006) and signed the TRIPS agreement in 1995. Therefore, it provides a context where the strategic choices of firms are not limited by the regulatory framework, thereby allowing us to explore the full range of factors that can drive R&D evolution.[1]

We explored three most R&D intensive industries: Automotive, information and communication technologies (ICT), and pharmaceuticals. These three sectors together accounted for over 90% of MNE R&D in India (Bharadwaj and Kapoor 2008). These sectors also varied significantly in the types of technologies involved and the regulatory framework (Patibandla 2006), both of which impact the appropriability conditions (Teece 2000). The more variance in the data, the more powerful the analytic conclusions, strengthening the validity and reliability of the findings (Yin 2009).

Taking a nested approach (Yin 2009), within each sector, we identified the ten EU MNEs with the largest R&D expenditure and an R&D presence in India and reached out to them. Three auto companies, six ICT companies and four pharma companies agreed to speak to us. One pharma company was dropped because we found that the Indian center only provided IT support to R&D and did not perform any core R&D work. To ensure a balanced design, we chose three firms from each of the three sectors (3×3 design), which allowed us to observe replication of patterns. Table 1 provides an overview of the nine firms in our study. We focused our analysis on units that had an explicit research and development mandate. For example, we did not

[1] This study was part of a larger effort commissioned and funded by the European Commission to understand the nature of innovation within European Union (EU) firms, and the nature of EU MNE R&D in India.

Table 1 Details of R&D units in the study

Company ID	HQ country	Primary business	Activities in India (other than R&D)	Year of R&D setup	At the time of inception		At the time of Interview	
					# ppl	Role	# ppl	Role
Information and communications technology industry:								
ICT1	Switzerland	Semiconductors	Sales and marketing	1995	40–50	OU	2200	GPU
ICT2	The Netherlands	Electronic equipment manufacturer	Sales and marketing, services	1996	< 100	OU	750	GPU
ICT3-Unit1	France	Networking equipment manufacturer	Sales and marketing, managed services	1995	50	OU	2600	ITU
ICT3-Unit2				2004	< 10	CoE	70	CoE
Pharmaceutical industry								
Pharma1	UK	Research-based health care	Manufacturing, sales and marketing	1984	35	CoE	110	CoE
Pharma2	France	Research-based health care	Manufacturing, sales and marketing	2004	8	OU	40+	FTU
Pharma3	UK	Research-based health care	Manufacturing, sales and marketing	2004	< 10	OU	45	FTU
Automotive industry								
Auto1-Unit1	Germany	Component manufacturers	Manufacturing, sales and marketing	Acquired in 2007	Not available	OU	500	ITU
Auto1-Unit2				Acquired in 2007	Not available	MU	136	LPU
Auto2	Sweden	OEM	Manufacturing, sales and marketing	1998	20	OU	500	GPU
Auto3-Unit1	Germany	Component manufacturers	Manufacturing, sales and marketing	1992	63	OU	5700	ITU
Auto3-Unit2				1951	Not available	MU	455	GPU

ICT3, Auto1, and Auto2 had two R&D units each in India. Others had only one

consider technical support units attached to manufacturing, which were providing only standardized support functions. Three of the MNEs (ICT3, Auto1, and Auto3) had two separate R&D centers and for these firms, we follow the evolution of both the units (identified as unit1 and unit2) over the two decades.

3.2 Data Collection

We collected primary data through interviews and supplemented it with secondary data to get a fuller picture of the journey of each R&D unit.

3.2.1 Interviews

In all, we interviewed 20 senior executives across the nine companies during the period 2010–2012. Since our intention was to capture the evolution, we found that the head of the R&D unit would be the most appropriate person to interview. Even though the head of the R&D unit we interviewed did not lead the unit through the entire evolution, we found him/her to be knowledgeable about how the unit evolved into its present role. In several cases, we interviewed a long-time employee of the R&D unit to cross-check facts and get a fuller picture of the evolution.

The interview was guided by a semi-structured questionnaire and lasted between 90 and 120 min, and largely focused on the following issues (Andersen and Kragh 2010; Suddaby 2006):

1. General information about the unit such as year of establishment, size (employees) at the time of inception, at the time of interview and relative to other R&D units;
2. Factors that motivated the establishment of the R&D unit and factors that drove investment in the unit at the time of interview;
3. Agenda at the time of establishment, important milestones in the progression of the unit leading up to its current state;
4. Actions of both the HQ and the subsidiary by encouraging respondents to discuss both internal and external factors that enabled or inhibited the evolution of the unit;
5. Data on how the unit was funded, its relationship with headquarters and its level of autonomy.

The interviews were recorded and transcribed and the notes were sent to the respondents for validation. In some cases, the respondents made corrections to the notes and those changes were incorporated.

3.2.2 Secondary Data

We gleaned data from secondary sources such as company annual reports, website, press releases, and articles in business press. Some firms shared their corporate presentations with us. We found a few others on online forums and company website. We especially focused on any articles with reference to India, R&D or

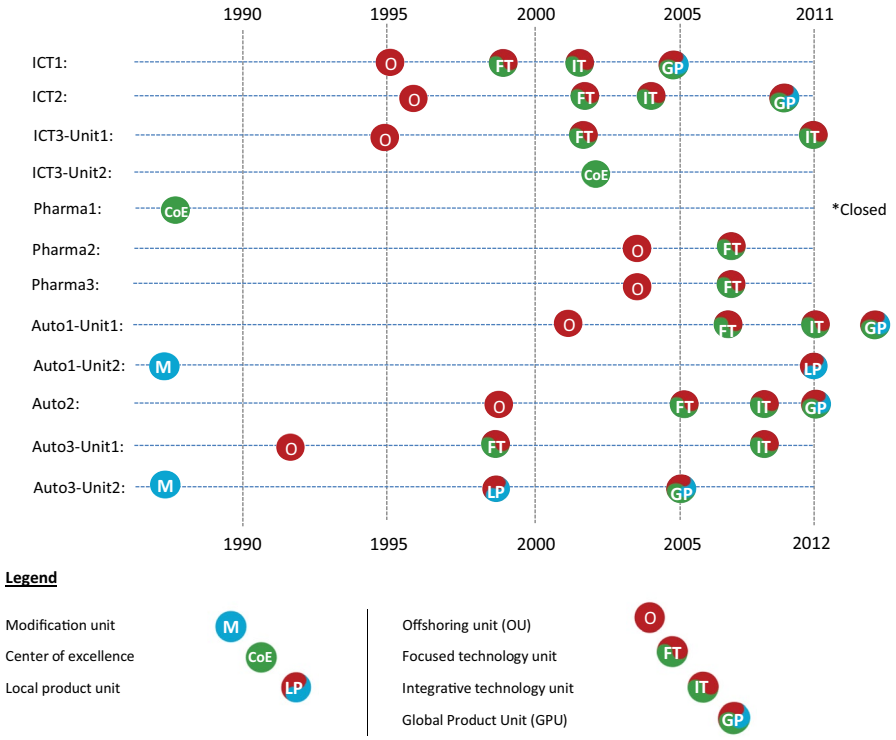


Fig. 1 Progression of R&D units in the study

emerging markets. Press releases regarding R&D investments and product development in India were carefully examined and juxtaposed with the data gathered from the interviews. We also gathered data on the company's investments in India outside of R&D. All this gave us a more complete understanding of the company's overall strategy and R&D strategy for India. We also searched online resources extensively to get an understanding of industry level dynamics for each of the three industries, which helped us grasp the broader context.

3.3 Data Analysis

The data collection and analysis were performed simultaneously and iteratively to develop the theory inductively (Dubois and Gadde 2002; Eisenhardt 1989; Orton 1997). After each set of interviews, we wrote a detailed case study for that R&D unit. Our analysis progressed in two phases. First, we identified key stages in the evolution of the R&D unit, where each stage denoted a distinct change in the role played by the unit within the MNE. We labeled each of these roles by drawing on the literature where possible, and assigning new labels for roles not discussed in received view. Figure 1 captures the evolutionary journey of each of the 12 units in our study. Second, we analyzed the data to isolate the factors that triggered the

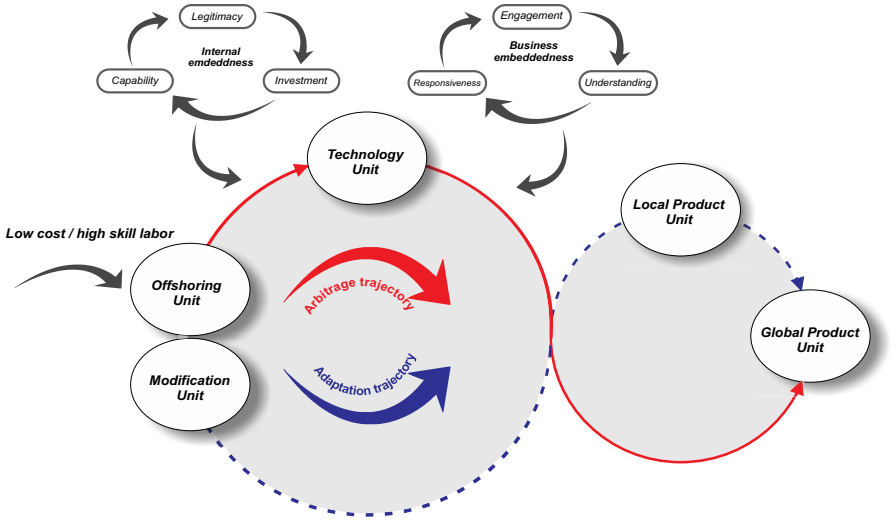


Fig. 2 Framework of R&D evolution in emerging markets

establishment of the R&D unit and subsequently propelled it from one stage to another, which essentially addresses the 'how' part of our research question. With each additional case, using replication logic, we revisited and fine-tuned the framework. On occasion, we gathered additional data on previous cases to resolve conflicts and enhance clarity.

The framework emerging from the case analyses was continuously compared with existing theoretical frames to identify new insights. Thus, the framework emerged as a result of constant iteration between data collection, analysis and theory building. Once a framework emerged, we tried to isolate sectoral patterns. Since our sample contained three firms from three different industries, we were able to compare the trends within and across industries. For instance, we analyzed whether the evolution of R&D units within a sector followed a similar path of evolution. Similarly, we also looked at whether there were systematic differences between how companies across sectors evolved. The final framework of R&D evolution emerging from our study is presented in the next section.

4 Evolutionary Model of MNE R&D in Emerging Markets

The framework emerging from our analysis is captured in Fig. 2. Out of 12 R&D units spanning nine firms, two units started with an *adaptation* motive and eight units started with an *arbitrage* motive. We term the former as 'modification unit' and the latter as 'offshoring unit'. There were also two units that started as a center of excellence (COE), focusing on researching technologies relevant for India and India-like markets. One of them (Pharma1) was eventually shut down and the other (ICT3-Unit2) has remained a very small unit and not evolved

further, thus making them peripheral to our analysis. Finally, what we find are two distinct evolutionary trajectories in emerging markets: One triggered by *adaptation* motive (Fig. 2, dotted blue line) and the other triggered by *arbitrage* motive (Fig. 2, solid red line).

The adaptation trajectory reflects the received view on MNE R&D evolution, moving from modification unit to local product unit and finally a global product unit. The two units in our study that began as modification units (Auto1-Unit2 and Auto3-Unit2) followed this trajectory and went on to develop substantive R&D capability. While this is a familiar trajectory, the evolution of the offshoring unit (arbitrage trajectory) is the one that is novel and unique to emerging markets. This trajectory is the focus of our subsequent analysis.

We present our analysis in four parts. First, we examine the triggers for establishing an offshoring R&D unit in the host country. In Parts 2 and 3, we pursue the arbitrage trajectory elaborating on how the R&D unit evolves from an offshoring unit, specifically identifying two stages, that we term as 'technology unit' and 'global product unit'. We analyze the evolution by weaving together existing theory and our data focusing on three aspects: (1) The characteristics of the emergent unit leading up to its formal labeling and definition; (2) the process through which the evolution unfolds and (3) the critical contingencies that impact the evolution, advanced as propositions. We argue for their distinct position in the evolution, and subsequently identify the key drivers of the evolution. As we map our observations, we note that the processes are fundamentally those that advance organizational embeddedness, internally and externally. This allows us to open the 'black box' of the embeddedness framework (Andersson et al. 2002; Ciabuschi et al. 2011; Frost et al. 2002; Uzzi 1997; Yamin and Andersson 2011). In Part 4, we compare the arbitrage and adaptation trajectories for those firms that have R&D units on both trajectories and their relative velocity of evolution.

4.1 Arbitrage Trajectory: Starting Conditions

Offshoring units (OUs) in contrast to modification units are a more recent development in the overseas R&D activities of the multinational. Task decomposability and the proliferation of communication technologies make it possible for MNEs to isolate labor-intensive activities such as clinical trials in pharmaceuticals and embedded software technologies in automotive and ICT industries. The OUs are also unique to emerging markets such as India. They do not belong to either the 'competence exploiting' or the 'competence creating' categories (Cantwell and Mudambi 2005). They are driven neither by market considerations nor by the availability of unique geographically embedded specialized knowledge. Overwhelmingly, the primary motive for these entries was the generous availability of a talent pool at low cost. One of the R&D leaders observed:

> *"We decided to set up a center in 1988–1989. This decision was based on the fact that the country had a lot of bright, raw engineering talent."*

These R&D units function primarily as an extension of the headquarters and execute well-defined tasks under close supervision by headquarters, as the following quotes suggest:

> *"To start with, the development work undertaken at the India center was being handed down in small work packages with heavy dependency on the Swedish team."*—Manager at Auto2.

> *"To begin with, the India center worked as an engineering extension of the HQ. Initial activities were characterization, designing the layout, working on libraries and so on."*—Manager at ICT1.

The unit typically works in a very narrow technical area, for one or at the most two business units, much like an outsourcing company. The work undertaken contributed to the MNE's global market. We term such centers *offshoring units* (OUs) and define them as *'R&D units that execute clearly defined work packages in a cost-effective fashion, under close supervision and guidance from headquarters'.*

The motivation for the establishment of the R&D unit and the nature of the work undertaken during the initial years shows a consistent pattern across sectors. Interestingly, the local government played a limited role in the R&D establishment decision. There was no evidence of governmental coercion to set up R&D in exchange for market access, as has been documented other contexts (Gassmann and Han 2004). Further, government assistance and other institutional support (Meyer and Nguyen 2005) was a peripheral, comfort factor rather than a driving factor. Quality of IPR protection also played a limited role.

> *"Government assistance is not a reason for locating here, but we do take advantage of government incentives, for example in locating in special economic zones (SEZ). Quality of IP protection was evaluated to determine if it would be a show stopper rather than a facilitator."*—Manager at Auto3-Unit1.

This consistent pattern we see in the decisions for initial R&D investments mimicked the patterns of offshoring in the IT industry (Arora and Gambardella 2006). Hence, we posit:

Proposition 1: *The likelihood of an MNE opening an R&D unit focused on offshoring in a host country increases with the level of stable supply of skilled knowledge workers at below-market prices, irrespective of the product market conditions or intellectual property regime existing in the host country.*

4.2 Emergence of Technology Unit

As we analyzed the narratives from our cases, we observed a distinct pattern of entities advancing to a stage that we termed as *'technology units'* (TUs), when the units gain the capability and mandate for developing one or more technologies. Typically, they first develop capabilities in a niche technology area, as evident from the following:

"Over the years, the center specialized in software based solutions."—Manager at ICT2.

"*The center is a software development center that supports the core platform development that spans multiple business divisions, for consumption in the world market.*"—Manager at Auto1-Unit1.

"*The goal was to grow in size, skills and competency to take on clinical trials in more therapeutic areas.*"—Manager at Pharma2.

We observed similar trends across the sectors. ICT1 developed competency in chip design. Pharma2 and Pharma3 developed into clinical trial hubs. The advanced capability of the centers was used by the MNE to deliver products for its global market. We term this as a *focused technology unit* (FTU) and define it as '*an R&D unit with advanced capability in a focused technology area, which is leveraged across multiple products and business lines in the firm'*.

Some units went on to expand their technological scope by building capabilities in complementary technology areas. This is evident from the following:

"*Today, the center does everything in VLSI design, embedded software and the final solutions.*"—Manager at ICT1.

"*ICT2 Innovation center today has competence spanning the innovation chain. Whilst software is the center's competence area, it has now developed competence in mechanical and electrical design and development.*"—Manager at ICT2.

"*Gradually, the activities of the center have moved up the value chain to encompass complete product design i.e., Electronic design, Hardware design, Software design and Integration.*"—Manager at Auto3-Unit1.

This expansion of technological scope allowed the units to contribute to multiple areas of product development and build capability to undertake end-to-end product development. For instance, Auto3-Unit1 moved from embedded software development into complete product design and development. ICT1 also developed complete system design and development capabilities. We refer to these R&D units as an *integrative technology unit* (*ITU*) and formally define an ITU as '*an R&D unit that has expertise in a wide spectrum of technological areas and can undertake end-to-end product development*'.

In summary, technology unit is the stage of an R&D unit wherein the unit has accumulated capability either in a niche or a wide spectrum of technologies. Technology units are spread on a continuum between FTU on one end and ITU on the other. It should be noted that these are distinctly different from centers of excellence (COEs) (Andersson and Forsgren 2000; Frost et al. 2002). COEs thrive on unique, geographically embedded competencies with world class expertise in some niche technology, and have far-reaching impact for the MNE globally. By contrast, the technology units were learned MNE competencies, and were focused on efficient execution in one or more technology areas.

4.3 Emergence of Technology Unit: A Process of Developing Internal Embeddedness

How do R&D units move up the value chain from OU to TU? Our analysis of the case narratives reveals a self-reinforcing, dialectic process between the R&D unit and the headquarters, whereby the R&D unit progressively embeds itself with the HQ i.e., gains internal embeddedness.

The process begins with the R&D unit building legitimacy with the HQ. We find that R&D units use a variety of legitimacy-building tactics such as delivering superior performance (Geppert and Williams 2006), feedback seeking (Gupta et al. 1999) and profile building (Bouquet and Birkinshaw 2008a, b) to strengthen their relationship with the corporate headquarters. The following excerpts underscore this important first step of the process.

> "*The center built credibility with global leaders by consistently meeting performance requirements with respect to quality and on-time delivery. This brought more work to the center.*"—Manager at ICT3-Unit1.

> "*The process of moving up the value chain was a gradual one. The India management team met with the internal customers (the business unit heads), understood their concerns/issues and worked with them to build confidence and trust.*"—Manager at Auto2.

> "*By demonstrating proof points step by step on the ladder of maturity, the trust will build up and more (work) will come to ICT2 Innovation Center*."—Manager at ICT2.

The enhanced legitimacy of the R&D unit within the MNE leads to more investment from the HQ in the R&D unit. The increased investment from the HQ is evident from the following excerpts.

> "*The center has expanded from supporting one product line to 20+ product lines*."—Manager at ICT3-Unit1.

> "*The center saw a rapid growth (20–30%) over the next few years."*—Manager at ICT1.

> "*The center grew 20% year-on-year after inception, taking on software development responsibilities for multiple business divisions in the company*."—Manager at Auto1-Unit1.

An increase in the HQ investment has two implications. First, given the higher stakes in the R&D unit, the HQ is likely to interact more closely with the unit. The greater the interaction between two units, the more they learn from each other. Working closely with the HQ will allow the R&D unit to learn rapidly, assimilating complex and tacit organizational knowledge (Hansen 1999; Lane and Lubatkin 1998). Second, the increased scale of R&D allows spontaneous, informal communication between R&D personnel and joint problem solving, leading to rapid learning and innovation (Gassmann and von Zedtwitz 1998, 1999; Lasserre 2003). As a

consequence of the learning opportunities and agglomeration benefits accruing from increased investment, the R&D units are able to enhance their capability as evident from the following quotes.

> *"The center has evolved from being an extended workbench of the HQ to being completely accountable for software development*."—Manager at Auto1-Unit1.

> "*The center is striving to be a one-stop center for clinical research for all Pharma3 entities in India*."—Manager at Pharma3.

> "*The center went on to build capabilities that would enable it to design full chips* (*the hardware and software that goes into the chips*) *and complete systems* (*set top boxes*)*."*—Manager at ICT1.

In sum, the process that we see unfolding is one where the R&D unit establishes *legitimacy* with the HQ. This is reciprocated by the HQ with an increased *investment* in the unit. This in turn affords the unit an opportunity to access the MNE's organizational knowledge and leverage economies of scale to enhance its *capability* and make a more significant contribution to the MNE (Fig. 2). The increased capability is likely to further enhance the legitimacy of the unit in the MNE, setting up a virtuous cycle of *legitimacy-investment-capability*. Internal embeddedness or the closeness of relationship between the R&D unit and the corporate HQ evolves over time (Andersson et al. 2002), going from arms-length to more intense. With each turn of the legitimacy-investment-capability loop, the internal embeddedness of the R&D unit increases, propelling it from an OU to a TU with advanced capabilities. Hence, we posit:

> *Proposition 2: An R&D unit evolves from an offshoring unit to a technology unit through internal embeddedness, which comes about through legitimacy-investment-capability, a self-reinforcing, dialectic process between the R&D unit and MNE HQ.*

Note that we studied units that had been in operation for over 10 years. Thus, the fact that all units in our sample have moved into the FTU stage is an artifact of survival bias.[2] However, not all FTUs were able to evolve towards the ITU at the other end of the TU continuum. We find sharp differences across the sectors in the evolution towards ITU. Pharma R&D centers have not expanded beyond clinical studies, i.e., they have remained FTUs. The one exception is Pharma1, which started as a drug discovery unit. However, Pharma1 'moved' the drug discovery capability from developed countries rather than building it locally and is an outlier.

We first speculated that the evolution of the pharma R&D centers was muted because of the weak IP environment in India. However, we found that IP was a second order issue and the immediate roadblock to evolving towards an ITU was the

[2] Unless an OU evolves into an FTU, it has little chance of surviving, since the nature of work undertaken by an OU can easily be substituted with an arm's-length outsourcing arrangement or consolidated within another subsidiary. Therefore, any unit that fails to move beyond OU to take on a more strategic role is unlikely to survive.

weak supply side factors for the pharma industry in India. Specifically, researchers with an integrative knowledge of medicinal chemistry were not readily available and the educational infrastructure needed to create the skills required for pharmaceutical research was underdeveloped. As one of our respondents from Pharma1 pointed out:

> "*The education system in India is organized by disciplines. For instance, there are few people with expertise in interdisciplinary areas such as medicinal chemistry, which sits at the intersection of chemistry and biology. It is such interdisciplinary knowledge that is needed for drug discovery.*"

Prior studies reinforce this by noting that more advanced aspects of drug discovery such as medicinal chemistry require an understanding of the biology behind a drug candidate and such talent is sparsely available (Frantz 2006). Further, as our respondent from Pharma2 noted, "*This knowledge is highly tacit and cannot be easily taught or transferred, especially without the basic prerequisite knowledge".*

In contrast, the ICT and automotive sectors predominantly need skills in various engineering disciplines (software, mechanical, electrical, etc.). India has a large-scale engineering education program (Patibandla 2006), creating a large pool of raw engineering talent. Over 200,000 people are engaged in engineering services spanning mechanical, hardware and software engineering and thousands more are expected to join the employable pool each year. While this talent pool may not have a deep expertise, they have the necessary knowledge to learn and upgrade their skills rapidly. Therefore, ICT and automotive units were able to absorb this capability from the environment and evolve into ITU. Fundamentally, this translates into the technological scope of the local ecosystem. In sectors where the ecosystem is munificent in the range of technologies required by the particular sector, we see an evolution towards ITU. In sectors where the local ecosystem in underdeveloped (as in Pharma), evolution towards developing integrative capability is muted. Thus:

> *Proposition 3: The likelihood that an R&D unit will evolve into an integrative technology unit* (*ITU*) *is contingent upon the technological scope of the local ecosystem for the sector.*

4.4 Emergence of a Global Product Unit

The most advanced R&D unit has a global mandate (Ronstadt 1978; Pearce 1999; Kuemmerle 1999; Cantwell and Mudambi 2005) and a few of the OUs eventually reach that stage. Four units in our sample have evolved towards taking business responsibility for product development, for both emerging markets and global markets. For instance, ICT1 has successfully field deployed India-made satellite set-top boxes (STB) for a leading Digital TV provider in the country. Other units have also taken strides in this direction as evident from the following:

> "*The center has taken complete product ownership for certain products targeted at the Indian market and beyond."*—Manager at ICT2.

> "*The center now spearheads Auto1's affordable car strategy that caters to the requirements of emerging markets like India*."—Manager at Auto1-Unit1.

"*Recently, the center has begun working on a product for emerging markets. The bumper-to-bumper responsibility of this project is with the India center.*"—Manager at Auto2.

We refer to this as a *global product unit* (GPU) and define it as a unit that takes the *leadership for developing products that may be deployed in multiple markets* across the globe, and is analogous to the global technology unit (Ronstadt 1978) or global creator (Nobel and Birkinshaw 1998). The key difference between an ITU and a GPU is the ability to conceptualize a product based on market needs *in addition to* orchestrating end-to-end technology development.

4.5 Emergence of a Global Product Unit: A Process of Developing Business Embeddedness

How does a technology unit move towards gaining a product mandate? Our narratives bring forth that this process involves the unit purposefully developing a deep connect with the local business partners i.e., developing business embeddedness, to create products that fulfil pressing market needs. Business embeddedness also develops through a three-step self-reinforcing process of engagement with the business ecosystem, which is followed by developing an understanding of market needs, which is then followed by responsiveness to those needs (Fig. 2).

The first step of this process is where the R&D unit takes concrete steps to engage with the local business ecosystem, which comprises customers, suppliers and other actors who can provide valuable market insights to the R&D unit. This conscious process of *engagement* is evident from the following.

"*The biggest challenge I've had in this is history, legacy. Traditionally, such centers are set up to serve the global organization. They don't talk to the local organizations. I decided to make engineers directly talk to the sales team. The direct connection has helped, but it had to be built.*"—Manager at ICT2

"The ecosystem has been a very important plus of this location. The relationship with consulting companies, universities and other automobile manufacturers has been very positive."—Manager at Auto2.

This engagement with the business ecosystem may happen directly or through the local market-facing functions (sales, marketing) of the company. Either way, it needs to be undertaken purposefully. This is because, as noted by the manager of ICT2, the R&D units that started as offshoring units are typically inward-focused, working with HQ to serve the global market needs and have few or no linkages to the local business ecosystem.

As the R&D unit engages with the local business ecosystem, it begins to develop an *understanding* of the market needs. The following quotes underscore this.

"*There is need for more value products in the Indian market. Until now, the lowest products in the US market were picked up for sale here. We are heading* [*towards a position*] *where the country organization can gauge business opportunities.*"—Manager at ICT2.

"*The low affordability of emerging markets has been a key driver for developing products targeted at these markets. When we say 'affordable car strategy,' these are not lower quality vehicles equipped with the most basic components,* [*but they*] *instead feature minimalist, market-specific functions based on the latest technologies.*"—Manager at Auto1-Unit1.

Upon getting a pulse of the market needs, the next step for the R&D unit is to respond to these needs. The response would typically involve a credible change to the unit's strategy and structure to support the unique needs of the customers and suppliers. The *responsiveness* of the R&D units comes through in the following excerpts:

"Today, 5–10% of the staff at the center is focused on products for the Indian market while the rest of the center is focused on building lifestyle and healthcare products sold worldwide."—Manager at ICT2.

"About 34% of the staff is focused on developing new products for India and India-like markets."—Manager at Auto2.

The *responsiveness* of the R&D unit lays the foundation for a deeper *engagement* with the business ecosystem, which in turn leads to a more intimate *understanding* of the marker needs and trends, thus setting off a virtuous cycle. *Engagement-understanding-responsiveness* captures the process through which R&D units progressively build close relationships with actors in the local business ecosystem i.e., achieve business embeddedness, and move from arms-length transactions to creating closeness and trust with their business partners (Andersson et al. 2002; Yamin and Andersson 2011). The technology units that go on to undertake a product mandate already have a high level of internal embeddedness, which means that the products developed by the unit can be diffused rapidly across the MNE (Håkanson and Nobel 2001), giving them a global mandate. We posit:

Proposition 4: An R&D unit evolves from a technology unit to a global product unit through business embeddedness, which comes about through engagement-understanding-responsiveness, a self-reinforcing process between the R&D unit and the business partners in the local ecosystem.

A key factor that facilitates (or inhibits) the evolution of a TU towards GPU is the strategic importance of the local market for the company. In general, India and other emerging markets are seeing above average growth across sectors and are therefore becoming increasingly important for MNEs, especially with developed country markets becoming more saturated (London and Hart 2004). For instance, according to the auto component industry body ACMA (2010), vehicle production in India is expected to triple by 2020 and the auto component industry is expected to reach US$110 billion by 2020. Telecommunications and consumer electronics are also seeing explosive growth. The companies in our study echoed the broader market sentiments:

"*BRIC and other growing markets like Poland, Ukraine, Turkey and the Middle East, account for one-third of our revenues. India and China are very*

important markets for us and have recorded the most growth over the last 6 months."—Manager at ICT2.

"*Auto1* (*India*) *has registered a sales revenue of about 200 million euros in 2011 and is expecting to grow faster than global operations.*"—Manager at Auto1-Unit1.

"*In India, we will be working to achieve the billion-dollar mark in the coming years, grow multi-fold, expand our industrial activity and enter new segments. The sheer volumes allow us the opportunity to develop new products here, built for Asia. In turn, these new products will have the opportunity to cater to specific new segments globally.*"—Manager at Auto2.

Reflecting the strategic importance of emerging markets like India, the MNEs in our study rated 'prospect of a large market' and 'proximity to customers' as important factors that are driving R&D investment in India today. Extrapolating from this, we posit that if the host country is not strategically important for the MNE, the R&D unit would be unable to shore up the resources needed to respond to market needs, breaking the process of building business embeddedness. Therefore, strategic importance of the host country for the MNE is an important contingency for an R&D unit to evolve towards a GPU. Thus, we posit:

Proposition 5: The likelihood that an R&D unit will evolve into a global product unit (*GPU*) *is contingent upon the strategic importance of the host country for the MNE.*

4.6 Relative Velocity of Adaptation and Arbitrage Trajectories

Our final analysis presents the relative velocity of evolution within the two trajectories. Two firms in our study (Auto1 and Auto3) had two large R&D units each—one started as a modification unit and the other as an offshoring unit.

Let us consider the evolution of the two units of Auto3. Auto3-Unit1 began operations in 1992 as an OU and was striving to consolidate its position as an ITU in the early 2000s. Auto3-Unit2, by contrast, is a much older unit that started in India in 1951 as a modification unit. With the automotive market in India starting to mature in the 1990s, there was an opportunity for Auto3-Unit2 to make its products suitable for the Indian market, motivating it to take on an LPU role. This is evident from the following:

"*When the price war started amongst the OEMs, that's when we also started recognizing that there is some kind of a product gap. Everything is cost driven and when the cost consciousness came into the picture in the late 90s, beginning of the 2000s, that is when we started identifying the product gaps within Auto3 saying that what is available off-the-shelf in Europe is not directly suitable here for Indian application.*"—Manager at Auto3-Unit2.

The unit developed a spectrum of capabilities and evolved from doing simple product modifications to complex adaptations and development for the local

markets, *a la* LPU. When the Indian OEMs conceived products such as the Tata Nano and Mahindra Gio in the mid-2000s, Auto3-Unit1 was still evolving into an ITU but Auto3-Unit2 was already an LPU and had the capability to develop new platforms. Despite its capabilities, the progression of Auto3-Unit2 into a GPU was not without challenges. The unit had to overcome skepticism from headquarters to undertake platform development as evident from the following:

"*Initially, there was lot of apprehension from the headquarters saying, are you capable enough to do a platform development? Let's do this in Germany. This was also tried. But, European customers had never asked for such low-cost levels and HQ could not think of such a low level simplification, low cost but high technology. This could happen only by the local thinking and the local mind set.*"—Manager at Auto3-Unit2

With headquarters convinced, Auto3-Unit2 went on to build platforms, which found global application (e.g., the platform for two-cylinder engines). Though Auto3-Unit2 had developed advanced capabilities, its lack of internal embeddedness raised questions from headquarters on its ability to take on a global mandate. It took several years of internal negotiations and confidence building to establish credibility with HQ and move towards a GPU.

In the case of Auto1, the race to GPU played out differently. At the time of the interview in 2010, Auto1-Unit1 was consolidating its position as an ITU, as evident from the following:

"*Recently, the center has been looking to expand its capabilities in order to undertake system development, rather than contribute only to software development. We have been trying to develop capabilities in electrical/mechanical design.*"—Manager at Auto1-Unit1.

Auto1-Unit2, which began as a modification unit, had evolved into an LPU as the following quote from the interview reveals:

"*At the beginning, the center's activities were almost 100% mechanical engineering in nature. Today, we have broadened our capabilities and about 30% of the work falls in the category of electrical hardware and software engineering. The strategic goal has been to support the Indian customers—which we are doing more comprehensively today than we were when we started. Recently, we leverage our expertise and cost effectiveness to support other manufacturing units.*"—Manager at Auto1-Unit2.

Both units seemed equally well-positioned to move into a GPU role. Secondary data from 2011 however reveals that it was Auto1-Unit1 that evolved into a GPU and went on to drive the company's affordable car strategy globally, while Auto1-Unit2 remained an LPU. This presents a case in which there were two R&D units, one on each trajectory and both capable of evolving into a GPU. However, it was the ITU that evolved into a GPU.

The embeddedness framework provides a reasonable explanation as to which unit is likely to take on the GPU role. As we have argued before, the ITU evolves

into a GPU through a process of business embeddedness, which allows it to become aligned with local requirements. The LPU, by contrast, already has a high level of business embeddedness since its primary focus is on the local market. So, it would seem as if the LPU should have an advantage over an ITU in evolving into a GPU. The difference, however, lies in the level of internal embeddedness. The ITU with its mandate to develop products for the global markets in close collaboration with the HQ has a high level of internal embeddedness, whereas the LPU with a focus on the local market is quite autonomous and may have a low level of internal embeddedness. Winning a global mandate requires strong credibility with the HQ and can be achieved only through high internal embeddedness. However, the process of achieving this is not easy, as is evident from Auto3-Unit2's experience. Conversely, establishing business embeddedness for an ITU should be relatively easy, since it can leverage the global MNE brand and reputation to forge local connections. Therefore, we posit:

Proposition 6: Ceteris paribus, internal embeddedness is more critical than business embeddedness for speeding up the evolution of the R&D unit towards GPU in an emerging market.

5 Discussion

We primarily focused our analysis on the trajectory that began with the establishment of an offshoring unit since this is more prevalent among Indian R&D units and is also unique to India and India-like countries that offer cost arbitrage opportunity for MNEs. Our propositions position embeddedness as a critical measure of the legitimacy, knowledge and resources flowing between the R&D unit and its internal and external business network, which, we suggest, influences the evolution of R&D units. Further, we capture the process through which embeddedness is created and strengthened over time. We also compare the relative importance of internal and external business embeddedness in propelling an R&D unit towards global product mandate.

Our study presents two new insights into the world of MNE R&D. First, the study provides a process view of embeddedness and a nuanced understanding of the relationship between embeddedness and competence creation. Second, it brings forth a new trajectory of R&D evolution that accommodates the MNE R&D phenomenon in emerging markets. Together, these have important theoretical implications while also being relevant for managerial practice. We discuss each of these below.

5.1 Embeddedness and R&D Evolution

As the study traces the trajectory of R&D evolution, it underscores the role of embeddedness in driving the evolution and its relationship to various forms of competence creation. Specifically, the study contributes to the embeddedness narrative in the following ways. First, it unpacks embeddedness and lays out the process of achieving it. Though the concept of embeddedness has received substantial

scholarly attention, the focus has been on understanding the importance of embeddedness for a given unit in terms of its competence development (Andersson et al. 2001; Frost et al. 2002), performance (Andersson et al. 2002) and influence within the MNE (Andersson and Forsgren 1996; Andersson et al. 2007). The question of how embeddedness might be developed is relatively unexplored. Our study posits that internal embeddedness comes through a dialectic, self-reinforcing process of *legitimacy building—increasing investment—capability enhancement* between the R&D unit and HQ. Business embeddedness comes through a process of *active engagement—developing understanding—increased responsiveness* that plays out between the R&D unit and the customers and suppliers in its business ecosystem. The study isolates useful concepts for future research while also providing practice-relevant guidelines to develop embeddedness.

Second, our study brings forth the importance of internal embeddedness for competence creation. Much of the extant literature has dwelled on the importance of external embeddedness of subsidiaries for competence creation (Andersson and Forsgren 2000; Andersson et al. 2001, 2002; Asmussen et al. 2009; Cantwell and Mudambi 2011; Frost et al. 2002). Internal embeddedness on the other hand has not been found to directly or independently impact competence creation (Ciabuschi et al. 2011, 2014) and has even been found to be detrimental for gaining product development competence (Yamin and Andersson 2011). Our study finds that MNE R&D units in emerging markets can achieve competence-creating mandates (FTU and ITU) with internal embeddedness alone. In achieving a FTU role, units absorb a technology from HQ, and then gradually expand the scale of R&D on the back of lower costs and availability of raw talent in the ecosystem, to build competence in that technology. An increased scale of R&D in a specific area gives agglomeration benefits, allowing the FTU to contribute to the efficiency of MNE R&D. In moving to an ITU role, in addition to having technical expertise in niche areas, units develop complementary capabilities in adjacent technological areas that allows for end-to-end technical development of products. The co-location of complementary technology reduces coordination effort, allowing the unit to rapidly develop products. In other words, ITU contributes to speed or time-to-market for the MNE. In both these roles, R&D units are internally embedded, drawing and building on the knowledge base within the MNE, rather than absorbing knowledge from the external network. Both FTU and ITU are competence-creating roles but the competence is not in the form of new technologies derived from host country knowledge base, but rather, in the form of increased efficiency and speed in applying existing MNE technologies. Subsequently, when R&D units move into a GPU role, internal embeddedness facilitates the transfer of technology and products from the unit to the HQ and sister subsidiaries, paving the way for a global mandate (Håkanson and Nobel 2001). In a way, internal embeddedness is the crucial plumbing that allows for bi-directional knowledge transfer.[3]

The previous discussion raises the question of why these R&D units strive for internal embeddedness rather than external embeddedness in the initial stages. The

[3] We thank one of the anonymous reviewers for pointing this out.

implicit assumption in the developed country context is that the host country industry is competitive and local firms are generating knowledge flows that can be productively leveraged by the MNE unit to gain a competence-creating mandate. However, in the emerging country context (e.g. India), the assumption about the existence of competitive local players does not hold true. In the sectors we studied, the local industry was either non-existent (e.g., semiconductor industry) or not globally competitive. In such a scenario, the local context does not offer deep technical knowledge from which the MNE R&D units can benefit. However, it does offer abundant raw talent in multiple technologies that can be upgraded over time by drawing on the internal knowledge of the MNE. Under such conditions, MNE R&D units rely on internal embeddedness to propel them towards a competence-creating mandate.

Our study's third contribution is to the recent scholarly conversation on dual embeddedness. Studies have found that simultaneous internal and external embeddedness or dual embeddedness is important for subsidiary competence creation and innovation-related business performance (Achcaoucaou et al. 2014; Athreye et al. 2014; Ciabuschi et al. 2014; Figueiredo 2011). Therefore, there is a need for balancing external and internal relationships to nurture innovation (Ciabuschi et al. 2014). Our study contributes to this conversation by advancing how a unit can build these relationships and achieve dual embeddedness. We find that internal embeddedness takes much longer to develop than external embeddedness although the subsidiary and HQ have a preexisting relationship. This is because the subsidiary needs to compete for HQ attention, prove its capability and gradually win over the trust and confidence of the HQ. On the other hand, external business embeddedness is relatively easy to develop because the subsidiary can leverage the MNE's legitimacy, reputation and brand to forge partnerships with local business actors. This counterintuitive finding is an important consideration as subsidiaries strive to achieve dual embeddedness.

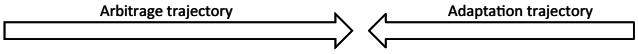
5.2 Dual Trajectory of MNEs' Overseas R&D Evolution

Our study also brings forth two trajectories of R&D subsidiary evolution in emerging markets. The first path of evolution, depicted in the lower half of Fig. 2 by dotted lines, is consistent with the received view (Cantwell and Mudambi 2005; Pearce 1999; Ronstadt 1978) and common in developed markets. In this route, the R&D units start off by adapting existing MNE products for the local market, working closely with local production and business functions, i.e., they start along the adaptation dimension. As they gain a better understanding of the local and local-like markets, they develop products for the local market, moving into a local product mandate role. Finally, these products might find an application in global markets, in which case, the units would achieve aggregation with the rest of the MNE and receive a global product mandate. Only two units in our study (Auto1-Unit2 and Auto3-Unit2) follow this trajectory with Auto3-Unit2 evolving into a GPU.

The second trajectory depicted in the upper half of Fig. 2 is the more common trajectory in emerging markets. In this path, R&D units begin as offshoring units, executing well-defined tasks, making a marginal contribution to the MNE's global

Table 2 Integrative framework of global MNE R&D

R&D Unit Attributes	Offshoring Unit	Focused Technology Unit	Integrative Technology Unit	Global Product Unit	Local Product Unit	Modification Unit
Role played in MNE R&D	Cost efficiency	Efficiency and speed	Efficiency and speed	Creation	Adaptation	Localization
Intensity of relationship with HQ	Low	Med	High	High	Low	Low
Intensity of relationship with other R&D units	None	Low	Med	High	Med	Low
Intensity of relationship with suppliers/customers	None	None	None	High	High	Med
Intensity of relationship with local sales/marketing	None	None	None	High	High	Med
Structural position in the MNE R&D network	Peripheral	Semi-peripheral	Semi-peripheral	Central	Semi-peripheral	Peripheral
Access to resources	Low	Med	Med	High	Med	Low
Autonomy of the R&D unit	Low	Low	Med	Med	High	High



products. Essentially, these units are set up to take advantage of the favorable costs in these locations. They have no link to the local production or business functions and are internally oriented, working under the close supervision of headquarters. Over time, they expand in scale and scope, evolving into FTUs and ITUs and creating competence in one or more technological areas. However, they continue to be internally focused, leaning heavily on the MNE's internal knowledge base. Finally, when they move towards a GPU role, they purposefully embed themselves in the local context in order to access the business knowledge required to develop products.

This trajectory is very different from the trajectory seen to unfold in developed countries. In advanced host countries, the market-focused R&D units have extensive linkages to the local context right from the outset. As they evolve to secure a global product mandate, they need to embed themselves internally to be able to transfer the new products and technologies to the HQ and other subsidiaries (Håkanson and Nobel 2001). The two trajectories exhibit equifinality i.e., they move towards the GPU role. However, the path they take to become a GPU is different. Together, these two trajectories depict a more complete picture of the MNE R&D evolution, one that includes the phenomenon unfolding in emerging markets as well as what we see in developed markets.

Table 2 captures how the relational, structural and resource attributes of the R&D unit changes as it evolves into different roles. The relational attributes (rows 1–5) flow directly from our analysis while the others are imputed. Take for instance, the resources controlled by the unit. It is apparent that an offshoring unit with its limited mandate has access to limited resources. As the scale and scope of R&D work increases, due to the increased criticality of the unit for

the MNE, the resources it can access are also likely to increase. Another interesting characteristic is the autonomy of the unit. The autonomy of units along the arbitrage trajectory (OU, TU) is low since they work closely with the corporate HQ and seek HQ's involvement to develop competence (Ciabuschi et al. 2011). Even as they get to a GPU role, they are unlikely to become highly autonomous since the HQ is clued into their activities. On the other hand, the units along the adaptation trajectory (MU, LPU) have a high degree of autonomy since they are focused on the local market. As they develop internal embeddedness to get to a GPU role, they are likely to sacrifice autonomy for embeddedness and/or attract higher HQ involvement due to their increasing strategic importance (Nell et al. 2011; Nell and Ambos 2013). Table 2 presents an integrated framework of global R&D evolution.

5.3 R&D Evolution and Internationalization Theories

The R&D evolution framework developed in this paper builds on and extends the broader theories of firm internationalization. The two theories of internationalization that have shaped current scholarship are the eclectic paradigm that subsumes internalization theory (Buckley and Casson 1976; Dunning 1993), and the Uppsala model (Johanson and Vahlne 1977, 2009). The eclectic paradigm or OLI framework of internationalization is rooted in transaction cost economics and posits that firms internationalize, either to leverage their unique advantages in foreign markets or to take advantage of the location-specific capabilities that foreign countries have to offer (Dunning 1993). Taking a processual approach and rooted in behavioral theory, the Uppsala model advances an incremental approach to internationalization, where the firm progressively increases its commitment to a foreign market as it gets more entrenched into the host country business networks and develops a better understanding of the foreign market (Johanson and Vahlne 2009).

The R&D framework coming forth from this study confirms that the initial R&D investment in India is driven by location-specific advantages as articulated by the OLI paradigm i.e., the availability of skilled, low-cost personnel. However, we find that subsequent investments are incremental and contingent upon the R&D unit's embeddedness as posited by the Uppsala model, gradually taking the unit to higher levels of value addition. Our study contributes to this incremental approach of internationalization in two ways—first, we find that incremental commitment and R&D progression depends not only on embeddedness in business networks as posited by Uppsala model but also on internal embeddedness. This finding could be function-specific since our study looks only at R&D units. However, given that the HQ often has more knowledge and expertise than subsidiaries across several functions, this finding may be universally applicable and needs further attention. Second, we take a subsidiary-centric view that emphasizes the agency of the foreign R&D unit, and the dialectic process that unfolds with headquarters and external actors, leading to incremental commitment. This dialectic process of creating internal and business embeddedness contributes to a more nuanced 'how' aspect of the Uppsala model.

5.4 Limitations and Implications

As with any study, there are limitations. First, the evolutionary trajectory and the factors driving the evolution are based entirely on subsidiary-level data. The role of HQ has been inferred from the responses of the R&D unit managers. Ideally, matched two-ended interviews with subsidiary and HQ managers would have provided us richer data but we were limited by lack of access to HQ managers. Second, we are generalizing the findings from India to emerging markets. For instance, there could be other motives for establishing R&D, such as political pressure and local government mandate. These did not come out as motives in the context of our study but they need to be given due consideration while extending these results to other contexts. While we concede that there may be other location-specific factors in play in other contexts, we believe that the arbitrage-driven trajectory would hold in other emerging markets that offer cost arbitrage for R&D. However, the last leg of the evolution which relies on the presence of a large local market may not play out in smaller markets. Third, we have considered only European MNEs for the study. This choice was made because the study was funded by the European Commission. However, our in-depth study of a US MNE, which has substantial investments in India, revealed the same arbitrage-driven trajectory of evolution. Finally, given our interest in understanding the evolutionary process, we focused on R&D units that had a reasonable history. This introduces survival bias in our sample. We miss what may have led to the failure or divestment of R&D units in countries like India.

The study opens several lines of scholarly inquiry. To start with, a large sample confirmatory study of the proposed framework would be a useful empirical extension. It would also be useful to examine whether and to what extent the theoretical findings of this study are applicable in other emerging markets. A second line of inquiry would be to study how the variation between competence-creating units might translate into differential structural arrangements i.e., the level of autonomy (Birkinshaw 1997; Birkinshaw et al. 1998; Krishnan 2006), embeddedness (Andersson and Forsgren 2000; Andersson et al. 2001, 2002) and power position within the MNE (Andersson et al. 2007). A third line of inquiry would be to understand the implications of the dual market orientation of R&D subsidiaries. Our study revealed that several R&D centers were becoming responsive to the local needs even as they continued to contribute to the MNE's global market. This emerging duality of roles reflects the Janus-faced form of the R&D units (Meyer et al. 2011; Mudambi 2011) and poses a management challenge for an already complex R&D organization (von Zedtwitz et al. 2004), and merits detailed study.

Our study is relevant for practitioners as well. R&D unit managers can use the taxonomy of R&D roles to assess their current position and leverage the embeddedness framework to systematically move to the next rung of value creation within the MNE. The framework also allows HQ managers to understand the dynamics of the company's R&D network and accordingly rationalize activities and allocate resources.

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