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Accumulative and Assimilative Learning, Institutional Infrastructure and Innovation orientation of Developing Economy Firms

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**ACCUMULATIVE AND ASSIMILATIVE LEARNING, INSTITUTIONAL  
INFRASTRUCTURE AND INNOVATION ORIENTATION OF DEVELOPING  
ECONOMY FIRMS**

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**ACCUMULATIVE AND ASSIMILATIVE LEARNING, INSTITUTIONAL  
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ECONOMY FIRMS**

**Abstract**

We examine the role of internationally acquired knowledge and supra-firm institutional infrastructure on developing firms' innovation orientation. Empirical results, based on a panel of 11,048 Indian manufacturing firms during the period 1990-2009, show that the macro- and micro-institutional context in which firms are embedded condition the effect of global resource and product market participation on indigenous innovation efforts. In particular, technology imports (accumulative learning) have a stronger effect on inducing investments in innovation when the macro-institutional development is weak and for firms that are affiliated to business groups. On the other hand, product-market internationalization (assimilative learning) plays a more important role in facilitating innovation efforts as the institutional environment becomes stronger and for independent firms that do not possess the network advantages inherent in business groups.

The global strategy literature recognizes two important sources of firm motivations to expand into international markets: exploiting existing know-how through a process of transferring a firm's unique knowledge, whether it is related to technology, production, marketing or other activities, across borders (Hitt, Hoskinson and Kim 1997; Ghoshal, 1987, Tsang 1999); and exploration whereby exposure to and learning from diverse institutional contexts, competitive conditions, and customer behavior increases its knowledge base, which in turn, fosters innovation in different aspects of the value-chain (Barkema and Vermeulan, 1998; Zahra, Ireland, and Hitt, 2000). Much of the research based on the former assumes that the internationalizing firm already possesses the technology and product-related knowledge it needs in order to meet the demand of the foreign markets, and the act of internationalization is undertaken in order to exploit this stock of existing know-how (Hitt, Bierman, Uhlenbruck and Shimizu, 2006). However, an emerging body of research suggests that internationalization of firms from developing economies is guided primarily by learning motivations, with foreign markets serving as channels through which firms gain access to diverse ideas and knowledge that are unavailable domestically, but which are essential for survival and growth in a changed institutional context (Chittoor, Sarkar, Ray and Aulakh, 2009; Doz, Santos, and Williamson 2001; Luo and Tung, 2007; Nelson, 2005). According to Nelson (2008a: 14-15), "for countries aiming to catch up, the basic challenge is to learn to master new ways of doing things .... The innovation in catching up involves bringing in and learning to master ways of doing things that may have been used for some time in the advanced economies of the world, even though they are new for the country or region catching up."

While there is a general consensus that global markets provide learning opportunities for firms from developing economies, which in turn can provide the impetus for investments in

innovation and facilitate catching-up on the knowledge frontier, we are yet to fully understand the mechanisms by which external learning is internalized and applied for indigenous innovation (MacGarvie, 2006; Nelson, 2005; Lall, 1992). Placing our paper in the context of post-liberalization era that facilitated access to global resources and markets, we study the effects of learning through resource and product-market internationalization on firm R&D investments, and how the institutional infrastructure in which firms are embedded conditions these relationships.

Our base theoretical arguments are anchored in two distinct perspectives on how external learning is internalized and applied to indigenous innovation in developing economies. One view, rooted in neoclassical economics, considers learning, and the associated economic growth, coming primarily through investments in physical and human capital (e.g., Abramovitz, 1986; Amsden, 1989; Kim and Lau, 1994). Accordingly, investing in technology imports and adapting them to local contexts allow firms to move up the technology frontier. An alternative perspective, with roots in evolutionary economics (Dosi, 1988; Nelson and Winter, 1982; Nelson and Pack, 1999; Nelson, 2005; Lall, 1992; Bell and Pavitt, 1993), identifies ‘learning by doing’ as the primary mechanism that motivates innovation efforts of developing economy firms. In order to use the acquired know-how effectively, new sets of skills and organizing principles are required, which can be achieved when firms actually step outside to pursue product-market internationalization in global markets and interact with advanced market firms and customers (Nelson, 2005).

These two perspectives highlight the learning potential, and the related motivations for investments in innovation, from participating in international resource and product markets, respectively. However, given the diverse theoretical assumptions of these two perspectives and

their level of analysis,<sup>1</sup> it is unclear theoretically and empirically how and under what conditions each learning mechanism facilitates innovation efforts. For instance, developing countries' liberalization efforts to facilitate inward technology flows have led to unequal absorption of the external technology to jump start indigenous innovation efforts (OECD 2006). Similarly, evidence on the effect of product-market internationalization as a source of innovation is inconclusive. In a review of the extensive learning-by-exporting literature, Wagner (2007) reports that while there is converging evidence that more productive firms undertake internationalization because these firms are able to afford the extra sunk costs of entering new markets (Melitz, Helpman and Yeaple, 2004), whether internationalizing firms become more innovation oriented is still not clear from evidence across a wide range of industries and countries. Furthermore, although the literature has highlighted the important role played by institutions (North, 1990) on firms' learning and innovation, we are yet understand the exact nature and mechanisms of their influence (Nelson, 2008). The question of how institutional environment of firms shape their learning from global markets assumes particular significance given that most developing economies are undergoing substantial liberalization and institutional changes (Hoskisson, Eden, Lau and Wright, 2000).

In this paper, we advance this stream of research by developing and empirically testing a model explaining the drivers of investments in innovation by developing economy firms. We first examine the competing accumulation and assimilation arguments by hypothesizing the effects of the two learning mechanisms (technology imports and product market

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<sup>1</sup> The traditional approach to economic growth (accumulation) focuses on investments at the country level (Nelson, 2005). "Countries simply settle on appropriate level of capital/labor intensity.... Firms in a given industry are all on the same production function and select their techniques with reference to relative factor price ratio..." (Lall, 1992: 165). The assimilation argument of 'learning by doing' considers economic growth by incorporating firm level heterogeneity in the analyses as firms within the same country may possess different internal processes to assimilate external knowledge.

internationalization) on investments in innovation. We then theorize that the institutional context in which a firm is embedded conditions the relationship between the two learning mechanisms and innovation efforts. In particular, we incorporate institutions at two levels. At the macro level, we analyse the influence of economy wide institutional development on the relative importance of the two types of learning on innovation efforts. According to Coriat and Weinstein (2002: 282), macro-institutions (or Type 1 institutions) define rules of the game which “are singular insofar as they include an explicit “enforcement” dimension, imposed on all agents. This dimension is guaranteed by a sanction system ... that make the imposed rules of the game operational and guarantee their respect by agents.” At the micro level, we consider the influence of the intra-organizational context - specifically a firm’s affiliation (or non-affiliation) to business groups (BGs) that are widely prevalent in developing economies (Morck, 2007). Business groups have been theorized as supra-firm institutions (Chang, Chung and Mahmood, 2006) that substitute for institutional voids or underdeveloped institutions that characterize developing economies (Leff, 1978; Khanna and Palepu, 1997). Akin to Type 2 institutions suggested by Coriat and Weinstein (2002), firms affiliated to business groups can be seen as private collective agreements between a group of firms linked together through the hierarchy of the business group. The proposed overall conceptual model is summarized in Figure 1 and we develop these arguments in greater detail in the next section

*INSERT FIGURE 1 HERE*

We empirically test our model using a comprehensive and unbalanced panel dataset of 11,048 manufacturing firms from India during the period 1990-2009. India is one of the largest emerging economies and Indian firms have been making steady progress to catch up and emerge as significant players in the global markets. The period of our study coincides with the

integration of the Indian economy with the rest of the world due to the onset of significant liberalization measures and institutional development. Thus, our empirical context (India) which has seen heterogeneity in the institutional environment (significant changes in macro institutional environment as well as a mix of BG and stand alone firms) constitutes a unique natural experiment setting to test our theoretical predictions.

## **THEORY AND HYPOTHESES**

The starting point of our theorization is the literature on economic growth that identifies two broad mechanisms to explain the process of technological learning and economic growth in developing economies - accumulation and assimilation (Kim, 1997; Lall, 1992; Nelson and Pack, 1999; Nelson, 2005). These theories in turn build on the two dimensions of knowledge respectively – explicit and tacit (Polanyi, 1966) or objective and experiential (Penrose, 1959). Explicit knowledge can be codified and can be acquired through books, technical specifications, designs and machinery. On the other hand, tacit knowledge is deeply rooted, hard to codify and can be acquired primarily through experience such as observation, imitation and practice (Lyles and Salk, 1996; Dhanaraj, Lyles, Steensma and Tihanyi, 2004; Kim, 1997). Rooted in acquiring explicit knowledge, accumulation approaches emphasize high rates of investment in physical and human capital (Young, 1994; Kim and Lau, 1994; Krugman, 1994). This view assumes that technological knowledge is largely embodied in machinery and codified documents and thus can be gained through investments to acquire them. The second set of theories emphasizes ‘assimilation’ processes that stress learning by doing, entrepreneurship and innovation, in addition to accumulation through investments (Nelson and Pack, 1999). While accumulation is necessary, it is not a sufficient means to achieve technological learning. According to this view, competitiveness is seldom achieved through simple accumulation of technology without

concomitant investments in technology upgradation, improvement and innovation (Evenson and Westphal, 1994). Assimilationists argue that only a small portion of technology is codified in the form of blue prints and therefore learning is accomplished as much by doing and using as by reading and studying (Nelson, 2005).

We extend the theoretical ideas of accumulation and assimilation from macro level to firm level – in particular, to conceptualize firm learning from foreign markets. We argue that learning from international sources broadly takes two forms – through direct imports of technology and an endogenous process of learning by doing through product market internationalization. Developing economy firms leverage on inflows of foreign technology to improve their technological base (Pack and Saggi, 1997). Import of technologies from industrially advanced countries has been a primary means for firms from newly industrializing firms in their quest for ‘catching up’ technologically. Foreign technology transfer can provide new dimensions in raising the knowledge level and can serve as a catalytic source of technological change (Kim, 1997).

However, there are many elements of experiential learning from foreign markets that cannot be acquired by accumulation through imports alone. From the perspective of the assimilation scholars, venturing into international markets through exports or other modes stimulates and supports learning (Pack and Westphal, 1986; Nelson, 2005). Internationalization necessitates firms to pay attention to world standards and meet the high performance demanded by international customers, which stimulates learning (Nelson, 2005). This view is supported in the international business literature which has highlighted the multitude of learning opportunities that product market internationalization offers (Johanson and Vahlne, 1977; Ghoshal, 1987; Zahra, Ireland and Hitt, 2000; Doz, Santos and Williamson, 2001; Salomon, 2006).

### **Technology Imports and Investments in Innovation**

Innovation in the context of developing economy firms includes bringing in technology and learning processes that may have been already in existence in developed economies for a considerable period of time. Thus at the base level, investment in innovation by developing economy firms is facilitated simply through imports of technology (Cusumano and Elenkov, 1994; Young, Huang and McDermott, 1996; Kumar and Aggarwal, 2005). In developing economies, import of technology is considered the most important source of knowledge acquisition by firms (Kumar and Aggarwal, 2005). This is based on the premise that technological activity in developing countries is to a large part directed at adapting imported technologies (Lall, 1983). The adaptation could involve use of local inputs, product and process modification and improvement through conscious technological effort both on the shop floor and through formal R&D.

This would be akin to the concept of accumulation by economists who argue that economic development is driven by acquisition of resources through higher investments of capital. Technology forms a critical 'gap' between firms from developing markets and those from developed countries (Khanna and Palepu, 2000). Since the quality of technology accessed from domestic sources is often found to be inadequate, technological development in emerging economies often comprises of import of foreign technology and its adaptation to develop new innovation (Pradhan, 2004; Young, Huang and McDermott, 1996). Technology imports facilitate continuous interaction with foreign suppliers, which over time could help develop knowledge about foreign markets and development of a network of valuable contacts (Korhonen, Luostarinen and Welch, 1996). Technological knowledge may be imported both in embodied (plant and machinery) and disembodied (patents, designs and drawings, process and product

licensing) forms. Both these type of technology imports are likely to increase the propensity of a firm to undertake R&D, particularly in developing economies (Aggarwal, 2000). This is because technology imports lead to further technological work to adapt and assimilate the imported knowledge, which requires investments in R&D. In other words, imports of technology induce adaptive R&D. Therefore, technology imports in developing economies are followed by increase in R&D investments to absorb the imported technologies.

*H1: Import of international technology resources is positively related to investments in innovation by firms in developing economies.*

### **Product-Market Internationalization and Investments in Innovation**

Another key driver of catch up is assimilation which involves the endogenous process of learning-by-doing. An important means of endogenous learning and assimilation for developing economy firms to move up on innovation is product market internationalization. The very process of internationalization has been conceptualized to involve gradual acquisition, integration and use of knowledge about foreign markets and operations (Johanson and Wiedersheim-Paul, 1975). While objective knowledge can be easily acquired remotely, experiential knowledge can only be gained successively during operations in foreign markets (Johanson and Vahlne, 1977). There is a substantive body of literature in economics and management that has examined the learning benefits/opportunities for firms through internationalization of product markets (Ghoshal, 1987; Barkema and Vermeulen, 1998; Nelson, 2005; Wagner, 2007; Zahra, Ireland and Hitt, 2000). Markets serve as ‘learning laboratories’ (Hitt et al., 2005) in which firms engage in organizational learning and develop their innovation capabilities (Kotabe, 1990). On one hand, international markets create incentives for innovation (Hitt, Hoskisson, and Kim, 1997); on the other, they create an opportunity to create value by searching out and mobilizing untapped pockets of technology and market intelligence that are

dispersed across the globe. According to Doz, Santos and Williamson (2001), the fragmentation of innovation clusters and ensuing dispersion of knowledge among geographically diverse locations around the world, combined with the convergence between hitherto separate knowledge domains, is creating new global innovation opportunities for firms. Firm exposure to diverse circumstances and experiences increases its knowledge base, which in turn, fosters innovation in different aspects of the value-chain (Miller and Chen, 1996).

Participation in international markets thus functions as an important tool for organizational learning, and constitutes a route to new capability development. Catering to new markets, while requiring the exploitation of resources that a firm possesses, also acts as a lever through which firms are able to develop new capabilities. Firms' ability to compete in global markets may therefore accrue endogenously through experiential learning in international markets (Hitt et al. 1997, Zollo and Winter 2002). This is particularly salient in the case of developing economy firms which are plagued by significant knowledge and resource disadvantages. Therefore, the generation of innovation capabilities may follow an iterative process of exploration or learning activities, and then their subsequent exploitation by using these capabilities in new product markets (Danneels 2002). Accordingly, we test this linkage between product market internationalization and innovation orientation and hypothesize that:

*H2: Product-market internationalization is positively related to investments in innovation by firms in developing economies.*

### **Institutional Infrastructure and Learning Mechanisms**

Recent innovation literature emphasizes the key role played by a wide range of institutions that are involved in supporting and orienting innovation in organizations (Coriat and Weinstein, 2002; Nelson, 2008). Institutions are understood broadly as basic rules of the game (North, 1990) or as governing structures molding different aspects of economic activity. These

supporting institutions may include the financial system, industry associations, technical societies, universities and legal institutions, and organizational structures that facilitate firms in learning and undertaking innovation activities (Nelson, 2005, 2008). The emergence and existence of these institutional actors significantly influence the nature of the firms, the organization of the industry and development of technology (Murmann, 2003; Nelson, 2005). The institutional infrastructure necessary for innovation, often described as innovation systems or innovation infrastructure, has been explored at various levels, including at the level of a nation (Freeman, 1988; Lundvall, 1992), an industry (Mowery and Nelson, 1999; Murmann, 2003) or a technology (Carlsson, 1995). Effective development of capabilities by developing economy firms involves the coevolution of technologies employed, firm and industry structure and broader economic institutions (Nelson, 2007, 2008).

Institutional factors are considered the third leg in the “strategy tripod”, particularly in the global strategy context, with industry and resource factors constituting the other two legs (Peng, Wang and Jiang, 2008). With most developing economies in the world undergoing significant institutional changes, it is important to theorize how institutional environments influence the relationship between learning from foreign markets and firms’ investments in innovation. We focus on the moderating role of institutional environment at both macro and micro level. At the macro level, we consider the influence of economy-wide institutional changes including the substantial opening up of the Indian economy and the major liberalization measures introduced from 1991 onwards. At the micro level we consider the influence of the organizational context - specifically a firm’s affiliation (or non-affiliation) to business groups (BGs) that characterize most emerging economies and even some developed economies (Morck, 2007). Business groups

are quasi-institutions that create internal markets substituting for market-supporting institutions that are either underdeveloped or lacking in many developing economies.

**Macro-Institutional Development and Learning Mechanisms:** The institutional view posits that country level “innovativeness is determined largely by the institutional context in which innovation agents, primarily firms, operate” (Chang et al., 2006: 638). This may include formal and informal regulations and norms and their associated enforcement mechanisms (Coriat and Weinstein, 2002; North 1990) that provide incentives for innovation, as well as presence of research institutes and universities which provide the necessary intellectual resources needed for innovation (Nelson 2008). We suggest that the liberalization process in developing economies over the last two decades has led to the evolution of these macro-institutions associated with innovation activities (Kim, Kim and Hoskisson, 2010). The initial phase of liberalization or market-oriented institutional change can be a period of institutional frictions where the newly introduced institutions coexist with legacy institutions. After the initial adjustment period, institutional frictions would give way to institutional convergence and in the latter period there are only incremental institutional changes guided by the new institutional logics. The relative import of resource and product market internationalization on innovation investments is likely to vary in these two phases of institutional development.

Inputs of international technology from foreign sources are critical during the initial period of liberalization and institutional development as firms in developing economies have been cut off from global markets for long periods of time (Kumar and Aggarwal, 2005). In the initial phase of market-oriented institutional change, firms are likely to continue the legacy of learning through import of technologies as a primary means of technological catch-up. With imports substantially liberalized, this serves as an effective as well as an efficient way of learning

given the significant potential to catch-up by accumulation processes. During this period, there is substantial scope for import and adaptation of technologies as there are still a lot of ‘low-hanging fruit’. Over time, through the absorption of imported technology resources, firms are likely to catch up and develop internal technologies. Thus, we expect that the marginal impact of foreign technology imports on investments in innovation to be high in the initial phase of institutional development and to decline over time as institutions develop.

*H3a: The impact of technology imports on a firm's investments in innovation will be stronger in the initial phase of institutional development compared to the latter phase.*

Accumulation through imports of technology alone may not be sufficient for developing economy firms to catch up with their developed economy counterparts in innovation investments (Nelson, 2007, 2008). In the latter phase of institutional change, mere imitation and reverse engineering would become increasingly difficult and inadequate, thus necessitating assimilation and indigenous development on the part of developing economy firms. A sustainable increase in the level of innovation investments requires much more than simply import of technology and calls for assimilation through endogenous processes of learning by doing. Product market internationalization serves as one such important assimilation mechanism as it provides an opportunity for learning by doing as well as forces the firms to move up on innovation capabilities to meet the exacting standards of the international customers. Furthermore, a stronger legal framework and enforcement mechanisms associated with institutional development attracts inward FDI by multinationals, thus making it difficult for indigenous firms to compete through adaptive innovation. Instead, firms are likely to push for assimilative learning through product market internationalization in the hope of moving up the value curve through investments in innovation. Thus, it is likely that the marginal impact of assimilation

mechanisms such as internationalization on a firm's investments in innovation would increase as with institutional development in the home market. Hence, we hypothesize,

*H3b: The impact of product market internationalization on a firm's investment in innovation will be stronger in the latter phase of institutional development compared to the initial phase.*

**Business Groups and Learning Mechanisms:** In the context of developing economies, certain unique organizational forms such as business groups could act as micro-level institutions, substituting for some of the functions that are typically provided by stand-alone institutions in developed economies (Mahmood and Mitchell, 2004; Chang, Chung and Mahmood, 2006). According to Leff (1978: 667), "institution of the (business) group is thus an intra-firm mechanism for dealing with deficiencies in the markets for primary factors, risk and intermediate products in the developing countries". The speed and the effectiveness with which a firm adopts and integrates new technologies is often influenced by regional and national networks of firms and institutions and hence we posit that business groups, to which many developing economy firms are affiliated, condition the relationships between technology imports/ product market internationalization and investments in innovation.

A rich body of work has established the significance of business groups in the socio-economic landscape of developing economies (Strachen, 1976; Amsden, 1989; Keister, 1998; Khanna and Palepu, 1997; Khanna and Yafeh, 2007). While the focus of earlier research was to understand the rationale behind formation of business groups, and relate their underlying characteristics to different country contexts (e.g., Khanna and Palepu, 2000; Guillen, 2000; Kock and Guillen, 2001), recent studies have attempted to understand how unique firm structures such as business groups affect firms' innovation processes and their adaptation to institutional transformations (e.g., Mahmood and Mitchell 2004; Chang, Chung and Mahmood, 2006; Yiu,

Bruton and Lu, 2005; Yiu, Ng and Ma, 2012). Business groups are increasingly seen as providing two types of advantages for member firms (Langlois, 2012): “gap-filling function,” whereby in the presence of strategic factor market imperfections (or institutional voids), business groups fill the void by generating their own internal markets for financial capital and managerial talent; and “coalitional function” whereby business groups “characterize an economic coordination mechanism in which legally independent companies utilize the collaborative arrangements to enhance their collective economic welfare” (Colpan and Hikino, 2010: 17). This includes sharing resources and capabilities and cross-pollination of ideas across group affiliated firms (*The Economist*, 2014). These two different categories of advantages offered by BGs are not mutually exclusive and could reinforce each other. Firms affiliated to business groups benefit from access to group resources including capital, technology, human resources and complementary products and services - which substitute as institutional infrastructure for innovation - and hence are better placed to develop innovative capabilities (Chang, Chung and Mahmood 2006).

BG firms are better placed compared to stand-alone firms both in their ability to import technologies as well as in their ability to absorb them through adaptive R&D. By transferring capital within the group or by leveraging their reputation and underwriting capital issues, groups are able to alleviate resource deficiencies common to most developing economy firms. In addition, due to their superior visibility and reputation benefits, business groups are in a position to attract and retain better talent and develop internal talent markets. Given the weak protection for property rights in developing economies, developed economy firms are hesitant to share knowledge fearing expropriation of their intellectual property rights (Khanna and Palepu, 1997). In order to safeguard their long term reputation benefits, business groups tend to provide better

protection to property rights and enforce contracts in their affiliate firms in comparison to unaffiliated firms. Hence, foreign technology providers prefer to share technological knowledge to business group firms that are likely to honor contracts and are more hesitant to deal with independent firms (Hobday and Colpan, 2012).

Secondly, BG firms are able to leverage accumulation-based learning such as technology imports more effectively than stand-alone firms to catch-up technologically and boost innovation investments. Exploitation and absorption of external technologies requires a basic ability on the part of the firms to understand the technology and apply/adapt it internally. In other words, firms need a threshold technological ability to optimally utilize the imported technologies (Cohen and Levinthal, 1989; Aggarwal, 2000). If the firm is in a better position to utilize the imported technologies, it will make greater efforts to adapt and absorb the technologies and hence its subsequent investments in R&D will be higher. Due to sharing of knowledge and support from the parent firm as well as from the other member firms of a business group, BG affiliation enhances a firm's ability to adapt the imported technologies. This in turn induces the BG firms to make higher investments in adaptive R&D when compared to stand-alone firms. Hence we hypothesize that,

*H4a: The impact of technology imports on investments in innovation will be stronger for business group firms when compared to stand-alone firms.*

When it comes to assimilation-based learning through product market internationalization, BG firms need not engage in it directly, but can learn vicariously through the internationalization experience of other BG firms. Elango and Pattnaik (2007) find that the extent of international experience of the parental BG network has a positive influence on the degree of internationalization of a BG firm. Business groups can thus be viewed as a strategic network providing member firms with access to information, knowledge, resources, markets, and

technologies including that related to internationalization. We had argued earlier that internationalization serves as an effective assimilation mechanism as it exposes firms to diverse contexts and experiences, which in turn fosters innovation. BG firms can readily draw on their members firms' relationships with foreign customers, suppliers, partners and intermediaries, without actually internationalizing themselves. Independent firms do not have access to such internal markets and knowledge sharing mechanisms and their need for assimilation mechanisms such as product market internationalization is higher compared to stand-alone firms. To conclude, business group firms have alternative assimilation mechanisms available through their access to the network of other BG firms which stand-alone (non-BG) firms lack. Therefore, we hypothesize that

*H4b: The impact of product market internationalization on investments in innovation will be stronger for stand-alone firms when compared to business group firms*

## **METHODOLOGY**

### **Data and Context**

The Indian economy has been undergoing significant institutional changes for the last two decades and has seen substantial improvement in its economic institutions over this period. A severe crisis in its balance of payments position triggered a series of major economic liberalization measures by the Indian government, starting in 1991, to establish stronger linkages with the global economy as well as to improve free market mechanisms in the country. The institutional changes resulting from these economic reforms can be broadly grouped into three major categories (Ray, 2003) – (a) privatization or change of ownership of key sectors of the economy from government to private sector (b) founding and development of market institutions to bring about efficient intermediation in financial, legal, labor and regulatory domains, and (c) a

wide range of measures to liberalize trade and open up the economy to competition, particularly from foreign players.

We used the *Prowess* database from the Centre for Monitoring Indian Economy (CMIE) for our data, which is being increasingly used by economists and strategy researchers (e.g., Khanna and Palepu, 2000; Khanna and Rivkin, 2001; Kumar and Aggarwal, 2005; Chacar and Vissa, 2005) for large sample studies on India. *Prowess* also has an advantage from our study's point of view as it uniquely identifies a firm's business group membership through a rigorous, on-going process (Khanna and Rivkin, 2001). CMIE *Prowess* contains detailed financial data on over 20,000 Indian firms comprising all companies traded on India's major stock exchanges and several others including the central public sector enterprises. The database covers most of the organized industrial activity in India and the companies covered in *Prowess* account for 75 per cent of all corporate taxes and over 95 per cent of excise duty collected by the Government of India.

We exclude firms from the financial sector and the government sector as their business objectives and innovation activities are not comparable with those of the other sectors of the economy. As we are primarily interested in the Indian private sector, we also exclude the subsidiaries of foreign multinationals operating in India. Since the dataset includes many small companies with hardly any data, we exclude all small firms that never crossed an annual income of USD 250,000 during the whole study period. Based on these criteria, we had a list of 11,048 firms in the *Prowess* database for which some financial data are available during 1990-2009. Our eventual sample consisted of an unbalanced panel dataset with 58,334 non-missing observations for all the variables of interest for the 1990-2009 period.

## Measures - Dependent Variable

*Investments in Innovation:* In this paper, we are primarily interested in examining the determinants of developing economy firms' investments in innovation, or the innovation efforts (Ahuja, Lampert and Tandon, 2008). Following Hitt et al. (1997), we used percentage of the annual research and development expenses to total sales as a proxy for a firm's investments in innovation. While we do recognize the general nature of this measure, it was preferred over more specific measures for two reasons – availability of data for all the firms for the whole twenty year period; and its very high correlation with other output measures of innovation orientation and innovation capability such as patents.<sup>2</sup>

## Independent Variables

*Technology Imports:* As is typical of closed economies, many government regulations and controls prevailed and continue to prevail in India on all transactions involving foreign exchange. Due to these, all Indian companies registered under the Indian Companies Act have to record and disclose detailed accounts of foreign exchange spending. We found two specific categories of annual foreign exchange spending that are related to inflows of international technology (Kumar and Agarwal, 2005): a) capital goods; and b) royalty and know-how. Import of state-of-the-art capital equipment for manufacturing and research and development is the most common means by which developing economy firms try and catch up with the latest technologies of the developed world. While capital goods represent the tangible side, royalty and

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<sup>2</sup> Many of the firms in India are just beginning to invest in innovation and the most appropriate way to capture the innovation orientation of a large sample of firms is to track their investments in innovation/R&D. R&D expenses are a standard component of financial statements and are available for a wide cross-section of firms. Patenting activity is limited to an extremely small set of firms in developing economies and also is specific to a select few industries and markets. Innovation orientation of firms can be conceptualized on both input (e.g., investments in R&D) and output (e.g., patents) dimensions (Ahuja, Lampert and Tandon, 2008). In this study, we focus on the former but suggest that future research should examine the output aspects, especially as more developing economy firms evolve towards filing their own patents.

know-how represent the intangible technological assets imported by companies. Thus our measure of international technology resources is the natural logarithm of total annual foreign exchange spending on capital goods and know-how.

*Product market internationalization* of a firm was measured as the natural logarithm of export sales (Salomon and Shaver 2005). We chose the logarithm of export sales over other possible measures such as the ratio of foreign sales to total sales, international geographic spread, growth in foreign sales or foreign direct investment (FDI) for two reasons. First, the validity of any measure has to be assessed based on its potential explanatory power in the context of the theoretical assumptions on which it is based (Hassel, Hopner, Kurdelbusch, Rehder and Zugehör, 2003). Given that a majority of firms from emerging economies are still in the early stages of the internationalization process with exporting being the dominant mode of international expansion (Aulakh, Kotabe and Teegen, 2000), the chosen measure for internationalization is contextually appropriate compared to more involved internationalization measures such as FDI. Second, while the data on export sales was available for all the firms, data availability on other variables was limited to a few firms and for a few years.

We have chosen volume measures for both technology imports as well as product market internationalization instead of ratio measures (viz., a percentage of sales or assets) as these are used as proxies for learning-oriented constructs and hence are likely to capture cumulative learning better. We account for size-related effects separately, by including firm size as a control variable in the models as described later in this section.

*Business Group Membership:* We operationalized a firm's membership in an Indian business group through a dummy variable which took the value of one if the firm was affiliated to a business group and zero if it was not. For identifying group affiliation, we adopted CMIE

*Prowess*' classification of firms into groups following Khanna and Palepu (2000) and Bertrand, Mehta and Mullainathan (2002).

There are two idiosyncratic aspects to the way CMIE records affiliation of a firm to a BG. The BG affiliation information is updated retrospectively by CMIE and hence historical year-by-year changes, if any, in BG affiliation status are not recorded. As Khanna and Palepu (2000) noted, it is generally true that BGs in India are not very active in the market for corporate control (firms typically are neither divested nor acquired into BGs and a stand-alone firm stays a stand-alone firm and a BG affiliated firm stays a BG affiliated firm). Secondly, CMIE continues to record BG affiliation for a firm even when it is the only affiliate of the BG in question. However, a BG exists by definition when at least two firms are affiliated to it (Khanna and Palepu, 2000; Morck, 2012). De facto there is therefore some variation in BG affiliation within firms over time as the BG in question either shrinks or expands its portfolio of affiliate companies either below or above 2. We chose to exploit this variation and so conducted our analyses with a time varying BG affiliation dummy and conducted robustness checks by re-estimating all models with a time invariant BG dummy. We cross-checked our results by using an alternative measure for BG firms namely *BG size*, measured as a simple count of the number of firms in a BG in line with prior studies.

### **Control Variables**

There is a considerable body of research that has examined the determinants of both firm internationalization and investments in innovation (see Ahuja et. al., 2008 and Wagner, 2007 for extensive reviews). Based on these reviews, we identify a comprehensive set of variables to control for possible confounds in testing our model. The size of the firm constitutes a critical control variable, as it can be argued that larger firms are more advantageously positioned to

internationalize. *Firm size*, measured as natural logarithm of total sales, was used to control for size effects. The second critical set of control variables pertain to the endogenous pool of knowledge, resources and capabilities that are unique to each firm and that are expected to account for a significant part of the variance in product market internationalization and R&D investments. We attempted to capture these heterogeneous resources and capabilities of firms using two variables related to the stock of marketing and experiential capabilities (Berry and Sakakibara, 2008; Kumar and Aggarwal, 2005; Hitt et. al., 1997). Accordingly, *marketing capability* was operationalized as the percentage of total annual marketing expenses (which included advertising, sales promotion and sales and distribution expenditures) to sales. We also included *prior investments in innovation*, measured as the one year lagged R&D intensity, as a control since it is possible that past R&D intensity could impact the current R&D input (Powell, Koput and Smith-Doerr, 1996; Wagner, 2007). The *age* of each firm since it was founded, in years, was used as a measure of experience. Finally, it can be argued that better performing firms undertake exploration activities and R&D investments. To account for this argument, we used the *prior profitability*, percentage of gross profit to total sales of the firm lagged by one year, as a control. We created industry dummies to control for the 2-digit industries in which our sample firms are present. To ensure that we separate out all the unobserved year effects, including macro-economic and environmental effects, we also use nineteen year dummies to control for period effects pertaining to the twenty-year study period.

### **MODEL SPECIFICATION AND RESULTS**

As we include a near-census of manufacturing firms from the Indian private sector, we believe that the likelihood of sample selection bias is minimal. Table 1 reports the descriptive statistics and product-moment correlations for all the variables. Collinearity diagnostics indicated

that multicollinearity was not an issue with VIF values of less than 2.5 for all the variables. We see that both technology imports and product market internationalization are positively and significantly correlated with investments in innovation indicating that both factors play an important role in R&D investments of firms in our sample. The average investment in innovation for all the firms in our sample was low at 0.24 per cent given that nearly the whole population of Indian firms was included in the sample. We estimate our models using fixed effects generalized least squares panel regression procedures. We first conducted a Hausman test (Baltagi, 2005) to compare the random-effects and fixed-effects models and fixed-effects models were preferred in all cases. The panel design used in this study allows us to explicitly control for unobserved effects that vary over time and across firms, minimizing to the extent possible the likelihood of biased parameter estimates.

*INSERT TABLE 1 HERE*

We test H1 and H2 by modeling investments in innovation as a function of technology imports and product market internationalization, and controlling for investments in marketing and R&D, business group membership, firm size, age, and prior profitability. To separate the year effects, we incorporate nineteen year-dummies for the twenty years of data. We lag the explanatory variable technology imports by one year to account for any spurious correlation due to reverse causality.

Product market internationalization may be an endogenous choice for the firm i.e., firms decide whether to internationalize or to focus on domestic markets alone. While the firm fixed effects account for stable unobserved features of the firm that may be correlated with internationalization, time varying unobserved effects cannot be ruled out. It also known that innovative firms are likely to internationalize more, thus raising the likelihood of reverse

causality. This poses a threat to the validity of our conclusions based on the above model. One of the best ways to address the concern of endogeneity and reverse causality is by using an instrumental variable. We therefore implement a panel instrumental variables regression model (Baltagi, 2005) to account for the possibly endogenous nature of product market internationalization.

In order to estimate an instrumental variables regression for panel data, we need an exogenous instrument for product market internationalization. Wooldridge (2008) defines a good instrument as one that is, (a) correlated with the endogenous independent variable concerned and (b) uncorrelated with the error term. So we need an instrument that is correlated with product market internationalization but that is uncorrelated with the error term in our model. Industry-level exports is a good instrument for the endogenous independent variable product market internationalization as (1) it is highly likely that it has an influence on a firm's decision to participate in internationalization and (2) it is unlikely to be correlated with investments in innovation of the focal firm. We use the command 'xtivreg' in stata version 12.1 to implement the panel instrumental variables regression and present the results in Table 2.

The results of the testing for Hypothesis 1 and 2 are provided in Models 1 and 2 in Table 2. Model 1 gives the results of the first stage of the instrumental variable regression with product market internationalization as the dependent variable, industry-level exports as the instrumental variable and all other control variables. The overall model is statistically significant (R-square = 0.3626, F statistic = 1090.37,  $p < .001$ ). The coefficient of the instrument is positive and statistically significant ( $\beta = 0.008$ ,  $p < .001$ ) and the signs of the coefficients of all the other variables are on expected lines. Model 2 in Table 2 gives the results of the second stage of the instrumental variable regression with investments in innovation as the dependent variable. Model

2 is also statistically significant (R-square = 0.2481, Wald Chi-square = 6732.90,  $p < .001$ ). H1 predicts that the import of technology resources will be positively related to investments in innovation of firms. As shown in Model 2, the coefficient for technology imports is positive and statistically significant ( $\beta = 0.050$ ,  $p < .001$ ) thus providing strong support for H1. H2 predicts that product market internationalization will be positively related to investments in innovation of a firm. We find that H2 is also supported as the coefficient for product market internationalization in Model 2 is positive and statistically significant ( $\beta = 0.241$ ,  $p < .01$ ) after controlling for all other variables including technology imports. These results also indicate that the impact of assimilative learning (product market internationalization) on investments in innovation is significantly higher than technology imports as the size of the beta coefficient of the former is nearly five times that of the latter.

*INSERT TABLE 2 HERE*

Hypotheses H3 and H4 are related to the moderating effect of institutional environment on the relationship between technology imports and product market internationalization and investments in innovation of firms. In terms of the macro level influence (H3), we propose that the impact of accumulation-based learning (technology imports) will be higher when compared to assimilation-based learning (product market internationalization) on a firm's investments in innovation in the initial phase of institutional development (H3a). On the other hand, assimilation-based learning (product market internationalization) has a higher impact on investments in innovation in the latter phase of institutional development (H3b) when compared to accumulation-based learning (technology imports). In terms of the micro level influence (H4), we argue that the relative impact of product market internationalization on investments in

innovation is higher for standalone firms when compared to business group firms (H4a), whereas technology imports plays a relatively higher role in business group firms (H4b).

To test H3 and H4, we performed sub-sample analyses by dividing the full sample data into two groups – (a) data pertaining to the early phase of liberalization (1992 to 2000) and data pertaining to the latter phase of liberalization (Models 3 and 4 in Table 3) and (b) data pertaining to firms affiliated to business groups and data pertaining to independent firms not affiliated to any business groups (Models 5 and 6 in Table 3). We then replicated the models and panel regressions on these sub-samples with same dependent and independent variables as described above for the full sample analysis. The results of the sub-sample regressions are shown in Table 3 (Models 3 to 6). In the interest of space, we only report the second stage regression results for these models, with investments in innovation as the dependent variable. All the models are found to be statistically significant ( $p < .001$ ).

Model 3 (Table 3) pertains to the results with the sub-sample of data from the early phase of liberalization (1992-2000). In this model, the coefficient for technology imports is positive and statistically significant ( $\beta = 0.064, p < .001$ ) whereas the coefficient for product market internationalization is negative and not significant statistically ( $\beta = -0.006, p > .10$ ). Model 4 (Table 3), on the other hand, pertains to the results with the sub-sample of data from the latter phase of liberalization (2001-2009). In this model, we find that the coefficient for technology imports is positive, but statistically not significant ( $\beta = 0.007, p > .10$ ) while the coefficient for product market internationalization is positive and statistically significant ( $\beta = 0.307, p < .10$ ). Thus we find that the impact of technology imports on investments in innovation is higher and statistically significant in the early phase of liberalization; whereas the impact of product market

internationalization is higher and statistically significant in the latter phase of liberalization, thus providing support to H3a and 3b.

We now turn to the results using the sub-samples of BG and independent firms, which we use to test H4a and 4b. These results are presented in Models 5 and 6 in Table 3, with Model 5 representing results with the sub-sample of BG-affiliated firms and Model 6 representing results with the sub-sample of non-BG (independent) firms. In Model 5, which has the results of BG sub-sample firms, the coefficient for technology imports is positive and statistically significant ( $\beta = 0.061$ ,  $p < .001$ ) whereas the coefficient for product market internationalization is positive and not statistically significant ( $\beta = 0.138$ ,  $p > .10$ ). Model 6 (Table 3), that pertains to the results with the sub-sample of non-BG firms, shows that the coefficient for technology imports is positive, but not statistically significant ( $\beta = 0.007$ ,  $p > .10$ ) while the coefficient for product market internationalization is positive and statistically significant ( $\beta = 0.542$ ,  $p < .001$ ). Thus we find that for BG sub-sample firms, the impact of technology imports on investments in innovation is higher and statistically significant; whereas the impact of product market internationalization is statistically insignificant. On the other hand, the impact of technology imports on investments in innovation is insignificant for non-BG firms, but the impact of product market internationalization is higher compared to BG firms and statistically significant. Thus we find that H4a and 4b are supported.

*INSERT TABLE 3 HERE*

### **Robustness Checks and Additional Analysis**

Institutional changes and institutional development may not be evenly spread over the time period of our study and hence dividing the sample into two equal sub-sample periods may not capture the institutional development accurately. Similarly, it is possible that BG affiliation

dummy is too coarse-grained measure to capture the BG effect. Therefore, we conducted additional analysis using more fine-grained measures for institutional development and BG effect as a robustness check, which is captured in Table 4.

To capture the institutional development over time in India in a more fine-grained fashion, we developed an Institutional Development Index using data from IMD World Competitive Scores for India. The index is an average of scores for three dimensions namely (a) legal and regulatory framework, (b) intellectual property rights and (c) development and application of technology. These scores are available from 1995 onwards and hence we could calculate the index for the fifteen-year period starting 1995. In the case of BG effect, we had argued that BGs provide alternative assimilation mechanisms through other firms in the BG and that is why the impact of internationalization on investment in innovation is likely to be lower in BG firms when compared to stand-alone firms. Such alternative assimilation possibilities will be minimal in a BG with fewer companies as compared to a large group. Hence we use 'BG size' to capture the BG effect and checked its interaction effect with technology imports and internationalization on investments in innovation. We measured 'BG size' as the number of companies in the business group to which a firm is affiliated.

*INSERT TABLE 4 HERE*

Models 7 and 8 (Table 4) capture the second stage instrumental variable panel regression results of the interaction effects with Institutional Development Index. In Model 7, we replicated the models and instrumental variable panel regressions with same dependent and independent variables as described above for the full sample analysis, but with an additional variable 'Institutional Index' added. In Model 8, we further added the interaction terms 'Technology imports x Institutional index' and 'Product market internationalization x Institutional index'.

Both Models 7 and 8 are statistically significant ( $p < .001$ ). In Model 8, we find the coefficient of the interaction term ‘technology imports x institutional index’ to be negative and statistically significant ( $\beta = -0.074$ ,  $p < .10$ ), while the coefficient of the interaction term ‘product market internationalization x institutional index’ is positive and statistically significant ( $\beta = 0.137$ ,  $p < .10$ ). Thus we find that the effect of technology imports on investments in innovation is higher in the initial phase of institutional development while the impact of internationalization on investments in innovation increases as institutions develop. These results are in line with the subgroup results reported earlier confirming support for H3a and 3b.

We further checked the interaction effects with BG size as a robustness test (Table 4 Models 9 and 10). Both the models are statistically significant ( $p < .001$ ) and Model 10 presents the results with the interaction terms. In Model 10, the coefficient of the interaction term ‘Technology imports x BG size’ is positive, but statistically not significant ( $\beta = 0.001$ ,  $p > .10$ ), whereas the coefficient of ‘Product market internationalization x BG size’ is negative and statistically significant ( $\beta = -0.006$ ,  $p < 0.05$ ). Thus we find that the effect of product market internationalization on investment in innovation is negative for firms affiliated to larger BGs when compared to firms affiliated to smaller BGs; whereas BG size has no statistically significant impact on the effect of technology imports thus providing partial support to H4a and 4b.

## **DISCUSSION AND CONCLUSIONS**

As developing countries become more integrated in the global economy, there is considerable interest in both the academic literature and business press about their paths to economic growth. While the growing importance of these economies in the global supply chains of advanced country multinationals and the emergence of high profile ‘emerging multinationals’

from developing economies have been hailed in terms of the success of liberalization policies (BCG, 2006; OECD, 2006), there is also concern from a policy perspective whether economic liberalization is achieving the underlying objectives of improving the capabilities of a broad set of indigenous firms. The economic reforms and the associated trade policies related to inward and outward flows of capital, goods and technology seem to have yielded country level benefits reflected in positive trade balances and accelerated economic growth in developing economies. However, there are questions about whether such policies have enhanced the innovation orientation and investments in innovation of indigenous firms (*Business Week*, 2007; *The Economist*, 2007). Our research was motivated to understand how different types of cross-border learning influence the investments in innovation by developing economy firms after the initiation of economic reforms in one large developing economy, India.

Using a longitudinal panel of manufacturing firms from the Indian private sector, and controlling for a number of firm level factors that have been shown to impact innovation efforts (Ahuja et. al., 2008), we find that participating in international resource and product markets provide the impetus for firms to invest in innovation. These results support both the traditional view of knowledge accumulation (through investments in import of technology) and evolutionary economists' idea of knowledge assimilation (learning-by-doing through internationalization) as the foundations of technological development in developing economies. The results, however, show that the relative importance of accumulative and assimilative on innovation efforts is conditioned by both the macro- and micro-level institutions within which firms are embedded. In particular, our findings show that when the macro-institutional environment is less developed or when firms have access to business group related infrastructure, accumulative learning through technology imports is the primary mechanism that induces firms'

investments in innovation. On the other hand, assimilation based learning through product market internationalization is the main determinant of innovation as the institutional environment gradually develops and for independent firms.

Our study makes a number of contributions to the literature. First, our findings resonate with the broader literature on learning and capabilities and extend it by underlining the role of cross-border learning on boosting investments in innovation by developing economy firms. The extant research distinguishes sources of firm level capabilities in terms of knowledge accumulation through deliberate investments in organizational routines and structures (Zollo and Winter, 2002), and assimilation mechanisms such as learning-by-doing (Nelson and Winter, 1982) and experiential learning (Huber, 1991). Ethiraj, Kale, Krishnan and Singh (2005) show how investments in project related infrastructure and learning-by-doing through repeated interactions with clients jointly determine project performance in the software industry. Our study complements this research by drawing attention to the role of strategic choices related to geographic scope of a firm (accessing tangible and intangible know-how through technology imports and product-market internationalization) in firms' capability development. In this regard, while a number of studies have alluded to the learning and catch-up objectives that determine the speed and paths of internationalization of developing economy firms (e.g., Luo and Tung, 2007; Guillen and Garcia-Canal, 2009), there has been a lack of systematic theoretical and empirically derived research identifying the specific learning mechanisms and linking those to realization of internationalization objectives. Our study shows how the two types of learning mechanisms are linked to strategic choices across both resource (inward internationalization) and product-market (outward internationalization) domains of internationalization and thus the close linkages between capability development, learning and international strategy.

Second, by explicitly theorizing and empirically testing the role of institutions, both macro and micro, on investments in innovation, our paper answers Nelson's (2008:2) call that "the principle task on the economic growth theory front therefore would seem to be to build institutions coherently into theory, and to link analysis of institutions with analysis of technological advance". Our study contributes to the recent agenda in global strategy research to highlight how institutions matter and the important role played by institutional factors in shaping strategy (Peng, Wang and Jiang, 2008). Modeling the role of unique institutional entities prevalent in developing economies into the accumulation and assimilation framework provide interesting insights. Furthermore, modeling these may also help reconcile some of the inconsistent findings related in the learning by exporting literature, which by and large does not capture the institutional infrastructure in which firms are embedded. Given that much of the research in international business has looked at institutional factors determining firm (both domestic and foreign) choice primarily from the macro-country level regulatory and normative institutions, our findings related to the role of micro level institutions in influencing firm behavior adds to the recent attempts to incorporate different levels and types of institutions in the study of organizational strategies (Kostova, Roth, and Dacin, 2008; Mahmood and Mitchell, 2004).

Lastly, our research has specific implications to the literature that has examined the determinants of innovative efforts (research production function) and innovative output (innovation production function) (Ahuja et al., 2008). Much of the empirical effort in this literature has focused on firms from advanced markets and innovation from the perspective of developing radically new products and services (i.e., new to the world). In contrast, there is relatively less effort to understand the determinants of innovation in developing countries where

it is argued that the focus is not as much in developing new products as in adapting existing technologies to local contexts from supply side (e.g., process innovation that incorporates appropriate combinations of factors of production) and demand side (e.g., product innovations to incorporate the purchasing power of consumers) perspectives. By identifying unique factors that determine innovation efforts in these contexts, our research adds to this existing body of research.

The study's findings also have policy implications. Developing countries have used diverse combinations of policy instruments to achieve economic growth, some examples being export push to induce local firms to internationalize, attraction of inward FDI either through joint ventures or allowing wholly-owned subsidiaries, and liberalization of imports to facilitate the inflows of critical factors of production, among others. However, the success of these individual policy instruments has been called into question. For instance, there is concern whether inward FDI actually facilitates the intended spillovers to indigenous firms (Spencer, 2008). Similarly, Wagner's (2007) findings that only better firms undertake internationalization and out of these, only a few become better because of internationalization, calls into question the capability enhancement objectives of export push policies. There is also a considerable debate in the technology transfer literature whether liberalization of technology imports substitutes or complements in-house R&D efforts of local firms (Kumar and Aggarwal, 2005). Our results suggest the synergistic effects of at least two policy instruments, import liberalization and export promotion, for a set of firms' innovation orientation. Furthermore, even for firms that may have the wherewithal to undertake innovation activities because of supra-firm infrastructure (through business group affiliation), technology imports play an important role in facilitating product market internationalization, which in turn boosts innovation orientation.

Although the findings from our study are noteworthy, we underline its limitations. As our research setting is limited to the Indian context, we recognize that the conclusions drawn are only indicative. Second, our study is limited by the coarse-grained operationalization of investments in innovation. As our sample included over 11,000 firms belonging to a diverse set of industries, many of which had negligible levels of investments in innovation, the average innovation investment for the sample is low and the statistical significance of some of our results is weak. Future studies could focus on R&D intensive industries such as pharmaceuticals and technology and also consider more fine-grained measures of innovation such as new products and patents. Third, our measure of product market internationalization is limited by its focus on foreign sales. Ostensibly firms aim to become globally competitive by dispersing value chain activities across the globe and these may also entail foreign direct investment activity. Further research examining asset seeking internationalization, including overseas acquisitions, may shed more light into accumulation and assimilation routes of learning and innovation orientation. For instance, developing economy firms are increasingly using international acquisitions for the purpose of resource augmentation (UNCTAD, 2006) and there is evidence that such acquisitions are creating positive expectations reflected in shareholder returns (Gubbi, Aulakh, Ray, Sarkar, and Chittoor, 2010). A systematic study of the impact of these inorganic modes of international expansion on development of firms' innovation capabilities can provide useful insights. Fourth, we used a broad classification in our conceptualization and empirical testing of business group effects. It is conceivable that different types of business groups (more diversified versus less diversified, family managed versus professionally managed, etc.) with differential resource endowments and organizational structures may exhibit unique resource repositories for access by affiliated firms. Despite these limitations, we believe that our study constitutes an important

effort in explaining investments in innovation by developing economy firms by highlighting the significant role of cross-border learning.

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**Table 1**  
**Means, Standard Deviations and Correlations**

	Mean	s.d.	1	2	3	4	5	6	7	8	9
1 Investments in innovation	0.242	1.672	1.000								
2 Technology imports <sup>a</sup>	0.486	0.962	0.087***	1.000							
3 Product market internationalization <sup>a</sup>	1.476	1.732	0.099***	0.467***	1.000						
4 Business group affiliation dummy	0.347	0.476	0.036***	0.170***	0.126***	1.000					
5 Marketing capability	4.096	4.942	0.032***	0.091***	0.113***	0.065***	1.000				
6 Firm age	24.528	19.886	0.001	0.078***	0.084***	0.139***	0.076***	1.000			
7 Firm size <sup>a</sup>	4.201	1.267	0.058***	0.579***	0.577***	0.259***	0.119***	0.216***	1.000		
8 Prior profitability <sup>b</sup>	11.937	20.788	0.036***	0.128***	0.102***	0.031***	-0.025***	-0.021***	0.059***	1.000	
9 Business group size	2.952	7.139	0.024***	0.178***	0.114***	0.560***	0.042***	0.109***	0.213	0.021***	1.000
10 Institutional development index	5.073	0.517	0.025***	0.078***	0.124***	-0.072***	0.011**	0.064***	0.176***	-0.019***	-0.001

\*  $p < .05$ , \*\* $p < .01$ , \*\*\*  $p < .001$ ; Two-tailed significance levels

<sup>a</sup>Natural logarithm      <sup>b</sup>One year lag

**Table 2**  
**Impact of Technology Imports and Product Market Internationalization on Investments in Innovation<sup>a</sup>**

FE Models	Instrumental Variable Panel Regression	
	Product-market Internationalization	Investments in Innovation
Independent Variables	Model 1 First Stage	Model 2 Second Stage
Technology imports <sup>b</sup>	0.126*** (0.006)	0.050*** (0.013)
Product-market internationalization <sup>b</sup>		0.241** (0.085)
Industry exports (Instrumental variable)	0.008***(0.001)	
Business group affiliation (0-non-group; 1-group)	0.096*** (0.030)	-0.044 (0.045)
Marketing capability	2.799*** (0.145)	-0.199 (0.318)
Firm size <sup>b</sup>	0.754*** (0.008)	-0.187** (0.066)
Firm age	0.002 (0.002)	0.008** (0.003)
Prior profitability <sup>c</sup>	-0.004 (0.019)	-0.025 (0.028)
Prior investments in innovation <sup>c</sup>	0.009***(0.002)	0.216***(0.004)
Constant	-2.114***(0.046)	0.382 <sup>+</sup> (0.206)
Year dummies	Included	Included
<u>FE Model Indices</u>		
R-square	0.3626	0.2481
Goodness of Fit Indicators	F = 1090.37***	Wald $\chi^2 = 6732.90***$
Number of observations	50,991	50,991

<sup>+</sup> p < .10, \* p < .05, \*\*p < .01, \*\*\* p < .001; two-tailed tests

<sup>a</sup> Unstandardized regression coefficients reported.

<sup>b</sup> Natural logarithm

<sup>c</sup> Lagged by one year

**Table 3**  
**Moderating Effects of Institutional Infrastructure on Investments in Innovation<sup>a</sup>**

Instrument Variable Panel Regression FE Models	Investments in Innovation		Investments in Innovation	
	Early Phase of Liberalization (1992-2000)	Latter Phase of Liberalization (2001-2009)	Business Group (BG) Affiliated Firms	Independent Firms (non-BG)
Independent Variables	Model 3	Model 4	Model 5	Model 6
Technology imports <sup>b</sup>	0.064***(0.014)	0.007 (0.025)	0.061*** (0.018)	0.007 (0.025)
Product-market internationalization <sup>b</sup>	-0.006 (0.153)	0.307 <sup>+</sup> (0.183)	0.138 (0.102)	0.542*** (0.155)
Business group affiliation (0-non-group; 1-group)	0.009 (0.047)	-0.014 (0.088)		
Marketing capability	0.522 (0.590)	-0.609 (0.479)	-0.339 (0.448)	-0.797 (0.542)
Firm size <sup>b</sup>	0.001 (0.105)	-0.267* (0.129)	-0.102 (0.085)	-0.415*** (0.114)
Firm age	0.022*** (0.005)	0.003 (0.006)	0.007 (0.005)	0.007* (0.003)
Prior profitability <sup>c</sup>	0.040 (0.047)	-0.037 (0.041)	-0.100 <sup>+</sup> (0.053)	-0.025 (0.034)
Prior investments in innovation <sup>c</sup>	0.069*** (0.007)	0.201*** (0.005)	0.205*** (0.006)	0.225*** (0.006)
Constant	-0.495 (0.353)	0.821* (0.395)	0.185 (0.302)	0.907** (0.312)
Year dummies	Included	Included	Included	Included
<u>FE Model Indices</u>				
R-square	0.0093	0.2478	0.3610	0.0783
Wald $\chi^2$	1993.38***	3538.93***	2669.72***	3594.71***
Number of observations	20,499	30,492	18,129	32,862

<sup>+</sup> p < .10, \* p < .05, \*\*p < .01, \*\*\* p < .001; two-tailed tests

<sup>a</sup> Unstandardized regression coefficients reported.

<sup>b</sup> Natural logarithm

<sup>c</sup> Lagged by one year

**Table 4**  
**Effects on Investments in Innovation – Robustness Tests<sup>a</sup>**

Instrument Variable Panel Regression FE Models	Effect of Institutional Index		Effect of BG Size	
	Investments in Innovation	Investments in Innovation	Investments in Innovation	Investments in Innovation
Independent Variables	Model 7	Model 8	Model 9	Model 10
Technology imports <sup>b</sup>	0.048*** (0.014)	0.439 <sup>+</sup> (0.238)	0.050*** (0.013)	0.043** (0.017)
Product-market internationalization <sup>b</sup>	0.301** (0.105)	-0.604 (0.497)	0.244** (0.086)	0.288** (0.094)
Business group (BG) size			-0.003 (0.004)	0.018* (0.009)
Institutional index	-0.019 (0.074)	-0.283 <sup>+</sup> (0.164)		
Technology imports x BG size				0.001 (0.001)
Product-market internationalization x BG size				-0.006* (0.002)
Technology imports x I. Index		-0.074 <sup>+</sup> (0.046)		
Product-market internationalization x I. Index		0.137 <sup>+</sup> (0.076)		
Marketing capability	-0.403 (0.359)	0.204 (0.450)	-0.203 (0.320)	-0.312 (0.334)
Firm size <sup>b</sup>	-0.237** (0.081)	-0.091 (0.102)	-0.189** (0.067)	-0.208** (0.070)
Firm age	0.001 (0.009)	0.014 (0.011)	0.008** (0.003)	0.007** (0.003)
Prior profitability <sup>c</sup>	-0.038 (0.031)	-0.028 (0.031)	-0.025 (0.028)	-0.027 (0.028)
Prior investments in innovation <sup>c</sup>	0.204*** (0.004)	0.204*** (0.004)	0.216*** (0.004)	0.216*** (0.004)
Constant	0.827** (0.275)	1.471*** (0.455)	0.375 <sup>+</sup> (0.206)	0.393 <sup>+</sup> (0.209)
Year dummies	Included	Included	Included	Included
<u>FE Model Indices</u>				
R-square	0.2192	0.2587	0.2459	0.2298
Wald $\chi^2$	5603.25***	5750.81***	6729.13***	6694.62***
Number of observations	45,213	45,213	50,991	50,991

<sup>+</sup> p < .10, \* p < .05, \*\*p < .01, \*\*\* p < .001; two-tailed tests

<sup>a</sup> Unstandardized regression coefficients reported.

<sup>b</sup> Natural logarithm

<sup>c</sup> Lagged by one year

**Figure 1**  
**Conceptual Model**

