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Banker on board and innovative activity☆

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ABSTRACT

Employing data on publicly listed manufacturing firms in India during 2001–2012, the paper examines whether banker–director on firm board influences R&D activities. Evidence indicates that firms with commercial banker–director invest significantly less in R&D, although no such evidence is forthcoming for investment banker–directors. A disaggregation of firms based on the extent of equity and board presence suggests that group-affiliated firms with commercial banker nominees are less likely to engage in innovative activity.

1. Introduction

Ever since the time of Schumpeter, the technological capability of an economy has been identified as an important driving force for improving its growth and competitiveness. In this context, the relevance of innovativeness has been an important area of research (Cohen, 1995; Hall & Lerner, 2010). An important aspect of this innovative behaviour is the conduct of research and development (R&D) by firms. Given the growing emphasis on knowledge and skills as a key factor driving economic growth going forward, the relevance of R&D as a key ingredient in this process has assumed relevance. A growing body of literature has focussed on understanding the factors affecting firm R&D activities (Brautzsch, Gunther, Loose, Ludwig, & Nulsch, 2015; Cassiman & Veugelers, 2002; Jaffe, 1986).

Another strand of literature highlights the importance of bankers in enhancing corporate governance in firms. Booth and Deli (1999) find that bankers on boards provide certification and offer expertise for raising debt. Dittmann, Maug, and Schneider (2010) show that bankers on board of non-financial firms promote their banks as lenders and advisers.

The theoretical literature regarding the impact of a banker on a firm board is not unambiguous. Using the *Forbes* 500 database for 1992, Kroszner and Strahan (2001) report that lenders opt out of firm boards when the cost of monitoring outweighs the benefits. As compared to this, Booth and Deli (1999) find limited support for a positive role of commercial bankers on board of their borrowing firms.

In the Asian context, Morck and Nakamura (1999) have found that poorly performing firms are more likely to have a bank representative appointed to the board. Dittmann et al. (2010) find that bankers on the board of German firms further their own interests as lenders. Evidence reported by Nachane, Ghosh, and Ray (2005) for India suggests that bankers primarily serve as expertise providers on boards of manufacturing firms. Whether the presence of banker–director influences firm R&D activity has not been addressed in prior research.

Using an extended sample of Indian firms for the period 2001–2012, the article investigates several issues. First, does a bank nominee in non-financial firms affect their R&D?[1] Since the viewpoints of commercial bankers in terms of their loan or investment exposures are likely to be different from those of investment bankers, we take this aspect on board by segregating bankers into commercial and investment bankers.[2] Additionally, we provide evidence about the effects of an executive from a commercial bank that has an outstanding lending relationship with the company, an 'affiliated' commercial banker–director. Second, what are the possible channels through which a banker–director affects firm R&D? Drawing upon extant evidence, we posit several channels through which bankers can influence firm innovativeness. Third, does non-bank debt influence firm innovative activity? As is well known, banks have additional channels to influence firms over and above their debt financing. One possible way is through shareholdings in a firm and another is through interlocking directorates. We exploit this variation in the data to address as to what extent does non-debt bank influences firms' R&D decisions. And finally, what is

☆ The views expressed and the approach pursued are solely the author's personal opinion.

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[1] We employ the terms banker on board, banker-director and bank nominee interchangeably.

[2] We consider DFI/investment banker nominees as one category and label it as investment bankers.

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the relationship between group-affiliated firms and R&D activity when such firms have banker nominee on their board of directors. Although the role of business groups has been well-explored in the Indian context (Ghosh, 2008; Gopalan, Nanda, & Seru, 2007; Khanna & Palepu, 2000), the interface between group affiliation and R&D behaviour when a firm has a commercial banker-director has not been addressed earlier.

India offers a compelling case among emerging markets to examine this aspect in some detail. First, India is rapidly emerging as a knowledge society. According to Mrinalini, Nath, and Sandhya (2013), during 2003–09, the total number of foreign direct investment (FDI) in India was 964 from over 700 MNCs originating from 23 countries; the total FDI by these companies during the period aggregated USD 30 billion. At the same time, given the importance of bank funding in a corporate capital structure (Allen, Chakrabarti, De, Qian, & Qian, 2012), bankers are increasingly asserting themselves by seeking a position of their boards. Whether such presence of bankers on firm boards influence their R&D remains an empirical issue. Second, while there is an emerging volume of work focused on a high-tech industry, the analysis relating R&D to firm-level governance is less than adequate. This lack of careful empirical analysis on the interlinkage between R&D and banker on firm board points to the need for further research. Finally, India has a rich microeconomic database on firms which contains detailed information on, among others, the number of bankers on firm boards and the ownership of firms. Such a comprehensive and reliable information base over an extended time span makes it an amenable to a rigorous statistical analysis.

The remainder of this paper continues as follows. In Section 2 we provide an overview of the relevant literature. Section 3 discusses the institutional environment, followed by the database (Section 4) and empirical strategy (Section 5), results (Section 6), robustness checks (Sections 7 and 8) and the concluding remarks in the final section.

2. Relevant literature

Conflict of interests between owners and managers is one of the long-standing debates in corporate finance (Berle & Means, 1932; Williamson, 1964). According to this argument, since managers are protected by limited liability, they can deviate from value-maximization objective and enhance private benefits. In order to minimize this conflict, companies resort to a team of monitoring directors. One such director on a firm board which is quite pervasive in bank-based financial systems is the banker.

Banks can influence corporate governance in several ways. Firstly, as shareholders, banks have exclusive information regarding the investment opportunities of the firm and in fact, banks as shareholders improve the selection of profitable investment projects (Kang, Shivdasani, & Yamada, 2000; Morck, Nakamura, & Shivdasani, 2000). In addition, firms with bank-shareholders are likely to have better chances of raising external resources (Hoshi, Kashyap, & Scharfstein, 1990) or even funds at competitive rates (Petersen & Rajan, 1994).[3]

The more pervasive role of banks is in their capacity as nominees on the boards of firms. We postulate several channels that are germane for the role of banker nominee in the R&D activity of non-financial firms.

The *information channel* contends that bank nominees collect information about the firm and transmits it to the lender. A board position provides the bank nominee with proprietary information about the firm. In that case, the bank nominee is likely to dissuade poorly performing firms from undertaking R&D, since it is a risky investment (Hall, 2009) and banker-nominees have greater incentives to protect their debt claims (Ciamarra, 2012). This would explain why such firms invest less in R&D. We employ firm profitability (*RoA*) as a proxy for its performance.

The *debt monitoring channel* that bank nominees seek to safeguard their existing loans by actively monitoring the management on behalf of outside stakeholders. In such a case, bankers would be more likely to be present on the boards of companies that have a higher burden of debt and low solvency (Dittmann et al., 2010; Gilson, 1990). On the other hand, the higher debt burden entails limited incentives for firms to engage in R&D. As a result, R&D would be less likely in firms with a higher burden of bank debt. We proxy debt burden by the ratio of borrowings to total asset (*Leverage*) and consider the interest coverage ratio as a proxy for solvency.

The *equity monitoring channel* observes that banker–directors pursue their interests as shareholders. In that case, banker-directors are more likely to be present in underperforming firms with lower valuation. Kaplan and Minton (1994) show that in Japan, poor stock performance increases the likelihood of bankers being appointed on boards of manufacturing firms. To the extent that these companies would be less inclined to invest in R&D, we would observe a negative association between banker–director and firm value. On the other hand, provided that banks press for higher pay out of free cash flow to shareholders, it is likely that banker representation would manifest in firms with higher valuation. Since higher valuation entails high growth opportunities and possibly higher R&D, we would expect banker–directors to promote R&D in firms with high growth opportunities. In our analysis, growth opportunities are proxied by *Tobin'sQ*.

The *capital market channel* postulates that companies that have higher funding requirements are more likely to have banker–directors. As Dittmann et al. (2010) assert, faster growing companies are those that are likely to have higher funding requirements. To the extent that these companies engage in R&D in order to ensure their growth momentum, we would expect banker–directors to promote R&D in firms with higher growth. We employ *SalesGrowth* as a proxy for the growth of the firm.

The existing literature does not address the issue as to whether banker–director matters for firm innovative activity. In one of the earliest studies, Baysinger, Kosnik, and Turk (1991) examined the role of inside directors for the firm's R&D strategy. Employing a sample of Fortune 500 companies, their analysis finds that higher fraction of inside directors improves R&D spending. Thereafter, using a sample of nearly 4000 observations from the Mannheim Innovation Panel, Czarnitzki and Kraft (2004) show that management control significantly dampens innovative activity. Subsequently, Czarnitzki and Kraft (2009) document that manager-led firms invest more in innovative activities as compared to firms controlled by dominant shareholders.

Two recent papers come close to the spirit of the present analysis. The first by Hoewer, Schmidt, and Softa (2011) employs a detailed database on German firms and provide evidence that the firm's main bank – defined as the bank considered by the firm as the primary source for its banking activities – exerts a significant and non-negligible impact on R&D investment. Thereafter, utilising longitudinal data for 2000–09, Balsmeier, Buchwald, and Stiebale (2014) show that external managers on supervisory boards of German firms improve firm innovativeness.

A significant shortcoming of these studies is their failure to account for specific categories of external directors. More specifically, these studies treat external directors as a catch-all category, with limited cognizance as to which category facilitates or impedes innovation. By focussing squarely on an important category of external director, i.e., banker–director, for a leading emerging economy, the study sheds light on the role that these external monitors play in influencing firm innovative activity.

We make three contributions to the literature. First, this is one of the earliest studies for an emerging economy to examine the interaction between corporate governance, corporate finance and innovative activity,

[3] Under the present dispensation, industrial houses in India are not allowed to float banks. However, banks are permitted to hold shares in any company, whether as pledgee, mortgagee or absolute owner, of an amount exceeding 30% of the paid-up share capital of that company or 30% of its own paid-up share capital and reserves, whichever is less. The aggregate exposure of a bank on a solo or consolidated basis to capital markets (which includes both fund- and non-fund based) should not exceed 40% of its consolidated net worth as on March 31 of the previous year.

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an under-researched area of study, primarily from an emerging economy standpoint (See, for example, Hall & Lerner, 2010). On the one hand, whilst a banker–director could result in negative market reaction (Byrd & Mizruchi, 2005; Kracaw & Zenner, 1998), on the other, it could result in lower cost of private borrowings (Ciamarra, 2012). These studies focussed on advanced economies and none of them explored the interrelationship between banker–director and firm innovation, an aspect which is central to the empirical inquiry of the paper.

Second, it is well-recognised that banks play an important role in enhancing corporate governance in firms. Booth and Deli (1999) find evidence to suggest that commercial bankers on firm boards are associated with higher debt levels. Subsequently, Kroszner and Strahan (2001) reports that lenders opt out of firm boards when the costs of monitoring outweigh the benefits. The present analysis augments these findings by exploring the involvement of commercial bankers on firm boards across different degrees of equity and ownership interlocks.

Relatedly, the paper also adds to the literature that investigates the role of investment bankers in influencing firm behaviour. Several studies have focused on the role and relevance of commercial banker-director (Ciamarra, 2012), lawyer–director (Litov, Sepe, & Whitehead, 2014) or even women directors (Adams & Ferreira, 2009) in non-financial firms. The role of investment banker–director has been studied for the US economy. Guner, Malmendier, and Tate (2008) for instance, show that firms with investment bankers lose 1% more value in the period around takeover bids. Ciamarra (2012) finds that investment bankers exert a negative impact on debt ratios. Huang (2012) find that firms with investment banker directors exhibit a higher probability of acquisition. Our analysis contributes to this stream of work by examining the role of investment banker–director on firm innovative activity.

Third, the paper supplements the literature that explores the interface between firm ownership and R&D activity. In an early study, Francis and Smith (1995) found that firms with concentrated managerial ownership engage more in R&D., Czarnitzki and Kraft (2004) show that there exists an inverse relationship between insider ownership and firm innovation. More recent research has examined the empirical association between innovation and ownership across countries. Lee (2008) show that the positive relationship between ownership concentration and R&D spending in the USA is not found in Japan. Munari, Oriani, and Sobrero (2010) also find a difference in the relation between ownership and R&D between the UK and continental European countries. Employing longitudinal data on over 150 publicly traded European firms during 2003–07, Honore, Munari, and Van Pottelsberghe de la Potterie (2015) provide evidence that certain corporate governance mechanisms such as limitations of anti-takeover devices and financial performance-based remuneration exert a negative effect on R&D intensity. Unlike these studies, our focus is on the intrinsic nature of firm ownership. Based on available data, we explicitly explore the R&D behaviour of group-affiliated firms: to the extent that the learning curve of group-affiliated entities is better than other firm categories (Belenzon & Berkovitz, 2010; Singla & George, 2013), we would expect this coefficient to the positive.

Finally, our paper belongs to a wider literature that explores the relationship between corporate governance arrangements (in particular, for what concerns the composition of the board of directors) and innovation. Drawing on the organizational control theory, Baysinger and Hoskisson (1990) observe that the representation of outside directors would engender lower R&D expenses, because the use of financial control by these directors leads to risk aversion among managers. This is consistent with the research which uncovers a positive relation between insider directors and corporate R&D expenditure (Hill & Snell, 1988; Zahra, 1996).

A description of the institutional environment that follows is crucial towards understanding the rationale for appointment of bankers on firm boards in India. A key take away from the discussion on the institutional environment is that the appointment of bank nominee directors is driven by statutory obligation. As a result, endogeneity concerns are much less compelling as compared to comparable studies in other countries.

3. Institutional environment

Prior to the inception of financial sector reforms in the 1990s, the financial sector in India broadly comprised of banks and government-owned development finance institutions (DFIs). While banks provided short- to medium-term credit to industry and agriculture, long-term finance was provided primarily by DFIs. These institutions received concessional funds from the government which was on-lent to the industrial sector. In addition, both banks and DFIs could also have equity stakes in companies, including their borrowers. In order to protect their investments, the founding Act of Parliament of the DFI entailed two specific clauses: (a) a convertibility clause which ensured that a loan can be converted into equity in case of default and (b) a nominee director clause which imparted flexibility to the DFI to appoint one or more directors on the firm board.

The economic reforms of the 1990s altered the financial landscape for these entities. Competition in the financial marketplace increased manifold with the liberal entry of foreign banks as well as de novo private banks. However, it was the DFIs that experienced the biggest change. With gradual lowering of concessional finance from the government alongside increased competition, particularly for access to low-cost resources, several of these entities metamorphosed into banks. More importantly, they began competing with commercial banks for credit extension, besides making large equity investments in firms.

In March 1984, the Ministry of Finance issued guidelines focussing on the issue of nominee directors. More specifically, it stipulated that term-lending institutions should create a separate Cell, with the avowed objective of representing the DFI on the board of companies. All MRTP companies assisted by the DFI should compulsorily have a DFI representation. Non-MRTP companies with institutional shareholdings in excess of 26% of the firm's equity or where the firm is likely to encounter distress or the DFIs stake through equity/loan exceeds Rs. 50 million should also have a banker nominee director representation.

In terms of their roles and responsibilities, the guidelines highlighted an illustrative list of responsibilities, including a focus towards prompt repayment of DFI loans, monitoring its financial performance as well as related-party transactions. In addition, it was also mentioned that it order to guard against extravagant expenditure, there should be an audit sub-committee of the board of directors and the nominee director would invariably be a member of this sub-committee.

In 2000, a committee appointed by the Securities and Exchange Board of India, the capital market regulator, recommended that institutions should appoint nominee directors on firm boards on a selective basis, where such appointment is pursuant to a right under loan agreements or where such appointments are considered necessary to protect the interest of the institution. In addition, it was recommended that the nominee director should be subject to the same discipline and responsibility and should be equally accountable to the shareholders as the other directors of the company. Similar views were also echoed by the Narayana Murthy Committee in 2003 which noted that all directors, whether nominee or otherwise, should have similar responsibilities and liabilities as other directors.

Taking these considerations on board, the new Companies Act 2013 has excluded nominee directors from the list of independent directors and incorporated it as a separate category. More specifically, the newly inserted Section 161(3) of the Companies Act states that, subject to the articles of the company, the Board may appoint any person as a director nominated by any institution in pursuance of the provisions of any law for the time being in force or of any agreement or by any Central Government or the State Government by virtue of its shareholding in a government company.

For the purposes of our analysis, we segregate nominees of all financial institutions, into commercial bank and investment bank nominees.

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We make this segregation based on the consideration that the viewpoints of commercial banks and investment bankers are likely to be different in terms of their loan or capital investment exposures.

4. Database and variables

4.1. Database

The data employed for the study is extracted from the *Prowess* database. This is a publicly available firm-level database generated and maintained by the Centre for Monitoring the Indian Economy (CMIE), a private think-tank in India. A significant volume of research has, in recent years, employed this database to address issues such as the performance of Indian business groups, the effect of privatization on firm profitability, the impact of trade liberalization on firm productivity and the effect of improvements in creditor rights on firm credit behaviour.

From the present database, we select all publicly listed manufacturing firms during 2001–2012. This provides us with a total of nearly 1650 firms. Subsequently, we delete several firms from the sample. First, we delete firms with extremely misrecorded data on some of the relevant variables. Second, we exclude firms with no reported information on ownership. After these adjustments, the final panel consists of 15,297 firm–years from 1457 companies. On average, these firms account for 80% of total sales and over 85% of the market capitalization of all listed firms. To moderate the influence of outliers, we winsorize all observations at 1% at both ends of the sample.

Table 1 highlights the sample. Taken together, chemicals, textiles, electrical machinery and heavy engineering account for half of the total firms. In terms of ownership, over 50% of the firms belong to business groups, with their percentage representation being the highest in electrical machinery.

4.2. Dependent variable

Consistent with the literature, the dependent variable is R&D-to-Sales (Baysinger et al., 1991; Beyer, Czarnitzki, & Kraft, 2010; Czarnitzki & Kraft, 2004; Hoewer et al., 2011; Honore et al., 2015; Munari et al., 2010). The generally accepted disclosure norms requires Indian firms to report all heads of expenditures which account for more than 1% of their turnover. Because R&D expenditure often account for less than 1% of turnover, its reporting is not mandatory. This could entail an element of bias, because it is not obvious whether the firm does not undertake R&D or alternately, whether it does, but chooses not to report it. In that case, conducting R&D analysis only for firms which report R&D expenses (Ghosh, 2009; Kumar & Aggarwal, 2005) leads to a self-selection bias. Therefore, employing OLS techniques will yield inconsistent estimates. To circumvent this problem, we apply the Heckman two-step procedure.

Table 1
Distribution of sample firms by industry.

Industry	Number of firms	Percent	Of which group affiliated
Food, sugar and beverages	86	5.9	52
Construction	116	8.0	58
Chemicals	118	8.1	54
Textile and textile products	167	11.5	83
Cement	25	1.7	20
Electrical machinery	264	18.1	124
Metal and metal products	135	9.3	70
Rubber and plastic products	61	4.2	34
Heavy engineering	99	6.8	49
Miscellaneous manufacturing	140	9.6	70
Others	246	16.9	115
Total	1457	100	729

Table 2
Variable definitions and summary statistics.

Variable	Empirical definition	Mean (SD)
Dependent		
D_R&D	Dummy = 1 if a firm reports positive R&D in a year, else zero	0.217 (0.412)
R&D/Sales, %	R&D intensity	0.103 (0.315)
Explanatory		
D_CB	Dummy = 1 if a firm has a commercial banker–director on board, else zero	0.076 (0.045)
CB/BoD	Number of commercial banker–director on firm board/ Total board size	0.088 (0.070)
CB_A/BoD	Number of affiliated commercial banker–director on firm board/Total board size	0.012 (0.033)
D_IB	Dummy = 1 if a firm has a DFI/investment banker–director on board, else zero	0.056 (0.049)
Sales	Log Sales	2.268 (0.809)
SalesGrowth	Log difference of real sales between two consecutive years	0.184 (0.681)
RoA	Operating profit/Total asset	0.044 (0.083)
Leverage	Total borrowings/Total asset	0.332 (0.307)
Tobin's Q	(Market value of equity + book value of debt)/Total asset	0.406 (0.246)
Liquidity	Current assets/Total asset	0.404 (0.209)
Solvency	Earnings before interest and taxes/Interest expense	12.89 (5.91)
Capex	Capital expenditures/Total asset	0.021 (0.011)
Promoter	Promoter share in the firm	0.385 (0.273)
Board	Total board size	8.978 (3.253)
Independent	Independent directors/Total board size	0.479 (0.173)
Ownership		
Group	Dummy = 1, if a firm belongs to business group, else zero	0.490 (0.499)

The average R&D in the sample is 0.10% of total sales (Table 2) ranging from around 0.05% during the initial years and finally reaching around 0.17% during the final several years. On average, 20% of the firms report positive R&D over the sample period, ranging from 7% during the initial years of the sample to over 30% during the last couple of years (Fig. 1).

4.3. Explanatory variables

Based on our earlier discussion, we categorize bankers into two categories: commercial bankers and investment bankers.

The major variable of interest is the commercial banker nominee on the firm's board of directors. We employ two variables to signify the presence of a commercial banker–director. The first is a dummy which equals one if a firm has a commercial banker–director. On average, 7.5% of the firms have at least one commercial banker–director on their board. This variable however, does not take into account the size of the board. All other factors remaining constant, a commercial

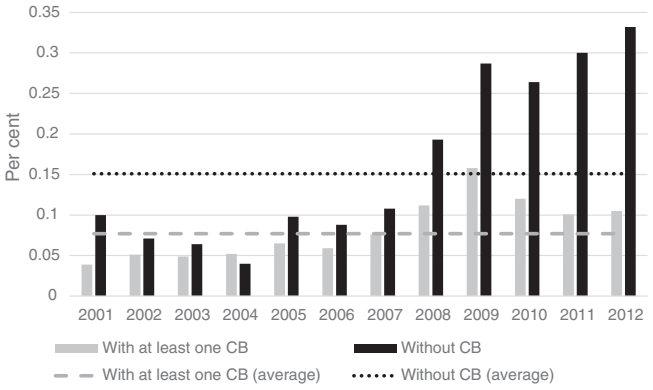

Fig. 1. Comparison of R&D across firms with and without commercial banker.

banker-director is most likely to be present on a larger rather than a smaller board. To take this into account, we consider the ratio of the number of commercial banker-directors on the firm board to the size of the board (Kroszner & Strahan, 2001). The share of commercial banker–directors on the firm board equals roughly to 9%. As mentioned earlier, since the appointment of banker–directors is driven by statutory obligations, it is less likely to be plagued by endogeneity concerns.

Using the database, we are also able to ascertain whether a commercial banker–director has an outstanding lending relationship with the firm — an affiliated banker–director. It appears likely that the affiliated banker–director would have greater incentives to monitor the firm so as to protect the value of their debt claims and consequently, less inclined to promote risky investment such as R&D. In our sample, about 1% of the commercial banker–directors are affiliated.

Similarly, we also consider the role of investment banker–directors on R&D activities. Around 5% of the bank nominees in the sample are investment banker–directors.

The other explanatory variables include size, profitability, leverage, sales growth, current assets to total asset ratio, interest coverage ratio, capital expenditures and Tobin'sQ. Akin to Dittmann et al. (2010), we include both log Sales and SalesGrowth. The Schumpeterian notion suggests that large firms are more owing to scale economies (Cohen & Levin, 1989). We also control for leverage, since prior research indicates that higher debt levels may impede R&D investments (Hall, 1990, 2009). Higher profit margins are more likely to increase the firm's resources and consequently, increase R&D expenses. Besides, we control for other variables that could relate to R&D intentions such as solvency (proxied by interest coverage ratio), liquidity (proxied by current assets to total asset) and capital expenditures (proxied by capital expenditures to total asset). Finally, Tobin'sQ proxies for the firm's growth opportunities.[4]

In the Indian context, Bertrand, Mehta, and Mullainathan (2002) provide evidence of tunnelling by business groups. Taking this consideration on board, we include the proportion of insider ownership as a control variable. The average insider ownership for the sample firms equals 39%, lower than those reported by Chakrabarti, Megginson, and Yadav (2008). This reduction in stake of domestic promoters could be due to the capital constraints faced by companies in funding their growth projects.

At the board level, we include board size and the proportion of independent directors. In order implement R&D activities more effectively, firms demand knowledge, skills and resources across diverse functions. In this context, larger boards which bring diverse skills and greater domain knowledge across multiple fields (Goodstein, Gautam, & Boeker, 1994; Jackling & Johl, 2009) might be better equipped to enable firms to better understand complex environments and develop more holistic alternative solutions (Ruigrok, Peck, & Keller, 2006), consequently improving the quality of strategic investment decision in R&D. On the flip side, it is possible that larger boards might entail conflicts and coordination problems (Yermack, 1996), increasing the difficulty of arriving at a consensus on critical decisions and consequently, limiting a board's ability to direct R&D decisions. The net effect could therefore, be either positive or negative. The average board in the sample comprises of 8.9 members.

Finally, we include the proportion of independent directors on firm board. On the one hand, greater independence provides boards with the flexibility to terminate the manager in case of poor performance (Weisbach, 1988). Increased scrutiny and demands for results would impel managers to focus on quantifiable results, driving the need for innovation. On the other, it is possible to envisage that by limiting managerial discretion, board independence may also stifle innovation. The overall effect therefore, remains to be empirically determined. The share of independent directors in the sample is 48%, on average.

Fig. 2 illustrates the year-wise R&D-to-sales ratio for firms with at least one commercial banker–director and those without it. Without loss of generality, innovative activity appears to be higher for firms without commercial banker–directors. Illustratively, the average R&D for firms without commercial banker–directors equals to 0.15%, roughly double the number obtaining for firms with at least one commercial banker–director. The difference is statistically significant at the 0.01 level.

5. Empirical strategy

We build on the univariate framework by undertaking a multivariate regression to examine the impact of a commercial banker–director on firm innovative activity. As discussed earlier, not all the firms in an industry undertakes R&D in any year. The firms can self-select into R&D driven by considerations of expected net gains from R&D or even the prevailing market structure. The progress of R&D can therefore be modelled as a two-stage process (See, for example, Honore et al., 2015; Munari et al., 2010). In stage 1 (selection stage), the firm decides whether to undertake R&D. In stage 2 (outcome stage), it decides how much resources to spend towards undertaking R&D.

Empirically, this involves estimating the following two-equation model for firm i in industry j at time t:

$$\begin{aligned}&\text{Selection: } \text{Prob}(\text{R\&D})_{ij,t} = \alpha_i + \alpha_1[\text{R\&D intensity sector}]_{j,t-1} \\ &\quad + \alpha_2[\text{Banker}]_{ij,t-1} + \alpha_3[\text{Controls}]_{ij,t-1} + \alpha_4\,\text{Group}_{ij,t} + \gamma_j + \xi_{ij,t} \\ &\text{Outcome: } (\text{R\&D/Sales})_{ij,t} = \alpha_i + \alpha_1[\text{Banker}]_{ij,t-1} + \alpha_2[\text{Controls}]_{ij,t-1} \\ &\quad + \alpha_3\,\text{Group}_{ij,t} + \gamma_j + \eta_t + \xi_{ij,t}\end{aligned} \quad (1)$$

It can be observed from the selection and outcome equations that the former has one variable different than the latter equation. Following Honore et al. (2015), we rely on the average R&D intensity level in the year before the relationship is estimated as the selection variable. The maximum likelihood estimation leads to robust identification (Cameron & Trivedi, 2009).

In (1), Controls includes the set of explanatory variables discussed earlier; Group is a dummy variable for group-affiliated firms. Industry dummies (γ_j, not reported) are included to control for industry-specific features (e.g., differences in technological opportunities), whilst year dummies (η_t, not reported) are included in all models to control for common trends or business cycle effects. $\xi_{ij,t}$ denotes the random error.

Table 3 reports the correlation matrix for the variables. A higher share of commercial banker–directors appears to be correlated

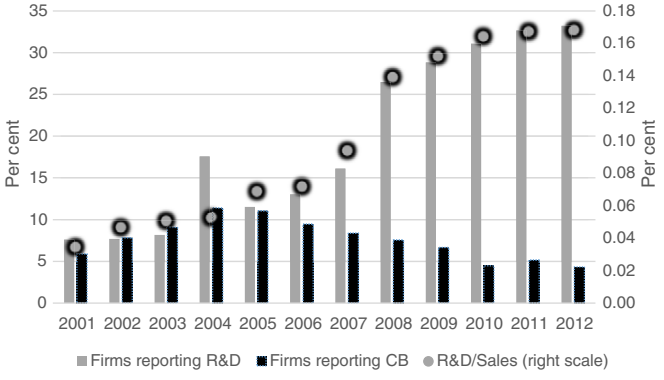

Fig. 2. Status of firms by R&D and commercial banker–director.

[4] In several emerging economies including India, a significant proportion of the corporate debt is institutional and not actively traded. Additionally, firms typically report asset values at historical rather than at replacement costs. Reflecting these specificities, we compute the proxy for Tobin's Q, employed in similar studies on India (see for example, Ghosh, 2008; Khanna and Palepu, 2000).

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Table 3
Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) D_R&D											
(2) R&D/Sales	0.625***										
(3) CB/BoD	−0.095***	−0.123***									
(4) IB/BoD	−0.036	0.021	−0.416***								
(5) Sales	0.296***	0.130***	−0.104***	−0.007							
(6) SalesGrowth	−0.042***	−0.032***	0.018	−0.069***	0.035***						
(7) RoA	0.121***	0.097***	−0.081***	0.142***	0.243***	0.172***					
(8) Leverage	−0.098***	−0.089***	0.002	−0.171***	−0.105***	−0.049***	−0.452***				
(9) Liquidity	−0.079***	−0.023***	−0.019	−0.004	−0.200***	−0.009	0.107***	−0.057***			
(10) Solvency	−0.006	0.009	−0.002	−0.005	−0.004	−0.005	0.010***	−0.003	0.005		
(11) Capex	0.088***	0.058***	−0.104***	0.030	−0.084***	0.009	0.123***	−0.052***	−0.129***	−0.008	
(12) Promoter	0.125***	0.069***	−0.017	−0.135***	0.255***	−0.080***	0.092***	−0.098***	−0.038***	−0.009	0.054***

*** $p < 0.01$.

negatively with the R&D measures. To illustrate, the correlation of R&D with measures of commercial banker-directors ranges from 9 to 12%; it is however uncorrelated with the share of investment banker–directors. The computed variance inflation factors of the banker variables are quite low. As a result, there is unlikely to be any multi-collinearity concerns.

Table 4
Regression results of impact of commercial banker-director on R&D.

	D_R&D	R&D/Sales, %	D_R&D	R&D/Sales, %	D_R&D	R&D/Sales, %	D_R&D	R&D/Sales, %
	Model 1		Model 2		Model 3		Model 4	
	Selection	Outcome	Selection	Outcome	Selection	Outcome	Selection	Outcome
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D_CB	−0.014***	0.185						
	(0.003)	(0.109)						
CB/BoD			−0.089***	0.259				
			(0.026)	(0.671)				
CB_A/BoD					−0.219	0.392		
					(0.263)	(0.365)		
D_IB							−0.006	−0.115
							(0.036)	(0.940)
Selection variable								
Log[Average Industry R&D intensity (t-1)]	0.023**		0.042**		0.023*		0.021*	
	(0.012)		(0.019)		(0.014)		(0.012)	
Sales	0.022***	0.126	0.024***	0.131	0.131***	0.331***	0.018***	0.122
	(0.004)	(0.219)	(0.004)	(0.103)	(0.012)	(0.076)	(0.004)	(0.103)
SalesGrowth	−0.014***	−0.285**	−0.014***	−0.279*	−0.077**	−0.193	−0.009*	−0.248*
	(0.005)	(0.149)	(0.006)	(0.149)	(0.040)	(0.157)	(0.005)	(0.151)
Leverage	−0.509***	−0.389***	−0.508***	−0.380***	−0.063	−0.616***	−0.477***	0.373***
	(0.028)	(0.091)	(0.028)	(0.089)	(0.095)	(0.236)	(0.029)	(0.092)
RoA	0.191***	0.688***	0.203***	0.674	0.019	1.562***	0.171***	−0.611
	(0.033)	(0.229)	(0.033)	(0.837)	(0.171)	(0.366)	(0.033)	(0.845)
Tobin'sQ	0.529***	0.282***	0.528***	0.274**	0.003	0.564***	0.499***	0.274***
	(0.025)	(0.091)	(0.025)	(0.091)	(0.083)	(0.191)	(0.026)	(0.097)
Liquidity	0.003***	0.008	0.003***	0.002	0.0009	0.042***	0.003***	0.002
	(0.0009)	(0.024)	(0.001)	(0.024)	(0.004)	(0.019)	(0.001)	(0.024)
Solvency	0.008	0.017	0.009	0.014	0.002	0.292	0.006	0.012
	(0.008)	(0.027)	(0.008)	(0.027)	(0.084)	(0.403)	(0.009)	(0.027)
Capex	0.687***	0.122***	0.680***	0.110**	0.331***	0.179***	0.352*	0.809*
	(0.207)	(0.047)	(0.207)	(0.047)	(0.089)	(0.049)	(0.209)	(0.490)
Promoter	0.082***	−0.001	0.087***	0.024	0.217	−0.095	0.074***	0.074
	(0.012)	(0.299)	(0.012)	(0.298)	(0.053)	(0.279)	(0.012)	(0.303)
Board size, log	−0.021**	−0.017	−0.019*	−0.018	−0.020	−0.022	−0.016	−0.017
	(0.009)	(0.012)	(0.010)	(0.014)	(0.013)	(0.015)	(0.011)	(0.013)
Independent	0.023**	0.018*	0.022*	0.018	0.023	0.019	0.021	0.017
	(0.011)	(0.011)	(0.013)	(0.012)	(0.016)	(0.013)	(0.019)	(0.012)
Group	0.823***	2.077***	0.819***	2.016***	0.186***	0.164*	0.763***	0.201**
	(0.015)	(0.862)	(0.015)	(0.830)	(0.034)	(0.097)	(0.019)	(0.087)
d_Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d_Year	No	Yes	No	Yes	No	Yes	No	Yes
Lambda	−0.014***		−0.022***		−0.187***		−0.023***	
Rho		−0.539**		−0.533**		−0.497***		−0.781***
Wald χ^2 (p-Value)	0.00		0.00		0.00		0.00	
Observations	5324	1195	5298	1097	4976	985	3803	854

Standard errors are in brackets.
*** $p < 0.01$.
** $p < 0.05$.
* $<p < 0.10$.

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6. Results and discussion

The result of the empirical estimation is presented in Table 4. The Wald chi-square statistics is significant across all specifications: the independent variables account for variation in R&D intensity. The significance on the inverse Mills' ratio (λ) supports the existence of a sample selection bias. In this respect, the use of the Heckman model seems appropriate.

We first discuss the explanatory variables. As expected, the selection variable is positive and significant across all specifications.

The coefficient on Sales is positive and significant in column (1). In other words, the likelihood of pursuing R&D is higher for large firms. Several studies find a positive association between firm size and R&D intensity (Aghion, Bond, Klemm, & Marinescu, 2004; Bah & Dumontier, 2001), which suggests that large firms are better able to appropriate returns from their R&D activity. The effect is small: in column (1), a 10% increase in size improves the likelihood of R&D activity by 0.2% points.

SalesGrowth enters a negative sign, suggesting that high growth firms are more likely to lower R&D and even lower the intensity of such activities. This runs contrary to Coad and Rao (2010) who find that growth in R&D expenses strongly correlates with sales growth for US firms.

The sign on the profit (RoA) variable is positive and it is statistically significant, conforming a priori expectations that higher margins increase the availability of funds and improves the chances of undertaking R&D. One possible explanation could be that R&D investment is a long-term and capital intensive process and therefore, the 'deep pockets' of the firm strongly influence R&D intensity: a 1% improvement in profitability improves R&D intensity by nearly 0.7% points.

Higher leverage dampens both the likelihood as well as the intensity of innovation: a 1% increase in leverage lowers the likelihood of innovation by 0.5% points and its intensity by nearly 0.4% points. This is consistent with the research by Atanassov (2013) and Graham and Harvey (2001) and supports the fact that creditors are less likely to finance innovative-intensive projects.

Provided that there are imperfections in the capital market, higher liquidity levels could make it easier for the firm to make new investments. As a result, a firm with higher liquidity is likely to undertake R&D. This is borne out by our result, which shows that an improvement in liquidity raises the likelihood of R&D activity. These results are consistent with Bougheas, Gorg, and Strobl (2001) who show that liquidity constrained firms are less likely to undertake R&D activities.

Capital expenditures are significant in both columns (1) and (2). In effect, firms with higher capital expenditures are more likely to undertake R&D activity and with higher intensity. The effect is quite sizeable: a 10% rise in capital expenses raises the likelihood of R&D by nearly 7% points and its intensity by 1.2% points. As observed by Alderson and Betkar (1996), liquidation costs and R&D activity are positively correlated across firms. An implication of this finding is that sunk costs associated with R&D investment are higher than for ordinary investment. Our findings appear consistent with this conjecture and show that firms that undertake capital expenditures devote a significant proportion to R&D activity.

The coefficient on a promoter's share is positive in column (1), but insignificant in column (2), so that although higher promoter share improves the likelihood of R&D, the actual R&D intensity is unaffected. As Rajan (2014) observes, promoters of businesses in India actually enjoy significant managerial control with very little equity investment of their own. As a result, they recoup their investments in a short period with little incentive to ensure the long-term viability of the business based on knowledge capital.

Akin to Balsmeier, Fleming, and Manso (2015), we insulate the effect of board independence from changes in the number of directors by including board size. We find that bigger boards lower the likelihood of undertaking R&D. These results are consistent with Lipton and Lorsch (1992) who find that smaller boards tend to be more effective in monitoring and more cohesive in decision making, with the optimal size being no more than eight members (Jensen, 1993).

Board independence exerts a perceptible impact on the likelihood of R&D, although its impact on R&D intensity is much less compelling. These findings refute the agency theory which predicts that an independent board deters innovation as a result of excessive monitoring (Baysinger et al., 1991; Zahra, 1996). In contrary, our findings support empirical studies that report that independent boards encourage long-term investment as a means of maximizing firm value (Dong & Gou, 2010).

When significant, the coefficient on Group enters with a positive sign. Blanchard, Huiban, and Sevestre (2005) note that business groups are able to actively engage in R&D activity because of two intrinsic features. The first is the greater possibility to internalize the knowledge spillovers (Cefis, Rosenkranz, & Weitzel, 2009). The second is the existence of an internal capital market that facilitates the financing of R&D projects, thereby mitigating informational asymmetries among the different constituents (i.e., demanders versus suppliers of funds) of the business group. Research supports the existence of such an internal capital markets for Indian business groups (Gopalan et al., 2007).

Our coefficient of interest is the proxy for commercial banker–director (columns 1 to 6). In column (2), the coefficient is statistically significant at the 1% level with a point estimate equal to −0.014. In other words, firms with commercial banker–directors are less likely to invest in R&D. The magnitudes are economically meaningful, as well. A one standard deviation increase in the likelihood of banker is associated with a 0.06% point reduction in R&D. As compared to this, the estimates in column (2) indicate that the presence of banker–director exerts no perceptible impact on R&D intensity.

As discussed earlier, the banker–director dummy does not consider the size of the board, although it has indirectly taken on a board by including firm size. To adjust for board size and the incidence of multiple bankers, we re-define the major independent variable as the share of commercial banker–directors on a firm board scaled by the number of board members.

The estimates in column (3) suggest that commercial banker–directors are likely to reduce the likelihood of R&D: a one standard deviation increase in the number of banker directors lowers the likelihood of R&D by 0.6% point. As opposed to this, there is no influence of the proportion of commercial banker–directors on the intensity of undertaking R&D.

In columns (5) and (6), we check whether affiliated commercial bankers affect firm R&D. Although the magnitude of the coefficient is much larger, it is not significant.

Finally, in columns (7) and (8), we examine whether investment bankers influence the R&D behaviour of firms. As observed, neither of the relevant coefficients is statistically significant.

Summing up, our results suggest that, after controlling for firm-specific and industry-wide factors including the economic environment, the presence of a commercial banker–director significantly lowers the probability of undertaking R&D activity, although there is no discernible impact on R&D intensity.

7. Channels

In this section, we examine the channels through which a commercial banker-director influences firm R&D activity (Table 5). According to the information channel, profitable firms are more likely to engage in R&D. In columns (1), the coefficient on the interaction term is positive, suggesting that banker-directors are more likely to promote R&D in high-profit firms. In addition, the intensity of R&D is higher for these firms. Therefore, for a firm with profitability equal to 0.04, the average for the sample, the intensity of R&D is higher by 0.1% (= 0.04 * 2.38) point. This corroborates the information channel postulated earlier.

The debt monitoring channel finds partial support in the data. According to this channel, bankers will dissuade firms with high debt burden to engage in risky ventures. R&D being a risky activity, the

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Table 5
Channels of influence of banker-director on R&D.

	(1)	(2)	(3)	(4)
Selection equation				
D_CB	−0.007**	−0.049***	−0.013***	−0.042***
	(0.003)	(0.008)	(0.004)	(0.009)
RoA * D_CB	0.223***			
	(0.049)			
Leverage *D_CB		−0.091***		
		(0.018)		
SalesGrowth * D_CB			0.007	
			(0.012)	
Tobin'sQ * D_CB				0.064***
				(0.021)
Selection variable	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Ownership	Yes	Yes	Yes	Yes
d_Industry	Yes	Yes	Yes	Yes
d_Year	No	No	No	No
Observations	5324	5324	5324	5324
Outcome equation				
D_CB	0.121	0.464**	0.193*	0.570**
	(0.108)	(0.223)	(0.106)	(0.262)
RoA * D_CB	2.384*			
	(1.365)			
Leverage * D_CB		−0.692		
		(0.486)		
SalesGrowth * D_CB			−0.086*	
			(0.047)	
Tobin'sQ * D_CB				0.863*
				(0.519)
Controls	Yes	Yes	Yes	Yes
Ownership	Yes	Yes	Yes	Yes
d_Industry	Yes	Yes	Yes	Yes
d_Year	Yes	Yes	Yes	Yes
Lambda	−0.019***	−0.016***	−0.014***	−0.016***
Rho	−0.541**	−0.599**	−0.539**	−0.601**
Wald χ^2 (p-value)	0.00	0.00	0.00	0.00
Observations	1195	1195	1195	1195

Standard errors are in brackets.
*** $p < 0.01$.
** $p < 0.05$.
* $< p < 0.10$.

likelihood and intensity of R&D should be lower for high debt firms. In column (2), the coefficient on Leverage*d_CB is statistically significant only in the likelihood equation, so that the likelihood of undertaking R&D is 0.03% points lower for a firm with mean leverage in the sample.

The capital market channel does not find favour with the data. If it were the case, banker–directors will promote R&D in firms with higher sales growth. In column (3), the interaction terms SalesGrowth*d_CB is negative and statistically significant in the outcome equation, implying that the intensity of R&D is actually lower for firms with high sales growth. In other words, firms experiencing high sales growth have limited incentives to undertake R&D since their market is still expanding.[5]

Our analysis supports the equity monitoring channel. According to this channel, banker–directors are more likely to promote R&D when the firm exhibits high growth opportunities. Higher expected growth should also be reflected in higher Tobin'sQ. In column (4), both the likelihood as well as the intensity of R&D is higher for firms exhibiting higher growth prospects. For a firm with Tobin'sQ equal to the sample average, the increase in the likelihood and the intensity of R&D are respectively, 0.26% points and 0.34% points.

Summing up, the overall verdict appears to be that commercial bankers tend to dissuade firms from engaging in R&D activity when their debt levels are high although they are much more inclined to increase R&D in profitable firms with high growth opportunities.

[5] The net effect of the presence of commercial bankers on R&D intensity is however positive, equal to 0.11% points. Commercial banks favour innovation, but might be less inclined to promote such investment if the firm is already doing well.

8. Different degrees of equity and ownership interlocks

As argued earlier, bank involvement in firms might go well beyond their presence on the board of directors. To investigate this further, we analyse the role of a commercial banker–director by splitting the sample into four sub-samples. These sub-samples differ in terms of the potential influence that banks' exert over the firm's decision-making. Depending on the nature of involvement, we classify firms into four categories based on the nature of their non-promoter (bank) shareholding and commercial banker–director representation on the board.

The first group consists of firms with no commercial banker on their board and no banks amongst its shareholders. We refer to this group as nCB_nEQ (group 1). In the second group (group 2), we include with no commercial bankers on the board, but banks' shareholding is non-zero (nCB_EQ). In the third group (group 3) are firms with at least one commercial bank representative on the board, but with no bank shareholdering (CB_nEQ). The final group (group 4) consists of firms with both bank shareholding and at least one commercial banker–director on its board (CB_EQ).

The results of the equality of mean tests among these groups are set out in Table 6. Without loss of generality, firms with no banker representation appear to be more innovative as compared to those with banker–director. To exemplify, for firms in group 2, R&D-to-sales equals to 0.16 as compared to 0.08 for firms in group 4. The difference is statistically significant at conventional levels. In most of the other instances, the differences across groups are statistically significant, as well.

In the remainder of this section, we explore to what extent the R&D activity of firms is influenced by the strength of ties with commercial banks. To do this, we re-estimate the earlier equation, but allow the coefficients on commercial banker-director to vary, depending on non-promoter banks shareholding and the presence of a commercial banker–director. All results contain the full set of control variables, although they are not reported to conserve space.

Table 7 presents the estimation results. Controlling for the different types of bank involvement provides additional insights. First, the likelihood of R&D activity is significantly higher for firms with no commercial banker–director, where non-promoter banks have an equity stake. Economically, as minority shareholders, commercial banks are generally less inclined to support risky ventures, presumably to prevent erosion in market value, in the event such ventures do not fructify. In addition, firms with commercial banker–director with no equity stake, are invariably inclined to undertake R&D. In other words, the flexibility to commercial banks to exercise control in the form of a board seat might be useful to ensure that banks induce firms to engage in innovation.

To understand whether this behaviour differs across ownership, we interact each of these bank involvement variables with the dummy for group-affiliated firms. The coefficient on these interaction terms enables us to infer the behaviour of group-affiliated firms with varying combination of bank presence. What the table suggests is that group-affiliated firms with commercial banker–directors are not only less likely to invest in R&D, but the intensity of R&D is low as well. In terms of magnitudes, this translates into a decrease in R&D likelihood by 0.006% points and a fall in R&D intensity by 0.03% points for a firm with R&D intensity equal to 0.08%.[6] This finding is in consonance with Bhattacharya and Chiesa (1995) and suggests that group-affiliated firms with banker–directors might be less inclined to undertake R&D in order to minimize the spillovers resulting from leakage of confidential information. Our paper therefore, contributes to the literature on the interlinkage between group-affiliation and firm innovation (Belenzon & Berkovitz, 2010; Guzzini & Iacobucci, 2014) by suggesting

[6] From Table 6, the average R&D intensity of firms with at least one commercial banker-director and non-promoter (bank) equity stake (i.e., CB_EQ firm) equals 0.08. Therefore from Table 7, the decline in likelihood of R&D for group firms equals 0.006% (=0.08*-0.07) points. Likewise, the fall in R&D intensity equals 0.03% (=0.08*-0.34) points.

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Table 6
Comparison of means based on degrees of commercial bank involvement.

Variable	Mean				Significance of equality of means test across groups					
	Group 1	Group 2	Group 3	Group 4	1 vs. 2	1 vs. 3	1 vs. 4	2 vs. 3	2 vs. 4	3 vs. 4
	nCB_nEQ	nCB_EQ	CB_nEQ	CB_EQ						
Non prom banks equity	0.000	0.095	0.000	0.068	−20.21***	N.A.	−29.72***	20.22***	5.20***	−29.71***
CB/BoD	0.000	0.000	0.126	0.122	.	−44.79***	−78.20***	−44.79***	−78.20***	−0.93
R&D/Sales (%)	0.100	0.157	0.049	0.083	−1.12	2.05**	2.16**	5.17***	3.82***	−2.48***

*** $p < 0.01$.
** $p < 0.05$.

that the association between R&D and business groups needs to be investigated more thoroughly, especially when the group-affiliated firm has a banker nominee on its board of directors.

9. Concluding remarks

Employing data on an extensive sample of Indian publicly listed firms during 2001–2012, we model the impact of a commercial banker–director on firm innovative activity. Our results appear to suggest that commercial banker nominees are associated with lower innovative activity. Intuitively, in emerging economies, a position on firm board provides bankers with significant prestige and ability to forge network connections, making them oblivious to the management decision regarding innovative activity. Our results therefore, run contrary to those reported by Balsmeier et al. (2014) who find evidence that external directors on German firms enhance innovation.

Further disaggregation based on the presence of commercial banker–director suggest that the negative impact on R&D is manifest for low-growth and low-profitable firms. Our findings are therefore consistent with the information and equity monitoring channel, which predict that banker nominee on firms with low profitability and growth prospects are typically less inclined to engage in R&D activity.

These issues hold significant policy relevance in emerging economies. More often than not, these countries confront problems of asymmetric information between the lender and the borrower. To address this aspect and ensure better monitoring of loans, bankers are represented in the form of a board seat. The evidence presented in the paper suggests that such presence of banker-director might not necessarily foster innovation by firms, since the power and networking that comes with these positions might tempt them to overlook societal interests in favour of private interests. What policies can be devised to address such divergences constitutes elements for future research.

Table 7
The effects of different levels of bank involvement on firm R&D.

	D_ R&D Selection	R&D/ Sales, % Outcome	D_ R&D Selection	R&D/ Sales, % Outcome
	(1)	(2)	(3)	(4)
CB_nEQ	0.034***	0.145	0.245***	−0.083
	(0.014)	(0.381)	(0.041)	(0.423)
CB_EQ	0.019	−0.141	0.323***	−0.083
	(0.008)	(0.413)	(0.034)	(0.423)
nCB_EQ	0.041***	0.267***	0.277***	0.556
	(0.013)	(0.378)	(0.039)	(0.389)
Log[Average Industry R&D intensity $(t-1)$]	0.009* (0.005)		0.068*** (0.014)	
CB_nEQ * Group			0.013	0.213
			(0.040)	(0.342)
CB_EQ * Group			−0.074***	−0.340***
			(0.015)	(0.139)
nCB_EQ * Group			−0.021	0.263
			(0.025)	(0.218)
Controls	Yes	Yes	Yes	Yes
d_Industry	Yes	Yes	YesS	Yes
d_Year	No	Yes	No	Yes
Lambda	−0.024***		−0.097***	
Rho		−0.802**		−0.871**
Wald χ^2 (p-Value)	0.00		0.00	
Observations	5324	1195	5324	1195

Standard errors are in brackets.
*** $p < 0.01$.
** $p < 0.05$.
* $< p < 0.10$.

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