How I Met Your Market: CEO's Professional Experience and Reverse Innovation in Indian Pharmaceutical Firms

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Abstract

Reverse innovation refers to an innovation first developed or adopted in an emerging economy before being further developed and/or adopted in advanced ones. Despite the growing research on reverse innovation over the past decade, its firm-level antecedents remain relatively unexplored. We examine how different dimensions of CEO professional experience can impact reverse innovation in multinational firms from emerging markets, drawing on Upper Echelons Theory and data from the ORBIS IP dataset alongside manually collected data. On a sample of 8,301 India-USA patent dyads representing the reverse innovation of 143 pharmaceutical firms between 2014 and 2023, we find that firm-level experience and international experience of the CEO are positively associated with reverse innovation. In contrast, CEOs' overall professional work experience has a negative influence on a firm's reverse innovation capability, whereas multi-industry experience of CEOs shows no significant impact on reverse innovation. Our study contributes to the reverse innovation debate by disaggregating the specific aspects of CEO experience that enhance or hinder reverse innovation, with a specific focus on emerging market multinational firms.

Keywords*: CEO professional experience; Emerging market multinationals; Pharmaceutical sector; Reverse Innovation; Upper Echelons Theory.*

1. Introduction

Traditionally, international business and innovation studies have portrayed emerging economies as passive recipients of technologies originating from advanced economies (Vernon, 1966, Cantwell, 1995). Yet, over the past two decades, emerging market multinational corporations (EMNCs) have proven capable of developing innovations that address local markets but also achieve global competitiveness. (Govindarajan and Ramamurti, 2011, von Zedtwitz et al., 2015). This phenomenon, known as *reverse innovation*, refers to innovations first developed or adopted in emerging economies before being transferred to, further developed in, and subsequently diffused within advanced economies. Reverse innovation, thus, captures a fundamental transformation in global knowledge and innovation dynamics, with EMNCs playing an ever-increasing role in a landscape traditionally dominated by advanced countries market multinationals corporations (AMNCs). This raises new theoretical and managerial questions about the internal conditions enabling firms from emerging economies to generate and internationalize innovation, with a growing body of literature exploring the determinants of reverse innovation (Govindarajan and Euchner, 2012, Roth et al., 2024, Sears and Muhammad, 2024). At a macro-level, unique market characteristics, innovation-fostering policies, and strong economic growth can position emerging markets as providers of novel and globally relevant innovations (Govindarajan and Euchner, 2012) Much less is known about the micro-level factors that shape firms' ability to undertake reverse innovation, particularly given that innovation strategies depend not only on external opportunities but also on how their leaders interpret, prioritize, and act upon them (Tidd, 2001).One of the best-known insstances of reverse innovation occurred at General Electric (GE) Healthcare, where CEO leadership explicitly encouraged innovation aimed at resource-constrained markets. Under this strategic direction, GE's India operations developed affordable, portable medical equipment – including low-cost

ECG and imaging technologies for rural settings – which were subsequently introduced in advanced markets, illustrating how a CEO can shape organizational commitment to reverse innovation transfer (Immelt et al, 2009). Understanding how managerial cognition and experience influence innovation choices is therefore essential for explaining the heterogenous innovation performance amongst EMNCs. Notably, the antecedents of reverse innovation cannot be assumed to mirror those of EMNC innovation more broadly. Reverse innovation requires senior leaders to recognise the global potential of locally developed innovations, navigate institutional and technological asymmetries across markets, and orchestrate exploration in emerging markets alongside exploitation in advanced ones. These capabilities differ from the requirements of domestic or South–South innovation. Given these, CEO-level characteristics are theoretically central in determining reverse innovation in firms. Building on Upper Echelons Theory (UET) and dynamic managerial capabilities, we argue that CEOs' experiential backgrounds influence the cognitive frames, relational resources, and boundary-spanning abilities needed to initiate and scale reverse innovation.

UET (Hambrick and Mason, 1984) posits that organizational outcomes are partly determined by the experiences, values, and cognitive frames of top executives. Built on bounded rationality theory (March and Herbert, 1993, Simon, 1997), it suggests that in uncertain and imperfectly known environments, strategic decisions depend on executives' interpretations rather than purely rational analysis (Hambrick and Mason, 1984). UET also identifies that the CEO's professional background and prior experiences shape how they perceive risks, opportunities, and the appropriate scope of innovation (Wang et al., 2016). In emerging markets, where volatility, resource scarcity, and institutional gaps are pronounced - CEOs' experiential backgrounds may become even more influential in shaping firms' innovation direction (Chen et al., 2022, Aghasi et al., 2024). Yet, despite the growing literature on

reverse innovation, the role of CEOs in providing the micro-foundations of this process remains largely unexplored.

To fill this gap, this study builds on UET and investigates how the professional experience of CEO affects reverse innovation in EMNCs. Specifically, we focus on how CEO experience shapes variation in the extent of reverse innovation among firms already engaged in international innovation, rather than on the initial adoption of reverse innovation, which in the Indian pharmaceutical context is largely driven by industry structure and regulatory internationalization pressures (Sahasranamam et al., 2019; Munjal et al., 2021). However, CEO professional experience is not a singular construct but encompasses a range of professional attributes that may shape strategic orientation and decision-making (Ahn, 2022). Therefore, we conceptualize CEO experience as a multidimensional construct comprising (1) overall career experience, (2) firm-specific tenure, (3) international exposure, and (4) multi-industry background. Each dimension offers distinct cognitive and relational resources that can either facilitate or constrain innovation. For example, while firm-specific and international experience may enhance contextual understanding and absorptive capacity, extensive career experience or multiple industry exposures may induce strategic rigidity or dilute focus.

We focus on the specific context of India for this examination. India is a leading emerging market, which also hosts the world's 3rd largest pharmaceutical industry (Harish et al., 2025). Given its global scale and international growth, the Indian pharmaceutical industry offers an ideal setting to test our hypotheses on reverse innovation. On a sample of 457 individual data points, corresponding to 143 unique Indian pharmaceutical firms and 8,301 reverse innovations, in the 2014-2023 time-period, we perform several sets of analysis and tests of robustness. Although reverse innovation is conceptualized as a broader strategic process, we operationalize it through India-USA paten dyads, which provide a concrete indicator of

realized innovation transfer. Our findings reveal that the experience of CEOs in the specific firm as well as their international experience have a positive influence on a firm's reverse innovation capability. However, the overall professional experience of CEO has a negative impact on reverse innovation in our sample firms, whereas multi-industry experience has no consequence for reverse innovation.

Our findings contribute to the literature in two main ways. First, we shift the focus from macro to firm-level determinants of reverse innovation in the context of emerging economy firms. In doing this, we reposition the focus of reverse innovation studies from AMNCs to EMNCs and identify how the different dimensions of CEO experience hinder and support reverse innovation. We thereby respond to calls for the examination of firm-level factors that trigger reverse innovation and push and pull factors in global innovation, in various settings (Corsi and Bianchi, 2024, von Zedtwitz et al., 2015). Second, by applying UET in the context of reverse innovation in EMNCs, we extend the relevance of this theory in the outcomes of strategic innovations. By disaggregating the various aspects of CEO experience, which had predominantly been examined as a single construct, we enhance the predictive capability of UET by offering a more nuanced and context-specific understanding of CEO professional experience on their performance outcomes, specifically in relation to reverse innovation. Our work therefore offers contextual refinement and specificity to managerial attributes and their ability to strategic outcomes in complex environments (Carpenter et al., 2004, Hambrick, 2007).

2. Literature Review and Theoretical Discussion

Traditionally, innovation flows have been viewed as originating in advanced economies and diffusing to emerging markets, in line with theories such as the Product Life Cycle Theory (Vernon, 1979, Vernon, 1966) and Research and Development (R&D) internationalization literature (Di Minin and Bianchi, 2011, Papanastassiou et al., 2020, Sears and Muhammad,

2024). More recently, however, a growing number of studies have investigated the phenomenon of reverse innovation - innovations originating from emerging economies, which later diffuse to developed markets (e.g. von Zedtwitz et al., 2015). Table 1 synthesizes these limited set of studies able 1 synthesizes thse limited set of studies examining antecedents of reverse innovation in EMNCs.

Insert Table 1 about here

Notably, while reverse innovation of AMNCs through their subsidiaries in emerging markets is significant, it is arguably even more critical for EMNCs which compete internationally with domestically developed innovations, or new products, services, and business models ideated based on inputs from their home markets (Malodia et al., 2020). Despite macro-level analyses emphasizing institutional complexity and market heterogeneity in emerging economies (Govindarajan and Euchner, 2012, Hadengue et al., 2017), firms operating in similar environments still display significant variation in their reverse innovation outcomes. This implies that managerial cognition and experience can potentially play a decisive role in whether EMNCs can sense and seize global opportunities arising from locally developed innovations. Reverse innovation in EMNCs requires not just local responsiveness to the external environment but a clear and focussed strategic vision to scale innovations globally (Immelt et al., 2009), which is potentially led by their CEOs. In this context, UET suggests that CEO experiences and cognitive frames guide the response of firms to external stimuli (Hambrick and Mason, 1984). Thus, CEO characteristics can be critical enablers or constraints on a firm's ability to produce reverse innovations (Corsi et al., 2014, Guo et al., 2024). Recent evidence supports this logic in R&D and innovation decision making processes. For example, CEO overconfidence steers open innovation choices (Xia et al., 2023), political ideology affects R&D spending (Guo et al., 2024), and top-management

interactions with suppliers enhance product innovation (Prokop and Hajek, 2023). Research in emerging markets also shows that CEO experience meaningfully shapes strategic innovation decisions and leaders' cognitive frames, international exposure, and experiential learning enable firms to navigate institutional complexity and uncertainty (e.g. (Chen et al., 2022, Aghasi et al., 2024, Maitland and Sammartino, 2015)Chen, Li & Snell, 2022; Aghasi, Lee & Park, 2024; Maitland & Sammartino, 2015). Despite these implications from the extant literature that the CEO can have a strong role in determining reverse innovation efforts in EMNCs, as Table 1 reveals, this relationship has not been empirically tested, to the best of our knowledge. As Table 1 illustrates, prior empirical studies on reverse innovation have primarily focused on firm, product, subsidiary, or TMT-level determinants. By explicitly theorizing and testing multiple dimensions of CEO experience, our study addresses this gap and provides the first CEO-level account of reverse innovation in EMNCs.

While UET explains why managerial background matters, it tends to portray experience as static. The dynamic-managerial-capabilities (DMC) framework reconceptualises experience as an active mechanism that enables managers to sense, seize, and reconfigure opportunities (Teece, 2007, Helfat and Martin, 2015). In volatile emerging-market environments, CEOs' experiential diversity influences how effectively they orchestrate resources, manage uncertainty, and legitimise innovation both locally and globally (Khan et al., 2022, Li and Cui, 2018, Zhang et al., 2020). We posit that reverse innovation epitomises this dynamic, requiring CEOs to balance exploration **(**developing novel solutions) and exploitation (refining and scaling already developed solutions). This duality reflects the essence of organisational ambidexterity (O'Reilly and Tushman, 2013). In EMNCs, firm-specific experience facilitates exploitation through deep organisational understanding and embedded networks, whereas international exposure supports exploration by broadening cognitive maps and enabling boundary-spanning learning (Roth et al., 2024), transforming experience into a dynamic

managerial capability. CEOs professional experience shapes decision-making processes by shaping cognitive framing and perceptual filters, affecting how decision-makers interpret available information (Hunt et al., 2024), generating tacit knowledge that can enhance their ability to handle uncertain, complex, or novel situations (Garrick and Chan, 2017), shaping risk propensity and therefore attitudes towards innovation investments (Michel and Hambrick, 1992) and providing network linkages and resource access (Milosevic, 2018). Further, the accelerating levels of digital transformation in emerging markets also enhances information connectivity and knowledge recombination (Li et al., 2023), enabling experienced CEOs to better leverage their firm-specific and international learning to coordinate dispersed innovation efforts and scale new products globally.

However, 'experience' is a multi-faceted construct. Extant studies suggest that firms consider a varied range of experiences in individuals (such as prior functional roles, industry-specific expertise, multi-industry backgrounds, and international exposure), when selecting CEOs (Hamori and Koyuncu, 2015). Notably, each dimension of executive experience can uniquely influence managerial cognition and decision-making capabilities: firm-specific experience enhances internal knowledge about the resources, capabilities and aspirations of the firm (Hamori and Koyuncu, 2015), while multi-industry and international experiences can enhance cognitive adaptability, global mindset and innovation orientation (Hambrick, 2007, Carpenter et al., 2004). To account for this, we examine the impact of a range of CEO experiences, viz., their overall, firm specific, international and multi-industry experience, on reverse innovation in their respective firms.

3. Hypotheses Development

3.1 Overall professional experience of the CEO

Experience enables CEOs to accumulate contextual and organizational knowledge that they can rely on to navigate complex environments (Hamori and Koyuncu, 2015, Beal and Yasai-Ardekani, 2000, Custódio and Metzger, 2013). Click or tap here to enter text.UET posits that decision-makers such as CEOs act on their understanding of the strategic situations they face (Hambrick and Mason, 1984), and this understanding is shaped by their experience, which reflects their skills, knowledge, and cognitive orientation (Barker and Mueller, 2002). More experienced CEOs can draw on prior decisions to develop viable innovation plans (Liao and Wu, 2024, van de Wal et al., 2020). In emerging markets, extensive experience generates valuable resources: senior executives often develop political skills, broad stakeholder networks, deep regulatory knowledge, and external legitimacy (Finkelstein et al., 2009, Maitland and Sammartino, 2015, Banna et al., 2024). Evidence from Brazilian, Chinese, and Indian firms shows experienced leaders leverage social capital and political competencies to navigate regulatory complexity and manage key innovation partnerships (Borini et al., 2016, Chen et al., 2022).

While CEO experience can equip emerging-market firms with valuable strategic insight, extensive overall professional experience may also hinder reverse innovation in the following ways. First, greater experience often reinforces established mental models and success formulas, increasing cognitive rigidity and risk aversion (Barker and Mueller, 2002, Herrmann and Datta, 2005, Chen et al., 2022). This reduces support for unconventional and disruptive initiatives such as reverse innovation, which require openness to experimentation and comfort with ambiguity (Hadengue et al., 2017). Second, in dynamic technological environments, accumulated experience can further magnify inertia as CEOs become attached to familiar routines and are therefore, less willing to adopt new digital tools and organizational forms that enable distributed, bottom-up innovation (Khan et al., 2022, Aghasi et al., 2024). Third, CEOs whose careers were shaped when innovation predominantly

flowed from developed economies may undervalue innovations originating in emerging markets, viewing them as misaligned with their strategic worldview (Gupta and Thomke, 2018, Roth et al., 2024). Taken together, these mechanisms suggest that longer CEO experience may constrain the adoption of reverse innovation strategies despite their growing relevance for EMNCs competing globally.

We posit that the potential constraining effect of overall professional experience on reverse innovation derives from its external and generalized nature. Accumulated career experience tends to produce broad managerial schemas and success templates that are portable across firms but less sensitive to firm-specific contexts. While such generalized expertise can be valuable, it may also reinforce path dependence and cognitive inertia, particularly when strategic renewal requires abandoning established innovation logics, as is the case with reverse innovation.

Therefore, we hypothesize the following:

Hypothesis 1: Overall professional experience of the CEO is negatively associated with the extent of reverse innovation undertaken by the firm.

3.2 Firm specific experience of the CEO

In contrast to overall professional experience, firm-specific experience is rooted in prolonged organizational embeddedness (Hambrick and Fukutomi, 1991; Finkelstein et al., 2009). Rather than shaping generalized managerial schemas, this form of experience generates deep contextual knowledge of internal processes, technological capabilities, and stakeholder relationships (Chen et al., 2022; Cummings and Knott, 2018). As such, firm-specific experience primarily operates through organizational mechanisms, enhancing coordination capacity, internal legitimacy, and access to relational resources, rather than through broad cognitive templates (Helfat and Martin, 2015; McDonald et al., 2008; Maitland and

Sammartino, 2015). This enables them to better orchestrate complex initiatives such as reverse innovation, which requires cross-functional coordination and alignment of diverse internal resources across the firm. In the context of emerging markets, firm-specific experience of CEOs is particularly critical in navigating complex institutional landscapes and mobilizing internal resources effectively to drive innovation (Chattopadhyay et al., 2012).

While UET explains why firm-specific experience shapes interpretation and decision-making, dynamic managerial capabilities (DMCs) suggests that embedded experience also equips CEOs with the ability to *sense* emerging opportunities, *seize* promising ideas, and *reconfigure* internal resources to support innovation (Helfat and Martin, 2015). Because firm-specific experience builds tacit knowledge about internal competencies and bottlenecks, embedded CEOs can more effectively coordinate distributed R&D teams, realign internal structures, and mobilize the resources required for the upward diffusion of local innovations : capabilities central to reverse innovation.

Additionally, reverse innovation, by its very nature, entails substantial organizational change and can face resistance from internal and external stakeholders. Internal stakeholders such as middle managers, employees, R&D teams, and domestic subsidiaries may perceive non-traditional innovation as a threat to established decision-making authority and disruptive towards domestic market responsibilities (Bagrationi and Thurner, 2023, Splitter et al., 2023). Externally, customers, distributors, shareholders, institutional investors, suppliers, and alliance partners may resist such innovations due to fears of quality compromise, reputational risks, added supply chain complexity, and uncertain financial returns (Talwar et al., 2023). CEOs with longer firm-level experience can overcome such resistance and concerns as they possess accumulated relational capital and organizational embeddedness, having developed trust and credibility through sustained interactions with these stakeholders (McDonald et al., 2008). This legitimacy enhances their ability to initiate and sustain transformative initiatives

that may be difficult for newer CEOs to implement (Kaplan and Minton, 2012). This in-turn will enable them to manage conflicts, phase in changes strategically, and buffer the firm against external pushback (Hambrick and Fukutomi, 1991), thereby increasing the likelihood of successful implementation of reverse innovation.

Research on CEOs in emerging-economy firms further supports this view: embedded leaders often possess the relational, political, and cultural competencies needed to operate in fragmented or institutionally weak environments (Maitland and Sammartino, 2015, Borini et al., 2016). In such contexts, these competencies enable more effective engagement with regulatory authorities and external stakeholders, facilitate alliance formation with suppliers and partners, and help balance continuity with strategic adaptation in exploration-oriented strategies. These political and relational skills are especially relevant for reverse innovation, which requires translating locally developed ideas into globally legitimate offerings.

Finally, longer association with the firm is linked to stronger psychological ownership of the firm (Pierce et al., 2001), which can encourage CEOs to prioritize longer-term, legacy-building strategies. While some scholars have argued that long tenure can also foster strategic rigidity and reluctance to pursue disruptive innovation (Hambrick and Fukutomi, 1991, Miller and Shamsie, 2001), others suggest that it can also provide CEOs the freedom and security to engage in high-risk innovation strategies (Balsmeier and Buchwald, 2015, Barker and Mueller, 2002). We argue that in the context of reverse innovation, which requires internal credibility, and deep firm-specific knowledge, the benefits of longer firm-specific experience are likely to outweigh the risks of conservatism.

This clarifies why firm-specific experience promotes reverse innovation while overall experience may hinder it (as argued in Hypothesis 1). Overall career experience reinforces general managerial templates and cognitive inertia, whereas firm-specific experience creates

embedded learning about the organisation's unique capabilities, technological paths, and social dynamics. This embeddedness strengthens the CEO's ability to orchestrate ambidextrous innovation, balancing local exploration with global exploitation (Roth et al., 2024), and enhances the capacity to mobilise support for reverse innovation. The direction of effect differs not because one form of experience is inherently superior, but because the locus of experience shapes whether it produces rigidity (Hypothesis 1) or adaptive capability (Hypothesis 2).

Therefore, we hypothesize the following:

Hypothesis 2: Greater firm-specific experience of the CEO is positively associated with the extent of reverse innovation undertaken by the firm.

3.3 International experience

As previously argued, reverse innovation represents a relatively novel strategic behaviour for EMNCs, whose historical internationalization strategies have focused more on market access or resource acquisition than innovation (Luo and Tung, 2007). Reverse innovation is likely to require organizational change implemented by the senior management team and the CEO. Previous research demonstrates that CEOs' international experience positively affects strategic change (Le and Kroll, 2017), providing firms with the necessary resources and capabilities to compete globally (Carpenter et al., 2001). International experience allows CEOs to develop those competences and capabilities that reduce the cultural distance between the firm they lead and their country of expansion (Ghemawat, 2001). International experience also provides them with market knowledge that can further reduce that distance, decrease their liability of foreignness (Zaheer, 1995), which is particularly relevant in the case of EMNEs (Li and Fleury, 2020). The reduction of distance and liability of foreignness can ease the CEOs' perception of risk and therefore increase their propensity to engage in reverse innovation. Therefore, we hypothesize the following:

Hypothesis 3: Greater international experience of the CEO is positively associated with the extent of reverse innovation undertaken by the firm.

3.4 Multiple industry experience

CEOs can gain their professional experience from a single industry, or from a range of industries, and the nature of their technical knowledge can differ based on this aspect of their background (Woo, 2019). CEOs' industry experience provides valuable network connections and insights into industry conditions and trends, enabling them to respond effectively to opportunities and threats in changing business environments, while also bringing broader cognitive repertoires, greater adaptability, and stronger cross-domain problem-solving capacity (Custódio and Metzger, 2013, Li and Patel, 2019).

However, reverse innovation in firms can be impaired due to the multi-industry experience of CEOs for the following reasons. First, sectoral reverse innovation in science-based and regulation-intensive industries demands deep domain expertise, specialised mental models, and strong absorptive capacity (Pisano, 1997, Cohen and Levinthal, 1990). In pharmaceutical firms, for instance, CEOs lacking detailed prior knowledge may struggle to assess scientific opportunities, navigate therapeutic markets and regulatory pathways, or evaluate which locally developed innovations can succeed globally (Nadkarni and Chen, 2014, van de Wal et al., 2020). Second, reverse innovation in such settings requires credibility with technical experts and without industry-specific legitimacy, leaders have limited influence over R&D priorities and face resistance when steering complex, cross-functional collaboration (Elkins and Keller, 2003, Berson and Linton, 2005, Zucker et al., 1998). Third, effective coordination further depends on shared cognitive understanding between decision-makers and scientific personnel and insufficient depth can create misalignment and communication barriers that obstruct the orchestration of regulatory, clinical, and technological capabilities essential for

reverse innovation (Grant, 1996, Nonaka and Takeuchi, 1995, Pisano, 1997). Thus, although generalist CEOs may offer breadth and adaptability, in knowledge-intensive pharmaceutical contexts the liabilities of insufficient depth outweigh those benefits, making domain specialisation more predictive of reverse innovation success (Munos, 2009, Medcof, 2008).

We however acknowledge that the effects of multi-industry experience can be context dependent. While generalist CEOs benefit from broader cognitive repertoires and adaptive capacity (Custódio et al., 2013; Ederer and Manso, 2013), in science-based and highly regulated industries such as pharmaceuticals, reverse innovation places particularly strong demands on domain expertise, regulatory knowledge, and technical legitimacy (Pisano, 1997, Henderson and Cockburn, 1994). Moreover, in emerging-market contexts such as India, generalist leadership is often institutionally legitimised and valued (Cappelli, 2010), potentially offsetting the disadvantages associated with reduced sectoral depth. Thus, although we hypothesise a negative association in the present setting, we acknowledge that the influence of multi-industry experience may vary across institutional and industrial contexts.

Hypothesis 4: Greater multi-industry experience of the CEO is negatively associated with the extent of reverse innovation undertaken by the firm.

We present the overall conceptual model of our study in figure 1.

Insert Figure 1 about here

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4. Research methodology

4.1 Empirical Background

We choose the context of India to test our hypotheses. The world's 3rd largest by volume and 14th largest by value, the Indian pharmaceutical industry has emerged as a global player,

accounting for 60% of global vaccine production (Foundation, 2025). The Indian pharmaceutical industry provides a compelling context for examining reverse innovation as it represents one of the most dynamic emerging-market sectors, combining strong scientific capabilities, cost-efficient R&D, and growing international linkages (Dhar and Joseph, 2019, Munjal et al., 2021). Over the past two decades, Indian pharmaceutical firms have evolved from generic producers to global innovation players, increasingly engaging in R&D collaborations and patenting activities targeted at advanced markets such as the United States and Europe (Brandl et al., 2015, Sahasranamam et al., 2019). Indian pharmaceutical ecosystem exemplifies how emerging-market firms integrate domestic and international knowledge sources to upgrade technologically and compete globally (Dhanora et al., 2024, Munjal et al., 2021). This combination of local innovation capability and international orientation makes Indian pharma an ideal setting for studying reverse innovation.

4.2 Data

For our analysis we use data sourced from ORBIS Intellectual Property (IP) dataset, operated by Moody's, along with manually collected data on the CEOs of Indian pharmaceutical firms. ORBIS IP dataset collates and links firm and patent-level information for 2.4 million firms worldwide and is often used in R&D and innovation-based studies across multiple contexts (Li and Deng, 2025). In line with extant literature, we use transnational patent data as a measure of reverse innovation (Huang and Li, 2019, Willoughby and Mullina, 2021). Specifically, we collect details on patent dyads between India and the United States of America (USA). The USA is the most significant export destination for the Indian pharmaceutical industry (Industry, 2022). Furthermore, due to the stringent standards of U.S. Food and Drug Administration, engagement with this market also signals technological and regulatory credibility for the Indian firms involved (Kamal et al., 2024). This focus does not imply that U.S. regulatory standards are superior to those of other advanced economies;

rather, we employ FDA-related market entry as one observable and consistent indicator of successful innovation transfer for Indian pharmaceutical firms into a stringent advanced-market regulatory environment. Therefore, examining these patent dyads enables us to capture the extent of reverse innovations in Indian pharmaceutical firms aiming to develop or adapt their innovations in international markets. While patent dyads do not encompass the full spectrum of organizational capabilities underlying reverse innovation, they constitute a rigorous and comparable outcome-based measure of realized cross-border innovation transfer. We choose the 10 years in the 2014-2023 time-period for our analysis. In the year 2013, Companies Act 2013, which provides a robust framework for corporate governance in Indian firms was enacted, and therefore, we expect a higher level of consistency in data availability and compliance standards in firms from 2014 onwards (Dharmapala and Khanna, 2018).

From the Orbis IP database, we first identify Indian pharmaceutical firms by filtering for firms located in India and classified under SIC code 2834. Next, based on the typology of reverse innovation developed by Von Zedtwitz *et al.*, (2015), we identify four different kinds of reverse innovations using transnational patents filed by Indian pharmaceutical firms. The first category of RI involves cases where the R&D for the innovation takes place in India (i.e. inventors are located in India), after which the innovation is patented in the USA (Number of patents identified: 334). In the second category of reverse innovation, we include those cases where the R&D for the innovation takes place in India (i.e. inventors are located in India), after which the innovation is first patented in the USA, and later, in India (Number of patents identified: 7800). The third category includes those innovations developed by Indian inventors in India, first patented in India and later in the USA (Number of patents identified: 82). Finally, we also include those innovations whose inventors are located in the USA, but the invention is first filed in India before making it to the USA (Number of patents identified: 85). The final sample consists of 457 individual data points, corresponding to 143 unique

Indian pharmaceutical firms and 8,301 reverse innovations, in the 2014-2023 time-period. These details are summarized and presented in Table 2.

Insert Table 2 about here

To this dataset, we add detailed information on CEOs' professional experience. For each of the firm–years where the firm was engaged in reverse innovation, we identified the CEO in office and compiled their background information for that specific year. CEO data were manually collected between December 2023 and April 2024 by a research assistant under the supervision and random verifications by the second author for accuracy and robustness. The primary source of information was the CEO's LinkedIn profile, which was cross verified with firm annual reports, company websites, and stock exchange filings wherever possible. In cases of discrepancies, LinkedIn data were prioritized unless clear documentary evidence suggested otherwise.

CEO information was successfully obtained in most instances. Missing observations arose primarily when the CEO could not be identified for a specific year; in such instances, the corresponding firm–year was excluded from the analysis. This retrospective, hand-collected dataset thus provides a reliable representation of CEO career characteristics in the identified reverse innovation years, while acknowledging that certain personal attributes (such as age) are not publicly disclosed and therefore unavailable for this study.

4.3 *Variables*

Dependent variable: We measure reverse innovation as a count of total number of transnational patents with the USA that an Indian pharmaceutical firm has filed for, based on

the criteria explained in the previous section. We identify a total of 8,301 patents, corresponding to 143 Indian pharmaceutical firms.

Explanatory variables: We measure the impact of different CEO experience attributes by identifying four aspects of their professional experiences. First, the *CEO overall experience* is measured as the overall professional work experience of the CEO in months. Second, the *CEO firm experience* is measured as the number of months the CEO has worked at the focal firm in any capacity. Third, we use a dummy variable to indicate whether the CEO has multi-industry experience or not. This variable, *CEO multi-industry experience* takes value 1 if the CEO has professional experience in multiple industries and a value 0, otherwise. Finally, we use a dummy variable *CEO international experience* which takes a value 1 if the CEO has international professional experience, outside India, and a value 0, otherwise. While overall and firm-level experiences could be recorded precisely in months from company disclosures and professional profiles, information on international or multi-industry experience was typically qualitative (e.g., mentioned without specific durations). Therefore, these latter dimensions were coded as binary indicators to ensure consistency and accuracy across the manually collected dataset. Notably, the CEO experience variables are time-varying: for firms appearing in multiple years, CEO attributes were recorded for each firm–year in which reverse innovation occurred; for continuing CEOs, both overall and firm-specific experience were updated annually to reflect additional tenure, while CEO changes were coded as new observations, resulting in CEO characteristics varying both across firms and within firms over time.

Control variables: Based on a survey of extant literature, we also control for several variables which may impact the level of reverse innovation in firms. These include the age of a firm measured as the number of years since inception (Balasubramanian and Lee, 2008), the size of a firm measured as its total assets (Rogers, 2004), the performance of a firm measured

as the return on assets (Singh and Gaur, 2013), the liquidity of the firm measured through its current ratio (Fang et al., 2014), the R&D intensity of the firm (Cincera, 1997), the percentage of shares held by different ownership groups such as corporates, promoters and institutional investors (Edacherian and Panicker, 2022), and the characteristics of the board of directors of each firm, including board size and board independence (Sierra-Morán et al., 2022). We also include year fixed effects in all models to account for time-specific shocks in the environment (Allison, 2009).

4.4 Methods and Results

Our dependent variable is a count variable; the two appropriate estimation techniques in such situations are negative binomial regression and poisson regression (Hausman et al., 1984). Our preliminary analysis with the overdisp command in Stata (Fávero et al., 2020) showed evidence of overdispersion in our data. We therefore employed negative binomial estimation which corrects for overdispersion. We use multilevel mixed-effects regression model (using MENBREG command on STATA) to account for the hierarchical structure of our panel data, incorporating random effects at the firm-level, handling the nested nature of the data and allowing us to capture firm-specific heterogeneity (Faems et al., 2020). We also employ a one-year lag between the dependent variable and independent variables which corresponds to a typical business planning sequence (Geringer et al., 2000, Wan and Hoskisson, 2003).

Further, while the theoretical framework distinguishes among multiple forms of reverse innovation (von Zedtwitz et al., 2015), the empirical distribution in our dataset is highly skewed (as presented in Table 2). More than 90 percent of identified cases correspond to Type 2 reverse innovation (innovations developed in India and first patented in the USA). Given this overwhelming concentration, separating types empirically would add little analytical

variation and risk unstable estimates. Accordingly, our data analysis focuses on the overall intensity of reverse innovation at the firm level, treating all types as manifestations of the same underlying process of innovation transfer from emerging to advanced markets.

In Tables 3 and 4, we present the descriptive statistics and correlation matrix. The descriptive statistics in table 3 demonstrates that while the average number of reverse innovation patent dyads per firm is 18.16, the high standard deviation (33.54) and large range (1 to 258) indicate significant variation in the level of reverse innovation among our sample firms. Overall, the CEOs in our sample have long tenures, with an average of 220 months of firm-specific and 395 months of overall experience. Further, around 40% of CEOs have international and around 20% have cross-industry experience. We also find from table 3 that firm size has a high variance, and hence we calculate and utilize the logarithms of firm size in our analysis. We also winsorize all the dependent and control variables at the 1st and 99th percentiles to mitigate the influence of outliers.

From table 4, we find that there is significant correlation between certain variables, which raises the concerns of possible multicollinearity. We computed the Variance Inflation Factors (VIF) and our results show that the average VIF is 1.6, which falls below even the most conservatively accepted range of 5 (Hair et al., 2010), confirming that our model does not suffer from multicollinearity.

Insert Tables 3 and 4 about here

Table 5 presents the outcomes of multilevel mixed-effects negative binomial estimation on the relationship between CEO experience and reverse innovation in Indian pharmaceutical firms. We present our results hierarchically, by adding one attribute of CEO experience to each model. Model 1 in table 5 shows that CEO overall experience is negatively related to

reverse innovation (b-value=-0.004, p-value=0.020), thereby supporting hypothesis 1. From model 2, we find that CEO firm experience has a positive and significant impact on reverse innovation (b-value=0.001, p-value=0.024), thereby supporting hypothesis 2. From model 3, we find that hypothesis 3 is supported, as CEO international experience dummy is positively related to reverse innovation (b-value=0.419, p-value=0.005), thereby supporting hypothesis 3. Finally model 4 shows that CEO international experience has no impact on reverse innovation (b-value=0.235, p-value=0.437), rejecting hypothesis 4.

We also interpret the economic significance of our findings from each of these models. From model 1 in table 5, we find that one additional year of CEO experience decreases reverse innovation by about 4.7%. Similarly, from model 2 in table 5, we find that one additional year of firm-specific experience increases reverse innovation in a firm by around 1.2%. Finally, from model 3 in table 5, we can interpret that CEOs with international experience have an expected reverse innovation count 52% higher than those without it.

Insert Table 5 about here

Further, we acknowledge that our models can suffer from potential endogeneity (Iyengar and Zampelli, 2009). Potential endogeneity arises in this setting because CEO experience is unlikely to be randomly assigned across firms. Boards may strategically select CEOs whose experience profiles align with the firm's innovation and internationalization ambitions, while more innovative firms may attract or retain CEOs with stronger international or firm-specific backgrounds. Such board–CEO matching and strategic selection processes imply reverse causality and omitted-variable bias, as unobserved firm characteristics (e.g., innovation orientation or governance quality) may jointly influence both CEO appointments and reverse innovation outcomes (Iyengar and Zampelli, 2009). To ascertain the robustness of our

outcomes by accounting for this potential endogeneity, we employ Generalized Methods of Moments (GMM) in our estimations. We accomplish this by using the xtabond2 command in Stata to execute system GMM estimator (Blundell and Bond, 1998, Roodman, 2009). While the reported results correspond to instruments lagged to time-periods t2 and t3, we performed analysis with alternate lags and received similar outcomes. The results of these analyses are presented in Table 6. We also report the autocorrelations AR1 and AR2, which correspond to first order and second order correlation of residuals and Hansen's J-test of over-identifying restrictions, for each of our models. In a dynamic panel data regression, we expect to have a first-order serial correlation (i.e., AR1), but there should be no second-order serial correlation (i.e. AR2) (Zhou et al., 2022), as is the case with all our estimation outcomes. We also find from the Hansen's J-test statistics that the null hypothesis that the estimates are not consistent, is not rejected, confirming the validity of our instruments. From Table 6, we find that the outcomes of system GMM estimations are qualitatively similar to that of our initial sets of outcomes, further ensuring the robustness of our findings.

Insert Table 6 about here

Next, we acknowledge COVID-19 pandemic created significant macroeconomic shocks, both to the overall economy and the pharmaceutical industry (Tirivangani et al., 2021). To account for this, we estimate additional models excluding the pandemic years (2019, 2020, and 2021). The results of this analysis (with 384 data points), presented in Table 7, are also qualitatively similar to our initial findings.

Insert Table 7 about here

Further, because our dependent variable captures only firms that have undertaken reverse innovation, observations with zero reverse innovation are absent from our dataset. This can produce a zero-truncated count distribution, as the outcome is observed only for firms with positive counts. To account for this truncation and avoid bias in parameter estimates, we re-estimated the model using a Zero-Truncated Negative Binomial specification, which explicitly adjusts the likelihood function for the absence of zero outcomes. The results from this model are identical to the initial findings and are shared in Table 8.

Insert Table 8 about here

Further, UET suggests that accumulated experience can simultaneously expand managerial capabilities and reinforce entrenched cognitive frames, implying that the marginal value of one experience type may depend on the presence of others (Hambrick and Mason, 1984; Liu and Ji, 2022). Accordingly, we examine two-way interactions among all the CEO experience dimensions as exploratory extensions to our base models. Of these, two were statistically significant and negative: (1) overall experience × international experience, and (2) firm-specific experience × international experience, and are presented in table 9. These results suggest that although international experience generally enhances reverse innovation, its marginal benefits diminish when CEOs possess extensive overall or firm-specific tenure. This pattern is consistent with UET arguments that accumulated experience may constrain cognitive flexibility, thereby moderating the advantages of boundary-spanning exposure gained through international experience (Liu and Ji, 2022, Okrah and Irene, 2023). The remaining interactions were insignificant and are not reported.

Insert Table 9 about here
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5. Discussion and conclusion

This study examines the firm-level determinants of reverse innovation in EMNCs, which currently play a dominant role in a global innovation landscape traditionally led by AMNCs. We focus on the CEO, the primary member of the top management team, in driving reverse innovation in Indian pharmaceutical firms. In doing so, we capture reverse innovation through India-USA patent dyads as an observable indicator of realized innovation transfer, while recognizing that their broader strategic capability extends beyond what patent data alone can reveal. We find that not all kinds of experience are significant in driving or hindering reverse innovation in EMNCs. More specifically, we find that longer CEO professional experience can potentially reinforce reliance on established cognitive models of traditional innovation, thereby reducing openness to non-traditional and disruptive strategies like reverse innovation. Beyond cognitive rigidity, accumulated experience may constrain reverse innovation in several other ways. Research on managerial cognition shows that executives socialised in earlier technological and organisational paradigms may carry forward schemas that are less compatible with digitally enabled or bottom-up innovation models (Kaplan and Tripsas, 2008, Nadkarni and Chen, 2014). Generational cohort effects may therefore reduce receptiveness to novel strategic logics. Governance research further suggests that long-tenured CEOs often receive greater deference and weaker monitoring from boards (Finkelstein et al., 1996), which can reinforce reliance on historically successful strategies (Miller, 1991). Additionally, organisational culture theory emphasises that prolonged leadership tenures tend to produce strong, stability-oriented cultures that resist experimentation (Schein, 2010, Chatman and O'Reilly, 2016). These interacting mechanisms clarify why extensive experience may reduce willingness to pursue reverse innovation despite its strategic importance. On the other hand, longer firm-specific experience can develop deeper organizational knowledge, relational capital, and stakeholder legitimacy, while also enhancing the CEO's ability to manage internal resistance to implement transformative

initiatives such as reverse innovation. Taken together, these results highlight that not all experience operates uniformly. Overall professional experience mainly affects strategic cognition and openness to novel innovation logics, whereas firm-specific experience strengthens organizational embeddedness, internal legitimacy, and execution capability. This distinction helps clarify how different experiential loci produce divergent effects on reverse innovation and advances Upper Echelons Theory by specifying when experience generates rigidity versus adaptive capacity.Further, CEOs with international experience can facilitate increased reverse innovation by reducing institutional distance and liability of foreignness, which reduce the perceived and actual risks in this strategy. Consistent with our theorization of multi-industry experience as context-dependent, the insignificant outcome suggests that competing mechanisms may offset one another in the Indian pharmaceutical setting. A substantial literature on generalist CEOs shows that cross-industry experience broadens cognitive repertoires, enhances adaptability, and facilitates creative recombination (Custódio et al., 2013, Ederer and Manso, 2013). In diversified business-group contexts in India, managerial breadth is often institutionalised as a desirable leadership trait (Cappelli, 2010). Institutional theory suggests that when a managerial attribute is socially legitimised, its performance effects may be attenuated or neutralised (Greenwood et al., 2011). Thus, although reverse innovation in pharmaceuticals requires deep domain-specific knowledge (Henderson and Cockburn, 1994, Pisano, 1997), the institutionalised value placed on generalist leadership in India may counterbalance the disadvantages of limited technical depth. This pattern aligns with our argument that institutionalised preferences for generalist leadership in India may neutralise the disadvantages of limited domain depth, resulting in a net null effect.

5.1. Theoretical contributions

Our findings offer two theoretical contributions to the extant literature. First, we extend understanding of the antecedents of reverse innovation, specifically by contributing to the current knowledge on the micro-antecedents of reverse innovation in the context of EMNCs. In so doing, we restore the importance of EMNCs to the debate on the reverse innovation phenomenon. Furthermore, we provide a first understanding of how the experience profile of EMNCs' CEOs can hinder or support reverse innovation. Interestingly, prior studies have consistently emphasized the critical role of CEOs and senior management in driving reverse innovation in AMNCs (Immelt et al., 2009, Malodia et al., 2020), while overlooking the context of EMNCs and the factors shaping their reverse innovation strategies. Our findings suggest a nuanced differentiation with regards to criticalities of micro-determinants of reverse innovation in comparison to previous investigations. AMNCs' main micro criticality for reverse innovation seemed to be represented by senior management's scepticism about the innovation potential of subsidiaries in emerging economies. This shows an attitude that maintain an ethnocentric view of global innovation flows that see advanced economies at the centre and emerging ones at the periphery. Our study departs from this interpretation by adopting an EMNC perspective and provides a more detailed view of what CEOs' attributes are at play when considering their orientation towards reverse innovation. Therefore, our work offers a timely response to call for examination of firm-level factors that trigger reverse innovation and push and pull factors in global innovation, in non-western settings (Corsi and Bianchi, 2024, von Zedtwitz et al., 2015).

Second, by applying UET in the context of reverse innovation in EMNCs, we extent the relevance of this theory in the strategic innovation outcome within an emerging market setting. Specifically, we highlight a more systematic and accurate conceptualization and measure of CEOs' *experience*. Departing from the typical 'monolithic' conceptualization of previous studies (Balsmeier and Buchwald, 2015, Barker and Mueller, 2002), where

experience has been examined predominantly as a single construct, we offer a multi-dimensional approach that disaggregate the various aspects of the CEO *experience* and links its specific attributes to reverse innovation. This offers contextual refinement and specificity to managerial attributes and their ability to strategic outcomes in complex environments (Carpenter et al., 2004, Hambrick, 2007) such as emerging markets. This approach opens the black box of CEO experience, providing a platform for future research to build on the many facets of CEOs' background and its impact on innovation. Notably, our multidimensional conceptualisation of experience is not merely methodological but theoretically meaningful. Reverse innovation is an inherently multifaceted process involving opportunity sensing, internal coordination, capability recombination, and legitimacy building across markets (Govindarajan and Ramamurti, 2011, von Zedtwitz et al., 2015). Each of these subprocesses draws on different managerial capabilities. By disaggregating experience into overall, firm-specific, international, and multi-industry components, we show how distinct experience types map onto distinct capability domains: international experience facilitates boundary-spanning search; firm-specific experience supports internal seizing and alignment; overall experience may constrain reconfiguration through entrenched schemas; and multi-industry experience interacts with institutional legitimacy structures. This mapping advances UET and complements dynamic managerial capabilities research by showing how particular kinds of managerial histories shape specific dimensions of strategic action in complex innovation processes (Helfat and Martin, 2015). Furthermore, our findings illuminate how these different forms of experience align with the components of dynamic managerial capabilities: sensing (enhanced by international experience), seizing (supported by firm-specific experience and internal legitimacy), and reconfiguring (potentially constrained by accumulated general experience) (Helfat and Martin, 2015). By articulating how each experience dimension supports or inhibits specific capability requirements of reverse innovation, our work deepens

the synergies between UET and capability-based perspectives in explaining complex strategic outcomes in EMNCs.

5.2. Practical implications

Our findings offer actionable insights for boards of EMNCs seeking to strengthen their reverse innovation capabilities. The positive influence of firm-specific experience highlights the value of leaders with deep organisational knowledge and internal legitimacy, while the negative association with overall professional experience suggests caution in relying on overly broad external career trajectories. Prioritising CEOs with international experience, or building such exposure through targeted development programmes, can enhance global orientation and reduce the perceived risks of pursuing reverse innovation.

These insights point to the need for leadership development approaches that combine embedded organisational experience with global exposure. In knowledge-intensive, regulated sectors like pharmaceuticals, boards should attend to candidates' scientific and regulatory literacy, which is central to evaluating and scaling of innovation opportunities (Henderson and Cockburn, 1994, Pisano, 1997). Large EMNCs can cultivate such competencies through internal rotations across units and R&D functions, whereas smaller firms may rely more on mentoring and project-based learning to build contextual familiarity. The stage of internationalisation also matters: early-stage firms can benefit from cross-border assignments or global project teams, while firms more internationalised firms may gain from leadership teams that combine locally embedded executives with globally experienced ones.

Strengthening reverse innovation capability also requires attention to governance and policy infrastructure. Boards can conduct experience audits to assess the balance of firm-specific, international, and generalist experience in the top management team, using the results to guide succession planning and executive recruitment. Embedding global leadership competencies into performance evaluations, promotion decisions, and incentive structures

further signals organisational commitment to reverse innovation. Policymakers and industry associations can complement firm-level efforts by supporting executive internationalisation through public-private leadership programmes, cross-border innovation fellowships, and regulatory-science training. These initiatives would be especially valuable for smaller firms that lack the internal resources to build these capabilities independently.

5.3. Limitations and future directions

We acknowledge limitations of this study that offer opportunities for future research.

First, our study focuses on the functional aspects of CEO experience and does not capture the cognitive or behavioural dimensions that may also influence strategic decision-making. In addition, consistent data on CEO demographic attributes, such as age and educational background, were unavailable and therefore not included. Future studies could incorporate these characteristics to examine how executives' cognitive profiles and personal attributes shape EMNC engagement in reverse innovation.

Second, we employ a single proxy for reverse innovation, operationalized as India-USA patent dyads. While the use of transnational patent filings is well grounded in prior research on reverse innovation (Huang and Li, 2019), patent data capture the transfer of inventive activity across markets rather than downstream commercialization outcomes or market adoption. Our measure therefore reflects an early and necessary stage of reverse innovation involving the movement of inventive output from an emerging economy into a stringent advanced-market regulatory environment such as the United States. Although successful patenting in such a context signals technological capability and regulatory credibility, it does not guarantee subsequent market diffusion or commercial success. Future research could extend this analysis by examining later stages of the innovation process, including commercialization and market adoption, using complementary methods and data sources.

Third, our analysis is geographically and contextually bounded. The empirical setting focuses on India–USA patent dyads within a single industry. While the insights may be broadly informative for other emerging markets, further studies across industries and national contexts are needed to assess the generalizability of our findings. In particular, expanding the analysis to other advanced-market destinations would provide a richer understanding of reverse innovation pathways. Although the manual construction of the dataset limited such extensions in this study, future research could develop comparable datasets covering additional emerging and advanced economy pairs.

Finally, the empirical analysis aggregates across types of reverse innovation, reflecting the heavy concentration of observations of Type 2 reverse innovation (innovations developed in India and first patented in the USA). Future research with more balanced data could differentiate between distinct forms of reverse innovation and examine whether their antecedents and outcomes vary systematically.

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Table 1: Empirical Studies on Reverse Innovation Antecedents and Leadership-Driven Innovation

Study	Year	Theory / Lens	Context	Key Findings	CEO Characteristics Examined?	Level of Analysis
Borini et al.	2016	Resource Dependence & HQ–Subsidiary Governance	Foreign subsidiaries of emerging market firms (Brazil)	Subsidiary autonomy, HQ support, and integration enable greater reverse innovation output	No	Subsidiary
Giannetti et al.	2020	Innovation Diffusion, Product Strategy	Global product launches across emerging and developed markets	Lower-priced, well-featured products are more likely to follow a reverse-launch trajectory	No	Product
Zhu et al.	2017	Strategic Marketing, Market Fitness	MNC product-launch decisions	Commercial attractiveness of emerging market origin products predicts whether they are launched in developed markets	No	Product
Dudaklı et al.	2022	Organizational Design & Capability Theory	Firms engaging in reverse innovation across industries	Structural fit, contextual alignment, and process capabilities drive reverse innovation success	No	Firm
Adomako et al.	2023	Resource Constraint, Frugal Innovation logic	SMEs in emerging markets (Ghana)	Reverse-engineering capability enables frugal innovation, which acts as a	No	Firm

				precursor stage to reverse innovation		
Wei & Liu	2020	Strategic Innovation Theory	Firm innovation strategy decisions in emerging markets	Firm capabilities and market context determine selection of reverse innovation vs conventional innovation strategies	No	Firm
Raziq et al.	2020	Corporate Entrepreneurship / Leadership Exposure	EMNC subsidiaries	Expatriation & subsidiary initiative lead to reverse knowledge transfer.	No	Subsidiary
Fu et al.	2024	Upper Echelons Configurations	Tech ventures in China	TMT-resource combinations drive reverse innovation.	No	TMT
Okrah & Irene	2023	Classical Upper Echelons Theory	Russian SMEs	Top-manager experience can boost reverse innovation.	No	Firm
Xia et al.	2025	UET: Cognitive Diversity	EMNCs	Leaders with EM + global exposure enhance adaptive innovation capability (relevant competency for reverse innovation)	No	Firm
Current study		***UET and Dynamic Managerial Capabilities***	***Indian pharmaceutical EMNCs***	***CEO professional experience dimensions and reverse innovation intensity***	***Yes***	***CEO***

Figure 1: Overall conceptual model of the study

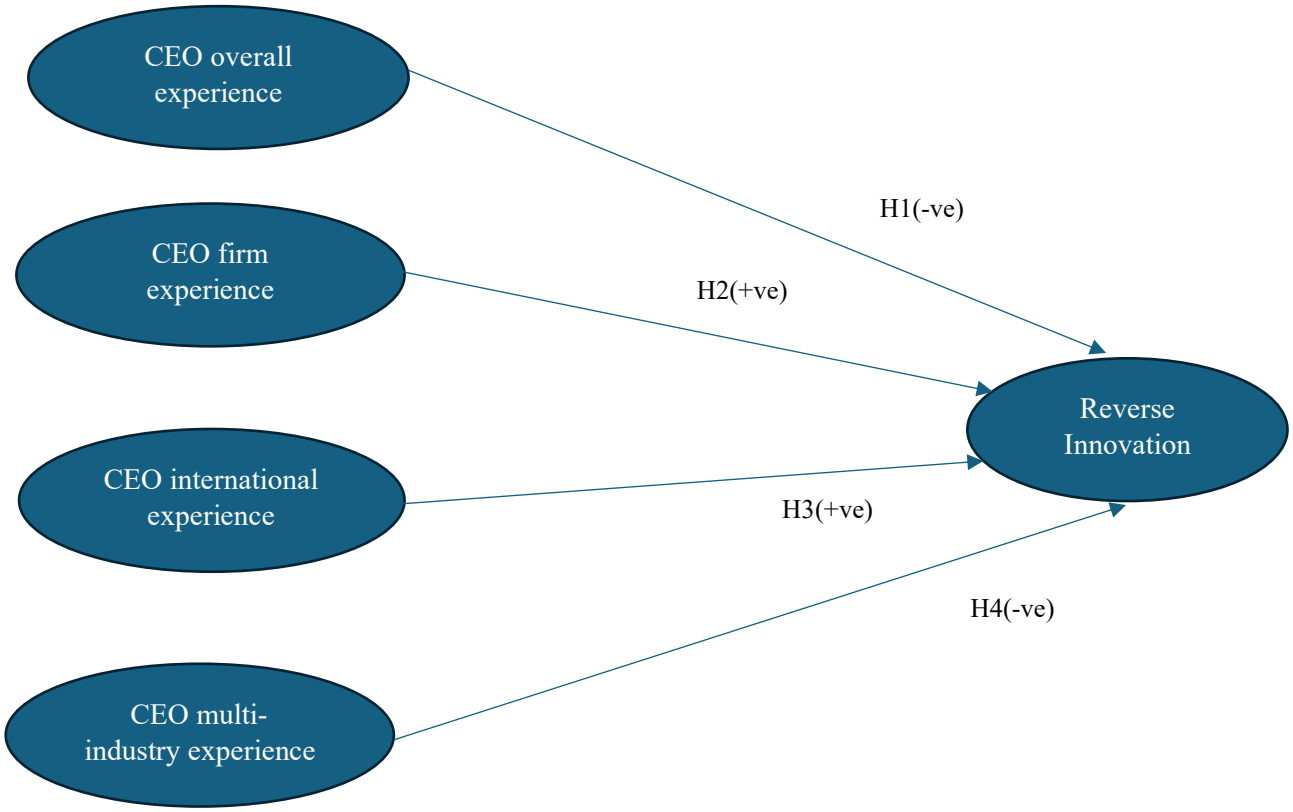

Table 2: Types of reverse innovation based on inventors' location and patent filing.

	Location of Innovation Phase			
Type of Reverse Innovation	***R&D (i.e. Location of inventors)***	***First Market (i.e. Patent first filing)***	***Second Market (i.e. Patent subsequent filing)***	***Number of Patents***
Type 1	India	USA	na	334
Type 2	India	USA	India	7800
Type 3	India	India	USA	82
Type 4	USA	India	USA	85

.

Table 3: Summary statistics

Variable	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*
Reverse innovation	18.164	33.541	1	258
CEO overall experience	394.543	125.772	72	864
CEO firm experience	219.733	156.645	1	740
CEO international experience	1.409	0.492	1	2
CEO multi-industry experience	1.197	0.398	1	2
Firm age	27.245	19.718	1	94
Firm size	1189070	3537946	0.01	48300000
Firm performance	11.440	38.749	-463.217	175.466
Current ratio	1.650	1.955	0	14.409
R&D intensity	0.036	0.327	0	6.688
Corporate share ownership	14.839	34.223	0	100
Promoter share ownership	48.542	35.121	0	100
Institutional share ownership	12.200	17.445	0	75
Board size	9.867	9.718	0	45
Board independence	0.163	0.236	0	0.857

Table 4: Correlation matrix

Variables #	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1.Reverse innovation	1													
2.CEO overall exp	0.121*	1												
3.CEO firm exp	0.657*	0.082	1											
4.CEO international	-0.303*	0.166*	-0.101*	1										
5.CEO multi-ind	-0.210*	-0.060	-0.103*	0.271*	1									
6.Firm age	0.112*	0.050	0.029	-0.078	0.150*	1								
7.Firm size	0.283*	0.081	0.092*	-0.153*	-0.139*	0.223*	1							
8.Firm performance	0.138*	0.033	0.006	-0.152*	-0.138*	0.089	0.801*	1						
9.Current ratio	0.105*	-0.054	0.035	0.0136	0.023	0.070	0.426*	0.488*	1					
10.R&D intensity	0.129*	0.009	0.054	-0.049	-0.039	-0.012	0.0614	0.262*	-0.003	1				
11.Corporate share	-0.161*	-0.034	-0.086	0.117*	0.010	-0.262*	-0.046	-0.070	0.013	-0.044	1			

12.Promoter share	0.0852	-0.085	0.011	-0.146*	-0.025	-0.067	0.109*	0.192*	0.048	0.024	-0.572*	1		
13.Institutional share	0.1123*	0.199*	0.028	0.063	-0.047	0.364*	0.411*	0.248*	0.086	0.001	-0.304*	-0.024	1	
14.Board size	0.0735	0.101*	-0.038	-0.019	-0.005	0.449*	0.476*	0.275*	0.198*	0.029	-0.209*	0.065	0.462*	1
15.Board ind	0.172*	0.098*	0.084	-0.005	0.037	0.399*	0.435*	0.267*	0.199*	0.166*	-0.251*	0.022	0.479*	0.754*

* Correlations are significant at 0.05 significance level.

Variable names have been further simplified for brevity

Table 5: Multilevel mixed negative binomial regression estimation outcomes of the impact of CEO experiences on reverse innovation

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value
CEO overall exp	***-0.004***	***0.001***	***0.020***										***-0.002***	***0.001***	***0.004***
CEO firm exp				***0.001***	***0.001***	***0.024***							***0.003***	***0.001***	***0.044***
CEO international							***0.419***	***0.235***	***0.005***				***0.745***	***0.255***	***0.004***
CEO multi-ind exp										***0.235***	***0.302***	***0.437***	***0.053***	***0.300***	***0.859***
Firm age	-0.001	0.009	0.898	-0.002	0.009	0.832	0.001	0.008	0.901	-0.002	0.009	0.816	0.000	0.008	1.000
Firm size	0.019	0.029	0.518	0.013	0.029	0.652	0.022	0.029	0.451	0.017	0.029	0.551	0.018	0.029	0.530
Firm performance	-0.046	0.081	0.574	-0.037	0.081	0.649	-0.041	0.081	0.607	-0.032	0.082	0.693	-0.034	0.081	0.677
Current ratio	0.095	0.092	0.306	0.101	0.092	0.271	0.090	0.091	0.324	0.094	0.092	0.306	0.088	0.089	0.322
R&D intensity	3.732	2.828	0.187	3.389	2.820	0.229	4.067	2.798	0.146	3.719	2.828	0.188	3.047	2.742	0.267
Corporate share	0.001	0.004	0.975	0.001	0.004	0.856	0.003	0.004	0.947	-0.004	0.004	0.992	0.000	0.004	0.939
Promoter share	-0.004	0.004	0.311	-0.004	0.004	0.354	-0.004	0.004	0.347	-0.005	0.004	0.285	-0.004	0.004	0.310
Institutional share	0.016	0.009	0.063	0.017	0.008	0.046	0.014	0.008	0.083	0.016	0.009	0.055	0.013	0.008	0.098
Board size	0.023	0.021	0.276	0.027	0.021	0.194	0.022	0.020	0.279	0.026	0.021	0.224	0.024	0.020	0.211
Board independence	-1.356	0.840	0.107	-1.523	0.837	0.069	-1.268	0.800	0.113	-1.431	0.835	0.086	-1.428	0.784	0.069
Wald chi squared	207.79***			207.21***			210.19***			207.92***			220.85***		

Table 6: GMM estimation outcomes of the impact of CEO experiences on reverse innovation

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value
CEO overall exp	***-0.007***	***0.003***	***0.018***										***-0.016***	***0.007***	***0.023***
CEO firm exp				***0.010***	***0.002***	***0.000***							***0.011***	***0.006***	***0.000***
CEO international							***4.089***	***1.052***	***0.000***				***8.829***	***1.336***	***0.000***
CEO multi-ind exp										***-0.284***	***0.970***	***0.770***	***-6.377***	***1.580***	***0.080***
Firm age	-0.113	0.030	0.000	-0.140	0.015	0.000	-0.060	0.033	0.070	-0.127	0.026	0.000	-0.024	0.034	0.470
Firm size	-0.621	0.153	0.000	-0.926	0.100	0.000	-0.167	0.163	0.306	-0.535	0.129	0.000	-0.745	0.216	0.001
Firm performance	0.778	0.377	0.039	2.493	0.225	0.000	0.881	0.467	0.059	1.139	0.384	0.003	1.592	0.357	0.000
Current ratio	1.065	0.614	0.083	0.926	0.404	0.022	0.393	0.713	0.582	0.325	0.646	0.615	0.491	0.410	0.232
R&D intensity	111.80	13.08	0.000	117.73	10.40	0.000	51.58	17.66	0.003	86.42	14.25	0.000	166.77	40.33	0.000
Corporate share	0.036	0.020	0.075	0.060	0.012	0.000	0.035	0.026	0.177	0.033	0.019	0.086	0.100	0.034	0.003
Promoter share	-0.059	0.024	0.013	-0.095	0.013	0.000	-0.024	0.028	0.395	-0.064	0.016	0.000	-0.010	0.033	0.752
Institutional share	0.220	0.051	0.000	0.300	0.031	0.000	0.150	0.039	0.000	0.251	0.043	0.000	0.193	0.039	0.000
Board size	0.403	0.038	0.000	0.451	0.040	0.000	0.305	0.073	0.000	0.400	0.041	0.000	0.333	0.074	0.000
Board independence	-14.13	2.191	0.000	-15.61	1.790	0.000	-11.84	3.098	0.000	-13.32	2.421	0.000	-9.49	3.018	0.002
AR1	0.012			0.011			0.011			0.012			0.013		
AR2	0.217			0.212			0.286			0.257			0.238		
Hansen J-Statistic	0.481			0.612			0.602			0.694			0.417		

Table 7: Multilevel mixed negative binomial regression estimation outcomes of the impact of CEO experiences on reverse innovation, excluding years of COVID-19 pandemic (2019, 2020 and 2021)

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value
CEO overall exp	***-0.003***	***0.001***	***0.018***										***-0.003***	***0.001***	***0.001***
CEO firm exp				***0.001***	***0.001***	***0.115***							***0.002***	***0.001***	***0.017***
CEO int exp							***0.488***	***0.255***	***0.056***				***0.859***	***0.269***	***0.001***
CEO multi-ind exp										***0.171***	***0.314***	***0.585***	***-0.027***	***0.311***	***0.930***
Firm age	0.003	0.009	0.975	-0.001	0.009	0.936	0.003	0.009	0.742	-0.004	0.009	0.969	0.002	0.008	0.793
Firm size		0.030	0.425	0.018	0.030	0.552	0.029	0.030	0.335	0.023	0.030	0.442	0.025	0.029	0.400
Firm performance	-0.072	0.085	0.398	-0.064	0.085	0.448	-0.067	0.085	0.430	-0.062	0.086	0.470	-0.063	0.085	0.459
Current ratio	0.107	0.096	0.266	0.116	0.096	0.225	0.097	0.095	0.308	0.107	0.096	0.267	0.096	0.093	0.300
R&D intensity	3.318	2.964	0.263	2.781	2.958	0.347	3.875	2.943	0.188	3.288	2.964	0.267	2.703	2.881	0.348
Corporate share	-0.001	0.004	0.902	-0.001	0.004	0.998	-0.001	0.004	0.892	-0.001	0.004	0.871	-0.004	0.004	0.918
Promoter share	-0.004	0.005	0.340	-0.004	0.004	0.375	-0.004	0.004	0.356	-0.005	0.005	0.319	-0.004	0.004	0.326
Institutional share	0.017	0.010	0.081	0.018	0.010	0.061	0.015	0.009	0.103	0.018	0.010	0.072	0.014	0.009	0.133
Board size	0.022	0.023	0.336	0.028	0.023	0.211	0.018	0.021	0.406	0.024	0.023	0.293	0.022	0.021	0.276
Board independence	-1.315	0.918	0.152	-1.626	0.925	0.079	-1.106	0.861	0.199	-1.380	0.910	0.129	-1.381	0.851	0.105
Wald chi squared	106.97***			107.59***			112.24***			106.99***			125.06***		

Table 8: Zero-truncated negative binomial regression estimation outcomes of the impact of CEO experiences on reverse innovation

	Model 1			**Model 2**			**Model 3**			**Model 4**			**Model 5**		
	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value	Mean	Std Err	p-value
CEO overall exp	***-0.003***	***0.001***	***0.026***										***-0.002***	***0.001***	***0.019***
CEO firm exp				***0.001***	***0.001***	***0.023***							***0.002***	***0.001***	***0.003***
CEO int exp							***0.544***	***0.193***	***0.005***				***0.767***	***0.221***	***0.001***
CEO multi-ind exp										***-0.019***	***0.215***	***0.931***	***-0.228***	***0.250***	***0.363***
Firm age	-0.006	0.005	0.245	-0.006	0.005	0.239	-0.002	0.005	0.764	-0.006	0.005	0.306	0.000	0.006	0.933
Firm size	0.012	0.032	0.710	-0.007	0.033	0.835	0.018	0.029	0.546	0.009	0.030	0.772	-0.007	0.032	0.829
Firm performance	-0.144	0.100	0.149	-0.086	0.091	0.345	-0.091	0.077	0.240	-0.130	0.083	0.115	-0.033	0.099	0.735
Current ratio	0.173	0.151	0.253	0.168	0.150	0.265	0.135	0.131	0.302	0.167	0.148	0.261	0.132	0.135	0.329
R&D intensity	5.750	2.326	0.013	4.896	2.396	0.041	6.149	2.376	0.010	5.626	2.364	0.017	4.767	2.488	0.055
Corporate share	-0.002	0.004	0.651	-0.001	0.005	0.859	-0.004	0.004	0.349	-0.002	0.005	0.719	-0.002	0.004	0.668
Promoter share	-0.012	0.004	0.006	-0.011	0.004	0.007	-0.011	0.004	0.005	-0.011	0.005	0.013	-0.009	0.004	0.030
Institutional share	0.029	0.008	0.000	0.028	0.008	0.000	0.022	0.009	0.011	0.029	0.008	0.000	0.018	0.008	0.029
Board size	-0.001	0.008	0.917	0.005	0.009	0.584	-0.002	0.008	0.853	0.000	0.008	0.983	0.008	0.009	0.339
Board independence	-1.379	0.701	0.049	-1.214	0.659	0.066	-1.440	0.633	0.023	-1.298	0.682	0.057	-1.377	0.682	0.044
Wald chi squared	228.71***			212.54***			201.32***			216.64***			224***		

Table 9: Multilevel mixed negative binomial regression estimation outcomes of the impact of combined dimensions of CEO experiences on reverse innovation

	Model 1			**Model 2**		
	Mean	Std Err	p-value	Mean	Std Err	p-value
CEO overall exp	0.007	0.004	0.070	-0.003	0.001	0.027
CEO firm exp	0.002	0.001	0.026	0.006	0.003	0.014
CEO int exp	3.180	0.912	0.000	1.287	0.416	0.002
CEO multi-ind exp	0.114	0.306	0.710	0.026	0.303	0.931
CEO overall exp * CEO int exp	***-0.006***	***0.002***	***0.006***			
CEO firm exp * CEO int exp				***-0.003***	***0.002***	***0.026***
Firm age	0.000	0.009	0.956	0.001	0.009	0.906

Firm size	0.030	0.029	0.296	0.027	0.029	0.353
Firm performance	-0.055	0.080	0.495	-0.044	0.081	0.585
Current ratio	0.069	0.087	0.427	0.073	0.087	0.406
R&D intensity	1.160	2.791	0.678	2.245	2.814	0.425
Corporate share	0.002	0.004	0.677	0.001	0.004	0.711
Promoter share	-0.003	0.004	0.478	-0.003	0.004	0.465
Institutional share	0.016	0.008	0.058	0.016	0.009	0.060
Board size	0.010	0.014	0.468	0.007	0.014	0.612
Board independence	-2.427	0.981	0.013	-1.770	0.953	0.063
Wald chi squared	233.13***			228.33***		