# Does Business Group Affiliation Encourage R&D Activities? Evidence from India

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## Abstract

This study empirically investigates the relationship between business group affiliation and research and development (R&D) activities of Indian firms. We consider both propensity for undertaking R&D activities and R&D intensity as the variables of interest. Using the panel Probit and Tobit models, we observe that the business group affiliation has significant positive influence on the sample firms' R&D activities.  Related industry diversification of business groups is observed to be strengthening the group – innovation relationship, whereas unrelated industry diversification is found to be weakening the same. Complementing the earlier findings, we report that capital market participation and external financial dependence do not influence the relationship between sample firms' business group affiliation and their innovative activities. Further, we report that the influence of business group affiliation on firms' R&D activities declines as the efficiency of institutional infrastructure improves. Our empirical evidence supports the institutional voids argument for the existence of business groups in emerging markets like India.

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# 1. Introduction

A distinct feature of the many of the economies is the presence of the business group firms. These group affiliated firms are known by various names such as *Keiretsu* in Japan, *Chaebol* in Korea, *Jituanqiye* in Taiwan, *grupos* economics in Latin America, business houses in India. Unlike the traditional enterprises, business groups model are quite unique. Even though there are definitional variations, and these are legal entities, Khanna and Rivkin (2001: 47–48) define business groups firms as a set of firms, which 'though legally independent, are bound together by a constellation of formal and informal ties, and are accustomed to taking coordinated action'. They act like a network and there is evidence that considerable resource sharing among affiliates is widely prevalent (Hsieh et al 2010). Such groups are considered as a way of ameliorating the financing constraints of the affiliated through the creation of internal capital market. An interesting question emerging from the working of internal capital market is whether the group affiliation hinders or promotes R&D activities.

The existing studies have mainly focused on performance related aspect of group affiliation (Carney et al 2011). There are very few studies that focus on the strategies (i.e R&D) of the business group firms. According to Mahmood and Lee (2004) "*We do not know, however, whether or not there is any systematic relationship between group structure and technological innovation*". Therefore, there is a need to probe whether the superior financial performance of business group affiliation stem from their distinct strategies like investments in R&D. From an emerging market perspective, Chang et al (2006) discuss in detail how the group affiliation fosters innovativeness of the firms. *First*, group affiliation provides valuable source of finance which otherwise is difficult to obtain from the market. Due to market imperfections, business groups in developing economies can overcome the problem of liquidity for investment in R&D activities (Belenzon and Berkovitz, 2010; Hsieh et al., 2010). *Second*, the absence of proper intellectual property rights protection may prevent foreign firms from entering into technology collaboration with the developing economy firms. Due to the reputation problem, business groups are likely to honor the intellectual property rights and contract enforcement. Hence, foreign firms are likely to collaborate and share technology with group affiliates than stand-alone firms. *Third*, business groups can act as source of labor market for scientific personnel, who can be employed across various affiliates. *Finally*, group affiliation provides scope for knowledge spillover. Complementarity

of the resources of the affiliates helps them in enhancing the innovativeness and improving the infrastructure.

Business groups are a unique feature of many of the emerging economies like China and India. It is widely held that the presence of strong business groups in emerging economies result in more investment in innovative activities (Mahmood and Lee 2004). Group affiliation is helpful in reducing the risk associated with investments in R&D by providing mutual insurance (Aoki 1984). In contrast, business group can hinder innovative activities by preventing new entrants and lowering technology accumulation. Give the importance of business groups in emerging economies; it is crucial to study its role. There is a dearth of empirical studies examining effect of group affiliation on innovative activities[1]. From the emerging economies perspectives, this issue of great importance since the economic reform measures undertaken by these economies provide both challenges and opportunities for the business groups to innovate and maintain dominance (Aghion et al 2005)

The existing studies mainly focus on the factors determining business group formation (Maman 2002), performance effects (Khanna and Palepu 2000b) and more recently innovation (Belenzon and Berkovitz 2010). Therefore, the goal of the present study is to add to the growing but small body of literature on business group affiliation and R&D in the context of an emerging economy, India. The main focus of this paper will be to explore the relationship between group affiliation and R&D dealing with group ownership and diversification. India's unique corporate sector setting provides an interesting case to study the relationship between business group affiliation and R&D efforts. A large number of Indian firms are under the control of the business groups. Further, this issue assumes greater relevance in India since the business group firms are considered as the main drivers of innovation and economic growth (Chakrabarti et al 2008). Therefore, the empirical evidence in this study can provide key insights in understanding the strategies of the business groups firms in a developing economy setting.

The present study is organized as follows. Section 2 discusses the relevant literature and proposes the hypotheses. Section 3 presents empirical model and data source. Section 4 presents the econometric results and discussion. Section 5 provides concluding remarks.

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[1] The existing studies are mainly concentrated on the experience Taiwan, Korea, Italy.

## 2. Related Literature and Hypothesis development

Unlike the traditional enterprise, business groups' model is quite unique, as firms within a group enjoy a common pool of production technology, marketing knowledge, R&D, and reputation in capital markets. Several arguments have been put forward by the previous studies regarding the role of business groups in fostering innovation (Belenzon and Berkovitz 2010). First, diversified business groups have deep pockets to finance innovative activities. The advantage of diversification is the reduction in uncertainty (Khanna and Yafeh 2007). Second, business groups can reduce the problem of agency costs, reducing the asymmetric information and increasing the availability of internal funds for the R&D investments. Third, the group affiliates can benefit from spillovers from the R&D efforts leading to internalization within the group. The studies focusing on the business group affiliation and R&D investment usually assume the presence of coordination among the business group affiliated firms (Cefis et al. 2009; Chang et al. 2006). They hypothesize that firms in the same group are more likely to coordinate their R&D activities, and share their results among themselves. Forth, it is often argued that threat of takeover can force managers to reduce investment, particularly in intangible assets such as R&D (Shelifer and Vishny, 1988). The dominant shareholder in the form of business groups can significantly reduce the threat of hostile takeover and facilitate investment in hard to value assets, like R&D (Becker – Blease, 2011)

On the other hand, there has been a strand of literature that argues that the business group affiliation might hinder the innovative activities. Business groups can dampen the creativity and even deliberately delay the development of new technologies to avoid cannibalizing the streams of rents from existing ones (Arrow, 1962). The evidence on the American conglomerates suggest that internal markets are prone to the agency problems that can lead to biased decision making, less risk taking, and weak commitments to long term profitable projects (Seru, 2014). These agency problems can be severe in the case of financing R&D investments. Further, the business groups perceived deep pockets may not always foster value enhancing investments due to the socialism and internal politics. Business group firms may function as large bureaucratic organizations and limit the creativity and flexibility required for the innovative efforts (Stein 1988). We provide a summary of the recent literature that focused on the relation between business group affiliation and R&D investment in the figure below.

**Table 1. Summary of Studies Related to BG Affiliation and R&D Investment**

| Authors | Type of Data | Country | Dependent Variable | Independent Variable | Results |
|---|---|---|---|---|---|
| Filatotchev et al., 2003 | Firm level / 2002 manufacturing firms | Italy / 1992–94 | R&D expenses /employees | Group dummy Position within the group (head or controlled | 1) group affiliation positively associated with R&D intensity<br>2) Higher positioning within the group's hierarchy is associated with higher R&D intensity |
| Blanchard et al., 2005 | Firm level and group level / 3100 firm Affiliates | France / 1994–98 | Value added Firm R&D | Group R&D | 1) Within group R&D has an impact on the productivity of affiliates<br>2) R&D of other affiliates is more profitable to firms not doing R&D than to those having their own R&D |
| Chang et al., 2006 | Firm level and group level / Sample from the largest 500 firms | Korea Taiwan / 1991–99 | US patents Group dummy | Group diversification | 1) Affiliation benefited firm innovation in Korea, but did not do so in Taiwan<br>2) the benefit of business group affiliation for firm innovativeness is contingent on a country's institutional environment<br>3) diversification at the group level negatively affected affiliate firms' innovation performance in Taiwan, where capital markets were more developed than they were in Korea. |
| Kim and Lee (2008) | Firm level/ 253 firms | Korea/ 1998-2003 | Ratio of R&D expenditures to total sales | Group Dummy | Do not find evidence of group affiliation influencing R&D investments |
| Cefis et al., 2009 | Firm level / 3696 Italian firms with a positive R&D budget | Italy / 1992 | R&D expenses on product and process innovation | Group dummy | 1) firms that belong to a group invest significantly more into aggregate R&D than independent firms.<br>2) the R&D portfolio of firms that belong to a group is more intensive in product R&D. |
| Belenzon and Berkovitz 2010 | Firm level / 11645 firm of which 5683 are affiliated | Europe / 1995–2004 | EPO and US patents | Group dummy Group diversification Industry dependence on external finance Research similarity index of affiliated firms | 1) group affiliates patent more than standalones or affiliates of small groups<br>2) group–innovation relation is stronger in industries that rely more on external finance and in groups with more-diversified capital sources<br>3) affiliates of the same group tend to have different research focus |

| | | | | | and are unlikely to cite each other's patents. |
|---|---|---|---|---|---|
| Hsieh et al., 2010 | Firm level and group level / 4170 firms of which 715 belonging to a group | Taiwan / 2001–2003 | Granted Patent applications | Group dummy Group diversification Ownership Industry dependence on external finance | 1) Business groups foster innovation of affiliated firms 2) Group-innovation relation is stronger in industries that rely more on external finance 3) group diversification is positively related to firm innovativeness 4) family ties results in a better innovative performance of affiliated companies |
| Guzzni & Iacobucci 2014a | Firm level/4,000 firms | Italy / 2001-2003 | Dummy variable for R&D expenses R&D intensity Degree of independence Indicator for knowledge spillovers | Group dummy Group diversification | positive association between R&D investment and group affiliation |
| Guzzni & Iacobucci 2014b | SMEs/3446 firms | Italy/2001-2003 | R&D propensity/ R&D intensity | Bottom Group Dummy Head/Intermediate Dummy | Positive association between R&D propensity and head/intermediate affiliate firms |

*Source*: own compilation and Guzzni & Iacobucci (2014a)

All the above studies presented in the Table 1 confirm the positive association between business group affiliation and R&D investment. The investment in R&D is riddled with information problems and lack of collateral value due to the uncertainty involved in R&D activities (Hubbard, 1998). Therefore, frictions are likely to arise in the case of obtaining funding for R&D. Stiglitz (1989) cites that informational problems are severe in the case of developing countries since the markets in these countries lack the capability to process and evaluate information. Business groups that are understood to fill the institutional voids are expected to fund their affiliates' R&D activities by substituting/complementing external sources with their internal capital markets (Khanna and Palepu, 1997; Carney et al, 2011). Such an access to finance encourages business group affiliated firms to embark on R&D investments. Hence, we propose following hypotheses.

*H1a: Firms affiliated to business group are expected to have higher propensity for R&D than stand-alone firms.*

*H1b: Firms affiliated to business group are expected to have higher R&D intensity than stand-alone firms*

Although the above hypothesis posits a positive association between BG affiliation

and R&D expenditure, BG characteristics and firm characteristics will have an impact on the above relationship. In the following subsection, we discuss the impact of BG and firm characteristics on R&D expenditure. We consider the BG characteristics such as BG diversification across industries and BG's industry share. In the subsequent subsections, we discuss the role of external financial dependence and capital market participation (listing on the exchanges) on R&D expenditure.

### 2.1 Business group characteristics and R&D investments

The previous empirical studies (Table-1) argue that business group affiliation facilitates easy funding and encourages its affiliates to embark on R&D activities in order to garner the positive knowledge spillovers. But these studies have been criticized as they do not consider the important dimension of business groups such as their diversification across industries (Hsieh et al., 2010). Khanna and Yafah (2007) reported that Indian business groups are comparatively far more diversified than the groups in other countries like Brazil, Indonesia, Phillipines, South Korea, etc,. The present study examines the impact of diversification on the relationship between business group affiliation and innovation in detail by considering the diversification across the related as well as unrelated industries. The spillover effects of R&D are expected to be higher among the business group affiliates operating in the related industries. However, an argument can be made that the R&D intensity may be lower since the benefits from R&D can be shared among the group members. In the case of business groups with unrelated diversification, the scope of sharing the benefits of R&D is minimal. Though, the reduction in risk due to diversification may have positive impact in taking up the long term investments. The unrelated diversification at the group level is likely to impede the innovativeness of the affiliates as it promotes the free rider problem. As argued by Chang et al. (OS, 2006), the undesirable effects of unrelated diversification on R&D are more pronounced in a mature and well-functioning markets.

*H2a: Firms affiliation to business groups with higher diversification across industries (total entropy) is not expected to influence their propensity for R&D and their R&D intensity.*
*H2b: Firms affiliated to business groups with higher diversification across the related industries (related entropy) are expected to show higher propensity for R&D and higher R&D intensity than the stand-alone firms.*

*H2c: Firms affiliated to business groups with higher diversification across the unrelated*

*industries (unrelated entropy) are expected to exhibit lower propensity for R&D and lower R&D intensity than stand-alone firms. It will be more apparent as the capital markets develop.*

### *2.2 The effect of external financial dependence and capital market participation on R&D investments*

The studies illustrated in Table 1 presume that mere business group affiliation enhances firms' R&D investments by facilitating easy financing for the same. We argue that capital market participation alone as well as coupled with business group affiliation positively influences firms' innovative efforts. Participation in efficient capital markets is argued to enhance firms' sources of capital. Well-developed capital markets are expected to process the information efficiently and reduce the frictions associated with the R&D investment. The participation in the capital markets thus is expected to encourage the firms to initiate as well as enhance R&D activities. Stock exchange listing provide an efficient mechanism to spread the risk across a large of group of investors which may provide an edge to publicly traded companies in undertaking investment in R&D (Aghion et al., 2013). However, stock market pressure and myopia may hinder investment in R&D (Fang et al, 2014).

Business groups offer few generic resources and capabilities to their affiliate firms such as reputation, brands, and operational knowledge. These resources will enhance the fund raising capabilities of business group affiliated firms that participate in the capital markets. Business group affiliated firms can take advantage of their group reputation to raise capital from external markets at more favorable terms when compared to their stand-alone counterparts (Marisetty and Subramanyam, 2010; Chittor et al., 2014). Moreover, in case of business group affiliated firms the monitoring by the external market expected to strengthen the governance. Such an enhanced access to capital markets and improved governance practices facilitate the BG affiliated firms to actively undertake R&D investments. Hence, we propose the following hypotheses.

*H3a: Capital market participation is expected to positively influence the firms' propensity for R&D and their R&D intensity.*

*H3b: Business group affiliation complemented with capital market participation positively influences the firms' propensity for R&D and their R&D intensity.*

A potential mechanism that may lead to the positive relationship between business

group affiliation and R&D investment is the functioning of internal capital markets. Such internal market facilitated by group headquarters, coupled with the reputation enjoyed by the business groups may facilitate the group affiliates with the cheap external funding for R&D investments (Belenzon and Berkovitz 2010). Hence, we expect the relationship between business group affiliation and innovation efforts to be stronger in case of firms operating in the industries with higher external financial dependence. Hence, we propose the following hypothesis.

*H4: The influence of business group affiliation on the propensity/intensity for R&D is expected to be positive in the case of industries with greater external financial dependence.*

### 2.3 Institutional voids argument and R&D investments

The previous studies highlight two important sources of positive relationship between business group affiliation and R&D: (a) positive spillover across the affiliates (b) ease of external financing. Moreover, the underdeveloped nature of institutions in emerging markets hinder the functioning of financial markets such as in India, in which business groups are responsible for firms' innovative activities and large parts of country's economic growth (Chakrabarti et al., 2008). However, the above argument may weaken once the external institutions emerge to fill the gaps. For example, an external contract research firm may be in a position to provide the benefits of R&D to multiple firms in a more efficient way. Similarly, a well-developed capital market can reduce the financial constraints associated with the R&D investment. In a comparative study of Korea and Taiwan, Chang et al (2006) show that the innovativeness of business group affiliates over stand-alone firms is high in South Korea but not in Taiwan; underlining the importance of business groups in the absence of alternative institutional infrastructure. As the institutions developed, this difference in Korea vanished in the late nineties.

*H5: The influence of business group affiliation on the affiliated firms' R&D (both propensity as well as intensity) declines as the efficiency of institutional mechanism improves.*

## 3. Methods
### 3.1 Model specification

We investigate the relationship between sample firms' business group affiliation and their innovation activities using the following econometric models. The similar models have been employed by the studies mentioned in Table 1.

$$Prob(R\&D)_{idt} = \emptyset \left( \beta_1 BG\ dummy_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \right) \qquad (1)$$

The equation-1 examines the relationship between the firm's business group affiliation and its propensity for undertaking R&D investment. We estimate the equation-1 employing Probit regression model. We calculate the relation between firm's business group affiliation and its R&D intensity employing the following equation 2.

$$R\&D\ Intsity_{idt} = \beta_1 BG\ dummy_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \quad (2)$$

The above equation-2 is estimated using Tobit regression model. Both the above equations have been employed considering the panel data structure in their specification. The equations include both time ($\delta_t$) and industry ($\alpha_d$) effects. The above equations are further extended to incorporate sample firms' capital market participation, external financial dependence of the corresponding industries, and various dimensions of business groups such as diversification across industries and industry share.

### 3.2 Variable description

#### 3.2.1. Dependent and independent variables.

This paper focuses on R&D investment rather than innovation performance as an indicator of innovative efforts of firms (Nieto and Quevedo, 2005; Guzzini and Iacobucci, 2014a). We consider propensity for R&D and R&D intensity as the dependent variables. Propensity for R&D implies whether a firm makes R&D investment or not in a given year of the study period. R&D intensity is measures as R&D expenditure as percentage of each firm's total assets in each year. These measures have been widely used in the management and finance literature (Guzzini & Iacobucci 2014a; Filatotchev et al., 2003; Cefis et al., 2009).

The independent variables have been the ownership classification of firms as business group affiliated firms and stand-alone firms. We consider the Center for Monitoring Indian Economy's definition in classifying the sample firms into business group affiliated or stand-alone firms. The similar definition has been previously employed by Khanna and Rivikin (2001) and Chittor et al (2014). We also construct the diversification measures to explore the relation between business group diversification on sample firms' R&D activities. Further, we consider group's industry share, industry external dependence, and sample firms' capital market participation as the independent variables. Following Palepu (1985), group

diversification is estimated using entropy measures over the study period. Total diversification (total entropy) computed at the five digit National Industrial Classification (NIC) level, and decomposed into related entropy (related diversification) and unrelated entropy (unrelated diversification). Industry segments operating in the same three digit NIC code are considered as related and those operating in the different three digit NIC are considered as unrelated. *Unrelated entropy* measures the extent to which the business group sales are spread across different (3 digit NIC code) industries and is defined as

$$Unrelated\ entropy\ (UE_{it}) = \sum_{D=1}^{n} P_{iDt} * \ln\left(1/P_{iDt}\right)$$

where D indicates an industry at 3-digit NIC level and $P_{iDt} = NIC\ 3d\ Firm\ sales_{iDt}/Total\ group\ sales_{it}$. Related entropy measures the extent to which the group firms operate in several businesses within the same industry (3-digit NIC code).

$$Related\ entropy\ (RE_{it}) = \sum_{d=1}^{n} P_{idt} * \ln\left(1/P_{idt}\right) * P_{iDt}$$

where d refers to an industry at the 5-digit NIC code level and $P_{idt} = NIC\ 5d\ Firm\ sales_{idt}/NIC\ 3d\ Firm\ sales_{iDt}$. The *total entropy* then is the sum of related entropy and unrelated entropy.

Sample firms' external financial dependence is computed at the industry level as the corresponding industry's median firm's external financial dependence. Following Huang and Ritter (2009), we define the external financial dependence as change in assets minus change in retained earnings as a percentage of beginning-of-year assets. It essentially captures the corresponding industry's dependence on external financing. Such a procedure is consistent with the one employed by Rajan and Zingales (1998). Sample firms' listing on either of the country's premier stock exchanges such as National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) is considered as having access to the capital markets. The similar approach has been employed by various studies in the management and finance literature (Chittoor, et al., 2014) to measure the firms' capital market access.

### 3.2.2 Control variables

The analysis incorporated several control variables along with time and industry fixed effects to control for the other firm specific factors that potentially affect the propensity for

R&D and R&D intensity. We control for the sample firms' financial constraints, leverage, size, and age. *Cash flow*, defined as a sum of profit after tax, depreciation, amortization, and R&D expenses (scaled by total assets) is considered as the proxy for firms' financial constraints. A numerous studies have highlighted the influence of financial factors on R&D (Hall and Lerner 2010). The recent empirical studies (Sasidharan et al, forthcoming; Guariglia and Liu 2014) focusing on emerging economies like China and India reported that firms' R&D investments are sensitive to the availability of internal cash flow. Gugler (2001) gives a detailed account on why the debt financing is not suited for investment in R&D. A number of empirical studies such as Bradley et al (1984); Long and Malits (1985); have highlighted the negative relationship between firms leverage and R&D intensity. *Firm size*, measured as natural logarithm of total assets is expected to have positive influence on R&D because larger firms will be able to appropriate the benefits of R&D investments (Nelson and Wintor, 1982). Previous studies based on India have generally reported a positive relationship between firm size and R&D (Kumar and Saqib, 1996). However, Siddharthan (1988) and Kumar and Aggarwal (2005) based on the Indian manufacturing firms report U-shaped and S-shaped relationship. *Age*, computed based on the year of incorporation is expected to influence R&D activities positively as experienced firms may have comparative advantage in exploiting the benefits of R&D efforts.

### 3.3 Sample and data

The analysis of the present paper relies on the firm level panel dataset of the Indian manufacturing industries for the period of 1992 to 2013. The studying of Indian firms is particularly interesting because of the way in which business group affiliated firms dominate Indian corporate sector. Around 35.9% of the Indian firms are affiliated to business groups and they constitute approximately 82% of the Indian market capitalization. The study uses the data from Prowess database, compiled and maintained by Center for Monitoring Indian Economy (CMIE). PROWESS provides information for over 25,000 firms belonging to manufacturing, services and other utilities. The database provides information about the firms such as their sales, R&D expenditure, total assets, current assets, total debt, and liabilities. The information is mainly drawn from the financial statements and annual report of the firms. This database was previously employed by many firm level studies for analyzing the R&D investments (Sasidharan and Kathuria, 2011), testing R&D financing constraints (Sasidharan et al forthcoming), analyzing the performance of business group firms (Khanna and Palepu,

2000b), and examining impact of equity market collapse on firm financing (Gopalan and Gormley, 2013).

We exclude firms that are controlled by the state as their investment activities are most often not driven by the objective market criterion. We also exclude foreign firms that are incorporated in India and affiliated to foreign business groups as they may leverage on the innovative benefits of their co-affiliates in the foreign countries. Further, we eliminate firm year observations either with negative net worth, or total assets (or sales) less than Rs 1 crore. The final sample consists of 62,623 firm year observations belonging to manufacturing industries. The sample consists both public as well as private firms of 6,779 with an average of 9.24 firm year observations each. It is an unbalanced panel dataset with gaps, as few firms were observed to be de-listing and re-entering the market after a few years for various reasons (acquisitions, bankruptcies, etc). Of the sample firms, 35.9% are business group affiliated firms and remaining 64.1% are stand-alone firms. In terms of market capitalization of listed sample firms, business group affiliated firms contribute on an average 82% of the total market capitalization during the study period. In a way, our sample consists of predominantly business group affiliated firms and it offers us an ideal testing ground to examine the relationship between firms' business group affiliation and their innovative activities.

## 4. Results and Discussion
### 4.1 Summary statistics

Table 2 presents the summary statistics of the relevant variables included in the econometric analysis. All the variables included (except total assets, size, and age) are winsorized at one and ninety nine percentile to eliminate the effect of outliers. The table presents the descriptive statistics by classifying the sample firms into business group affiliated firms and stand-alone firms. It further presents the characteristics of the sample firms that are classified into those participate in the capital markets and those that do not. By capital market participation, we mean having their equity shares listed and traded on the country's two major stock exchanges such as National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). The sample firms that participate in the equity capital markets are also referred to as 'public' firms and 'private' firms are those that do not participate in the equity markets.

**Table 2. Summary Statistics**

| Variable | All Firms | | | Listed firms | | | Unlisted firms | | |
|---|---|---|---|---|---|---|---|---|---|
| | All | Stand-alone | Business group | All | Stand-alone | Business group | All | Stand-alone | Business group |
| Total Assets | 297.03 | 99.93 | 648.29 | 552.91 | 156.99 | 1039.90 | 105.22 | 66.57 | 198.61 |
| LEV | 0.3531 | 0.3516 | 0.3557 | 0.3608 | 0.3516 | 0.3722 | 0.3471 | 0.3517 | 0.3357 |
| Size | 3.7990 | 3.3095 | 4.6711 | 4.4086 | 3.6970 | 5.2839 | 3.3419 | 3.0830 | 3.9675 |
| CF/TA_t-1 | 0.0857 | 0.0815 | 0.0925 | 0.0843 | 0.0778 | 0.0923 | 0.0868 | 0.0841 | 0.0928 |
| ROA | 0.1187 | 0.1158 | 0.1235 | 0.1133 | 0.1073 | 0.1206 | 0.1235 | 0.1218 | 0.1273 |
| CAPEX/TA_t-1 | 0.1004 | 0.0987 | 0.1031 | 0.1045 | 0.1053 | 0.1036 | 0.0967 | 0.0942 | 0.1024 |
| Current ratio | 2.8118 | 3.0776 | 2.3382 | 2.8818 | 3.2676 | 2.4073 | 2.7593 | 2.9664 | 2.2589 |
| AGE | 24 | 22 | 28 | 24 | 20 | 30 | 24 | 23 | 27 |
| DEF | 0.1678 | 0.1706 | 0.1630 | 0.1670 | 0.1741 | 0.1584 | 0.1685 | 0.1682 | 0.1691 |
| Net Equity/TA | 0.0368 | 0.0384 | 0.0341 | 0.0427 | 0.0488 | 0.0352 | 0.0316 | 0.0312 | 0.0326 |
| Proportion R&D | 0.2361 | 0.1541 | 0.3821 | 0.3262 | 0.2075 | 0.4722 | 0.1685 | 0.1229 | 0.2786 |
| RD /TA_t-1 (%) | 0.2273 | 0.1702 | 0.3226 | 0.2731 | 0.2012 | 0.3601 | 0.1873 | 0.1488 | 0.2742 |
| N | 62673 | 40146 | 22527 | 26852 | 14811 | 12041 | 35821 | 25335 | 10486 |

As it is observed from various previous studies, it is evident from the table that an average group affiliated firm is few times larger than the typical stand-alone firm. It is evident across both the public as well as private firms. The average R&D intensity for the sample firms for the entire study period is 0.22 percent. Business group affiliated firms are found to be active in their innovative efforts as they report both higher propensity for R&D and higher intensity than their stand-alone counterparts. Such evidence is found to be true in the case of both public as well as private firms. Public firms are found to be larger than the private firms irrespective of their ownership classification. Public firms also report higher propensity for R&D and R&D intensity when compared to their private counterparts.

## 4.2 Business group affiliation and R&D investment

Upon understanding the characteristics of sample firms, we embark on testing our first hypothesis whether firms affiliated to business groups are more likely to be undertaking R&D investment. Table-3 presents the Probit regression estimates of equation-1 in the form on specification-1 (propensity for R&D). Among the independent variables, we include business group dummy identifying firm year observations belonging to business groups; cash flow to total assets ratio representing firm's ability to generate internal cash flows; leverage representing firm's solvency position; size; age measuring firm's maturity; and dummy variables identifying corresponding industries and years to control for the industry as well as time fixed effects. As expected in our hypothesis, firms affiliated to business groups show higher probability of investing in R&D. Complementing the literature focusing on the

relationship between financial constraints and R&D, we report internal cash flow has significant positive influence on sample firms' propensity for R&D investments (Guzzini and Iacobucci, 2014a). As highlighted by the previous studies such as Gugler (2001), debt financing is negatively influencing the firm's probability of undertaking R&D investments. Firm size reports to have significant positive influence on probability of undertaking R&D investments (Nelson and Wintor, 1982; Guzzini and Iacobucci, 2014a). As envisaged firms' age has significant positive influence on their R&D activities, confirming the argument that the matured firms are better positioned to exploit the benefits of innovative efforts.

**Table 3. Business Group Affiliation and Innovation**

|  | R&D Propensity (1) | R&D Intensity (2) |
|---|---|---|
| BG dummy | **0.9729** | **0.6746** |
|  | 0.0000 | 0.0000 |
| CF_TA | **1.1764** | **3.3503** |
|  | 0.0000 | 0.0000 |
| Lev | **-0.4206** | 0.0945 |
|  | 0.0000 | 0.1500 |
| Size | **0.6054** | **0.3271** |
|  | 0.0000 | 0.0000 |
| Age | **0.5254** | **0.3516** |
|  | 0.0000 | 0.0000 |
| Constant | **-7.6311** | **-5.4159** |
|  | 0.0000 | 0.0000 |
| Time | Yes | Yes |
| Industry | Yes | Yes |
| Log Likelihood | -12730.62 | -27067.35 |
| Chi-square | 0.0000 | 0.0000 |
| N | 54256 | 54256 |

Table-3 also presents the findings of Tobit regression estimator of R&D intensity (equation-2). In this case as well, business group dummy shows significant positive sign, confirming the argument that business group affiliated firms spend more on R&D efforts than their stand-alone counterparts. The coefficients of the control variables show the same signs as for the R&D propensity, except leverage which turns out to be insignificant (Guzzini and Iacobucci, 2014a). Overall these results, presented in Table-3 suggest that business group affiliation provides significant advantage to firms to undertake R&D activities. This highlights the strategic choices made by the business groups in deciding how to compete (Siegal and Choudhury, (2012). As highlighted by Siegal and Choudhury (2012), the focus on R&D investment and innovation may provide the business group an edge in '*complex recombination of inputs*.' Hence, we conclude that hypothesis H1a (on the propensity of

business group affiliated firms to engage in innovation efforts) and hypothesis H1b (on the intensity of business group affiliated firms to make R&D investments) are supported by our findings.

### *4.3 Business group characteristics and R&D investments*

The second hypothesis we test is whether affiliation to diversified business groups across industries influences sample firms' R&D propensity and R&D intensity. We hypothesize that firms affiliated to business groups with higher diversification across related industries are more likely to undertake R&D investment and their R&D investment is also expected to be higher than that of their stand-alone counterparts. We argue that firms affiliated to business groups with higher diversification across unrelated industries are less likely to undertake R&D activities. Further, we hypothesize that the firms affiliated to business groups with higher total diversification do not garner any benefits from their affiliation; hence we do not expect any advantage from their affiliation to such business groups. To investigate the same empirically, we specify the following econometric specifications.

$$Prob(R\&D)_{idt} = \emptyset \left( \beta_1 BG\ dummy_{idt} + \beta_2 BG\ dummy_{idt} * Diversification_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \right) \qquad (3)$$

$$R\&D\ Intsity_{idt} = \beta_1 BG\ dummy_{idt} + \beta_2 BG\ dummy_{idt} * Diversification_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \quad (4)$$

where '*Diversification*' variable takes the form of related entropy, unrelated entropy, and total entropy accordingly.

Table-4 presents both the Probit and Tobit estimates of equation -3 and equation-4 respectively. Business group affiliation continues to have significant positive influence on the firms' likelihood to undertake R&D activities as well as R&D intensity. As hypothesized, evidence suggests that firms affiliated to business groups with higher related industry diversification are more likely to undertake R&D activities (specification – 3), whereas firms affiliated to business groups with higher diversification across unrelated industries are less likely to embark on R&D activities (specification – 2). Further, we report that firms affiliated to business groups with higher total diversification do not differ from their stand-alone counterparts in terms of their propensity to R&D (specification – 1). These findings

complement the argument of Villalonga (2004) that the related diversification is associated with premium whereas the unrelated diversification is associated with discount. However, the entropy interactions with business group dummy are not statistically significant in the case of Tobit estimates of R&D intensity, suggesting that R&D intensity is unaffected by the affiliation to the business groups that are variedly diversified. Overall, our findings reported in Table 4 indicate that business group related diversification has a positive impact on the probability of undertaking the R&D; whereas business group unrelated diversification negatively influences affiliated firms' propensity to R&D. This supports the spillover of innovation benefits and knowledge sharing argument but does not support the risk reduction argument. Hence, our findings support diversification related hypotheses (H2a, H2b, and H2c) in the case of propensity to R&D investment, but not R&D intensity.

**Table 4. Business Group Diversification Across Industries and Innovation**

| | R&D Propensity | | | R&D Intensity | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| BG dummy | **1.0051** | **1.0627** | **0.9435** | **0.6531** | **0.6704** | **0.6633** |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| BG*TE | -0.0272 | | | 0.0183 | | |
| | 0.3820 | | | 0.3270 | | |
| BG*UE | | **-0.0904** | | | 0.0043 | |
| | | 0.0170 | | | 0.8560 | |
| BG*RE | | | 0.1549 | | | 0.0571 |
| | | | 0.0240 | | | 0.1110 |
| CF_TA | **1.1760** | **1.1711** | **1.1700** | **3.3502** | **3.3505** | **3.3473** |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Lev | **-0.4236** | **-0.4274** | **-0.4155** | 0.0964 | 0.0948 | 0.0961 |
| | 0.0000 | 0.0000 | 0.0000 | 0.1420 | 0.1490 | 0.1430 |
| Size | **0.6062** | **0.6069** | **0.6032** | **0.3266** | **0.3270** | **0.3262** |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Age | **0.5251** | **0.5260** | **0.5279** | **0.3514** | **0.3515** | **0.3520** |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Constant | **-7.6402** | **-7.6525** | **-7.6168** | **-5.4100** | **-5.4152** | **-5.4067** |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Time | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes |
| Log Likelihood | -12730.07 | -12727.52 | -12728.30 | -27066.93 | -27067.34 | -27066.16 |
| Chi-square | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N | 54256 | 54256 | 54256 | 54256 | 54256 | 54256 |

### 4.4 The effect of capital market participation and external financial dependence on R&D investments

The third hypothesis we test is whether capital market participation positively influences firms' R&D propensity and their R&D intensity. As mentioned earlier, by capital market participation we mean firms having listed their equity shares on the stock exchanges. We further hypothesize that capital market participation is expected to strengthen the relationship between business group affiliation and innovation efforts. To test these hypotheses empirically, we specify the following econometric models.

$$Prob(R\&D)_{idt} = \emptyset \left( \beta_1 BG\ dummy_{idt} + \beta_2\ Listed_{idt} + \beta_3 BG\ dummy_{idt} * Listed_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \right) \qquad (5)$$

$$R\&D\ Intsity_{idt} = \beta_1 BG\ dummy_{idt} + \beta_2\ Listed_{idt} + \beta_3 BG\ dummy_{idt} * Listed_{idt} + \gamma'\ Controls_{idt} + \delta_t + \alpha_d + \vartheta_{it} \qquad (6)$$

where 'listed' is a dummy variable identifying the public firms (those whose equity is listed and traded on the stock exchanges).

**Table 5. Business Group Affiliation, Capital Market Participation, and Innovation**

|  | R&D Propensity | | R&D Intensity | |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| BG dummy | **0.9792** | **0.9577** | **0.6759** | **0.7088** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Listed dummy | **0.2378** | **0.2133** | **0.0723** | **0.1137** |
|  | 0.0000 | 0.0000 | 0.0070 | 0.0030 |
| BG*Listed dummy |  | 0.0490 |  | -0.0760 |
|  |  | 0.5290 |  | 0.1350 |
| CF_TA | **1.2182** | **1.2159** | **3.3633** | **3.3651** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Lev | **-0.4041** | **-0.4053** | 0.1011 | 0.1017 |
|  | 0.0000 | 0.0000 | 0.1240 | 0.1220 |
| Size | **0.5753** | **0.5752** | **0.3178** | **0.3178** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Age | **0.5231** | **0.5222** | **0.3506** | **0.3516** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Constant | **-7.6302** | **-7.6185** | **-5.4144** | **-5.4310** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Time | Yes | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes | Yes |
| Log Likelihood | -12713.9 | -12713.8 | -27063.7 | -27062.6 |
| Chi-square | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N | 54256 | 54256 | 54256 | 54256 |

Table-5 presents the Probit and Tobit estimates of equations 5 and 6 respectively. Business group affiliation continues to influence the sample firms' propensity for R&D and its intensity across all the specifications. Capital market access is also found to be positively influencing the sample firms both propensity for R&D and intensity. It is observed to be true across all the specifications. But when we interact the business group affiliation with capital market access, its coefficients are not statistically significant in both the cases of R&D propensity and intensity. Such a finding disproves our hypothesis (H3b) that capital market participation strengthens the relationship between business group affiliation and R&D activities.

Further, we hypothesize that the relationship between business group affiliation and innovation would be stronger in the case of firms operating in the industries with higher dependence on external finance. To empirically investigate the same, we specify following econometric models.

$$Prob(R\&D)_{idt}$$
$$= \emptyset \; (\beta_1 BG \; dummy_{idt} + \beta_2 \; DEF_{it} + \beta_3 BG \; dummy_{idt} * DEF_{it}$$
$$+ \; \gamma' \; Controls_{idt} + \; \delta_t + \alpha_d + \vartheta_{it}) \qquad (7)$$

$$R\&D \; Intsity_{idt}$$
$$= \; \beta_1 BG \; dummy_{idt} + \beta_2 \; DEF_{it} + \beta_3 BG \; dummy_{idt} * DEF_{it}$$
$$+ \; \gamma' \; Controls_{idt} + \; \delta_t + \alpha_d + \vartheta_{it} \qquad (8)$$

where 'DEF' measures the corresponding industry median external financial dependence.

**Table 6. Business Group Affiliation and Innovation in the Light of Firms' External Financial Dependence**

|  | R&D Propensity | | R&D Intensity | |
|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 |
| BG dummy | **0.9729** | **1.0131** | **0.6746** | **0.7107** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| DEF | 0.1668 | 0.4033 | -0.2616 | -0.0250 |
|  | 0.6750 | 0.3630 | 0.2760 | 0.9290 |
| BG * DEF |  | -0.4458 |  | -0.3923 |
|  |  | 0.2320 |  | 0.1000 |
| CF_TA | **1.1716** | **1.1700** | **3.3588** | **3.3578** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Lev | **-0.4202** | **-0.4187** | 0.0943 | 0.0956 |
|  | 0.0000 | 0.0000 | 0.1500 | 0.1450 |
| Size | **0.6053** | **0.6046** | **0.3271** | **0.3265** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Age | **0.5260** | **0.5285** | **0.3504** | **0.3529** |

|  |  |  |  |  |
|---|---|---|---|---|
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Constant | **-7.6529** | **-7.6734** | **-5.3812** | **-5.4048** |
|  | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Time | Yes | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes | Yes |
| Log Likelihood | -12730.53 | -12729.84 | -27066.76 | -27065.41 |
| Chi-square | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N | 54256 | 54256 | 54256 | 54256 |

Table-6 presents the empirical findings of testing our hypothesis – H4. The coefficients of DEF are not statistically significant both with respect to the R&D propensity and intensity. It is evident from the results that sample firm's R&D activities are not influenced by their corresponding industry level external financial dependence. Our empirical evidence does not support the expectation that the relationship between business group affiliation and R&D investments would be stronger in the case of the firms operating in the industries with higher external financial dependence. These findings complement the findings reported by Sasidharan et al, (forthcoming) that Indian firms R&D intensity is not influenced by the external financing even during the periods of active capital markets. Thus, our findings do not support the underlying hypothesis – H4.

### 4.5 Institutional voids argument and R&D investments

Finally, we test whether the strength of the relationship between business group affiliation and innovation declines as the efficiency of institutional mechanisms improves. Business groups in emerging markets substitute underdeveloped institutions (such as weaker investor activism, inefficient intellectual property protection, and underdeveloped capital markets) and foster the innovative efforts through their affiliates (Khanna and Palepu, 2000a). Such a positive association between business groups and innovation is argued to be weakening with the development of the institutional mechanisms. To examine the same empirically, we estimate the following econometric models.

$$Prob(R\&D)_{idt} = \emptyset \ (\beta_1 BG \ dummy_{idt} + \beta_2 BG \ dummy_{idt} * TimeClock_{idt} + \gamma' \ Controls_{idt} + \alpha_d + \vartheta_{it}) \qquad (9)$$

$$R\&D \ Intsity_{idt} = \ \beta_1 BG \ dummy_{idt} + \beta_2 BG \ dummy_{idt} * TimeClock_{idt} + \gamma' \ Controls_{idt} + \alpha_d + \vartheta_{it} \qquad (10)$$

where '*TimeClock*' refers to the variable we constructed to measure the time trend.

**Table 6. Effect of Business Group Affiliation on Innovation in the Light of Emerging Institutions**

|  | R&D Propensity | R&D Intensity |
|---|---|---|
| BG dummy | **1.2778** | **0.9596** |
|  | 0.0000 | 0.0000 |
| BG*TimeClock | **-0.0117** | **-0.0143** |
|  | 0.0000 | 0.0000 |
| CF_TA | **0.9336** | **3.2750** |
|  | 0.0000 | 0.0000 |
| Lev | **-0.4062** | 0.1194 |
|  | 0.0000 | 0.0660 |
| Size | **0.5048** | **0.2670** |
|  | 0.0000 | 0.0000 |
| Age | **0.2258** | **0.2076** |
|  | 0.0000 | 0.0000 |
| Constant | **-5.9872** | **-4.7031** |
|  | 0.0000 | 0.0000 |
| Industry | Yes | Yes |
| Log Likelihood | -12993.39 | -27208.74 |
| Chi-square | 0.0000 | 0.0000 |
| N | 54256 | 54256 |

Table-6 presents the empirical findings of Probit and Tobit models of equation 9 and 10 respectively. The business group affiliation continuous to positively influence the sample firms innovative efforts both in terms of R&D propensity and intensity. It is also evident from the findings that the interaction dummy of time clock with business group dummy takes significant negative sign both in the case of propensity for R&D and R&D intensity. Such evidence suggests that the relationship between business group affiliation and innovation weakens overtime as the efficiency of main stream institutional infrastructure (capital markets and legal enforcement mechanisms) improves. This finding is consistent with the available evidence from the Indian corporate sector (Bhaumik et al., 2012).

## 5. Concluding Remarks:

In the present study, we empirically investigate the relationship between business group affiliation and R&D activities in the case of firms operating in an emerging market, particularly India, where business groups control significant portion of corporate resources. We find that business group affiliation has a significant positive influence on the sample firms R&D activities (both propensity for undertaking R&D activities and R&D intensity). Our results are robust to the alternative definitions of R&D intensity such as R&D to sales ratio. We find that business groups' diversification across the related industries strengthens

the business group – innovation relationship, whereas diversification across unrelated industries weakens the relationship. This supports the argument of spillovers of innovation benefits and knowledge sharing among the group affiliated firms operating in the related industries. The empirical evidence suggests that sample firms' capital market participation and their external financial dependence do not strengthen the business group – innovation relationship. Such a finding complements the earlier evidence that the emerging market firms do not use the external finance to fund their R&D activities.

Further, we find that the influence of business group affiliation on sample firms' R&D activities declines with time. The passage of time during the study period coincides with the improvement in the efficiency of institutional mechanisms in India. Hence, it may be argued that the importance of business group reputation and its internal capital markets in facilitating the funding for R&D activities declines as the efficiency of institutional mechanisms improves. Such an argument complements the '*institutional voids theory*' for the existence of business groups in emerging markets, like India.

### Appendix 1. Variable Description

| Variable | Description |
|---|---|
| LEV | It is the ratio of total borrowing to total assets |
| Size | Natural logarithm of total assets |
| CF | It is the sum of profit after tax, depreciation, amortization, and R&D expenditure |
| ROA | It is the ratio of PBIT_pne to the beginning of the year total assets |
| CAPEX | It is the change in Net fixed assets plus depreciation and amortization |
| Current ratio | It is a ratio of current assets to current liabilities and provisions |
| AGE | It is computed based on the firm's corporation year |
| DEF | Change in total assets minus the change in retained earnings as a percentage of beginning of year assets. |
| Net Equity/TA | It is the change in the equity (net worth and convertible debentures) minus change in the cumulative retained earnings |
| Pro_R&D | Proportion of firm year observations with positive R&D |
| R&D | R&D expenditure including current as well as capital expenses |
| R&D Modified | As defined above, it is R&D expenditure, but considers it as zero if the data is not available. |

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