

Internationalization of latecomer firms from emerging economies—The role of resultant and autonomous learning

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Abstract This study tests the prescience of John Mathews' linkage-leverage-learning (LLL) model to explain internationalization by latecomer firms (LFs)—set in an evolutionary backdrop. The hypothesis harbored in this study is that while LLL explains how LFs initially compete in international markets, it is autonomous learning, independent of LLL that is crucial to internationalization. We used panel data from 1994 to 2012 with 821 observations from 69 firms and performed multiple econometric analyses to test our hypotheses. Our results suggest that autonomous learning rather than resource leverage and learning through linkages with MNCs explain the success of Indian pharmaceutical LFs. LFs progress from being a recipient of knowledge in a global production network to a phase where they can become important contributors in the global innovation network. This study therefore demonstrates that LFs that invest in autonomous learning in addition to reaping advantages through their linkages with global innovators are the ones that are successful in their internationalization process and are able to become dominant players in the global market.

Keywords Emerging economies · Latecomer firms · Internationalization · Autonomous learning · Linkages · Catch-up

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Firms from today's emerging economies bear many of the hallmarks of latecomer firms (LFs), the term used for progressive firms from late-industrializing nations. LFs lack many of the traditional advantages associated with well-established multinational corporations (MNCs). Their establishment, development and international expansion have occurred within an institutional environment that is different from those found in Western economies (Dunning, Kim, & Park, 2008; Mathews, 2001, 2002a, 2002b, 2006; Ramamurti, 2001). Due to institutional weaknesses under previously closed economies, LFs remained disconnected from the global economy and global networks of innovation. Being disconnected from the main centers of innovation they face steep learning curves to build capabilities (see Amsden, 1989, 1995; Hobday, 1995; Lall, 1992, 1994, 1995, 2003). Due to their country of origin effect typically characterized by weak human and entrepreneurial resources (Buckley, Munjal, Enderwick, & Forsans, 2016; Khanna & Palepu, 2000; Kumar, Mudambi, & Gray, 2013; Peng, 2003), and inferior technological and marketing resources (Dunning et al., 2008; Gaur & Kumar, 2009; Kumaraswamy, Mudambi, Saranga, & Tripathy, 2012) they typically lack resources to succeed in international markets. Yet, with global aspirations, the strategic goal of LFs is to internationalize and achieve positions similar to MNCs from advanced economies in terms of technological capabilities and ability to compete in global markets that initially lie beyond their reach due to resource deficiency. In fact, many LFs from emerging economies are serving international markets and successfully competing globally even in high technology industries (Awate, Larsen, & Mudambi, 2012). In knowledge-based industries such as telecom and information technology (IT), many have exploded into the global economy, and achieved a leading status in the global market (Gaffney, Kedia, & Clampit, 2013; Jain, Pangarkar, Yuan, & Kumar, 2015; Mathews, 2006; Peng, Wang, & Jiang, 2008).

In the new knowledge-based global economy where MNCs disaggregate their global value chains across emerging economies, LFs often serve global clients from their home base by engaging in their production and innovation networks. In this way LFs demonstrate their capability to serve international markets for knowledge through exports (Contractor, Kumar, & Dhanaraj, 2015; Lamin & Ramos, 2016; Thite, Wilkinson, Budhwar, & Mathews, 2016). Equally, LFs may engage in foreign direct investment (FDI) to compete in international markets (Buckley et al., 2016; Popli & Kumar, 2016). Hence for knowledge intensive sectors, the internationalization process of LFs can be reflected both via exports and FDI.

How could resource poor LFs establish an international presence and become global market leaders in highly competitive technology intensive industries that pose steep learning curves? Our conceptualization of internationalization of LFs is rooted in the literature advanced by Mathews (2002a, 2002b, 2006). It refers to increasing and rapid global presence of LFs manifested through foreign operating mechanisms such as exports and FDI leading to a narrowing of the gap between LFs and the global market leaders. Similar to Mathews (2002a, 2002b, 2006), this view of internationalization of LFs rests on the assumption that as LFs internationalize rapidly they achieve a scale that is proximate to that of the global market leader. Rapid internationalization of LFs from emerging economies is driven largely due to competitive pressures to catch-up with global market leaders (Awate et al., 2012; Cui, Meyer, & Hu, 2014) which enables them to reach their final goal, that is, to become dominant players in international markets (e.g., Chen, 2009; Luo & Wang, 2012; Mathews & Zander, 2007).

Adopting a latecomer perspective to account for the historical legacies of LFs from emerging economies, our research draws on Mathews' LLL model to focus on linkage,

leverage and learning strategies in order to understand how LFs build capabilities to respond to the opportunities and challenges presented in the new integrated global economy. The model has gained phenomenal recognition through a number of scholarly research articles on LFs (e.g., Chen, 2009; Luo & Wang, 2012; Mathews & Zander, 2007). The present research builds on this literature and provides a fresh insight into organizational transformation of LFs.

In our conceptualization of the LLL, we treat linkage and leverage by LFs to operate simultaneously which results in indirect learning. We posit that there is another type of learning, which we call autonomous learning, to be critical in the internationalization process of and catch-up by LFs. The objective of this paper is to explore the role of autonomous learning that is independent of linkage and leverage mediated learning. We ask whether linkage and leverage mediated learning, later termed as resultant learning, and autonomous learning are of equal importance in enabling internationalization by LFs in knowledge intensive industries. While there has been a number of qualitative case studies of how LFs internationalize and attain dominant positions internationally (e.g., Awate et al., 2012; Bonaglia, Goldstein, & Mathews, 2007; Mathews, 2006), there has been very little effort devoted to empirical testing of the LLL model. Especially lacking are studies that explicitly incorporate autonomous learning that is critical in the internationalization of LFs (Luo & Wang, 2012; Yiu, 2011). It is this shortcoming that makes the study of LFs' international competitiveness interesting, and as such the focus of our present study.

A new empirical insight about internationalization patterns and strategies adopted by LFs from the rapidly developing Asia Pacific region is expected to uncover the dynamics of their increasing competitiveness in the global stage. For our study, we choose LFs in the Indian pharmaceuticals industry. The choice of LFs in the pharmaceutical industry is justified because in the higher echelons of the industry, steep learning curves exist. Hence, it is in these strategic fields that internationalization is especially difficult and complicated. In the particular context of India, the pharmaceutical industry experienced major regulatory changes in the early 1990s leading to increased competition from foreign players and rapid internationalization by Indian firms (Gubbi, Aulakh, & Ray, 2015; Kumar & Singh, 2008). As such, the Indian pharmaceutical industry is an appropriate context to test and further refine the LLL model.

Theory and hypotheses

Background literature

An important aspect of internationalization by LFs in the twenty-first century is explained by Mathews and Zander (2007). The new breed of LFs and their pattern of internationalization is quite different from that of their predecessors. In the twenty-first century, barriers to inward and outward FDI started to come down, and institutional changes including harmonization of international law and business practices strengthened protection of intellectual property rights (Contractor, Kumar, Kundu, & Pedersen, 2010; Gao, Murray, Kotabe, & Lu, 2010; Stucchi, Pedersen, & Kumar, 2015). Furthermore, the advent of sophisticated information technology (IT) systems and the Internet have created new opportunities for LFs to network and expand through partnerships as well as acquisitions across international borders. These developments

offer new opportunities, new entry points into the global economy and new paths of international expansion for LFs (Barkema, Bell, & Pennings, 1996).

According to Mathews (2002a, 2002b, 2003a, 2006), LFs overcome their debilitating drawbacks by tapping into advanced technologies of global innovators through linkages, repeated leveraging and indirect learning, rather than having to replicate the entire previous technological trajectory to serve international markets that initially lie beyond their reach (Cho, Kim, & Rhee, 1998; Mathews, 2006). A large body of literature asserts that resources such as physical capital (i.e., machinery and codified documents) are exogenously available, and can be accessed by all firms under free trade. Diffusion occurs owing to the public goods nature of new ideas and technologies and has demonstration effects on other firms (Aitken & Harrison, 1999; Branstetter, 2000; Grossman & Helpman, 1991; Helpman, 1992; Kokko, 1994). By striking linkages with global innovators and working on behalf of MNCs as suppliers, they leverage resources from the advanced world to accelerate their learning to serve international markets, and bypass some of the organizational inertia that hold them back from their more established competitors (Mathews, 2006).

Mathews' (2006) LLL model argues that linkages with established MNCs and the simultaneous leveraging of resources, both backward and forward, cause knowledge spillovers in LFs and enable learning through upgradation of their organizational routines. But can such linkage and resource leverage facilitate competitive advantage in demanding global markets? As Nelson (1995, 2008) suggested, internationalization to attain global dominance requires LFs to stretch their learning to acquire, absorb and create new knowledge. Such efforts are cumulative and path-dependent and cannot be compressed (Nelson & Winter, 2002). Moreover, in order to fully leverage the linkages with global MNCs, LFs need to have invested significant resources in autonomous learning to develop their own absorptive capacity (Cohen & Levinthal, 1990).

Global linkages, leverage, and resultant learning

In the LLL model, linkages with global innovators is the vehicle for resource poor LFs to transform from imitation to innovation in their quest to internationalize and catch-up with global market leaders (Mathews, 2002a, 2002b, 2006). Linkages may be thought of as channels through which resources such as technology, knowledge and capital get efficiently transferred (Lorenzen & Mudambi, 2012). The concept of "linkage" draws on the "alliances or network perspective" in the strategic management literature which proposes that success of firms depends upon their inter-firm alliances and network (Gulati, 1998; Ray, 2013). Applied to the case of LFs, the "linkage" in the LLL model suggests that forming linkages or contractual connections with technologically advanced incumbent firms will be a critical element of its internationalization strategy. In fact it is through forming linkages with innovative MNCs from the industrially advanced nations that the LF is able to realize its aspirations of entering technologically sophisticated global markets that initially lie beyond its reach due its resource deficiencies (Hobday, 1995; Mathews, 2002a, 2002b). The concept of "leverage" in Mathews' LLL model is based on the concept of "resource leverage" in the strategic management literature that has been extensively used to illustrate how firms exploit resources accessed from alliance or network partners to stay abreast of new technology developments (Prahalad & Hamel, 1990). In the case of the LFs, their leverage from external sources becomes an obvious strategic choice. Thus, the concept of "resource leverage"

is central to account for how resource deficient LFs can exploit strategic resources accessed from its global partner to effectively internationalize and compete in demanding technology intensive markets (Mathews, 2002a, 2002b).

Empirical literature provides evidence of how LFs have drawn on global linkages to access technological and knowledge resources of foreign MNC partners to build capabilities (Hobday, 1995; Kim, 2003; Liu & Ray, 2012; Mathews, 2006; Mathews & Cho, 2000; Reddy & Zhao, 1990). Most importantly, knowledge transfer through alliance formation with a global innovator enhances the reputation and credibility of LFs amongst peers in the global industry (Bonaglia et al., 2007).

The importance of linkage and leverage mediated learning (or resultant learning) in the LLL model lies in the fact that resources accessed from linkages with incumbent firms can be leveraged for accelerated learning to upgrade technological capabilities to enable transition from the path of imitation to innovation, ultimately enhancing global competitiveness. Given that LFs are typically technology users and followers rather than innovators or leaders, the concept of “learning by doing” (Dunning, 1988; Kim, 2003; Lall, 1992; Lall & Lall, 1996), where knowledge is acquired through practical experience on using existing technologies, and the concept of “learning by using” (Rosenberg, 1976), become extremely important. This is significant, especially for LFs who are technology users that rely on products and processes developed by established global MNCs. LFs in knowledge intensive industries from Asia have evidently deepened their own knowledge base and expanded product offerings globally, by leveraging their global partner’s technologies by serving in contractual relationships and joint ventures. Such linkages have enabled these latecomers to enter lucrative global markets that were initially beyond their reach (Bonaglia et al., 2007; Chen, 2009; Kim, 2003; Mathews & Cho, 2000). Resultant learning through linkage and leverage enables a firm to be able to put together (or assemble) different types of process and product technologies efficiently and effectively (Mathews & Cho, 2000).

LFs learn in the process of combining foreign elements with its own stock of knowledge to eventually become technologically proficient. Evidence from semiconductor and cellular telephone industries reveal how outsourcing of production of semiconductor chips or PCs by leading innovators from the advanced economies offered LFs valuable learning opportunities (Mathews, 2002a, 2002b; Mathews & Cho, 2000). For example Haier, a dragon multinational from China (Mathews, 2006), established cooperative partnerships with innovative companies around the globe, spanning Tokyo, Los Angeles, Montreal, Lyons, Seoul, Sydney, and Amsterdam in order to scan and evaluate new emerging technologies (Duysters, Jacob, Lemmens, & Jintian, 2009). In the Indian pharmaceuticals industry, linkages with technology leaders in the global market have led to privileged proprietary new technologies (Athreye, Kale, & Ramani, 2009). Strategic alliances with global innovators have enabled Indian LFs to leapfrog by skipping some of the normal stages of an evolutionary internationalization path. Aggarwal’s (2007) (in Kumar & Joseph, 2007) findings suggest that acquisition of capital equipment from global innovators has been critical for rapid product market internationalization by Indian LFs in pharmaceutical industry. Chittoor, Sarkar, Ray, and Aulakh’s (2009) longitudinal study on Indian pharmaceutical firms in the pre-liberalized era found that international technological and financial resources have enabled these Indian LFs to internationalize in product-markets. Kale and Little

(2007: 608) suggested that through the “cumulative capability creating model” (Kim, 2003; Kim & Nelson, 2000) major Indian LFs have moved from “duplicative imitation” to “creative imitation” and “collaborative R&D.” Many Indian firms are already sub-contracted by big pharmaceutical companies to perform out-sourced R&D and clinical trials (Pradhan & Alakshendra, 2006) through which they have learned to become more innovative and have globalized their operations.

These resources obtained through linkages and their repeated leveraging result in learning that are all invaluable and allow LFs to compete effectively in the global market by enabling them to rapidly increase their global presence. We therefore make the following hypothesis:

Hypothesis 1 Resultant learning from linkage and leverage (LLL) will be positively related to LF’s internationalization in knowledge intensive industries.

Autonomous learning in LFs

In Mathews’ LLL, “learning” is proposed as the outcome of repeated application of linkage and leverage by the LF—for their transformation into a global firm. The effectiveness of resultant learning through linkage and leverage, however, depends on the prior absorptive capacity developed through in-house learning efforts and technological support provided by the institutional environment in which the LF is embedded. Such learning is independent of, and autonomous to the learning that results from the linkage with MNC partners and leveraging their resources.

The distinguishing feature of the LF’s success in internationalization is the fact that it is a “learning organization” par excellence (Mathews, 2002a, 2002b). The success of Korean and Taiwanese original equipment manufacturers in the semiconductor industry was based on the absorptive capacity and experience created through deliberate learning efforts in mastering mass production techniques. Frequently, knowledge created from formalized learning activities undertaken in public sector labs in Korea and Taiwan were made available to LFs free of cost in a coordinated market economy (Lall, 2000, 2003, 2005). In the case of LFs from Taiwanese machine tools industry, knowledge transfer from public sector research laboratories and industry provided an important local channel for autonomous learning and build technological capabilities. Such autonomous learning enables LFs to pursue a more sustainable internationalization strategy in the long run.

In the short run, LFs can initially exploit the few advantages that are intrinsic to their latecomer status—including low cost manufacturing, mass production capabilities or prior experience in technology in less demanding industry segments, to be able to strike linkages with global MNCs (Mathews, 2002a, 2002b). However, while simple production level activities in low technology industries is easy, it allows free entry by incumbents into these industries leading to margin pressures (Lall, Weiss, & Zhang, 2006; Teece, 2014). With increasing technological complexity, technology-based competition increases demanding more investment in developing absorptive capacity. Therefore, investment in prior autonomous learning is a necessary first step to be able to strike linkages with global MNCs and later in order to internationalize rapidly. LFs need to innovate and upgrade capabilities (Hu & Zhang, 2015; Li & Kozhikode, 2009; Mathews, 2002a, 2002b) and the process to do so is what we refer as autonomous learning.

The concept of autonomous learning is drawn from Lall's (2003) work which explains the learning strategy of latecomer firms in state-guided/coordinated market economies like Japan, Korea and Taiwan. Lall (2003) explained how LFs in Japan, Korea and Taiwan differed in their learning strategy vis-à-vis other Asian countries such as Singapore and Hong Kong. Lall emphasized that learning in LFs from Japan, Korea and Taiwan was autonomous because as national champions, they strove to internationalize and compete with advanced country MNCs on their own and did not depend on inward FDI from these MNCs. This stood in contrast to the strategy pursued in Singapore which depended much more on inward FDI and licensing of technology from MNCs for its industrial development.

Autonomous learning is analogous to the concept of exploratory learning. It entails the search for new knowledge typically associated with discovery, extensive experimentation, and the use of unfamiliar technologies to develop radically new products and technologies (March, 1991). Nevertheless, in our conceptualization autonomous learning and exploratory learning differ as well. While exploratory learning relates to search for new knowledge that is different from and independent of imitative learning from existing innovations of incumbents, autonomous learning is much broader in scope and relates to technology strategy of LFs who stayed independent of technology trajectories of advanced country MNCs. In part, many of the LFs employed their indigenous efforts to come up with new knowledge and innovations which were isomorphic to the institutional context of the home country (Ray & Ray, 2010). Autonomous learning is thus self-directed and independent of linkages with MNCs. For advanced industrial activities autonomous learning involves the undertaking of formal research and development (R&D) (Lall, 1993: 100) which is an integral part of a firm's activities to create the knowledge to innovate (e.g., Barney & Mackey, 2005; Simon, Hitt, & Ireland, 2007). As observed earlier, the institutional environment of the firm is often a significant determinant of the type of learning undertaken by firms in late industrializing economies.

In the new world of globalization and tighter appropriability regimes, the usefulness of exploitative or imitative learning such as incremental adaptations of patented products have been severely diminished (Ray, 2013). Whereas under a weak appropriability regime, many LFs pursued what is known as exploitative learning based on process innovation, under a tight intellectual property regime, LFs make a deliberate shift towards formal autonomous learning for product innovation. Pursuing exploration, positions firms to capitalize on changing circumstances under dynamic environments by creating new products and services or meeting the needs of untapped global markets, especially those in the emerging economies (Popli, Akbar, Kumar, & Gaur, 2017; Zahra, 1996). This is because in a tight intellectual property regime, the imitators' advantage gets blunted by the protection of patents, providing the impetus to shift learning routines towards exploration (Ray, 2013). Autonomous learning is accompanied by increased resource commitments in codification of knowledge base accumulated in, and utilized through an organization's patents, databases, structures, systems and processes—represented in intangible assets (De & Dutta, 2007; Subramaniam & Youndt, 2005).

Empirical evidence from the Indian pharmaceuticals industry suggests that LFs are increasingly moving up the innovation ladder via out-licensing new chemical entities, and full synthesis of pre-clinical molecules (Ramachandran, Mukherji, & Sud, 2006).

Using mini case studies, Chataway, Tait, and Wield (2007) found Indian firms are intensifying in-house R&D efforts to exploit the much more profitable highly regulated markets of US and Europe. Therefore, autonomous learning is expected to strongly impact internationalization, which will aid in them becoming dominant global players. Hence, we posit that autonomous learning that is independent of resultant learning through linkage and leverage will have a positive impact on internationalization.

Hypothesis 2 Autonomous learning will be positively related to LF's internationalization in knowledge intensive industries.

Research methods

Data

The statistical data for analysis were derived from the Prowess database of the Center for Monitoring Indian Economy (CMIE), by far the most comprehensive and reliable source of data on the Indian economy. This database provides cross-sectional data on a firm-by-firm basis for domestic and foreign affiliates. Prowess also gives background information on firms and their investments made in various areas. This results in the advantage of conducting a much more sophisticated analysis. The database has been used in recent studies on various facets of internationalization of Indian firms (Purkayastha, Kumar, & Lu, 2017). For this study, the Indian pharmaceuticals industry was chosen which includes drug formulations, bulk drugs, medicines and allied products among other organic and inorganic compounds manufactured.

We used panel data from 1994–1999 (weak appropriability period reflecting the pre-liberalized era) and 2005–2012 (tight appropriability period reflecting the post-liberalized era) which gave 855 observations from 69 firms of Indian origin. This dichotomous stratification was done with the purpose of investigating whether an institutional shift from a weak to a tight appropriability regime of the Indian pharmaceutical industry had an impact on their internationalization. The period between 2000 and 2004 was deliberately left out since this was a transition period granted to developing countries to amend their intellectual property regime related domestic laws in accordance with requirements of the Trade Related Intellectual Property Rights System (TRIPs) agreement (of 1994). During this transition period, prevailing laws under the India Patent Act (1970) permitted Indian firms to continue producing generic versions of drugs still under patent in the advanced economies. However from 2005 onwards, with the implementation of TRIPs, Indian firms had to cease all reverse engineering of drugs still under patent. Hence, two clearly dichotomous periods of weak and tight intellectual property regimes were 1994–1999 (Pre-TRIPs) and 2005–2012 (Post-implementation of TRIPs). In our equations, the post-TRIPs period is represented as the liberalization dummy (Libdum).

These 69 firms of Indian origin were the ones that featured continuously across the time period under study. A majority of these Indian firms had undertaken exports as well as had FDI across the two time periods. Many others had missing data, and were present in some but not in other years, hence were excluded through the panel data iterations. All data was standardized by size of firms measured by sales revenue to ensure comparability of variables across time.

Variables

In this study our dependent variable to capture internationalization is FDI which is measured in terms of the value of foreign investment made by the focal Indian firm. As noted in our introduction, our conceptualization of internationalization implies a mechanism enabling LFs to reduce the gap and catch-up with the global market leaders. Many LFs, including those from Korea, Taiwan, Singapore, and the like invariably start with exports as one of the main engines of internationalization (Lall & Urata, 2003) later becoming fully fledged MNCs. A large part of revenues of these Asian MNCs continue to be derived from exports—performed within and beyond their internal systems. Given that MNCs and LFs continue to use exports in their global expansion, we conduct further tests with export intensity as our dependent variable. FDI and export intensity are both relevant and well accepted measures for internationalization (Contractor, Kumar, & Kundu, 2007). Moreover, this is consistent with the view of internationalization that Mathews (2002a, 2002b, 2006) advanced in the context of LFs from Asia.

Our main empirical model containing FDI as the dependent variable and other explanatory and control variables is as follows:

$$FDI_{it} = a + b_1Age_{it} + b_2Size_{it} + b_3Profit_{it} + b_4Libdum_{it} + b_5Young_{it} + b_6Resultant\ Learning_{it} + b_7Autonomous\ Learning_{it-1} + \mu_{it} \quad (1)$$

Where FDI_{it} is the linear function of the lagged flow of *autonomous learning* made by the i th firm in time $t-1$ and *resultant learning* in time t . Here, the *autonomous learning* variable is a discrete measure that is entirely independent of *resultant learning* variable. *Autonomous Learning_{it-1}* represents the level of investments made by the i th firm in time $t-1$ (which is a composite index summated from three discrete measures, namely value of intangible assets added, R&D spending and spending towards scanning foreign markets made for the i th firm in time $t-1$); *Resultant learning_{it}* represents flow of foreign resources, embodied and codified for the i th firm in time t (which is a composite index summated from three discrete measures, namely imports of capital equipment, payment for royalty and knowhow imports for the i th firm in time t). The (lagged) autonomous learning variable, being for preceding years is unconnected to, and independent of the spending on resultant linkages and leverage which are expended for subsequent years. *Age_{it}* is a control variable for the i th firm in time t measured in years; *Size_{it}* is a control variable for the i th firm in time t measured by total assets; *Profit_{it}* is a control variable for the i th firm in time t measured in terms of ratio of profits (PBT) to sales ratio. *Libdum* is a dummy variable for institutional change for the i th firm in time t (which takes the value of 1 if taken after TRIPS was fully implemented by India or else 0, if before TRIPS implementation). As noted earlier, implementation of TRIPS denotes the start of the liberalised era and thus prior to TRIPS implementation denotes the pre-liberalised era. *Young_{it}* is another categorical dummy variable (which takes the value of 1 if the firm is less than 20 years in age, or 0 otherwise).

We control for firm heterogeneity through well accepted standard measures used in previous studies, namely, size, profitability and sales of the firm (Buckley et al., 2016). As indicated above, we introduce a contingency variable in terms of the impact of

institutional change from economic liberalization, that is, before and after the full implementation of the stricter appropriability regime of TRIPS under the World Trade Organization which promotes liberal trade and investment policies. This is necessary because TRIPS supposedly had a large impact on the ability of LFs to internationalize as well as leverage resources from international markets. In addition, we have a categorical variable—the young firm, to delineate the effect of new venture status, apart from the explanatory variables. This delineation is important because learning trajectory is path dependent and many older organizations who have grown in an import substituting economy may continue to serve domestic markets whereas young firms may not be bound by such organizational inertia and can internationalize rapidly in comparison to their older counterparts (Table 1).

Analysis

To run the analysis we first estimated Eq. 1 by pooled ordinary least squares (POLS). Subsequently we ran both fixed effect (FE) and random effect (RE) models and we found RE estimations were more robust than FE or OLS since the test statistic (.21) is less than the critical value of a Chi-squared (1df, 5%) (Table 2). The results for Eq. 1 (RE) are reported in Table 3.

Results

The results of our analysis are presented in Table 3. In Eq. 1 the proxy for internationalization is FDI, and the FE model reveals that the F -value (578) is greater than the tabulated value, hence this warrants rejection of the null hypothesis. Overall the R^2 of .45 makes the model a good fit for the hypotheses harbored in the study. We now discuss the evidence in the light of our two hypotheses.

Table 1 Definition of dependent, independent and control variables

Variable name	Variable definition
FDI	Inbound foreign direct investment flow measured by value (USD)
Exports	Exports measured by value (USD)
Age	Total number of years since inception
Asset	Size of total assets of the firm measured by both tangible and intangible assets
Profit	Profits before deduction of income tax and depreciation
Young	Dummy variable (equal to 1 if firm is less than 20 years in operation or else 0, if more than 20 years)
Libdum	Dummy variable (equal to 1 if taken after TRIPS was fully implemented by India or else 0, if before TRIPS implementation)
Resultant learning	A composite index measuring the flow of foreign resources both embodied and codified (summed from 3 discrete measures, namely imports of capital equipment, payment for royalty and knowhow imports)
Autonomous learning	A composite index measuring the level of investments made by the firm (summed from 3 discrete measures, namely value of intangible assets added, R&D spending and spending towards scanning foreign markets)

Table 2 Correlations of variables (FDI)

	Mean	Stdev	1	2	3	4	5	6	7	8	VIF	Tolerance
FDI	11.70	31.46	1									
Age	29.31	21.33	.07	1						3.29	.3	
Asset	1.31	.78	.47	.51	1					2.08	.48	
Profit	9.42	87.65	0	.09	.13	1				1.03	.97	
Young	.64	.47	-.05	-.81	-.48	-.08	1			3.06	.32	
Libdum	.46	.49	.27	.25	.31	.06	-.14	1		1.19	.84	
Resultant learning	2.99	19.94	.22	.01	.26	-.02	-.02	.15	1	1.15	.87	
Autonomous learning	1.02	2.13	.63	.1	.51	.08	-.1	.28	.31	1	1.54	.65

First, in relation to Hypothesis 1, which proposes resultant learning from linkage and leverage to be positively related to LF’s internationalization, the results do not turn out to be significant. This is contrary to our prediction and thereby does not support Mathews’ (2006) LLL thesis as far as FDI is concerned. Since in Mathews’ (2006) original study, based on which we proposed the impact of resultant learning on internationalization, the focus was primarily on internationalization through exports, we conduct further test using export intensity as our dependent variable. The following empirical model is tested.

$$\begin{aligned}
 EXP_{it} = & a + b_1Age_{it} + b_2Size_{it} + b_3Profit_{it} + b_4Libdum_{it} + b_5Latecomer_{it} \\
 & + b_6Resultant\ Learning_{it} + b_7Autonomous\ Learning_{it-1} + \mu_{it} \quad (2)
 \end{aligned}$$

In this Eq. 2, we replace the dependent variable from FDI to export intensity. All other explanatory and control variables remain the same as in Eq. 1. We estimated Eq. 2 by all three methods, POLS, FE and RE and found that FE was most efficient estimator. The FE model reveals that the *F*-value (403) is greater than the tabulated value, hence this warrants rejection of the null hypothesis. Overall the *R*² of .26 makes the model a moderately good

Table 3 Results of panel data analysis of FDI by LFs Eq. 1

FDI	Model 1	Model 2	Model 3	Model 4
Age	-.30***(.09)	-.41***(.11)	-.39***(.11)	-.22**(.10)
Asset	29.99***(2.04)	26.62***(2.16)	27.61***(2.25)	16.27***(2.13)
PBT	-.02**(.00)	-.01**(.00)	-.01**(.00)	-.02***(.00)
Young		1.99(3.50)	2.16(3.69)	3.56(3.29)
Libdum (Liberalization)		8.13***(1.90)	8.62***(1.93)	4.64***(1.74)
Resultant learning			.03(.16)	-.22(.14)
Autonomous learning				6.92***(.47)
Constant	-20.08***(3.29)	-17.86***(5.24)	-19.67***(5.41)	-14.96***(4.81)
Observations	889	889	822	822
<i>R</i> ²	.26	.29	.30	.45
<i>F</i> -Testest/Wald χ^2	259.49	283.72	290.23	578.27

Robust standard errors in parentheses; *** *p* < .01, ** *p* < .05, * *p* < .10

Table 4 Correlations table (Exports)

	Mean	Stdev	1	2	3	4	5	6	7	8	VIF	Tolerance
Exports	21.19	23.6	1									
Age	29.31	21.33	-.02	1							3.29	.3
Asset	1.31	.78	.38	.51	1						2.03	.49
Profit	9.42	87.65	0	.09	.13	1					1.02	.97
Young	.64	.47	.02	-.81	-.49	-.09	1				3.07	.32
Libdum	.46	.49	.14	.25	.31	.06	-.14	1			1.19	.84
Resultant learning	2.99	19.94	.36	.05	.42	.03	-.07	.17	1		3.26	.30
Autonomous learning	1.02	2.13	.41	.1	.51	.08	-.1	.28	.82	1	3.78	.26

fit for the hypotheses harbored in the study (Table 4). These results with export intensity as the dependent variable are presented in Table 5.

Our results in the further test indicate resultant learning from linkage and leverage has a positive impact on internationalization by LFs in a knowledge intensive industry when they internationalize via exports ($\beta = .44, p < .01$, Eq. 2). Such a finding leads us to conclude that linkage and leverage mediated learning may be more relevant for LFs' internationalization through exports but not FDI.

Our research findings therefore go against the grain of research conducted by Athreye and Godley (2009), Kale and Little (2007), Chataway et al. (2007), and Chittoor et al. (2009) whose work appear to suggest that leveraging of foreign technology explain technological leapfrogging by LFs through internationalization. Stricter appropriability regimes under TRIPS has restricted access to international technologies due to contractual difficulties, while high costs and large number of patents held on upstream research inputs and know-how make it difficult for innovative LFs to negotiate licensing contracts with patent holders from global pharma (Gehl-

Table 5 Results of panel data analysis of exports by LFs Eq. 2

Exports	Model 1	Model 2	Model 3	Model 4
Age	-.28***(.07)	-.05***(.09)	-.27(.09)	-.24(.09)
Asset	20.35***(1.33)	20.21***(1.39)	18.89***(1.40)	15.96***(1.43)
PBT	.00(.00)	.00(.00)	.00(.00)	.00(.00)
Young		1.15(1.93)	1.03(1.93)	1.63(1.88)
Libdum (liberalization)		-.20(3.63)	-.44(1.15)	-1.30(1.13)
Resultant learning			.50***(.08)	.44***(.07)
Autonomous learning				1.76***(.26)
Constant	2.02(2.66)	1.06(3.63)	1.83(3.58)	3.17(3.53)
Observations	890	890	823	823
R ²	.21	.22	.24	.26
F-Test/Wald χ^2	314.82	314.38	339.00	403.27

Robust standard errors in parentheses; *** $p < .01$, ** $p < .05$, * $p < .10$

Sampath, 2006). Our findings pertaining to role of resultant learning suggests that while LFs are able to enhance their export intensity they are not able to do so for their FDI.

If we associate exports as a foreign operating mechanism by firms typically pursued in the initial stages of internationalization and FDI in more advanced stages (as per Johansson & Vahlne, 1977), based on our results we can infer that resultant learning from linkage and leverage as proposed in the LLL model is constrained in explaining internationalization in the more advanced stages, at least in the context of knowledge intensive sectors.

In light of Hypothesis 2, which proposes that learning which is autonomous and linkage independent, will be positively related to LF's internationalization, the results demonstrate autonomous learning has a significant and positive impact on LF's ability to internationalize via both FDI ($\beta = 6.92, p < .01$, Eq. 1) and exports ($\beta = 1.76, p < .01$, Eq. 2). An autonomous learning strategy is akin to innovation activities pursued independently by LFs. As per received theory, firms need to have invested significant resources in prior learning to develop their own absorptive capacity before they can assimilate and leverage external knowledge resources (Cohen & Levinthal, 1990). Research on emerging economy firms in knowledge intensive sectors reveal that these LFs redress gaps in their knowledge base—a critical success factor in international markets for knowledge, by acquiring proprietary technologies and knowledge resources by FDI (Buckley et al., 2016; Chittoor et al., 2009) or by privileged access to these strategic resources via linkages with global innovators (Athreye, 2005). Our results however indicate that in order to internationalize, autonomous learning is a critical pre-condition.

March and Simon (1958: 188) suggested external sources and borrowings of knowledge rather than in-house knowledge creation is more critical for competitive advantage, however, our results suggest the LFs' ability to internationalize via FDI or exports relies more on firm-specific assets based on new knowledge created through autonomous learning. These results are supported by recent study on emerging economy firms by Buckley et al. (2016) which showed that their firm-specific knowledge assets are a critical condition in their ability to internationalize. Indeed, an alternate route for LFs to succeed in international markets entails expending efforts to build in-house innovation capabilities. Empirical evidence show that a sizable segment of Indian pharma companies are in fact drawing their innovation capabilities from an initial knowledge base cultivated through past learning in demanding science and technology related fields. Even those LFs that are participating in contract research with global pharma, are running parallel new drug delivery or discovery research that involve steep learning curves (Ray, 2013). Such in-house effort not only accumulates up to date knowledge about new developments at the frontiers of technology but look to the possibility of making a path breaking new drug discovery.

In sum, our results suggest LFs in the pharmaceutical industry in India appear to have accumulated enough innovation based firm-specific advantages to undertake advanced internationalization including via FDI in their own right. Besides the findings that are directly related to the two hypotheses in this research, the results also highlight an important role of institutional environment of LFs which impacted on their internationalization process. The contingency variable which is a proxy for institutional change, namely TRIPS ($\beta = 4.647, p < .05$, Eq. 1) has a positive and significant impact on internationalization through FDI. TRIPS (Liberalization) increases the incentive for LFs to invest in autonomous learning for knowledge creation for building product innovation capabilities (Ray, 2013). TRIPS also increases the opportunities in LFs to establish linkages with global innovators enabling them to participate in their global innovation networks. Our results

indicate that TRIPS has accelerated the process of internationalization of LFs by providing the incentive to develop firm-specific knowledge based assets to directly serve customers in international markets via FDI. Results might also imply LFs leapfrog beyond exports to FDI due to accelerated internationalization. Empirical evidence shows that in knowledge intensive industries LFs are increasingly engaging in learning from and interacting with stakeholders in foreign territories. As well, FDI establishes legitimacy with the community of specialist researchers from industry and university in the field (Bromfield & Barnard, 2010). We also note a deliberate shift in focus towards autonomous learning is used to complement rather than substitute resultant learning through linkage and leverage from existing off-the shelf explicit resources for sustained internationalization.

In essence, for LFs in knowledge intensive industries, it is autonomous learning that is the critical pre-condition for their internationalization, be it exports or FDI. In the early stages of internationalization, autonomous learning may also be a pre-condition for LFs to attract linkages with global innovators and develop firm-specific knowledge assets. In the later stages of internationalization, autonomous learning appears to be critical for LFs to deepen their firm-specific knowledge assets sufficiently for FDI. For LFs that have invested in autonomous learning, liberalization accelerates their internationalization enabling them to invest in FDI placing them in the league of MNCs from the developed world.

Empirical evidence supports this contention. Wadhwa, Rissing, Gereffi, Trumpbour, and Engardio (2008: 2) argued that several LFs have recently moved into the higher segments of the pharmaceuticals value chain through advanced R&D while Athreye et al.'s (2009) evaluation of "dynamic capability building strategies" of four leading Indian LFs (Ranbaxy, Dr. Reddy's, Wockhardt and Piramal) suggested that they have acquired skills for new drug discovery. Chittoor et al. (2009: 199) suggested that Indian firms have developed "innovation capabilities" by drawing on international resource and product markets. Chittoor and Ray (2007) found that out of 40 major Indian pharmaceutical companies, four have evolved as "emerging global firms" and one as a "global firm." Ranbaxy, Lupin, Torrent and Sun are investing more in in-house R&D to build a proprietary technological base and implement new approaches to drug/product development such as novel drug delivery systems. Our findings also bear similarities to an earlier study which showed that partners maximized benefits from R&D alliances when they had developed sufficient absorptive capacity and maintained internal "shadow projects" that paralleled those carried out in the collaborative R&D (Ham & Mowery, 1998).

Discussion

Contributions of the study

Our study contributes to the literature by filling four principal gaps in received theory. First, as per Mathews, internationalization involves strategic innovation, not technological innovation that includes both product and process innovations. Hence it implies that the LLL framework does not purportedly apply to LFs which typically compete on the basis of technological innovation. In this study we focus on a knowledge intensive industry in which LFs in the new liberalized era are compelled to compete on the basis of knowledge creation or technological innovation for gaining dominance in international markets.

Second, Mathews’ (2002a, 2002b, 2006) pioneering work on the LLL framework has yet to distinguish between the different types of organizational learning, namely autonomous and resultant learning from linkage and leverage, as well as their distinct roles in their internationalization process. Moreover, the LLL model does not distinguish between the types of knowledge resources, such as market knowledge, technological knowledge and managerial skills and so forth that are leveraged through linkages established by LFs with global MNCs. In this study we distinguish between autonomous learning and resultant learning from linkage and leverage to explain the internationalization process. Our results demonstrate that for LFs in knowledge intensive industries, it is autonomous learning that is the critical pre-condition for their internationalization, be it exports or FDI. In the early stages of internationalization, autonomous leaning may also be a pre-condition for LFs to attract linkages with global innovators and develop firm-specific knowledge assets. In the later stages of internationalization, autonomous learning appears to be critical for LFs to deepen their firm-specific knowledge assets sufficiently for FDI. For LFs that have invested in autonomous learning, liberalization leading to strengthening of the institutional environment accelerates their internationalization enabling them to invest in FDI placing them in the same league as MNCs from the developed world. Firm-level autonomous learning activities has parallels to the autonomous learning strategies that were pursued by the leading East Asian economies, Japan, Korea and Taiwan to promote their own national champions (Narula & Lall, 2006,). All three countries depended much less on FDI to pursue internationalization, but increased their own learning activities facilitated by an institutional context that encouraged learning (Lall, 2003).

An autonomous learning strategy can be likened to innovation activities pursued by LFs. Autonomous learning concerns all the *shadow activities* pursued by the LF to

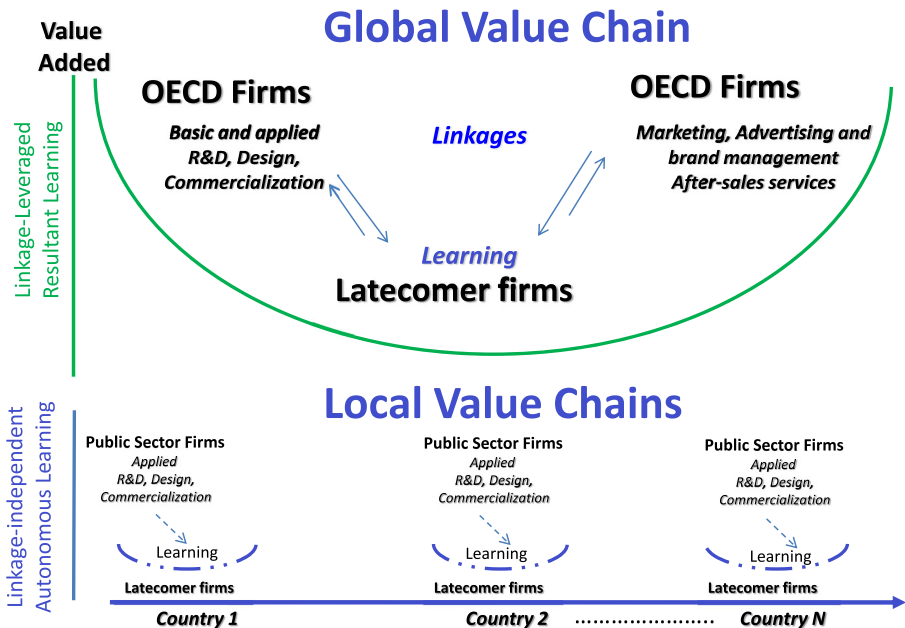


Fig. 1 Catch-up by LFs via global and local value chains

establish its own technological innovation trajectory (as depicted in Fig. 1 below). It is independent of but can be parallel to LFs participation in linkage dependent growth along global value chains (Mathews & Snow, 1998). For example Haier moved from original equipment manufacturing (OEM) to original brand manufacturing (OBM) by crafting their own adaptive activities to modify and innovate on MNC technologies to serve local markets, and gradually extended operations to other countries including developed ones.

Third, the LLL model highlights the role of resources leveraged by LFs from linkages with global firms for their internationalization. Mathews (2002a, 2002b, 2006) stated that resources leveraged from such linkages are least rare, and most imitable, not higher level technological or knowledge resources. Since our results indicate that resultant learning from linkage and leverage does not have a positive impact on internationalization via FDI, we argue that resources leveraged via linkages are indeed not valuable for organizational learning necessary for product or process innovation activities by LFs. If LFs' internationalization strategy was predicated on leveraging these off-the-shelf type resources (Lall, 2003) which can be easily available to most competitors in a globalized world (Teece, 2014), this would not confer catch-up per se, even though leverage of external resources represents an important first step in the internationalization by LFs.

Fourth, the LLL model assumes that emerging economy firms have pre-existing linkage capabilities that enable them to integrate into the global value chains of MNCs to upgrade their own learning and develop innovative capabilities (Ernst & Kim, 2002; Mudambi, 2008). However based on the experience of the East Asian Tiger economies it is important to note that these linkage capabilities in LFs were primarily shaped by cooperative and coordinated learning strategies with public sector firms. Frequently, knowledge created from formalized learning activities undertaken in public sector labs in Japan, Korea and Taiwan were made available to LFs free of cost under a coordinated market economy (Amsden, 1989; Lall, 1995; Lall & Narula, 2004). In the case of LFs from Taiwanese machine tools industry, knowledge linkages established between public sector research laboratories and industry provide an important local channel for learning and build technological capabilities. In the case of companies such as Matsushita, Hitachi and Toshiba (who worked as OEM supplier to RCA, Zenith and GE) Acer (OEM supplier to IBM), Samsung and LG for Korea—there was a significant role played by their public sectors to help private firms not only to replicate the entire value chain of MNCs, but also adapt and innovate new technologies and boost their own value chains.

As emerging economies become further integrated into the global economy, LFs are taking on autonomous learning to develop absorptive capacity even as the role of the public sector support for R&D is diminishing. Under such circumstances, our results imply that autonomous learning is significant determinant of their being able to mount the global value chain and attract foreign MNCs to strike linkages at the early stage of internationalization to catalyze and sustain their subsequent internationalization process (see also Pietrobelli & Rabelotti, 2011).

At more advanced stages of internationalization, linkages with global MNCs become less important for LFs. Our results are supported by findings of earlier studies. For example, in the case of Taiwanese firms that moved from OEM to OBM status, autonomous learning activities gained precedence over linkage and leverage mediated activities in internationalization (Liu & Ray, 2012). Gradually firms like Acer, Asus and Chi Mei were able to craft their own independent technological trajectories by pursuing in-house innovation activities in parallel to linkage and leverage mediated ones and if

anything, the value chains crafted by these LFs emerged as parallel forces in the global economy.

Implications for theory and practice

We now turn to deliberate on the propositions of the LLL model with an aim to offer refinements to the theoretical premises in light of the evidence presented in our analysis. First, in the LLL view, it is highly plausible that the least rare, inimitable and off-the-shelf resources can be instantly absorbed by LFs, since learning curves are predictable. But even though resources and services may be brought-in from (domestic or foreign) firms, it is doubtful they can be instantly absorbed, since by assumption, LFs suffer from severe knowledge gaps. There are many tacit elements of knowledge in both embodied and codified resources that need to be mastered before they can be absorbed into the production functions. Therefore, LFs that manage to internationalize must have had a prior base of learning. In line with this reasoning, our analysis demonstrates that LFs that have accumulated absorptive capacity have a significant opportunity to internationalize both via exports and FDI. As Mathews (2002a) explained, the notion of absorptive capacity offers the proposition that the “ability to absorb new information is a function of the richness of the pre-existing knowledge structure of the firm, and that learning performance is maximized when the object of learning is related to what is already known” (478). Hence it is instructive not to overestimate the opportunities to leverage resources presented through the interconnected nature of the global economy since a prior base of learning is essential before the LF can even mount the interconnected global value chain. In our view, this limitation needs to be more clearly specified in the LLL model.

Second, in the LLL view, learning apparently transpires through spillovers in the global value chain. The paradigmatic induction of the latecomer model may lead us to overemphasize the importance of linkage and leverage mediated learning to assimilate from and innovate on the least rare and most inimitable resources for internationalization. In our view, narrowing the gap and catching up requires a shift towards autonomous learning within LFs, even as they also take part in linkage and leverage mediated learning. Accelerated internationalization especially in economies where change is rapid requires LFs to go beyond mere OEM suppliers, as is demonstrated from the evidence of LFs from Asian economies. The case of Korean and Taiwanese LFs like Hyundai, Samsung, LG and Acer, who invested in organization learning buttressed via public sector institutions and established their own value chains, successfully accelerated their internationalization, while those that remained purely dependent on major MNCs did not (Kim, 2003). Hence, although Mathews (2002a, 479) suggested “LF is not concerned to generate ‘new knowledge’ but to adapt existing technologies as fast as possible for its own catch-up endeavors” and presents evidence of Korean semiconductor firms to support this notion, it is instructive to note Korean LFs actually deployed autonomous effort towards developing their own innovations and value chains entailing next generation products.

Third, it appears resources leveraged through linkages can be significant only in the initial stage of internationalization. Indeed, it may be argued, LFs would grasp a better chance of internationalization, if their autonomous learning activities are pointed towards exploration of new knowledge. Autonomous learning may lead to new discoveries and upgrade the LF from being a pure contract manufacturer to an independent MNC in its own right. Yet, how should an LF make strategic choices regarding “committing to long-term

paths or trajectories of competence development” (Teece, Pisano, & Shuen, 1997: 529) is, theoretically under-explored in Mathews’ own admission. Our research reveals that commitment towards capability to innovate and upgrade, depends on how they draw from their local science and technology infrastructure in addition to learning through linkages with foreign MNCs and leveraging their resources (Ray & Rahman, 2006; Ray & Venaik, 2001). Also, case studies in the Indian pharmaceuticals industry appear to suggest that sales of scale intensive generic drugs to developed country firms result in revenue streams to power new drug discovery research based on their unique knowledge conditioned by the institutional structure of learning in science and technology. All we may infer at this point is that LFs that aim to internationalize should make strategic investments in autonomous learning early in their life cycle and reduce dependence on MNCs from developed countries.

Limitations

Like most empirical studies, certain limitations constrain the generalizability of this study. First, the study was restricted to a single industry hence the obvious question is to what extent its findings can be ported to other industries. Technology or knowledge intensive industries such as pharmaceuticals are defined by innovation—hence in these industries it is unlikely that firms can simply accumulate knowledge via external linkages. Yet, not all industries are as technology intensive as pharmaceuticals. In certain mature industries such as steel, textiles and chemicals, knowledge accumulation is not as fast paced and hence there need not be much internal learning effort required to assimilate external resources. Hence, the generalizability of the results of this study could be improved if more industries are taken into account.

Second, this is also a single country study, albeit being concerned with an important question regarding LFs from a major emerging economy. Countries evolve differently in their trajectories of development and in their institutional framework and policy stance (Franco, Ray, & Ray, 2011). Hence, it is by no means certain that another developing country with an entirely different set of initial conditions would have LFs that are similar in profile to pharmaceutical LFs as India. The question therefore is to what extent its findings could be generalized to other emerging economies or even developing economies especially those whose national innovation systems are not so well-developed and which do not have large numbers of technical graduates at the tertiary level.

Conclusion

As observed by Mathews (2006), the progressive interconnectedness of the global value chain of innovation presents many opportunities for LFs to leapfrog into knowledge-based sectors. One such avenue was engagement of LFs in providing knowledge-based services through exports. Given the availability of large cadres of research personnel at substantially lower wages in emerging economies, particularly in countries such as India, there are strong incentives to engage LFs in innovation and use this for obtaining innovation returns.

The results of the study gives support to the hypotheses about the precise knowledge inputs that contribute to success of knowledge based exports and FDI. The study also nuances the different dimensions of learning activities that need to be pursued by LFs—R&D, market scanning and the like, as these dimensions determine how best resources may be allocated for firms from developing nations. Research findings of this study refine

the LLL model by identifying learning in LFs as being both autonomous and linkage and leverage mediated. In this way the present research explicitly links Mathews' LLL model to learning perspectives and directs attention to the novel ways via which LFs are catching up by often bypassing traditional routes to internationalization.

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