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The Influence of Blockholders on R&D Investments Intensity: Evidence From Spain *

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Abstract

Using data from 3,638 Spanish firms between 1996 and 2000, this article studies the relationship between the presence of large shareholders in the ownership structure of firms and R&D investment. Consistent with our theoretical contention, our results indicate that the impact of large shareholders on the R&D investment is (1) negative when blockholders are banks, (2) positive when blockholders are non-financial corporations, and (3) null when blockholders are individuals. In addition, we find a systematic negative relationship between the number of blockholders and R&D investment. Finally, we extend our study by analyzing the influence that the combined effect between blockholder type and R&D investment has on the firm's economic performance. Results of this work provide relevant implications for policy makers and academic research.

Keywords: Ownership structure, banks, institutional blockholders, non-financial blockholders, individual blockholders, R&D investment.

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INTRODUCTION

The ownership structure of firms is recognized as an important determinant of its general investment policy and, in particular, of its research and development (R&D) spending (Lee and O'Neil, 2003, Porter, 1990). However, there is no consensus regarding the effect of ownership concentration on a firm's R&D investment. To date, literature surrounding this relationship has only provided mixed results. While some studies showed a positive relationship between large shareholders and R&D investment (Hosono et al., 2004, Wahal and McConnell, 2000), others found negative (Yafeh and Yosha, 2003) or neutral (Francis and Smith, 1995, Holderness and Sheehan, 1988) association between these two variables.

The aim of this paper is to reconcile these conflicting results by enriching the analysis of the firm's ownership structure. We move a step further from the simple characterization of the stake of the main blockholders as the main determinant of a firm's investment policy to incorporate two features: (1) the *type* of blockholders and (2) the *number* of blockholders necessary to control a firm. Previous research rested on the assumption that shareholders have homogenous preferences for R&D strategies. Only recently, the type of blockholder has received initial attention (e.g., Kochhar and David, 1996, Lee, 2005, Hoskisson et al., 2002). Extending this line of research, we explore three different types of blockholders, namely: banks, non-financial corporations, and individuals. By introducing the type of blockholder as explicative element of a firm's R&D investment, we can evaluate how differences in preferences of blockholders may influence this type of investment. Moreover, we consider the number of blockholders, a variable that has been largely neglected in previous studies, as an additional determinant that is relevant for understanding corporate innovation strategies.

Using a comprehensive database from Spanish firms, we collected data of 3,638 companies during the period 1996-2000 to test our contention. We found that banks, which are more conservative investors and characterized by debt holdings in firms, influence negatively on R&D expenses, while non-financial blockholders, are more willing to promote innovative endeavors as there might be beneficial synergies for them. Concerning individual blockholders, we observed a neutral impact on R&D investments, since two countervailing effects are at work. On the one hand, individual blockholders are likely to exhibit stringent monitoring since their stake represents a significant part of their wealth. Given that their vigilant capabilities can prevent opportunistic actions, individual blockholders are more likely to engage in complex R&D activities. On the other hand, there is an effect that hinders the agreement on the decisions to be taken when there is a wide heterogeneity among blockholders, affecting R&D initiatives. Furthermore, and based on the notion of this bargaining effect, we found differential consequences on R&D investments once we compare a small number of blockholders with a large number of them. As the number of blockholder increases, the aforementioned disagreement effect that hinders concurrence among them becomes larger. This, in turn, negatively affects R&D initiatives. Finally, we suggest that combinations between blockholder types and R&D intensity influence the economic performance of firms in a way that is consistent with the foregoing determinants of R&D. That is, R&D investment in the presence of corporate ownership has a larger effect on performance than when banks or individuals are the blockholders.

Our analysis offers remarkable implications for policy makers. In particular, this article sheds light on the characteristics of the ownership structure that governmental agencies should look at in order to allocate funds efficiently for stimulating firms' R&D investments and their

performance. Also, the contrast of our contentions using a Spanish dataset is interesting in itself because it offers a European perspective and widens the traditional focus of this type of research mostly centered on U.S. companies.

THEORETICAL FRAMEWORK AND HYPOTHESES

The separation of ownership and control in modern corporations jointly with the existence of information asymmetries within the firm, spawn the possibility of opportunistic actions by the risk averse agent – the manager – who may have different objectives from a risk neutral principal – the owner– and thus pursue self-serving priorities, giving birth to the so-called agency problems (Jensen and Meckling, 1976). These problems are severe in R&D investment decisions and, consequently, the impact of ownership structure on R&D intensity is often studied in the context of agency theory (Baysinger et al., 1991, Lee, 2005, Tihanyi et al., 2003). Agency theory predicts that proper corporate governance mechanisms, like ownership concentration, can reduce agency problems and may help to ensure appropriate level of R&D investment since they curtail managers' propensity to pursue inefficient strategies (Jensen and Meckling, 1976).

The study of governance mechanisms to stimulate R&D investments is particularly relevant given that these investments improve the firm's capability to innovate, which is expected to generate greater profits (Hirschey, 1985, Jose et al., 1986). However, R&D activities are characterized by three main traits that make agency costs particularly severe. First, they are inherently risky as they provide greater variability of outcomes and greater probability of failure despite the best effort of managers (Baysinger et al., 1991). Second, R&D activities require long-term investments in projects that may have a negative impact on more immediate performance (Hoskisson et al., 1993). Consequently, risk-averse managers may be reluctant to invest in risky

long-term R&D projects (Mansfield, 1968). Third, R&D activities generally require high managerial autonomy (Hambrick and Finkelstein, 1987) to be effective since managers face a wide range of complex strategic choices. But, at the same time, risk-averse managers with great level of discretion may use their power to pursue low-risk strategies, avoiding R&D initiatives. Together, these characteristics can stimulate managerial opportunistic behaviors and increase agency costs. As a consequence, the ownership structure of the firm, which is a relevant mechanism of controlling agents' actions and preventing their opportunistic behavior, is likely to influence strategic decisions like R&D effort (Kochhar and David, 1996, Tihanyi et al., 2003, Hoskisson et al., 2002). However, previous empirical studies offer contradictory results, preventing from definitive conclusions. Our position, as argued next, is that these equivocal results can be explained by incorporating two features of blockholders: the type and number of blockholders.

The type of blockholder

Previous literature portrays different results regarding the link between large shareholders and innovation expenditures. Some studies found that a relationship (whether positive or negative) between the type of blockholder and R&D investment policy exists, whereas others postulate the non-existence of such a linkage. Concerning the first strand, several scholars (e.g., Wahal and McConnell, 2000, Hill and Snell, 1988, Baysinger et al., 1991) found the existence of a positive relationship between the presence of institutional shareholders and R&D investment. Conversely, Graves (1988) found in a sample of computer firms that the presence of institutional blockholders damaged R&D investment. On the neutral strand of the literature, Chung et al. (2003) deduced that there is no effect on R&D investment due to the existence of institutional

holdings. Also, Francis and Smith (1995) did not find significant differences in R&D-to-sales ratio when compared management-controlled firms with externally-controlled ones (with large and external blockholders).

A common characteristic of all these studies is that they assumed that ownership constituencies have identical preferences for corporate strategies. Only recently some studies have acknowledged the implications that the identity of such stakeholders can have for firms. A case in point is the work of Hoskisson et al. (2002), who found significant differences between two types of institutional owners (i.e., pension funds and professional investment funds) and firm's innovation strategies. Similar to this work, we argue that each type of institutional blockholders has distinguishable impact on the firm's R&D strategy. Unlike their work, however, we focus on three types of blockholders which have recognized particularities and deserve attention, namely banks, non-financial corporations, and individual blockholders.

Previous empirical evidence suggests that ownership by banks might be related to R&D initiatives (Kochhar and David, 1996, Lee, 2005) but results are not conclusive. We expect bank blockholders to have a negative impact on R&D investment for several reasons. First, banks maintains business relationships with the firm in which they invest beyond simple ownership, often in the form of loans and credits (Kroszner and Strahan, 2001). This exposes banks, which are conservative institutions, to the uncertainty of R&D investment returns through two channels: credits and stakes. Second, the presence of banks stimulates firms to raise capital through debt financing (Petersen and Rajan, 1994). The larger the amount of debt, the larger the riskiness of this debt and the more important the distortions that this debt generates in a firm's investment decisions. One of this distortions described in the literature is the short-term investment bias (Grinblatt and Titman, 1998). A firm tends to invest in short-term projects as a

way to reduce the burden of its debt. This bias should hinder R&D-investments, which are mainly long-term oriented. The foregoing arguments lead to our first hypothesis:

Hypothesis 1: *There is a negative influence of a bank's ownership on firm's R&D investment intensity.*

The second type of institutional blockholder that we identify is the non-financial corporation. We expect a positive influence of the presence of this blockholder on R&D investment due to different reasons:

First, compared to banks, non-financial corporations rarely have credit relationships with their controlled firms. This eliminates one channel of uncertainty in R&D investments for former corporations. Also, the non-existence of these credit relationships reduces debt riskiness and prevents investment inefficiencies like the aforementioned short-term investment bias which, in turn, would favor R&D investments.

Second, non-financial corporations, unlike banks, are more likely to recognize the relevance of R&D investment as a pivotal input for their market success. The existence of reciprocal business relationships, potential synergies, and spillover effects between the owner and the controlled firms should favor R&D investment of the controlled firms (Jaffe, 1986). By investing in R&D, controlled firms can improve their absorptive capacity (Cohen and Levinthal, 1990), enhancing their ability to learn from the corresponding R&D investments of the owner firms.

Last, in some occasions, owner companies invest in R&D-intensive firms strategically with the intention of delegating to these firms, that are specialist in such activities, part of their R&D investments. This allows efficient investments and superior returns. This kind of behavior

is observed in the venture capital industry, where large corporations invest in start-up firms and give these firms incentives for investing in R&D-intensive projects. If these start-up firms become successful, corporations integrate them in their own division as a way of improving their own R&D investments. Therefore, we can state as our second hypothesis:

Hypothesis 2: *There is a positive influence of non-financial corporation's ownership on firm's R&D investment intensity.*

The last type of blockholder that we identify is the individual or non-institutional blockholder. For this type of blockholder, we expect a neutral relationship between its presence and the R&D investment intensity of the controlled firm due to the existence of two countervailing effects. Baysinger et al. (1991) argued that the absence of systematic relationship between ownership concentration among individual shareholders and R&D investment is due to the heterogeneity of individual investor in terms of risk preference and investment horizons. This heterogeneity of individuals is translated into two opposite effects.

On the one hand, monitoring is enhanced because individual blockholders' stakes represent a significant part of their wealth and thus have an incentive to better observe managers' action. This enhanced monitoring is expected to favor the investment in complex R&D activities. On the other hand, agreements on long-term R&D-intensive projects are more difficult to achieve when there is great heterogeneity among blockholders that have to take the decision (*disagreement effect*). That is, conflicting voices are likely to be present when there is risk and investment horizons heterogeneity among owners (Hoskisson et al., 2002).

While these two countervailing effects are likely to exert influence on R&D investments, it is unclear whether one will have predominance over the other one, or instead they would cancel out. Thus,

Hypothesis 3: *There is an ambiguous impact of individual ownership on firm's R&D investment intensity.*

Number of blockholders

We focus on an additional dimension of ownership structure: the number of blockholders that form a coalition to control the firm (control group with a stake larger than 50%). We argue that *ceteris paribus*, increases in the number of blockholders within control group have an impact on R&D investment policy. This is so because the existence of a set of large shareholders with different individual objectives makes more difficult to reach consensus on firm decisions, especially in those decisions that involve a long-term agreements like those to undertake R&D-intensive projects. This is the aforementioned *disagreement effect*.

Moreover, the existence of a large number of blockholder weakens the degree of monitoring of manager's actions since vigilant responsibilities are diluted among a greater number of dominant shareholders. This, in turn, enhances managerial discretion and consequently managers have greater leeway to pursue low-risk strategies and show self-serving behavior (Finkelstein and Boyd, 1998, Tosi et al., 1997), evading risky R&D projects. Thus, we hypothesize the existence of a negative relationship between the number of blockholders and firm R&D investment policy.

Hypothesis 4: *The number of blockholders has a negative influence on firm's R&D investment intensity.*

The impact of the combined effect between blockholder type and R&D expenditures on firm performance

The discussion leading to the above hypotheses concerns with the differential effects that blockholder type and their number would have on the controlled firm's R&D intensity. However, as we mentioned above, the ultimate reason for investing in R&D is to improve the firm's performance. Consequently, a reasonable extension is to analyze whether ownership structure is exclusively a determinant of R&D or it also plays an additional moderating role connecting R&D investments and performance. In this article, we content that the impact of R&D expenditures on performance is contingent to the type of blockholder.

Given the above considerations concerning different types of blockholders, we expect that corporate owners are more efficient in channeling R&D investment into productive outcomes. This is so because they have superior skills – due to their own experience in such investments – and have more incentives, as they may want to integrate eventually their R&D-intensive controlled firms within their own corporation, than banks or other individuals have. Thus, our last hypothesis reads:

Hypothesis 5: *There is a larger marginal impact of R&D investments on performance when corporations are blockholders compared with other types of blockholders like banks or individuals.*

METHODS

Sample and Data

To test the empirical predictions, we use the SABE databases for the years 1996 through 2000. These databases, available from Bureau Van Dijk, provide the ownership structure, balance sheets, and income statements for over 190,000 Spanish firms (95% of all Spanish companies) that deposit their financial statements in the Central Mercantile Register (Registro Mercantil Central). We restrict the sample using three criteria: we eliminate firms that do not report the ownership structure, those that do not present detailed financial statements and those that are not corporations (cooperatives, partnerships, and proprietorship). Moreover, these three criteria have to be satisfied for at least three of the five available years. We are left with an unbalance panel of 3,638 different firms and 12,685 firm-year observations.

Measures

Dependent variables

R&D intensity. The variable to characterize a firm's R&D policy is its *R&D intensity* that is defined in terms of the ratio of R&D expenditures to total sales.

Financial performance. We approach to firm performance through the Return on Assets (*ROA*) defined as the ratio earnings before interests and taxes to the total value of assets.

Independent variables

Variables of ownership structure.

The first dimension of the ownership structure we focus on is the type of blockholders. We distinguish between banks, non-financial corporations, and individuals. In particular, we define as *Bank ownership* the stake in the hands of banks; *Corporate ownership* the stake in the hands of other firms; and *Individual ownership* the stake in the hands of individuals (non-institutional blockholders). Three comments are in order. First, we have aggregated the stake in the hands of the individuals with the same surname in the understanding that they belong to the same family. Second, following La Porta et al. (1999), we consider a blockholder as a shareholder who has at least 10% of the shares. Last, we follow Bennedsen and Wofelzon (2000) to define the number of blockholders that form the controlling coalition (*Number controlling blockholders*). When the largest shareholder owns more than 50% of the shares, we assume that it is the only member of the coalition. When the largest shareholder owns less than 50%, for a given ownership structure many different controlling coalitions may be formed. In a rough simplification we assume that in this case the two largest shareholders will always be in the coalition. If the joint stake of the two largest shareholders is lower than 50% then the coalition will also include the third largest shareholder and so on and so forth.

To study crossed effects between the aforementioned dimensions, we consider variables *Bank ownership*×*Number* that is the product of *Bank ownership* times the *Number controlling blockholders*. Following the same logic, we define *Corporate ownership*×*Number* and *Individual ownership*×*Number*.

In the performance specifications, we identify those firms with a value of R&D intensity larger than the mean for the sector in the corresponding year with a dummy variable *dummy*

R&D. Also, we consider the interactive effect of the ownership structure and R&D investment on a firm performance. This leads to define the following variables *Bank ownership*×*R&D* that is the product of *Bank ownership* times the *Dummy R&D* variable. Following the same logic, we define *Corporate ownership*×*R&D*, *Individual ownership*×*R&D*, and *Number controlling blockholders*×*R&D*.

Control variables

We control for size effects with the *Sales* variable that is the amount of sales on a log scale. We also control for the financial structure, which is captured with two variables. First, *Debt-to-equity*, which is the ratio of book value of debt to the book value of equity. Second, *Internal funds-to-assets*, which is the ratio of a firm's internal funds to the overall value of a firm's assets. In order to avoid potential endogeneity problems, we also control for previous performance. We lagged the *ROA* variable one period and named it *ROA*{*t-1*}. Finally, we introduce as an additional control a variable *family* that is a dummy that is equal to 1 when there are blockholders that belong to the same family.

We have controlled for sector and year by detracting from the dependent variables its mean value by year and 1-digit sector in the fixed-effect estimation.¹ For non fixed-effect estimations, we introduced temporal and sectoral dummies.²

Data Analysis and Model specification

Our main specification is aimed to test the effect of the presence of different types of blockholders as well as its number on a firm's R&D investment intensity. We accompany the

variables that characterize the ownership structure mentioned before, with the foregoing controls. Specifically, we focus on the following specification:

$$\begin{aligned}
 R \& D \text{ intensity}_{it} = \mathbf{a} + \mathbf{b}_1 (\text{Bank ownership}_{it}) + \mathbf{b}_2 (\text{Corporate ownership}_{it}) \\
 & + \mathbf{b}_3 (\text{Individual ownership}_{it}) + \mathbf{b}_4 (\text{Number controlling blockholders}_{it}) + \mathbf{b}_5 (\text{Sales}_{it}) \\
 & + \mathbf{b}_6 (\text{Debt-to-equity}_{it}) + \mathbf{b}_7 (\text{Internal funds-to-assets}_{it}) + \mathbf{b}_8 (\text{ROA}\{t-1\}_{it}) \\
 & + \mathbf{b}_9 (\text{Family}_{it}) + u_i + \mathbf{e}_{it}
 \end{aligned} \tag{1}$$

To test the effects on performance of different combinations of blockholders and a firm's R&D investment, we used the following specification:

$$\begin{aligned}
 ROA_{it} = \mathbf{a} + \mathbf{b}_1 (\text{Bank ownership}_{it}) + \mathbf{b}_2 (\text{Bank ownership} \times \text{Dummy R \& D}_{it}) \\
 & + \mathbf{b}_3 (\text{Corporate ownership}_{it}) + \mathbf{b}_4 (\text{Corporate ownership} \times \text{Dummy R \& D}_{it}) \\
 & + \mathbf{b}_5 (\text{Individual ownership}_{it}) + \mathbf{b}_6 (\text{Individual ownership} \times \text{Dummy R \& D}_{it}) \\
 & + \mathbf{b}_7 (\text{Number controlling blockholders}_{it}) \\
 & + \mathbf{b}_8 (\text{Number controlling blockholders} \times \text{Dummy R \& D}_{it}) \\
 & + \mathbf{b}_9 (\text{Dummy R \& D}_{it}) + \mathbf{b}_{10} (\text{Sales}_{it}) + \mathbf{b}_{11} (\text{Debt-to-equity}_{it}) \\
 & + \mathbf{b}_{12} (\text{Internal funds-to-assets}_{it}) + \mathbf{b}_{13} (\text{Family}_{it}) + u_i' + \mathbf{e}_{it}'
 \end{aligned} \tag{2}$$

It is important to emphasize that under both types of estimations, we recognize the possible existence of unobservable heterogeneity u_i (or u_i') potentially correlated with a firm's ownership structure and/or a firm's performance. We consider that the reasons that may explain the presence of a particular type of blockholder may be perfectly related with a firm's R&D policy and/or its performance. That is, there may be some unobservable firm's characteristics, like managerial skills, that trigger a particular type of R&D policy as well as a firm's performance and the same characteristics also may attract a particular type of blockholder. This may generate a correlation between a firm's intrinsic and unobservable characteristics u_i (or u_i')

and its type of blockholder. We deal with this problem by making use of *fixed-effect* techniques (within group estimators).³

RESULTS

We provide in Table 1 a description of the main variables that we use in order to test our hypotheses. We have to note the large ownership concentration of Spanish firms as the stake of the largest *blockholder* is 68.97%. Also, the stake in the hands of banks is, on average, 30.79%; in the hands of other corporations is 77.47%; and of individuals 67.14%.⁴

We also observe that the number of blockholders in the controlling coalition is significantly lower for those firms that invest significantly in R&D (i.e. when the *dummy R&D* variable is equal to 1) in comparison with those that do not, suggesting initial support for Hypothesis 4. Finally, those firms that invest intensively on R&D are more profitable, larger and less leveraged.

[INSERT TABLE 1 ABOUT HERE]

Table 2 shows the results of the presence of different types of blockholders on a firm's R&D intensity. In row 1 there is the result of specification (1), while in rows (2), (3), (4), we incorporate additional variables to study the moderator effect of the number of blockholders on the connection between blockholders' types and R&D investment. The full model is estimated in row (5).

[INSERT TABLE 2 ABOUT HERE]

Once we focus on the type of blockholder, we find that banks' ownership has a significant negative impact on R&D investment; the presence of non-financial blockholders

stimulates this kind of investments, while non-institutional blockholders (individuals) does not have a significant impact on the R&D investment. These results conform to Hypotheses 1, 2 and 3 respectively.

Concerning the number of blockholders, all specifications show a negative impact on a firm's R&D intensity. It seems that a *disagreement effect* exists, which hinders R&D investments as predicted by Hypothesis 4.

The interaction between the types of blockholders and their number reveals that the existence of a large number of blockholder has a negative moderating effect when other corporations have a controlling role in a firm.

Finally, we observe that those variables related to the financial structure (debt-to-equity and internal funds-to-assets) do not have a significant impact on R&D investment once we introduce variables of ownership structure. These results suggest that the connection between financial structure and R&D investment is fully mediated by a firm's ownership structure.

Finally, we focus on the possible moderating effect of ownership structure on the impact of R&D investments on performance (see Table 3). We find that this is positive and significant only when non-financial firms are the largest blockholders (positive and significant coefficient of Corporate ownership xR&D variable in row 2 of Table 5). This conforms to Hypothesis 5.

[INSERT TABLE 3 ABOUT HERE]

DISCUSSION AND CONCLUSION

Decisions regarding the magnitude and allocation of R&D expenditures are extremely important for corporations, particularly in some sectors, and it is crucial to identify the configurations that foster innovation activities. Thus, this study is important for both investors

and public authorities, as it helps identifying idiosyncratic ownership structures that favour R&D investment. Furthermore, we have investigated the relationship between ownership structure and corporate R&D investment in Spain. Previous studies have examined this relationship in the U.S. and Japan (Lee and O'Neil, 2003, Lee, 2005, Porter, 1992), but studies about the effects of ownership structure in European settings are inexistent. To the best of our knowledge, this is the first one of this kind and, thus, brings a European perspective into this field of research

The type of blockholders

Large shareholders play a decisive role in critical corporate decisions (Tirole, 2001). These blockholders have the incentives and the power to influence management's discretion with respect to R&D strategies. However, previous literature has provided ambiguous results concerning ownership concentrations and R&D investments, and has generally assumed that ownership constituencies have identical preferences for innovation strategies. This article offers an alternative perspective that helps reconciling conflicting results found in the literature.

In this study we have examined the effect of three blockholders, namely banks, non-financial corporations, and individuals, on R&D investment. Our findings indicated that bank ownership is negatively related with R&D investments, whereas non-financial corporation ownership shows a positive impact and individual ownership has a neutral effect.

We have drawn on the conservatism of banks in their investment policy and in their potential role as lenders of their partially-owned firms to justify their negative impact on a firm's R&D investment. Also, we have connected the presence of banks with a superior capacity to raise debt. This increases the debt riskiness which, in turn, generates inefficiencies like the short-term investment bias. This damages R&D investments, which are mainly long-term oriented.

We have relied upon the knowledge accumulated through their own R&D investment track to justify the positive impact of the presence of non-financial corporations on R&D investment of controlled firms. Owner firms have incentives to influence managerial decisions towards R&D projects developed within their controlled firms, as they can take advantage of future spillovers.

The neutral effect of individual ownership that we have found is consistent with the evidence found by Baysinger et al. (1991). This is explained by the characteristics of this group: they have more powerful incentives to scrutiny managerial decisions than institutional blockholders (*i.e.*, banks and corporations) because individual blockholders' stakes represent a significant part of their wealth, but at the same time, the high heterogeneity of these blockholders complicate the agreement on what investments should be made (*disagreement effect*). This damages a firm's R&D investments.

The number of blockholders

We stressed that not only the identity and the amount of stakes of large shareholders influence the R&D policy, but also the number of blockholders. The existence of a set of large shareholders with different preferences makes more difficult their agreements on firm decisions, which may depress R&D investments. We have found empirical support for our expectation of a negative impact of the number of blockholders on a firm's R&D.

This result is somewhat in line with the notion of managerial discretion treated by the agency literature (Finkelstein and Boyd, 1998). As the stock ownership is more disperse (greater number of stockholders), managerial discretion increases and risk averse managers would allocate resources away from risky projects like R&D investment. This suggests that investors

should invest with caution in firms with a high number of blockholder, especially if the company belongs to a high-tech sector, where innovation is vital for organizational survival.

Performance analysis

The previous discussion raises a natural question: Does the control device of large shareholders lead to select appropriate investment decisions?

Our results suggested that when firms engage in conspicuous R&D projects (*i.e.*, R&D investments higher than the mean of the sector), the presence of non-financial corporations as large shareholders has a positive impact on financial performance. This result is an illustration of the positive influence of corporations, which are expected to have their own experience in managing R&D investments, in leading their partially-owned firms to choose those projects that improve the financial performance.

Policy implications

The results reported in this paper have important policy implications. First, in the past decades governments worldwide set out privatization programs of state-owned firms. In some cases, like the Czech Republic, the ownership structure of the firms that emerged after the privatization was very diluted. Our results indicate that an excessive dilution of ownership (an increase in the number of blockholders) has a negative impact on the R&D investments incentives of the recently-privatized firms. Second, and following the privatization framework, governments should give priority to other firms instead of banks if they wanted to create reference blockholders in the privatized firms. Last, governmental agencies that allocate funds to stimulate firms' R&D investment should take into consideration the relevant role that ownership

structure plays in promoting such investments and also in moderating their impact on performance. As a rule of thumb, these agencies should give priority to those firms participated by other firms in their ownership structure as significant blockholders.

Future research

Our study can be extended in different ways. First, future research could address an aspect that has been barely mentioned in the paper: To what extent R&D investments may be used as a mechanism of earnings management by controlling blockholders? It could be argued that by investing in R&D, firms may channel more easily accounting expenses to investment ones and smooth income. Given this, institutional blockholder with a controlling stake in R&D-intensive firms may stimulate these practices in order to consolidate this income smoothing in their own balance sheet.

A second possible avenue refers to the use of alternative measures of corporate governance, and financial performance (e.g., market-based measures), to which we did not have access but would allow a more finely grained analysis to validate our analysis. In addition to this, ownership structure is only one mechanism that may influence R&D investment; others may be the composition of the board or the duality of the CEO. Then, it may be of interest to examine other relationships between governance mechanisms and innovation.

Finally, it would be of great interest to explore the relationships between corporate governance structures, financial structures, and R&D decisions. Our results hint an interesting and complex relationship, where the connection between financial structure and R&D investment is fully mediated by a firm's ownership structure, raising an exiting avenue to be pursued in future research.

End Notes

¹ We use a classification of sectors (CNAE) that has a correspondence with more standard SIC codes (available upon request).

² We had to rule out sectoral and temporal dummies in the fixed-effect estimation because these variables would have been dropped out.

³ The way to inspect whether there is correlation or not is through the Hausman test that studies whether systematic differences exist between those coefficients of the fixed-effect estimation and those of the random-effects estimations. If this null hypothesis is rejected, the only consistent estimator is the fixed-effects one. If not, the best alternative is to use the random-effect estimation. Additionally, in unreported estimations, we allowed for the possibility of a second endogeneity problem not linked to the unobservable heterogeneity, but to the error component. We addressed this problem making use of GMM techniques. However, results barely change from those provided in Tables 2 and 3. Hence, the main source of endogeneity is the unobservable heterogeneity that has been eliminated through fixed-effect estimations.

⁴ It is remarkable that we obtain a positive impact on R&D investment only for the presence of corporations, which have, on average, a larger stake. Hence, it seems that the larger the stake of blockholders, the larger the incentives for investing in R&D.

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TABLE 1
Means and Standard Deviations

	Mean	St. Dev.	R&D=1 ^a	R&D=0 ^a	T-test (p-
R&D intensity	0.006	0.058	0.046	0.001	0.000***
ROA	0.090	0.189	0.102	0.088	0.008***
Bank ownership	30.787	33.559	27.062	31.657	0.261
Corporate ownership	77.469	29.741	74.653	81.403	0.000***
Individual ownership	67.143	37.868	72.516	57.523	0.000***
Stake of the largest blockholder	68.969	31.359	69.945	68.839	0.199
Number controlling blockholders	1.279	0.723	1.229	1.285	0.004***
Sales	14.774	1.391	14.871	14.761	0.004***
Debt-to-equity	6.979	549.091	1.364	7.686	0.686
Internal funds-to-assets	0.377	0.317	0.364	0.379	0.077*
Family	0.148	0.356	0.068	0.150	0.000***

^a We define R&D=1 (0), when R&D intensity is larger or equal (lower) than the mean for the sector (1-digit) and year. The rest of the variables are defined in the text.

* $p = 0.10$; ** $p = 0.05$; *** $p = 0.01$

TABLE 2
Determinants of R&D Investment Intensity: Full Sample^a

Independent variables:	Dependent variable: R&D / Total sales ^b				
	Full model	Joint effect of blockholder & number of blockholders			Full model
		Banks	Corporations	Individuals	
Bank ownership	-0.0377***	-0.0438***			-0.0421***
Bank ownership×Number		0.0066			0.0041
Corporate ownership	0.0226**		0.0778***		0.0852***
Corporate ownership×Number			-0.0538***		-0.0644***
Individual ownership	0.0193			0.0352	-0.0082
Individual ownership×Number				-0.0120	0.0331
Number controlling blockholders	-0.0274***	-0.0307***	-0.0173**	-0.0200**	-0.0261***
Sales	-0.0056	-0.0029	-0.0067	-0.0054	-0.0050
Debt-to-equity	0.0001	0.0001	0.0001	0.0001	0.0001
Internal funds-to-assets	0.0085	0.0087	0.0047	0.0053	0.0074
ROA {t-1} ^c	-0.0105*	-0.0101	-0.0136**	-0.0125**	-0.0113*
Family	0.0041	0.0029	-0.0040	-0.0041	0.0035
Intercept	0.0005	-0.0071**	-0.0054	-0.0083	0.0014
<i>Hausman Test</i>	25.61 (0.002)	26.70 (0.001)	12.39 (0.135)	11.19 (0.191)	28.63 (0.000)
<i>Effects</i>	Fixed-effects	Fixed-effects	Random-effects	Random-effects	Fixed-effects
<i>F Test</i>	3.53***	2.96***			3.68***
<i>Chi-squared</i>			29.47***	13.94*	
<i>N</i>	8,221	8,221	8,221	8,221	8,221

^a Standardized regression coefficients are shown in the table.

^b The dependent variable is corrected by sector and year in the fixed-effect estimations. All the variables are defined in the text.

^c ROA(t-1) means ROA lagged by one period. We have lagged this variable to avoid potential endogeneity problems.

* $p = 0.10$ ** $p = 0.05$ *** $p = 0.01$

TABLE 3
Performance Analyses by the Type of Blockholder^a

Independent variables:	Dependent variable: ROA	
		Full model
Bank ownership	-0.0022	-0.0008
Bank ownership × R&D		-0.0052
Corporate ownership	0.0636***	0.0295
Corporate ownership × R&D		0.0590***
Individual ownership	0.0613***	0.0610***
Individual ownership × R&D		0.0056
Number controlling blockholders	-0.0181*	-0.0165
Number controlling blockholders × R&D		-0.0105
Dummy R&D	-0.0089	-0.0111
Sales	0.0578***	0.0588***
Debt-to-equity	0.0008	0.0009
Internal funds-to-assets	0.4342***	0.4347***
Family	0.0068	0.0072
Intercept	0.0041	0.0023
Hausman Test	27.32 (0.2427)	26.66 (0.482)
Effects	Random effects	Random-effects
Chi-squared	1371.07***	1384.32***
N	12,444	12,444

^a Standardized regression coefficients are shown in the table. The estimations include temporal and sectoral dummy variables. All the variables are defined in the text.

$p = 0.10$; ** $p = 0.05$; *** $p = 0.01$