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**Antecedents of R&D Intensity for Emerging Economy Firms:  
Evidence from India<sup>1</sup>**

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## *Antecedents of R&D Intensity for Emerging Economy Firms: Evidence from India<sup>2</sup>*

*I study the industry-level antecedents that determine the R&D intensity of the incumbent firms. Specifically, I examine the effect of industry export orientation, industry capital intensity, and dominance of foreign MNCs. I also study the moderating effect of the business group affiliation of incumbent firms on these relationships. By using random-effects GLS regression to study the private sector non-financial firms of India for the time period of 1999-2015, I find that industry export orientation (positively), capital intensity (negatively) and dominance of foreign MNCs (negatively) impact the R&D intensity of incumbent domestic firms. Moreover, business group affiliation positively moderates the innovativeness of affiliates. I conclusively establish the importance of industry characteristics on the R&D intensity of domestic firms of emerging market economies. The results also highlight the compounding effect of business group affiliation on the relationship between industry characteristics and a firm's R&D intensity.*

**Keywords** – R&D intensity, industry export intensity, industry capital intensity, foreign MNCs

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## **Introduction**

A plethora of papers have studied the antecedents and outcomes of firms' innovativeness and this stream of research is a central theme in the domain of strategic management research. Innovation is determined by the leadership (both at individual-level and group-level, the Upper Echelon Theory), managerial levers (organisation-level, Resource Based View and Dynamic Capabilities View), and business processes (process-level, Process Theory) (Crossan & Apaydin, 2010). The process and outcome constitute the two dimensions of the concept of innovation. While the distinction is blur, the former deals with the manner in which innovation takes place and the latter is concerned with the nature/kind and type (Crossan & Apaydin, 2010). Following the Penrosian approach (Penrose, 1959), broadly these studies probed firm-level heterogeneity and mostly omitted the effects of external environments, such as industry contexts, on firms' innovativeness. On the contrary, I examine the relationship between certain industry-level characteristics on firms' innovation orientation. The industry within which firms are situated imposes certain boundary conditions within which firms operate (McGahan, 2004; Porter, 2008). Therefore, industry conditions determine certain behavioural decisions of firms in that particular industry as well as restricts their decision choices available. I argue that this industry effects will be more pronounced in emerging market economies because these economies lack strong entrepreneurial sectors and are replete with institutional voids (Wright, Filatotchev, Hoskisson, & Peng, 2005). Specifically, this paper explores the effects of three industry characteristics, namely export orientation, capital intensity and dominance of MNCs, on firms' innovativeness in the context of emerging market economies. Prior studies observe that export orientation undoubtedly leads to superior firm performance (Cadogan, Boso, Story, & Adeola, 2016). Furthermore, I argue to do well in foreign markets firms needs to compete with technologically superior foreign firms. Thus, industry-level higher export orientation is expected to positively impact

the firm-level R&D intensity. I also posit that industry capital intensity will negatively relate to the firms' R&D intensity because technology upgradation in these industries require heavy investments. Thus, incumbent firms will have a higher propensity to focus on exploitative activities as against exploration while in capital intensive industries (O'Reilly & Tushman, 2004). I also hypothesize that the dominance of foreign multinationals will impel the domestic firms to reduce their R&D commitment to focus on consolidating their existing market position. Moreover, business groups dominate the corporate landscape of emerging market economies (Khanna & Palepu, 2000a, 2000b). Thus, I also examine the moderating effect of business group affiliation on the three relationships as discussed above.

I extract data from the Centre for Monitoring Indian Economy (CMIE) database, and the sample comprised of Indian private sector non-financial firms for the period 1999-2015. With a non-zero R&D intensity, this resulted in a firm-year observation of around 14,500 firms. The empirical evidence strongly supports my core argument. I find industry export orientation positively impacts firm-level R&D intensity. On the contrary, industry-level capital intensity and the dominance of foreign MNCs negatively impacts the R&D intensity of firms. I also observe affiliation to business groups broadly enhances firms' innovativeness. Theoretically, my conversation lies at the fascinating intersection of the literature on the industry characteristics (Bain, 1956; Mason, 1939; McGahan & Porter, 1997), the innovation orientation of firms (Pisano & Teece, 2007; Teece, 2010), the business group affiliation (Khanna and Palepu, 2000a; 2000b), and the idiosyncrasies of the emerging economy ( Peng, Wang, & Jiang, 2008; Wright, Filatotchev, Hoskisson, & Peng, 2005). Thus, this study contributes to the extant literature of innovation and business group related research in the context of emerging market economies.

## Theory and Hypotheses

The structure-conduct-performance (S-C-P) paradigm, in its conventional understanding, argued that the industry structure dictates the conduct of firms in the industry and this conduct drives firm performance (Bain, 1956; Mason, 1939). It is the salient characteristics of the industry environment that critically decides the conduct of firms such as innovativeness, and in turn performance of the firms. However, subsequent research highlighted the static nature of the conventional understanding of the S-C-P paradigm (McGahan, 2004; Porter, 1981). The institutional transitions, i.e., the elaborate changes that redefine the rules of the game for incumbent firms in an industry, may be either incremental or discontinuous (Peng, 2003). The simultaneous interplay between incremental and discontinuous transitions is understood as “*although institutions evolve through relatively long periods of stability during which incremental changes occur, such an evolution is also likely to be punctuated by discontinuous transformation*” (Peng, 2003: 279). Industry change, on the other hand, is a bit restrictive and is a subset of the institutional transitions. The trajectory of industry change depends on whether the incumbents’ core assets or core activities (if not both) are threatened, and takes one of the paths – progressive, creative, intermediating, or radical (McGahan, 2004). In a relatively stable environment when core activities are not threatened a firm can rely on exploitation. However, firms face maximal difficulty in addressing intermediating change, i.e., a change where the core activities are threatened and it triggers firm search behaviour or exploration activities, through higher R&D investments, according to behavioural theory of firms (Vissa, Greve, & Chen, 2010). In short, the industry characteristics play a crucial role in a firm’s strategic posture such as innovativeness. Thus, I examine the effects of industry-level characteristics such as export orientation, capital intensity and prevalence of foreign multinationals (which is closely linked to the industry’s

export orientation, albeit in an inverse fashion) on the firms' innovativeness in emerging market economies.

A fundamental tenant of the industry attractiveness (Porter, 2008), and the industry analysis in general (e.g., Bain, 1956; Mason, 1939; McGahan, 2004), is that the industry imposes certain boundary conditions and individual firms have limited leeway in manoeuvring and tend to be homogenous in their approach. However, extrapolating these arguments, mostly from the context of developed economies, are problematic in the context of emerging market economies because market institutions in these economies are far from efficient. So, relational transactions prevail over arm length transactions. Access to scarce resources, for pursuing innovation strategies such as technology imports, in these economies are functions of state-business nexus. Moreover, presence and dominance of business groups in the corporate landscape of these economies further complicates the context. Affiliated firms enjoy better access to group level resources, thus, they might be in a better position to overcome certain limitations with respect to standalone firms. Thus, this leads to the intriguing question whether affiliation to business group moderates the relationship between industry characteristics and firm's innovativeness.

#### *Industry Export Orientation*

The choice of entry mode is contingent on a complex interplay between environmental, strategic, and transaction variables (Hill, Hwang, & Kim, 1990). Broadly the positive impact of export orientation on firms' performance is well established by extant literature (Kotabe, Srinivasan, & Aulakh, 2002). The results have been consistent for large multinational enterprises (Audretsch & Thurik, 2000) and new ventures (Hessels & van Stel, 2011) alike. Interestingly, the results of Audretsch & Thurik (2000) also demonstrate that the export orientation of entrepreneurial enterprises result is lower unemployment, and consequently,

should be promoted in a nation's own economic interest. Thus, emerging market economies have incentivized their domestic firms to actively participate in foreign markets through export (Aulakh, Kotabe, & Teegen, 2000). Export orientation of a firm is an aggregation of export entrepreneurial orientation and export market orientation (Boso, Cadogan, & Story, 2012; Cadogan et al., 2016). The export entrepreneurial orientation involves searching, experimenting, and undertaking other risk-taking new business activities in foreign markets (He & Wong, 2004), and the export market orientation is a 'market-driven' approach to exploit the foreign market/s (Jaworski, Kohli, & Sahay, 2000). Not only these emerging market firms face liability of foreignness in developed market but also export entrepreneurial orientation, such as risk-taking new business activities in foreign markets, is challenging for firms from emerging market economies because these firms are technologically not at par with their developed economy counterparts. Thus, we may then argue that the export orientation, at the industry level, should lead to higher firm-level innovation orientation. I hypothesise,

***Hypothesis 1:** Industry export orientation will be positively related to the R&D intensity of a firm.*

#### *Industry Capital Intensity*

The capital intensity is a measure of a firm's output that involves significant fixed assets such as factories and equipment, and the inventory. Capital intensity is determined by both supply-side and demand-side conditions (Judzik & Sala, 2015). The supply-side conditions are a combination of factor-cost and factor-utilisation. The uncertainty in the demand estimates also impacts capital intensity (Fagnart, Licandro, & Portier, 1999). The firms that have a novelty-driven business model successfully retain value when capital intensity is high (Guo,

Wei, Sharma, & Rong, 2017), but contrarily, the firms with low capital intensity derive legitimacy by operating in high-technology orientated spaces (Pant & Ramachandran, 2012).

The importance of industry characteristics on individual firm performance and long-term competitive advantage has been established in both developed ((Kotha & Nair, 1995) and emerging economies (Lin, Chen, & Lo, 2014). Empirics indicate that meso-level factors such as the industry-specific capital intensity impacts the incumbent firms' innovative behaviours that in turn drives innovation performance (Guan & Pang, 2017). While Guan & Pang (2017) also conclude that firms in high capital intensive industries are more likely to innovate, albeit in monopoly industries and over a cross-sectional assessment. Further, broadly at an industry level high capital intensity symbolises deep resource commitment of incumbent firms in the current market. Consequently, the aggregate of those firms then deploy resources for exploitative activities as against exploration (O'Reilly & Tushman, 2004), as anyway these activities involve resource trade-off and conflicting organisational routines (Lavie, Kang, & Rosenkopf, 2011). Exploration requires activities designed around adaptability and new products, with loosely defined structure, with the focus on innovation. Furthermore, incumbent firms incur a high expenditure in making changes to their extant exploitative activities in capital intensive industries. The higher cost of adjustments (Geroski, 1995) is also expected to impede the innovation orientation. Hence, I hypothesise,

***Hypothesis 2:** Industry capital intensity will be negatively related to the R&D intensity of a firm.*

#### *Dominance of foreign MNCs*

The liberalisation is one of the tools that some of the historically 'closed' economies employed to open up their markets to foreign competition. The opening up of the markets to foreign players resulted in economies being characterised as emerging (Robert E. Hoskisson



et al., 2000; Khanna & Palepu, 2000b) and/or transitioning (Guo et al., 2017; Okpara, 2009; Tsang, 2002), while achieving a higher growth trajectory. However, this also resulted in the domestic players being exposed to foreign competition, the intensity of which they were not used to. The competitive threat that these dominant foreign MNCs pose is an outcome of “*superior capabilities in the area of R&D, manufacturing, marketing, reputation, and quality*” (Lavie & Fiegenbaum, 2000). The “*perceived brand globalness*” that foreign MNCs enjoy put domestic firms at a relative disadvantage, as the former are known to improve customer perception and loyalty (Swoboda & Hirschmann, 2016). A few countries have attempted to address such concern of extant state-owned enterprises by subtly discouraging foreign MNCs using a variety of institutional, albeit non-market based, tools (Chow, 2016). The domestic firms’ response to dominance of foreign MNCs is contingent on their processes to develop strategic capabilities and the ability to link to the competitive environment, and this results in a typology of four categories of firms – myopic (low/low), amorphous (low/high), narcissistic (high/low), and adaptive (high/high). While a majority of domestic firms fall under the first category as an outcome of negative spillover because of MNC presence (Manral, 2001), it is rare to witness firms following adaptive strategy of being simultaneously high on internal capability development and appreciation of external events (Lavie & Fiegenbaum, 2000). The predominance of myopic domestic incumbents is an indicator of low focus on new capability development and market sensing, both of which stem from their lacking in context-specific research and development. Thus, I hypothesise,

***Hypothesis 3: Dominance of foreign MNCs in domestic market is negatively related to the R&D intensity of a firm.***

This argument is also consistent with the literature on positive spillover, that is, that the domestic firms benefit as competition from foreign and other domestic firms force them to upgrade their productivity and technology (Sinani & Meyer, 2004). While entry of those players has been proven to improve the productivity of host country incumbent firms, the spillover has been found to be positive only at advanced level of economic development (Klaus E Meyer & Sinani, 2009). Further, longitudinal studies in the context of emerging and transitioning economies actually concluded the presence of either no or negative spillover to domestic firms. For example, research on India found that only MNCs gain from either others' R&D spillovers (Feinberg & Majumdar, 2001) and that local firms don't benefit from foreign presence at all (Kathuria, 2000). Likewise, while no evidence of spillover was found in Morocco (Haddad & Harrison, 1993), and Venezuela actually indicated the presence of negative spillover, namely, 'market stealing' (Aitken & Harrison, 1999). Similar results of negative or non-existent spillovers were found for Bulgaria, Romania, Poland (Konings, 2001) and Czech firms (Djankov & Hoekman, 2000).

### *The Role of Business Groups*

In a recent review paper, Holmes et al. (Forthcoming) emphasised the importance of business groups on economic development and innovation in emerging market economies. It is worth noting that emerging markets lack in terms of strong entrepreneurial sectors and business groups play a lead role in developing soft infrastructures for innovation (Dunning & Lundan, 2008; Mahmood & Mitchell, 2004). Chang, Chung, & Mahmood (2006) find that group affiliated firms are more innovative in South Korea but not in Taiwan and explain these differences through the institutional differences between these two countries. Similarly, Belenzon & Berkovitz (2010) also observe that business groups promote corporate innovation especially in industries that depend on external finance and characterised by high

information asymmetry. In other words, business groups promote affiliates innovativeness in the presence of weak factor markets and institutions (Li & Kozhikode, 2009). To sum up, institutional context does matter. More importantly, not only business groups facilitate innovation by providing institutional infrastructure for affiliated firms but also groups create entry barriers for non-affiliated firms in these economies (Mahmood and Mitchell, 2004). Thus, the following sections probe whether, and how, business group moderates the relationship between industry characteristics and innovativeness of affiliated firms. These question are worth exploring because “*as emerging economies mature ... advanced technology becomes increasingly important to global competitiveness, the future growth ... of many business groups probably depend ... on their ability to innovate*” (Holmes et al., Forthcoming).

The concept of firm’s resources as a source of a competitive advantage was initiated by Penrose’s (1959) seminal work. Resource based view formally defines firm’s resources as tangible and intangible assets which are “... tied semi-permanently to the firm” (Wernerfelt, 1984: 172). However, in the context of business group research, resource-based view slightly departs from this definition and emphasises the *access to resources and sharing of resources* within member firms. Resource based view also departs from the standard assumption of ‘business group as uniform group of entities’ rather it considers the proactive steps by business groups, after initial formation “...to develop capabilities through acquisitions, internal development, or international diversification”, as a discretionary variable in enhancing performances of member firms (Yiu, Bruton, & Lu, 2005:201). Hence, considering business groups as *a portfolio of heterogeneous resources* might be a useful perspective to probe how business group affiliation moderates the relationship between industry characteristics and innovativeness of affiliated firms.

A plethora of studies, following the seminal works of Khanna and Palepu (2000a; 2000b), argue that business groups enjoy superior access to financial resources, human resources, and sometimes knowledge-based resources through joint ventures with MNCs. Prior studies in the context of Korean chaebols (Chang & Choi, 1988; Guillén, 2000), Chinese national teams (business groups) (Keister, 1998; Yiu et al., 2005) and Latin America business groups (Strachan, 1976) confirm this resource based view. Business groups are in a preferable position to access technological know-how from advanced economies. Sharing of these resources such as knowledge within member firms helps business groups to balance exploration and exploitation (Lee, Park, Ghauri, & Park, 2014; Ramchandran, Manikandan, & Pant, 2013). In the context of China, acquiring developed market firms by business groups enhances the innovativeness of their affiliates in the domestic market (Anderson, Sutherland, & Severe, 2015). Similarly, technology imports enhance R&D more in affiliated firms with respect to standalone firms (Chittoor, Aulakh, & Ray, 2015). Moreover, Iona, Leonida, & Navarra (2013) observe that growth, as a consequence of innovation, is higher for group affiliated firms with respect to standalone firms, especially when affiliates compete in foreign markets. Thus, it can be argued that business group affiliation positively moderate the R&D intensity in export-oriented industries. Business groups create inter-firm network structure through multiple ties and use this network structure for facilitating financial and non-financial resource sharing, and in turn promote affiliate innovativeness (Chang & Hong, 2000; Mahmood, Zhu, & Zajac, 2011). Hence, I argue that in capital intensive industries, which require heavy investments in R&D, group affiliated firms will be in a better position to upgrade their technology, and in turn innovativeness. In general, MNCs enters emerging markets with technologically superior products (Khanna & Palepu, 2006). Thus, the dominance of MNCs in a particular industry indicates the presence of technologically superior products where domestic firms might struggle to compete. On the contrary, group

affiliated firms will be in a better position to import technology from advanced economies, and their reputation will help them to establish joint ventures with foreign MNCs (Khanna & Palepu, 2000b; Zhao, Anand, & Mitchell, 2005). Thus, Chari & Dixit (2015:1359) argue that the likelihood of “*business start-up by business groups ... is greater in industries privatised by reforms and in industries with greater foreign firm presence*” with respect to stand-alone firms. Thus, I hypothesise,

***Hypothesis 4:*** *Business group affiliation will positively moderate the relationship between industry export orientation and the R&D intensity of a firm.*

***Hypothesis 5:*** *Business group affiliation will positively moderate the relationship between industry capital intensity and the R&D intensity of a firm.*

***Hypothesis 6:*** *Business group affiliation will weaken the negative relationship between the dominance of foreign MNCs and the R&D intensity of a firm.*

## **Data and Methods**

I set the study in India, an emerging market economy, where the process of economic liberalisation has sharply changed the institutional context in the post-reform era. Since early 1990s India has embarked on a path of economic reforms that has led to substantial changes in the institutional context. For example, India has achieved a phenomenal growth momentum in international trade, suggesting greater participation by Indian firms in foreign markets as well as foreign firms in Indian markets in the years to come. Thus, these market-oriented institutional changes in Indian context provide an ideal context to explore the innovation orientation of Indian firms. Moreover, the existence of numerous business groups in Indian corporate landscape and the availability of reasonably detailed data also provide an

ideal setting to explore how business group affiliation moderates the innovation orientation of firms. It is worth to note that business groups have continued to remain a dominant force even during the post-reform era, an outcome quite at odds with the predictions of a series of papers by researchers examining the role of business groups in the new institutional environment.

I extract data from the Centre for Monitoring Indian Economy (CMIE) database which is a widely accepted secondary database for Indian firms. CMIE database provides detailed information on the financial performance of firms compiled from their audited annual reports. The sample comprises of Indian private sector non-financial firms for the period 1999-2015. However, the R&D data is missing for many smaller firms. So, the final sample comprises of a firm-year observation of around 14,500 firms. The study's main dependent variable is firms' innovation orientation. Extant literature has typically considered R&D intensity as a surrogate for the innovation orientation of a firm (Hitt, Hoskisson, & Kim, 1997). Scholars have, historically, accepted R&D intensity as an internal source of innovation (Crossan & Apaydin, 2010; Ugur, Trushin, & Solomon, 2016). A comprehensive review of extant literature also indicates that scholars have focussed on the study of R&D intensity as a determinant/independent variable (Singh, 2016; Ugur et al., 2016). So, following this stream of research, I consider R&D expenses as a percentage of total sales as a proxy for firms' innovation orientation.

The main explanatory variables are industry-level indicators because I are investigating the effects of industry characteristics, such as industry export orientation or dominance of MNCs, on firms' innovation orientation. I define the industry of a firm by using the 2-digit National Industry Code (NIC) code (NIC code is similar to SIC code of USA). I operationalize industry export orientation (*Ind\_ExpInt*) as a year-wise median of the firm-

level export intensity of all firms in the same 2-digit NIC code. I operationalized firms' export intensity as foreign exchange earnings through exports of goods and services divided by the net sales of the same year. Similarly, I operationalize industry capital intensity (*Ind\_Tang*) as a year-wise median of tangibility (firms' net fixed assets of a firm divided by the total assets of the same year) of all firms in the same 2-digit NIC code. I calculate dominance of foreign MNCs (*MNC\_Share*) as cumulative sales of all MNCs divided by the cumulative sales of all private sector firms (i.e. Indian private sector firms as well as MNCs) in the same 2-digit NIC code.

The next set of hypotheses investigates how business group affiliation (BGA) moderate the relationship between various industry characteristics and firms' innovation orientation. So, to test the moderating effects of BGA, I use a dummy variable (1 if the firm is affiliated with a business group and 0 otherwise). CMIE's classification of firms into groups, based on "...firm's history, monitoring its announcement closely, and examining directorate interlocks" (Khanna & Rivkin, 2001:53), is used for assigning the group affiliation to individual firms. This CMIE group affiliation has been used by prior empirical studies on Indian business groups (Khanna & Palepu, 2000b; Vissa et al., 2010).

Next, I have considered an exhaustive set of firm-level control variables. Prior studies observe a positive influence on intangible resources and innovation capabilities on firm's export intensity. I operationalized intangible resources (*Intang\_Res*) by dividing the sum of advertising and marketing expenses by net sales (Kotabe et al., 2002). I controlled for firms' financial resources (*Fin\_Res*) such as liquid assets in the form of cash, bank balances, and marketable securities, normalised with respect to total assets. I also controlled for capital structure (*Leverage* - borrowings divided by total assets) and profitability (*ROA*- profit before interest and tax/ total assets) of a firm. The age and the size of the firm have been considered

as an important determinant of firm's export intensity. So, I controlled for age (*Ln\_Age*) by taking the natural logarithm of the total number of years since the firm's inception and also controlled for firm's size (*Ln\_Size*) by taking the natural logarithm of net sales. I created a time-clock (*Trend*) variable over the 17-year study period to capture institutional transitions. *Trend* variable assumes positive integer values of 1 to 17 corresponding to the 17 years of the data used in my analysis. Prior studies also noted significant variations across industries in terms of firms' innovation orientation. Thus, I incorporate industry innovation orientation (*Ind\_R&DInt*) i.e. year-wise median of firm-level R&D intensity of all firms in the same 2-digit NIC code in the regression model. Similar to an industry dummy variable, *Ind\_R&DInt* takes care of the industry-specific idiosyncratic effects. Moreover, as a control variable industry dummies are time-invariant, but *Ind\_R&DInt* is not time-invariant.

I have used random-effects generalised least square (RE-GLS) regression, since firms' affiliation to business groups do not change over time (i.e. time invariant), making the fixed-effects model unsuitable for this study. I have used Rogers Standard Errors Estimator to control heteroskedasticity and autocorrelation issues. To control the effects of outliers, I winsorize all variables at the top and bottom one percentiles. I test for multicollinearity by carrying out an OLS regression in pooled data to determine the VIF. I observe for all the models VIF is much below 10 (except Model 6).

## **Findings**

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*Insert Table 1 here*  
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I report the mean, standard deviation and pairwise correlation for all variables in Table 1. Mostly all variables are normalised either by sales or assets. Hence, these mean values should not be interpreted as absolute values. The mean value for BGA is 0.359 which indicates



around 36% firms in the sample are affiliated with business groups. Models 1 is my base model with all control variables. It is worth noting that most of the control variables are statistically significant (except firms' age and financial resource) and the pattern remains consistent across models. Table 2 reports the output of regression analysis and all models, i.e. models 1 to 7, are statistically significant at 0.1% level. Models 2 to 4 in Table 2 reports the effects of industry effects on firms' innovation orientation (operationalised through R&D intensity). Hypothesis 1 proposes that industry export orientation will positively influence the innovation orientation of firms; whereas hypotheses 2 and 3 argue that industry capital intensity and dominance of MNCs will negatively impact the innovation orientation of firms. As hypothesised, I observe the coefficient of *Ind\_ExpInt* is positive and statistically significant at 0.1% level in model 2. Similarly, the coefficient of *MNC\_Share* is negative and statistically significant at 1.0% level in model 4. However, the coefficient of *Ind\_Tang* is not significant. Thus, the empirical evidence *strongly supports hypotheses 1 and 3* but not hypothesis 2.

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*Insert Table 2 here*  
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Models 5 to 7 reports the moderating effects of business group affiliation on the relationship between industry characteristics and firms' innovation orientation. Hypotheses 4 and 5 propose that affiliation with business groups positively moderates the innovation orientation in export-oriented and capital intensive industries. Hypothesis 6 argues that affiliation to business groups will weaken the negative effect of MNC dominance on firms' innovation orientation. As hypothesised, I observe that the interaction terms in models 5 and 6 are positive and statistically significant at 1% and 0.1% level respectively. Thus, this pattern *strongly supports Hypotheses 4 and 5*. More importantly, I observe the coefficient of *Ind\_Tang* is negative and statistically significant at 1.0% level. Thus, the empirical evidence

also *supports hypothesis 2* when I incorporate the interaction terms in the regression model. However, the coefficient of *MNC\_Share* in the model 7 is positive but not statically significant. Thus, neither it supports my hypothesis 6, nor it refutes. Overall, the empirical evidence strongly supports 5 out of the 6 hypothesis (except hypothesis 6).

As I noted earlier, the VIF for model 6 is higher than the suggested cut-off of 10. I carefully looked into the VIF analysis, and I observe that the coefficients of the BGA dummy variable and the interaction terms are responsible for this. It is worth noting that my interpretation of the hypothesised relations is not fraught with the pitfall of multicollinearity issues. However, this pattern, high VIF for *BGA* and interaction terms, indicates the dominance of group affiliated firms in capital intensive industries. Another potential issue can be the reverse causality between variables. Thus, in the robustness tests, I considered lagged value of my explanatory variables, such as industry export orientation, industry capital intensity and dominance of MNCs. The results remain consistent and reconfirm my argument. I have not reported the robustness tests for the sake of brevity.

## **Conclusion**

In spite of the importance of external environments on firms' strategic behaviour and performance, prior works have rarely considered the role of industry contexts as determinants of firms' innovation orientation. This paper has made an attempt to enrich the intersection of the literature on the industry characteristics (McGahan & Porter, 1997), the innovation orientation of firms (Teece, 2010), the business group affiliation (Khanna and Palepu, 2000b), and the idiosyncrasies of the emerging economy (Wright et al., 2005). I identified three industry characteristics, such as export orientation, capital intensity and dominance of MNCs, which influence firms' innovativeness. Extant literature mostly considered the role of firm-level heterogeneity as a determinant of innovation orientation. I showed that industry

characteristics matter even after controlling industry level R&D orientation. I set the study in India and considered an exhaustive dataset of around 14,500 firm-year observations for a 17-year period from 1999-2015 to test the hypotheses. My empirical evidence strongly suggests that industry-level export orientation positively impacts firm-level R&D intensity whereas the industry effect is reverse in capital intensive industries. It is also worth noting Indian business groups are mostly in capital intensive industries. Interestingly, the innovation orientation is impeded when the domestic firms face dominance of foreign MNCs in the industry. However, this is not the case for business group affiliated firms. Broadly, developing economy firms are at a competitive disadvantage when it comes to technological sophistication but business group affiliated firms are not fraught with this pitfall. This paper demonstrates that business group affiliation positively impacts the innovativeness of affiliates. To sum up, I conclusively establish the importance of industry characteristics on the innovation orientation of domestic firms of emerging market economies. The results also highlight the compounding effect of business group affiliation on the relationship between industry characteristics and a firm's innovation orientation.

I also acknowledge certain limitations of this study. In the CMIE database, I was constrained to eliminate many firms as they did not report any R&D intensity. Incidentally, this also resulted in the elimination of firms with a smaller scale. Moreover, except the trend variable (which is a crude proxy of institutional transitions), I did not theorise or consider any other institutional factors in this study. Institutional transitions can have many facets such as free market mechanisms or financial sector reforms. These multiple facets might affect firms' innovativeness differently in different phases. Even different industry characteristics might have divergent effects during different phases of institutional transitions. For example, the dominance of MNCs might not be that detrimental for firms' innovativeness in the presence

of free-market mechanisms like arm's length transactions. These issues need to be explored further.

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**Table 1: Descriptive Statistics of the Variables**

	<b>Mean</b>	<b>S.D.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<i>1 R&amp;D_Int</i>	0.010	0.024	1.000											
<i>2 Ind_ExpInt</i>	0.193	0.209	0.239*	1.000										
<i>3 Ind_Tang</i>	0.281	0.153	-0.153*	0.114*	1.000									
<i>4 MNC_Share</i>	0.092	0.101	0.030*	-0.077*	0.035*	1.000								
<i>5 BGA</i>	0.359	0.480	-0.066*	-0.068*	-0.033*	-0.010*	1.000							
<i>6 Fin_Resource</i>	0.118	0.210	0.066*	0.069*	-0.104*	-0.081*	0.080*	1.000						
<i>7 Intang_Resource</i>	0.034	0.067	0.168*	0.030*	-0.090*	0.018*	0.058*	0.089*	1.000					
<i>8 Leverage</i>	0.590	1.027	-0.038*	0.010*	0.040*	-0.029*	0.024*	0.086*	0.055*	1.000				
<i>9 ROA</i>	0.078	0.156	-0.114*	-0.007*	0.050*	0.049*	-0.008*	-0.010*	-0.194*	-0.229*	1.000			
<i>10 Ln_Sales</i>	5.045	2.734	-0.203*	-0.087*	0.123*	0.062*	0.236*	-0.150*	-0.306*	-0.199*	0.256*	1.000		
<i>11 Ln_Age</i>	2.692	0.890	-0.169*	-0.088*	0.046*	0.063*	-0.101*	-0.150*	-0.115*	-0.005	0.128*	0.146*	1.000	
<i>12 Ind_R&amp;Dint</i>	0.007	0.018	0.413*	0.107*	-0.165*	0.009*	0.054*	0.060*	0.091*	-0.002	-0.019*	-0.098*	-0.089*	1.000
<i>13 Trend</i>	9.000	4.899	0.076*	0.043*	-0.189*	-0.127*	0.000	0.099*	0.000	0.022*	-0.029*	0.131*	0.190*	0.051*

*\*Pairwise correlation is significant at 5% level.*

**Table 2: Effects of Industry Characteristics on R&D Intensity & Moderating Effects of BGA**

	M1	M2	M3	M4	M5	M6	M7
<i>Ind_ExpInt</i>		0.02*** (0.00)			0.01*** (0.00)		
<i>Ind_Tang</i>			-0.00 (0.00)			-0.01** (0.00)	
<i>MNC_Share</i>				-0.01** (0.00)			-0.01* (0.00)
<i>BGA*Ind_ExpInt</i>					0.01** (0.01)		
<i>BGA*Ind_Tang</i>						0.02*** (0.01)	
<i>BGA*MNC_Share</i>							0.00 (0.01)
<i>BGA</i>	0.00* (0.00)	0.00** (0.00)	0.00* (0.00)	0.00* (0.00)	0.00 (0.00)	-0.00* (0.00)	0.00 (0.00)
<i>Fin_Resource</i>	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
<i>Intang_Resource</i>	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
<i>Leverage</i>	-0.00* (0.00)	-0.00* (0.00)	-0.00* (0.00)	-0.00* (0.00)	-0.00* (0.00)	-0.00* (0.00)	-0.00* (0.00)
<i>ROA</i>	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
<i>Ln_Sales</i>	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)
<i>Ln_Age</i>	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00+ (0.00)	-0.00 (0.00)
<i>Ind_R&amp;Dint</i>	0.73*** (0.10)	0.69*** (0.10)	0.73*** (0.10)	0.72*** (0.10)	0.69*** (0.10)	0.72*** (0.10)	0.72*** (0.10)
<i>Trend</i>	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
<i>Constant</i>	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
<i>Chi-square</i>	309.719	344.1153	318.3628	309.7343	347.0206	326.4345	310.5116
<i>N</i>	14549	14549	14549	14549	14549	14549	14549
<i>VIF</i>	1.03- 1.48	1.03-1.48	1.03-1.48	1.03-1.48	1.03-2.77	1.03-16.2	1.03-4.40

*Dependent Variable: R&D Intensity. Random effects GLS model. Standard errors are in the parentheses. All one-tailed tests. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05, + p<0.10.*