The effect of institutional blockholders' short-termism on firm innovation: Evidence from the Korean market

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Abstract

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Keywords: Firm innovation; R&D; Institutional blockholding; Corporate governance; Chaebol; Emerging market

JEL Classification: F21, G32, G34, O31, O32, O33

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1. Introduction

Schumpeter's theory of creative destruction as "the essential fact about capitalism" (Schumpeter, 1942) remains valid. Innovation determines long-term economic growth at the country level (Solow, 1957) and is the main engine of growth at the firm level (Aghion et al., 2013), being an essential element of a firm's competitive advantage (Helfat, 2000) and sustainability (Honoré et al., 2015). Thus, decisions on investment in research and development (R&D), the primary source of innovation, are important to firms remaining innovative and sustainable. However, such decisions are complicated and risky, owing to the high level of uncertainty they entail (Chen et al., 2016; Rong et al., 2017).

Institutional investors play an important role in R&D investments. R&D projects are characterized as long-term, high-risk, and needing multiple steps to succeed (Rong et al., 2017). If managers dislike the high level of uncertainty related to R&D, this makes it difficult for them to commit to such investments. Aghion et al. (2013) state that managers who are sensitive to stock market fluctuations avoid investing in R&D because the failure of an R&D project can damage their reputations and expose them to the risk of being fired. The career concern model shows that when incentive contracts do not fully motivate managers to overcome this concern, active monitoring by large outside shareholders plays a role in insulating managers against early failure (Aghion et al., 2013).

In addition, monitoring by institutional investors discourages myopic managerial investments (Bushee, 1998). Conflict between managers and shareholders, referred to as the agency problem, arises from the separation of ownership and control (Berles and Means, 1932; Jensen and Meckling, 1976). When agents (managers) are distinct from the principals (shareholders) and the interests of the two parties differ, agents (managers) have an incentive to pursue private interests. For example, they may have excessive perquisites and compensation, invest in wasteful projects, or engage in managerial "empire building." In addition, managers tend to make decisions to meet short-term goals rather than on long-term investments such as R&D, which is referred to as "managerial myopia." When institutional ownership is high, managers are less likely to reduce investment in R&D, suggesting that institutional monitoring decreases managerial myopia (Bushee, 1998).

In this study, we focus on the role of institutional investors in corporate governance.

Specifically, we examine how institutional blockholders influence the R&D investment by Korean firms. Understanding the role of blockholders in corporate governance is an important issue in R&D. Here, considering the block size, we pay attention to that blockholders have a monitoring incentive with regard to R&D. Chen et al. (2007) argue that independent, long-term institutions with large shareholdings can monitor and influence firms because the benefits of monitoring outweigh the costs. Furthermore, the extant R&D and innovation literature provides evidence of blockholder monitoring, showing that the presence of monitoring institutions has a positive effect on R&D and innovation (Aghion et al., 2013; Choi et al., 2011; Choi, Park, and Hong, 2012; Kim et al., 2017; Eng and Shackell, 2001).

Foreign institutional blockholders have different, but important roles in addition to their monitoring role. According to Aghion et al. (2013), foreign blockholders insulate managers from the risk of early failure of R&D. Foreign blockholders have internationally diversified portfolios (Luong et al., 2017) and better access to capital in the capital markets of other countries (Kwon and Park, 2018). Thus, foreign blockholders are protected against the failure of R&D projects and, thus, can better tolerate the risk of failure, which encourages managers to invest in R&D.

Second, foreign blockholders provide technological and managerial resources and knowledge (Chen et al., 2016; Choi et al., 2011; Choi, Park, and Hong, 2012; Luong et al., 2017). This role as a resource and knowledge provider is particularly important for firms in emerging markets because, in general, firms in such economies do not have sufficient resources and knowledge to innovate. Foreign blockholders encourage R&D investment by resource-poor firms by providing advanced technological resources and boosting R&D activities (Choi et al., 2011). In addition, foreign blockholders promote business networks by connecting managers, investors, and other shareholders in order to exchange opportunities and knowledge, which increases the likelihood of successful R&D (Luong et al., 2017).

However, the results of previous studies vary in two areas: weak corporate governance, and the monitoring role of heterogeneous institutional blockholders. In Korea, owner-managers have absolute power over a firm's operation and exert a powerful influence on decision-making. Thus, there is a significant possibility of outside shareholders being expropriated by a dominant owner-manager.

Weak investor protection and poor disclosure may decrease the incentive to invest in and monitor these firms. Thus, institutional blockholders have fewer chances to intervene directly in management.

Because blockholders may find it difficult to monitor through direct intervention and run the potential risk of expropriation by controlling shareholders, they may exert governance indirectly, in a form known as "exit" (Edmans, 2014). Edmans (2014) and Edmans and Holderness (2017) state that direct interventions by blockholders are difficult to implement in some cases. For example, controlling shareholders can use corporate resources to support their preferred directors in a proxy fight or to reduce the incentives for small blockholdings to monitor. Furthermore, even if the incentives are sufficient, blockholders' small shareholdings reduce their voting power. Thus, blockholders are less likely to motivate firms to invest in R&D and more likely to sell their shares. This tendency can be stronger for foreign blockholders owing to their information disadvantages (Kang and Stulz, 1997; Choe et al., 2005).

In addition, institutional investors show heterogeneous investment objectives and strategies, causing differences in investment horizons and monitoring roles; that is, not all institutions actively monitor the firms they hold. Long-term institutions are likely to monitor actively owing to their long-term investment strategies, whereas short-term institutions are less likely to monitor firms because of their own short-term concerns. Furthermore, only long-term institutions benefit sufficiently to cover the cost of monitoring (Chen et al., 2007). Thus, short-term blockholders do not act as monitoring institutions and are reluctant to invest in long-term projects such as R&D, suggesting short-termism. Combining the short-termism and stronger tendency to avoid the risk of expropriation, foreign blockholders may be reluctant to monitor firms' R&D investments.

We find that institutional blockholdings are negatively related to R&D intensity. Furthermore, our results show that short-term blockholders' ownership is significantly and negatively related to R&D intensity, but that long-term blockholders show no significant relation. More importantly, firms with a higher proportion of foreign short-term blockholders spend less on R&D than those with domestic short-term blockholders do. These results support the argument that institutional blockholders who invest in the Korean market show short-termism, and that this tendency is more severe when blockholders are

short-term and foreign than when they are long-term and domestic. Blockholders' short-termism fosters managerial myopia and results in decreased R&D investment, which is consistent with the findings of Bushee (1998, 2001).

This study contributes to the extant literature in several ways. First, our findings add to the literature on R&D and innovation by suggesting a negative influence of institutional blockholders on R&D investment. Ownership by (foreign) institutional investors in (emerging markets) developed countries is increasing, and institutional investors are emerging as major players in the financial market. As such, a large body of literature examines the influence of (foreign) institutional investors on R&D and innovation. However, the results of empirical tests have been mixed. Eng and Shackell (2001) and Wahal and McConnell (2000) show a positive relation between institutional investors and R&D investment. Studies have found a positive relationship between innovation and institutional ownership in the United States (Aghion et al., 2013), Korea (Choi, Park, and Hong, 2012), and in a transition economy (Choi et al., 2011; Rong et al., 2017). Other studies identify a positive influence on innovation of foreign ownership (Choi et al., 2011; Choi, Park, and Hong, 2012; Luong et al., 2017), long-term institutional ownership (Kim et al., 2017), and business group affiliations (Choi et al., 2011). Although many studies suggest a positive influence of institutional investors, there is some evidence of a negative influence. While the presence of institutional ownership lowers the likelihood of reducing R&D expenditure for a short-term goal, transient institutional ownership increases the probability of reducing long-term investments, such as R&D (Bushee, 1998). In a similar vein, Bushee (2001) argues that transient institutional investors influence firm value negatively, and Choi et al. (2014) find that foreign institutions tend to invest less in countries with a large disparity between ownership and control. Un and Cuervo-Cazurra (2008) argue that subsidiaries of foreign multinational enterprises (MNEs) invest less in total R&D than domestic firms do. We add to the literature by suggesting a different role of institutional blockholders in R&D investment behavior.

Second, we reveal the influence of heterogeneous institutional blockholders on firms' R&D investment behavior. Previous studies do not consider the heterogeneity of institutional blockholders. For example, all institutional investors are treated as homogeneous in Aghion et al. (2013), Choi et al.

(2011), Choi, Park, and Hong (2012), and Wahal and McConnell (2000). Furthermore, while Eng and Shackell (2001) and Rong et al. (2017) consider different institution types, such as banks, investment firms, and investment advisors, they do not consider that these institutions have heterogeneous investment strategies, objectives, and styles, or that they exert divergent activism and governance. Similarly, studies such as Luong et al. (2017) and Chen et al. (2016), which investigate foreign institutions, overlook the heterogeneity of institutional blockholders. We complement these studies by decomposing institutional blockholders by their investment horizons and national origin. This enables us to investigate the different roles of institutional blockholders in firms' R&D investment behaviors.

Third, the effects of blockholders on R&D have been studied primarily in the context of advanced countries (e.g., the United States) or transition economies (e.g., China). However, the behavior of blockholders might differ in emerging markets, owing to the characteristics of such markets, of which there is little evidence. This study provides an extended understanding of the relationship between blockholders and R&D investments by considering the local characteristics of the Korean market.

The remainder of the paper is organized as follows. In section 2, we review the related literature and develop the main hypotheses. Section 3 describes the overall sample and presents the descriptive statistics for the main variables. The main empirical results are discussed in section 4. Section 5 concludes the paper.

2. Related Literature and Hypothesis Development

2.1. Institutional blockholders and R&D intensity

Institutional investors play an important role in corporate governance and affect corporate decisions, including R&D investment. The characteristics of R&D investments impede firms' investment decisions because they require a long time to yield a positive return. There is also no certainty that an R&D investment will succeed at all. R&D activities are based on tacit knowledge, which makes it difficult and costly for managers to inform shareholders of the possible outcomes of R&D (Honoré et al., 2015). Thus, managers tend to be passive and careful when deciding on R&D investment because

they are sensitive to their reputation in the stock market and risk losing their jobs if an investment is unsuccessful (Aghion et al., 2013). However, monitoring by institutional investors insulates managers from these concerns, which promotes investment in R&D (Aghion et al., 2013).

Institutional investors have two channels through which to influence R&D spending. The first is active monitoring or their "*voice*." Institutional blockholders usually hold large shareholdings and, thus, when they conflict with managers, find it difficult to sell their shares, encouraging them to monitor actively. For example, institutional blockholders can exert governance by a proxy vote against managers, public shareholder proposal, behind-the-scenes intervention, and direct discussion with management (Edmans and Holderness, 2016; McCahery et al., 2016).

A stream of literature describes the influence of monitoring by institutional investors on firms' R&D activities and innovation performance. For instance, Bushee (1998) suggests that monitoring institutions (dedicated institutions and quasi-indexers) suppress managerial myopic R&D investments, whereas transient institutions do not. In a similar vein, Bushee (2001) documents that transient institutions have strong preferences for near-term over long-term earnings. Both Eng and Shackell (2001) and Wahal and McConnell (2000) find a positive relation between institutional investors ownership and R&D investment. Using patent data, Aghion et al. (2013) support the career concern model: institutional monitoring insulates managers from the risk to their reputations and from being fired for bad earnings. They suggest that this insulation encourages managers to innovate. Whereas Aghion et al. (2013) describe institutional investors as homogeneous, Kim et al. (2017) consider the heterogeneity of institutions, and suggest that long-term institutional monitoring encourages firms' innovation activities. Unlike advanced countries, firms in a transition economy (e.g., China) tend to have a different ownership structure. Focusing on Chinese firms, Choi et al. (2011) and Rong et al. (2017) find a positive influence of institutional ownership on firms' innovation.

The second channel through which institutional investors influence R&D spending is that of passive monitoring, or "*exit*." When institutional investors are aware that managers' interests are not aligned with theirs, and if they cannot intervene directly, they may sell their holdings, following the so-called "Wall Street Rule" (Admati and Pfleiderer, 2009; Edmans and Holderness, 2017). Selling

blockholdings (or threating to do so) puts pressure on the stock price, which may discipline managers whose compensation is linked to the share price. Thus, when managers forgo long-term investments (e.g., R&D investments) to maximize short-term earnings, some institutional blockholders sell their shares and exit rather than intervene in the firms' management.

Not all institutional blockholders are able to engage in firms' management directly. According to Edmans and Holderness (2017), some institutional investors may have a comparative advantage in picking stocks rather than providing strategic advice. Alternatively, a board of directors that favors a manager may disable a proxy fight, even if small blockholdings are not sufficient to affect management. Parrino et al. (2003) show there is a decrease in institutional holdings before a forced CEO turnover, which means that institutional investors vote by exiting when they are dissatisfied with management. Duan and Jiao (2016) find that mutual funds with small blockholdings and short-term horizons tend to exit rather than voting against management, and that exits are more pronounced in small, liquid firms with greater insider ownership. Based on a survey of institutional investors, McCahery et al. (2016) find that institutional investors employ both the voice and the exit channels, and that the degree of intervention in management is more intensive in the case of long-term institutional investors than it is for short-term institutional investors.

In the Korean market, prior literature finds mixed results. Kim et al. (2008) find that both domestic and foreign institutional ownership negatively moderate the relation between financial slack and R&D. Choi, Park, and Hong (2012) investigate how ownership structure affects firms' innovation performance using patent data for the period 2000–2003. They find a positive influence of both institutional ownership and foreign institutional ownership on technological innovation performance. However, examining the period 1999–2008, Yoo and Rhee (2013) find that foreign investors show a positive relation with R&D investment, whereas institutional ownership has a negative relationship. These studies do not explain which institutional investors have a positive or negative effect on R&D investments or the monitoring channel through which they exert their influence. Thus, to identify the channel through which institutional blockholders affect R&D activities, we decompose total blockholdings into two components: active monitoring blockholdings and non-monitoring

blockholdings. However, before doing so, we examine the factors that may affect institutional blockholders' investment decisions in Korean firms, namely, the local characteristics related to corporate governance.

Corporate governance, along with traditional proxies for risk, is one of the main factors that investors consider when making investment decisions (Giannetti and Simonov, 2006). Prior studies document that institutional investors prefer firms with good governance quality. Li et al. (2006) show that countries with strong macro governance characteristics (i.e., strong shareholder rights, effective legal enforcement, and extensive financial disclosure) have more prevalent institutional blockholdings. This is consistent with the findings of Ferreira and Matos (2008), who show that institutional investors invest less in firms with weak corporate governance (i.e., firms largely held by insiders), and prefer firms from countries with good disclosure standards. Similarly, Chung and Zhang (2011) find that institutional ownership has a statistically and economically positive relation with corporate governance quality. Firms with stronger governance attract more institutional investors, and the percentages of shares owned by institutions are larger. This justifies the higher blockholdings found in firms with good governance characteristics.

Understanding the rationale for the preferences of institutional investors for good corporate governance provides meaningful clues on how institutional blockholders would affect firms' R&D activities. First, from the point of view of *monitoring benefits and costs*, it is optimal for institutional blockholders to invest more in firms with good governance quality. Institutional investors monitor firms they own only when the monitoring benefits outweigh the costs and not all institutional investors monitor (Chen et al., 2007). Bushee and Noe (2000) find that firms with higher disclosure rankings show greater institutional shareholdings and that the preference for higher disclosure rankings is stronger for quasi-indexers. They suggest that the rationale for this finding is that higher disclosure reduces the costs of monitoring firm performance. In a similar vein, Li et al. (2006) state that reduced monitoring costs in countries with strong macro governance environments attract institutional investors and increase the propensity of institutional monitoring. Firm transparency nurtured by good corporate governance reduces the costs of information acquisition, which enhances institutional monitoring

(Boone and White, 2015).

In addition, the preferences need to be understood within a *risk–return framework*. The extraction of private benefits by corporate insiders is one of main sources of distortion in corporate investments (Giannetti and Simonov, 2006). Governance problems and expropriation by insiders prevent institutions from investing in firms. Insiders are expected to have informational advantages because they have access to private information, which they can exploit to gain abnormal returns. However, outsiders, who do not have informational advantages, gain normal returns and only enjoy security benefits on a pro rata basis (Giannetti and Simonov, 2006). The risk of expropriation and self-dealing problems in firms with weak governance means different investors expect different rates of return (Chung and Zhang, 2011). Institutions investing in firms with weak corporate governance do not earn a fair return relative to their risk (Gompers et al., 2003), but insiders do. Hence, the expected return depends on firms' governance quality (Giannetti and Simonov, 2006).

Stock liquidity is another important factor considered by institutional investors when selecting a portfolio. When institutional investors sell their shares, this has an impact on the price of the shares. Hence, they cannot sell their stakes without price pressure, and this is more severe in the case of large shareholdings. Corporate governance affects stock liquidity. Chung et al. (2010) find that firms with better corporate governance show higher stock market liquidity and narrower spreads. They suggest that reduced information asymmetry between insiders and outsiders by good corporate governance lowers the probability of information-based trading and spreads. Because transient institutional investors trade aggressively and have a high portfolio turnover based on short-term trading strategies, liquidity is especially important to such institutions. Bushee and Noe (2000) suggest that transient institutions invest more in firms with better disclosure practices because such practices reduce the price impact of trades, which lowers trading costs and makes it easier to exit and realize a gain. Considering the size of the block, institutional blockholders are more likely to prefer firms with high market liquidity.

Firms in emerging markets are often considered to have heavily concentrated ownership (La Porta et al., 1999; La Porta et al., 1998), expropriation of minority shareholders by large shareholders (Dharwadkar et al., 2000), and weak corporate disclosure and financial opacity (Fan et al., 2011). Many

firms in Korea are controlled by the founders and/or their families, who have considerable power over a firm, despite having smaller shareholdings. The disparity between ownership and control is a stylized fact in Korean firms (Kim et al., 2010), which exacerbates agency problems such as expropriation and self-dealing (Choi et al., 2014). In addition, board members who are assigned based on the recommendations of controlling shareholders represent their interests, which tend not to be aligned with those of outside shareholders (Choi, Sul, and Min, 2012)

In this case, active monitoring of institutional blockholders is hardly effective. The presence of owner-managers with absolute power may deter direct intervention with management and, even when this is possible, the monitoring costs may be excessive. Monitoring blockholders do not have opportunities to influence firms' decisions, owing to the predominance of owner-managers. In addition, weak investor protection and poor corporate disclosure in emerging markets decrease the incentive for institutional investors to invest in and monitor such firms. Hence, institutional blockholders are less likely to invest and more likely to sell their shares rather than intervene directly in firms' management. Therefore, we argue that institutional blockholders that invest in Korean firms tend to have a short-term strategy (short-termism) rather than a long-term focus.

Hypothesis 1. Institutional blockholdings are negatively related to the R&D intensity of Korean firms.

2.2. Foreign institutional blockholders and R&D intensity

The importance of foreign institutional investors is quite different to that of domestic institutional investors, especially in emerging markets such as Korea. Domestic sources of outside finance are limited (Leuz et al., 2009). Liberalized capital markets and financial globalization lead to the increased significance of foreign capital. Foreign institutional investors have contributed to the recent migration from the German–Japanese stakeholder capitalism model to the Anglo-Saxon model, which is characterized by a dispersed and globalized shareholder structure (Bena et al., 2017).

Although foreign institutional investors share several characteristics with institutional investors, they contrast with domestic institutional investors in that they have internationally diversified

portfolios (Luong et al., 2017) and better access to capital markets from other countries (Kwon and Park, 2018). Thus, foreign institutional blockholders are less vulnerable to the failure of R&D projects in invested firms. As Aghion et al. (2013) state, this strength related to risk tolerance protects managers from potential career and reputation risks arising from the failure of R&D investments, which stimulates R&D investment. Foreign institutional blockholders act as a cushion against possible failure from R&D projects.

On the one hand, in emerging markets, foreign institutional blockholders can provide advanced resources and knowledge necessary for R&D and innovation. Chen et al. (2014) state that foreign firms have both codified technological knowledge, such as patents and research reports, and tacit knowledge obtained from global markets and experience associated with R&D. Global networks of foreign institutions serve as a bridge linking domestic and foreign firms, enabling them to exchange knowledge and experience (Luong et al., 2017). In addition, cross-border mergers and acquisitions (M&As) promoted by foreign institutions enhance knowledge spillovers across countries, which facilitate R&D and innovation activities (Luong et al., 2017). Guadalupe et al. (2012) find improvements in innovation and labor productivity after foreign acquisitions of domestic firms. Collectively, foreign institutional blockholders facilitate knowledge spillovers by implanting advanced knowledge and promoting global business networks and cross-border M&As, which enhance firms R&D activities.

On the other hand, foreign institutional blockholders do not always improve R&D activities. The transfer of knowledge from foreign MNEs may not encourage subsidiaries to invest in R&D (Un and Cuervo-Cazurra, 2008). Technologies developed by a parent firm and its subsidiaries decrease the need for R&D investments by other subsidiaries. They find that subsidiaries of foreign MNEs invest less in external R&D, suggesting that the transfer of knowledge and technology from the parent substitute for external R&D. Kwon and Park (2018) find that R&D intensity is negatively related to firms with more than 50% ownership by a parent firm, as well as in firms whose business is tied to that of a domestic parent firm. These findings imply that R&D activities of foreign-owned firms differ notably from those of domestically owned firms.

Moreover, the influence of foreign institutions on R&D activities may vary depending on the

investment objectives and types. Foreign institutions that have strategic objectives involving their core business or that have intention to obtain new access to domestic markets provide advanced resources (Douma et al., 2006) to enhance the R&D capabilities of their domestic firms (Choi et al., 2011). However, when foreign institutions focus on financial interests and are better suited to stock-picking, they do not commit to a long-term relationship with firms, and instead pursue short-term interests. Thus, foreign financial blockholders are not interested in R&D investments, owing to their emphasis on financial interests and liquidity.

At the same time, the preference for firms with good corporate governance is stronger for foreign institutional investors. Prior studies state that foreign institutions avoid investing in firms with poor corporate governance. (Foreign investors are mostly institutional investors (Choe et al., 2005) and share the same preferences as institutional investors.) Foreign institutional investors have smaller shareholdings in firms that have a high ratio of control to the cash flow rights of the principal shareholders (Giannetti and Simonov, 2006), have concentrated control rights and are not members of the Morgan Stanley Capital Internal World Index (Ferreira and Matos, 2008), are domiciled in countries with poor investor protection and disclosure practices (Leuz et al., 2009), and have high control–ownership disparity in Korea (Lee and Cho, 2016). Miletkov et al. (2014) find that the positive relation between board independence and foreign shareholdings is stronger in countries with poor investor protection.

In addition, foreign institutional investors are more likely to be at risk of being exploited by insiders or other local investors owing to information disadvantages. Equity home bias has long been recognized in the capital market. Information asymmetry, or the higher cost of information, is one of several factors contributing to this phenomenon. Foreign investors are in an inferior position to local investors in terms of information on firms (Choe et al., 2005; Kang and Stulz, 1997). Geography of information make a difference in the level of location-based information asymmetry (Bernile et al., 2015). Abilities to predict future stock returns for firms with high information asymmetry are weaker for non-local institutional investors than locals (Baik et al., 2010). Ferreira et al. (2017) find evidence that under the circumstances that information asymmetry is likely to be higher, such as in more opaque

countries or countries with less efficient market, local institutional investors do possess informational advantages. Similarly, in the Korean market, foreign institutional investors do not have superior information than local investors around earnings announcements (Park et al., 2014). Leuz et al. (2009) assess information asymmetry as one of possible factors that influence foreign investors' investment decisions. Within the *risk–return framework*, foreign investors do not expect to gain a fair return on the prices traded by local investors because of the risk from information asymmetry and, thus, invest less. Even if they invest in foreign stocks, from the point of view of *monitoring benefits and costs*, greater effort is needed to monitor poorly governed firms than in the case of well-governed firms, which incurs higher monitoring costs. This implies that foreign investors incur higher monitoring costs than locals do, who can better identify problems related to a poor governance structure. In summary, foreign institutional investors are reluctant to invest in weakly governed firms, and their reluctance is greater than that of local investors owing to their informational disadvantages.

Hypothesis 2. The negative effect of institutional blockholdings on R&D intensity is stronger among foreign institutional blockholders than it is for domestic institutional blockholders.

2.3. Heterogeneous institutional blockholders and R&D intensity

The investment horizon of institutional blockholders is one of the identifiers that distinguish monitoring blockholders from non-monitoring blockholders. Different investment objectives, strategies, and horizons cause institutional investors to have different incentives to interfere in a firm's management. Chen et al. (2007) identify that only long-term institutional investors with "large shareholdings" can afford monitoring efforts. Institutional monitoring is well-grounded on large ownership positions and a long-term horizon. Large shareholdings by blockholders limit their ability to trade, which promotes their monitoring of the firm. In addition, their long-term investment horizon encourages them to restrain managers' short-term focus and instead focus on long-term value. Thus, R&D investment decisions are affected by the extent to which institutional blockholders engage with the management of a firm.

The final hypothesis extends to the finding that long-term institutional blockholders have a

greater incentive to monitor firms than short-term institutional blockholders do, taking into account the short-termism of foreign blockholders. Presumably, if institutional blockholders that invest in Korean firms show short-termism, regardless of their national origin, then the presence of long-term institutional blockholders that can potentially monitor firms may not help to discipline managers in terms of investing in R&D. Similarly, short-term institutional blockholders who pursue short-term trading rather than long-term investing are more likely to have a short-term focus. In other words, monitoring incentives in institutional blockholders are hindered by short-termism. Considering that foreign institutional blockholders are more likely to have a short-term view, it is reasonable to expect that foreign short-term blockholders will be more reluctant to invest in R&D than other types of investors will.

Hypothesis 3. The negative effect of institutional blockholding on R&D intensity is stronger among foreign short-term blockholders than for other types of investors.

3. Sample

The sample data consist of all firms listed on the KRX. The financial and accounting data are taken from DataGuidePro, provided by FnGuide. FnGuide is a leading provider of financial data in South Korea. We obtain institutional ownership data for all common stocks from FnOwnership, also offered by FnGuide. In Korea, the Financial Supervisory Service (FSS) mandates that all investors that have more than a 5% share of a firm report their equity positions. Following Fama and French (2006), all financial firms are excluded from the sample data set, because financial firms have much higher leverage than non-financial firms do. We collect data on common stocks only for each fiscal year from March 2005 to September 2015. We include all firms traded on the KRX. The final sample comprises 11,535 firm-year observations, representing 1,513 distinct firms. Each firm in the sample is classified into one of 16 industries, including R&D-intensive industries such as biotech and pharmaceuticals, according to the Korean Standard Statistic Classification (KSIC).

The dependent variable employed in the tests is R&D intensity (hereafter, “RNDS”), following

Eng and Shackell (2001) and Choi, Park, and Hong (2012). RNDS is measured as annual R&D expenditure divided by sales. We use annual RNDS as a proxy for R&D activity. Following the R&D and innovation literature, RNDS is assigned the value zero when firms do not report R&D expenditure. Although spending on R&D does not directly reflect innovation (Dalziel et al., 2011), it is required in order for firms to innovate. Both exploitative and exploratory innovation is necessary for firms to prosper (Andriopoulos and Lewis, 2009), especially for firms in R&D-intensive industries, where managing the R&D allocation and spending is a key element of success (Dalziel et al., 2011). Furthermore, we investigate how ownership structures influence R&D activities and spending by examining how institutional blockholders introduce various R&D activities to the firm. Accordingly, we focus on understanding the level of R&D expenditure, differentiated by heterogeneous institutional blockholders.

Institutional blockholders are defined as those who own 5% or more of the shares outstanding in a firm, following Chen et al. (2007). This definition is generally accepted by the existing empirical literature (Edmans, 2014). It is typically considered that owning at least 5% of a firm's shares is significant enough to incentivize the monitoring of the firm. However, as the block size increases above 5%, theoretical models show that monitoring increases continuously, rather than discontinuously (Edmans, 2014). Although the 5% blockholder definition has been criticized, we use it here to facilitate comparisons with the findings in the literature.

In order to calculate institutional blockholders' ownership (BLOCK_IO), we divide all shares owned by institutional blockholders by the total number of shares outstanding in a firm. Foreign institutional blockholders might have different effects on R&D activities to those of domestic institutional blockholders. Therefore, we decompose BLOCK_IO into domestic institutional blockholdings (BLOCK_IO_D) and foreign institutional blockholdings (BLOCK_IO_F).

Furthermore, we consider the heterogeneity of institutional investors based on their investment horizons. Institutional investors show heterogeneous investment behavior, originating from differences in their investment strategies and objectives, leading to varying effects on, and/or incentives to monitor the firms in which they invest. Long-term blockholders have a long-term investment horizon, which

means they have a greater incentive to monitor firms rather than trade because the benefits of monitoring are higher than the costs associated with doing so in this case (Chen et al., 2007). On the other hand, short-term blockholders are less likely to monitor firms because of their short-term investment horizon. Specifically, to differentiate ownership by long-term and short-term institutional blockholders from that of total institutional blockholders, we use the investor portfolio turnover, following Yan and Zhang (2009). For quarter *t*, each institution's portfolio turnover is measured using institution *k*'s churn rate, as follows:

$$CR_{k,t} = \frac{min\left(Buy_{k,t}, Sell_{k,t}\right)}{\sum_{i=1}^{N_k} \frac{S_{k,i,t}P_{i,t} + S_{k,i,t-1}P_{i,t-1}}{2}},$$

where $Buy_{k,t}$ and $Sell_{k,t}$ are the aggregate purchases and sales, respectively, by investor *k* for quarter *t*; $P_{i,t-1}$ and $P_{i,t}$ are the share prices for stock *i* at the end of quarter *t* - 1 and *t*, respectively; and $S_{k,i,t-1}$ and $S_{k,i,t}$ are the numbers of shares of stock *i* held by investor *k* at the end of quarter *t* - 1 and *t*, respectively. Then, we average each institution's churn rate over four quarters, as follows:

$$AVG\_CR_{k,t} = \frac{1}{4}\sum_{j=0}^{3} CR_{k,t-j}.$$

All institutional blockholders are sorted into three terciles based on their average churn rate, AVG_CR. Blockholders ranked in the top tercile are classified as short-term institutional blockholders and those ranked in the bottom tercile are classified as long-term institutional blockholders. Short-term (SIO) and long-term institutional ownership (LIO) are defined as the ratio of the number of shares owned by short-term (long-term) blockholders to the total number of shares outstanding.

We also include several firm characteristic variables to control for potential drivers of R&D activities. High leverage induces managers to reduce their R&D expenditure to meet debt commitments (Bushee, 1998). In addition, a high leverage ratio affects corporate decisions related to innovation resources (Choi et al., 2011). Thus, we measure leverage (LEV) as the book value of debt divided by total assets, and expect a negative relation between R&D activities and leverage. A cash flow shortage leads to small-sized firms reducing their R&D expenditure (Bushee, 1998). Larger firms have a greater ability to invest in R&D. Following Choi et al. (2011), we measure a firm's size (SIZE) as the natural

logarithm of total assets. A firm's life cycle affects innovation (Kim et al., 2017). To control for the effect of age, we include the firm's age (AGE), defined as the natural logarithm of years since the firm was established. Following the innovation literature, we include the return on assets (ROA) as a proxy for a firm's profitability (Choi et al., 2011; Fang et al., 2014), the book-to-market ratio (BM) to control for growth opportunities in firms (Eng and Shackell, 2001; Wahal and McConnell, 2000), and Tobin's Q (TOBQ) as a stock market-based proxy for firm value (Aghion et al., 2013). Finally, we measure asset tangibility (TGBT) as tangible assets scaled by total assets.

Table 1 reports the descriptive statistics for the sample. The summary statistics of the major variables are the mean, standard deviation, minimum, 25th percentile, median, 75th percentile, 95th percentile, and maximum. On average, institutional blockholders hold about 4.2% of a firm's total shares of outstanding. The average number of shares owned by domestic (foreign) blockholders is 3.1% (0.9%), and domestic blockholders have greater shareholdings than those of foreign blockholders by 2.2%. Note that a large portion of firms in Korea are not owned by any blockholders. This suggests a dispersed ownership structure, in which the majority of shareholders might be individual investors or institutional investors with less than a 5% shareholding. Many firms are controlled by owner-managers and, thus, diffused shareholders cannot exert governance in firms. Therefore, institutional blockholders, especially foreign blockholders, are more likely to use an "exit" strategy than to exercise their "voice." Foreign blockholders have far lower shareholdings than domestic blockholders do. For example, in contrast to domestic short-term blockholders that hold 1.2% of shares outstanding, foreign short-term blockholders hold only 0.1% of outstanding shares. This suggests that foreign short-term blockholders are more likely to exit than use their voice.

[Insert Table 1 about here]

Table 2 presents the correlations between RNDS and the ownership variables. The lower diagonal shows the Pearson contemporaneous correlation coefficients, and the upper diagonal shows the Spearman contemporaneous correlation coefficients. Institutional blockholders show a significant negative correlation with RNDS, consistent with our hypothesis. Additionally, we find a significant negative correlation between RNDS and SIO. More importantly, the correlation for foreign short-term

blockholders is much higher than that of domestic short-term blockholders, suggesting that foreign blockholders might not encourage R&D activities by exercising a monitoring role.

[Insert Table 2 about here]

The correlations show the interrelation between R&D activities and the ownership variables. However, a causal relation cannot be identified because the variables are all contemporaneous. In addition, the relationship between R&D activities and the ownership variables might be the result of other firm characteristics. Thus, the analysis in the next section focuses on the influence of lagged blockholders ownership on R&D activities, controlling for firm characteristics.

4. Empirical Results

4.1. Baseline estimation

In this section, we examine the impact of institutional blockholders on firms' R&D activities, after controlling for other confounding factors, using a cross-sectional regression. The first empirical question is whether the presence of institutional blockholders affects firms' decisions on whether to invest in R&D, and if so, which blockholders are influential. For this, we define the dependent variable, RNDS_D, as one if RNDS is greater than zero, and zero otherwise. Then, I use a logit model to consider the categorical dependent variable. Specifically, we estimate four models as follows:

$$RNDS\_D_{i,t} = \alpha + \beta_1 \cdot BLOCK\_IO_{i,t-1} + \beta_2 \cdot LEV_{i,t-1} + \beta_3 \cdot SIZE_{i,t-1} + \beta_4 \cdot AGE_{i,t-1} + \beta_5 \cdot ROA_{i,t-1} + \beta_6 \cdot TOBQ_{i,t-1} + \beta_7 \cdot TGBT_{i,t-1} + \beta_8 \cdot BM_{i,t-1} + \beta_9 \cdot Industry\ Dummy_i + \beta_{10} \cdot Year\ Dummy_t + \varepsilon_{i,t}, \quad (1)$$

$$RNDS\_D_{i,t} = \alpha + \beta_1 \cdot BLOCK\_IO\_D_{i,t-1} + \beta_2 \cdot BLOCK\_IO\_F_{i,t-1} + \beta_3 \cdot LEV_{i,t-1} + \beta_4 \cdot SIZE_{i,t-1} + \beta_5 \cdot AGE_{i,t-1} + \beta_6 \cdot ROA_{i,t-1} + \beta_7 \cdot TOBQ_{i,t-1} + \beta_8 \cdot TGBT_{i,t-1} + \beta_9 \cdot BM_{i,t-1} + \beta_{10} \cdot Industry\ Dummy_i + \beta_{11} \cdot Year\ Dummy_t + \varepsilon_{i,t}, \quad (2)$$

$$RNDS\_D_{i,t} = \alpha + \beta_1 \cdot LIO_{i,t-1} + \beta_2 \cdot SIO_{i,t-1} + \beta_3 \cdot LEV_{i,t-1} + \beta_4 \cdot SIZE_{i,t-1} + \beta_5 \cdot AGE_{i,t-1} + \beta_6 \cdot ROA_{i,t-1} + \beta_7 \cdot TOBQ_{i,t-1} + \beta_8 \cdot TGBT_{i,t-1} + \beta_9 \cdot BM_{i,t-1} + \beta_{10} \cdot Industry\ Dummy_i + \beta_{11} \cdot Year\ Dummy_t + \varepsilon_{i,t}, \quad (3)$$

$$RNDS\_D_{i,t} = \alpha + \beta_1 \cdot LIO\_D_{i,t-1} + \beta_2 \cdot LIO\_F_{i,t-1} + \beta_3 \cdot SIO\_D_{i,t-1} + \beta_4 \cdot SIO\_F_{i,t-1} +$$

$$\beta_5 \cdot LEV_{i,t-1} + \beta_6 \cdot SIZE_{i,t-1} + \beta_7 \cdot AGE_{i,t-1} + \beta_8 \cdot ROA_{i,t-1} + \beta_9 \cdot TOBQ_{i,t-1} + \beta_{10} \cdot TGBT_{i,t-1} +$$

$$\beta_{11} \cdot BM_{i,t-1} + \beta_{12} \cdot Industry\ Dummy_i + \beta_{13} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (4)$$

In the above models, the subscripts *i* and *t* denote a firm and year, respectively, and industry and year dummies are included to consider that R&D activities in firms are dependent on the industry and time. All independent variables are lagged by one year. For instance, RNDS is measured in 2010, and the institutional blockholdings and control variables are measured in 2009. It takes time for institutional blockholders to monitor firms and to influence the decision process associated with R&D activities. This time-lagged approach not only considers the time taken to monitor a firm's activities, but also avoids reverse causality. The causality describing whether institutional blockholders encourage or discourage firms' spending on R&D might be reversely inferred as blockholders preferring firms with high or low R&D intensity. We use lagged blockholders' ownership to estimate firms' future R&D activities. However, the reverse-causality cannot be solved completely. To mitigate this concern, we revisit the reverse-causality problem in the robustness tests.

Following Petersen (2009), we adjust the standard errors for clustering at both the firm and the year levels; Table 3 provides the results. Consistent with the hypotheses, institutional blockholders are reluctant to invest in R&D. Furthermore, this negative influence is more pronounced for foreign blockholders than it is for domestic blockholders, and for short-term blockholders more than for long-term blockholders. For example, the coefficient of $BLOCK\_IO_{t-1}$ is significantly negative and the magnitude of the coefficient of $BLOCK\_IO\_F_{t-1}$ (SIO_{t-1}) is almost three times greater than that of $BLOCK\_IO\_D_{t-1}$ (LIO_{t-1}). Note that only the coefficient of SIO_F_{t-1} is significantly negative in Model 4. This suggest that foreign short-term institutional blockholders have a strong short-term focus and are less likely to invest in R&D.

[Insert Table 3 about here]

To further investigate each model in Table 3, we employ three estimation methods. First, we estimate each model using a pooled ordinary least squares estimation. Next, the model is estimated using the Fama–MacBeth cross-sectional regression approach (Fama and MacBeth, 1973) and we adjust the standard errors for Newey–West autocorrelations with three lags. Finally, the estimation results are

clustered by firm and year using a two-way clustered standard errors approach, following Petersen (2009). To examine the influence of total institutional blockholdings on firm's R&D activities, we estimate the model as follows:

$$RNDS_{i,t} = \alpha + \beta_1 \cdot BLOCK\_IO_{i,t-1} + \beta_2 \cdot LEV_{i,t-1} + \beta_3 \cdot SIZE_{i,t-1} + \beta_4 \cdot AGE_{i,t-1} + \beta_5 \cdot ROA_{i,t-1} + \beta_6 \cdot TOBQ_{i,t-1} + \beta_7 \cdot TGBT_{i,t-1} + \beta_8 \cdot BM_{i,t-1} + \beta_9 \cdot Industry\ Dummy_i + \beta_{10} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (5)$$

Table 4 shows the results of the three estimation methods for the relationship between institutional blockholding and RNDS, controlling for other firm characteristics. Regardless of the estimation methods, the one-year lagged institutional blockholding is significantly and negatively related to firm R&D intensity, consistent with the hypothesis. This result suggests that institutional blockholders who invest in Korean firms are less likely to exert an influence on a firm's R&D activities, and are more likely to sell their shares rather than engage in active monitoring.

[Insert Table 4 about here]

However, the presence of institutional blockholders might lead to the previous result. Because the majority of firms in Korea do not have institutional blockholdings, the negative relation between RNDS and $BLOCK\_IO_{t-1}$ might be derived from such firms, and firms with blockholdings might show a positive relation between them. To control for this possible contrasting effect, we aggregate firms with positive institutional blockholdings only (i.e., $BLOCK\_IO_{t-1} > 0$) to construct a subsample and then we re-estimate the model for the subsample. The results are shown in the last three columns. The results for the subsample are consistent with the previous results based on the full sample. Overall, institutional blockholders negatively affect firms' R&D activities and show short-termism. However, these results do not reveal which institutional blockholders have a negative influence on firms' R&D.

To investigate which blockholders have a negative effect, we first consider the national origin of institutional blockholders. For this, we estimate the following model.

$$RNDS_{i,t} = \alpha + \beta_1 \cdot BLOCK\_IO\_D_{i,t-1} + \beta_2 \cdot BLOCK\_IO\_F_{i,t-1} + \beta_3 \cdot LEV_{i,t-1} + \beta_4 \cdot SIZE_{i,t-1} + \beta_5 \cdot AGE_{i,t-1} + \beta_6 \cdot ROA_{i,t-1} + \beta_7 \cdot TOBQ_{i,t-1} + \beta_8 \cdot TGBT_{i,t-1} + \beta_9 \cdot BM_{i,t-1} + \beta_{10} \cdot Industry\ Dummy_i + \beta_{11} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (6)$$

Table 5 presents the estimated results when I consider the national origin of institutional blockholders. Although the three estimation methods do not all show significant results, the results of the Fama–MacBeth regression show that the negative influence is stronger for foreign institutional blockholders than it is for domestic institutional blockholders, which supports the hypothesis. The magnitude of the coefficient of $BLOCK\_IO\_F_{t-1}$ is larger than that of $BLOCK\_IO\_D_{t-1}$.

Additionally, we examine how institutional blockholders differ in terms of their influence on firms' R&D activities, depending on their investment horizon. We estimate the following model and present the results in Table 6.

$$RNDS_{i,t} = \alpha + \beta_1 \cdot LIO_{i,t-1} + \beta_2 \cdot SIO_{i,t-1} + \beta_3 \cdot LEV_{i,t-1} + \beta_4 \cdot SIZE_{i,t-1} + \beta_5 \cdot AGE_{i,t-1} + \beta_6 \cdot ROA_{i,t-1} + \beta_7 \cdot TOBQ_{i,t-1} + \beta_8 \cdot TGBT_{i,t-1} + \beta_9 \cdot BM_{i,t-1} + \beta_{10} \cdot Industry\ Dummy_i + \beta_{11} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (7)$$

As expected, short-term institutional blockholdings are significantly and negatively related to RNDS, regardless of the sample and the estimation methods. Long-term institutional blockholders, who are considered to monitor actively, do not motivate firms to invest in R&D. Short-term institutional blockholders dislike firms investing in R&D and show short-termism. The findings support the hypothesis that the monitoring incentives of institutional blockholders decrease with stronger short-termism. Thus, long-term blockholders do not monitor actively and short-term blockholders aggravate their myopic behavior. Taken together, institutional blockholders have a negative influence on firms' R&D activities, and this tendency is stronger for foreign blockholders than it is for domestic and short-term blockholders.

[Insert Table 5 about here]

[Insert Table 6 about here]

If the short-term focus is stronger for foreign and short-term institutional blockholders, it is reasonable to predict that the effect of foreign short-term institutional blockholders may be strongest. To verify this, we consider the national origin of institutional blockholders and their investment horizon simultaneously by estimating the model as follows:

$$RNDS_{i,t} = \alpha + \beta_1 \cdot LIO\_D_{i,t-1} + \beta_2 \cdot LIO\_F_{i,t-1} + \beta_3 \cdot SIO\_D_{i,t-1} + \beta_4 \cdot SIO\_F_{i,t-1} + \beta_5 \cdot$$

$$LEV_{i,t-1} + \beta_6 \cdot SIZE_{i,t-1} + \beta_7 \cdot AGE_{i,t-1} + \beta_8 \cdot ROA_{i,t-1} + \beta_9 \cdot TOBQ_{i,t-1} + \beta_{10} \cdot TGBT_{i,t-1} + \beta_{11} \cdot BM_{i,t-1} + \beta_{12} \cdot Industry\ Dummy_i + \beta_{13} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (8)$$

Table 7 presents the estimation results when we consider both the national origin and the investment horizon of institutional blockholders. Consistent with the hypothesis, only foreign short-term institutional blockholdings are significantly and negatively related to firms' R&D intensity. Long-term institutional blockholders do not show a significant positive influence on R&D intensity. Although the domestic short-term institutional blockholders in Model (1) for the full sample and Model (2) for the subsample show a significantly negative relation with R&D intensity, the magnitude is less than those of foreign short-term institutional blockholders. For instance, the coefficient for foreign short-term blockholders is about seven times higher than that of domestic short-term blockholders in Model (2) for the subsample. These findings suggest that the short-term focus of short-term institutional blockholders is intensified by the short-termism of foreign institutional blockholders.

[Insert Table 7 about here]

In summary, we find that institutional blockholders do not actively engage in firms' R&D activities. More importantly, foreign short-term institutional blockholders are incentivized to discourage firms from investing in R&D. Overall, in the Korean market, the monitoring incentive of institutional blockholders has weakened, but the myopic behavior incentive has strengthened. These results are contrary to the Rong et al's (2017) findings that independent institutional investors (mutual funds) promote R&D productivity. In the Korean market, institutional monitoring is not effective and institutional investors engage in myopic investment behavior consistent with Bushee (1998, 2001). As documented by Bushee (1998, 2001), short-term focus of institutional investors in the Korean market lead managers to cut R&D spending to meet short-term earnings goals. We argue that the local characteristics of Korean firms have led to these changes in the monitoring role of institutional blockholders and short-termism. To further investigate why the active monitoring channel is not effective and why institutional blockholders are short-term oriented, we examine the corporate governance environment and focus on how the preference for good governance quality affects institutional blockholders' engagement in firms' R&D spending.

4.2. Additional tests

Institutional blockholders consider the governance quality of a firm before investing. To capture the internal corporate governance of a firm, we first introduce three governance variables: KCGS, BOD_SIZE, and IND_PCT. Here, KCGS measures the overall internal governance quality of a firm, and BOD_SIZE and IND_PCT capture the composition of the firm's board of directors. The Korea Corporate Governance Service evaluates the comprehensive governance practices of firms listed on the KOSPI and selected KOSDAQ firms on an annual basis, and reports a total corporate governance score in each case. This firm-level corporate governance score is measured for the categories of shareholder protection, board of directors, corporate disclosure, auditing organization, and earnings distribution. BOD_SIZE is the natural logarithm of the total number of directors and IND_PCT is the percentage of independent directors on the overall board.

To examine the influence of heterogeneous institutional blockholdings on firm R&D activities when we control for corporate governance quality, we estimate the following model and present the results in Table 8.

$$RNDS_{i,t} = \alpha + \beta_1 \cdot LIO\_D_{i,t-1} + \beta_2 \cdot LIO\_F_{i,t-1} + \beta_3 \cdot SIO\_D_{i,t-1} + \beta_4 \cdot SIO\_F_{i,t-1} + \beta_5 \cdot KCGS_{i,t-1} + \beta_6 \cdot BOD\_SIZE_{i,t-1} + \beta_7 \cdot IND\_PCT_{i,t-1} + \beta_8 \cdot LEV_{i,t-1} + \beta_9 \cdot SIZE_{i,t-1} + \beta_{10} \cdot AGE_{i,t-1} + \beta_{11} \cdot ROA_{i,t-1} + \beta_{12} \cdot TOBQ_{i,t-1} + \beta_{13} \cdot TGBT_{i,t-1} + \beta_{14} \cdot BM_{i,t-1} + \beta_{15} \cdot Industry\ Dummy_i + \beta_{16} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (9)$$

The results presented in Table 8 are consistent with the previous results. Even after controlling for the corporate governance effects on R&D activities, we find that the negative relation between institutional blockholding and R&D intensity is strongest for foreign short-term institutional blockholders. Furthermore, the positive coefficient of KCGS shows that good governance quality leads to an increase in the level of R&D investment, which is consistent with the agency view that good governance practices align managers' short-term interests with shareholders' long-term interests and, thus, encourage R&D investment. The negative relation between board size and R&D intensity supports the view that a lack of cohesiveness of larger boards requires more compromises to reach agreement

and thus the decisions of larger boards are relatively less extreme. (Cheng, 2008).

[Insert Table 8 about here]

If the negative relationship between institutional blockholding and R&D intensity is driven by institutional blockholders' preferences for good governance quality, it should be more evident in firms with poorer governance practices. To investigate this, we divide the sample into two subsamples: a high KCGS, and a low KCGS. For each sample, we estimate Equation (8) and provide the results in Table 9. While the negative influence of short-term blockholdings on R&D intensity is still significantly negative in firms with a low KCGS, it is not statistically significant in firms with a high KCGS. In the low KCGS sample, the negative relationship is again stronger for foreign blockholders than it is for domestic blockholders, implying that the preference for strong corporate governance is more prevalent for foreign blockholders than for domestic blockholders. These results suggest that the overall quality of corporate governance influences institutional blockholders' behavior related to firms' R&D activities. Not only does poor corporate governance make institutional monitoring ineffective, it also makes foreign institutional blockholders susceptible to expropriation by the owner-manager. Thus, foreign short-term blockholders are more likely to avoid R&D investment and to be more short-term focused than domestic short-term blockholders are.

[Insert Table 9 about here]

Additionally, to consider the uniqueness of the Korean market, we investigate the effect of *Chaebols* (the Korean term for conglomerates controlled by an owner or family members) on the relationship between institutional blockholding and R&D intensity. We consider two aspects of *Chaebols*. First, *Chaebol*-affiliated firms are typically owned and controlled by the founder and the founder's family. Despite their small shareholdings, these family owner-managers maintain control over the firm's operations. In this ownership structure, institutional blockholders do not have sufficient opportunity to exert governance using their voice, and so are encouraged to have short-term interests and to avoid long-term investments, such as R&D.

However, the *Chaebol* structure does not only have a negative effect on R&D. Historically, *Chaebol*-affiliated firms have become the main players in the country's economic growth as a result of

government initiatives to boost the economy and to achieve export-oriented development. Under government protection, *Chaebols* have been provided various benefits and subsidies and encouraged to invest in R&D. As a result, *Chaebols* have become global players and continue to invest in R&D to maintain their competitive advantage, even after becoming a global player. For example, Samsung has been a top-ranked firm for several years in terms of the number of U.S. patents. Furthermore, according to the Annual Report 2017 by the European Patent Office, LG and Samsung rank third and fourth, respectively, and Korea is among the top 10 countries in terms of patent applicants. In addition, owner-managers' wealth is tied to the firm's performance. Thus, they are motivated to care about the long-term profitability of the firm, rather than focusing on managerial myopia. Accordingly, owner-managers' interests are aligned with those of shareholders, and the agency problem is less evident in family-run business groups (James, 1999). In summary, because *Chaebols* might invest in R&D for their own interests, with a sufficient incentive to be innovative, R&D in *Chaebol*-affiliated firms might not be influenced by institutional blockholders' monitoring.

To test the *Chaebol* effect, we include a *Chaebol* dummy (*Chaebol_D*), taking the value one if a firm is a *Chaebol*-affiliate, and zero otherwise. Furthermore, we add several interaction terms between various institutional blockholdings and the *Chaebol* dummy. The model is estimated as follows:

$$RNDS_{i,t} = \alpha + \beta_1 \cdot LIO\_D_{i,t-1} + \beta_2 \cdot LIO\_F_{i,t-1} + \beta_3 \cdot SIO\_D_{i,t-1} + \beta_4 \cdot SIO\_F_{i,t-1} + \beta_5 \cdot (LIO\_D_{i,t-1} \times Chaebol_{i,t-1}) + \beta_6 \cdot (LIO\_F_{i,t-1} \times Chaebol_{i,t-1}) + \beta_7 \cdot (SIO\_D_{i,t-1} \times Chaebol_{i,t-1}) + \beta_8 \cdot (SIO\_F_{i,t-1} \times Chaebol_{i,t-1}) + \beta_9 \cdot KCGS_{i,t-1} + \beta_{10} \cdot BOD\_SIZE_{i,t-1} + \beta_{11} \cdot IND\_PCT_{i,t-1} + \beta_{12} \cdot LEV_{i,t-1} + \beta_{13} \cdot SIZE_{i,t-1} + \beta_{14} \cdot AGE_{i,t-1} + \beta_{15} \cdot ROA_{i,t-1} + \beta_{16} \cdot TOBQ_{i,t-1} + \beta_{17} \cdot TGBT_{i,t-1} + \beta_{18} \cdot BM_{i,t-1} + \beta_{19} \cdot Industry\ Dummy_i + \beta_{20} \cdot Year\ Dummy_t + \varepsilon_{i,t}. \quad (10)$$

Table 10 provides the estimation results when we consider the *Chaebol* effect. The negative relation between foreign short-term blockholding and R&D intensity disappears in the case of *Chaebol*-affiliated firms. The foreign short-term blockholding interaction term is not statistically significant. In contrast, the coefficient of the foreign short-term blockholding term remains significantly negative.

In contrast to *Chaebol*-affiliated firms, non-*Chaebol* firms have not been provided with the

same level of support from the government. In addition to a lack of resources and knowledge, poor corporate governance in non-*Chaebol* firms reduces monitoring incentives and increases short-termism. Combining the results that short-termism disappear in firms with good corporate governance (see Table 9) and in *Chaebol*-affiliated firms (see Table 10) suggest that *Chaebol*-affiliated firms do possess good governance compared to non-*Chaebol* firms. As global players, *Chaebol*-affiliated firms have been continuously required to improve corporate governance. To meet this expectation, *Chaebol*-affiliated firms have tried to improve corporate transparency and satisfy good disclosure standards. However, non-*Chaebol* firms have been demanded of relatively less strict governance standards and have been monitored by fewer outside investors. Thus, the need to improve corporate governance is less in non-*Chaebol* firms and the opportunities to exert governance by monitoring are not sufficient due to stronger owner-managers in non-*Chaebol* firms. Overall, the findings shown in Table 10 suggest that the heterogeneous characteristics of *Chaebol*-affiliated firms and non-*Chaebol* firms have a fundamental difference in the influence of institutional blockholders on R&D activities.

[Insert Table 10 about here]

In summary, when the monitoring channel is not effective due to the existence of the absolute ownership, institutional blockholders exert a negative influence on firms' R&D spending. This is consistent with the findings of Choi, Park, and Hong (2012) and Rong et al. (2017). Choi, Park, and Hong (2012) cannot find a positive relationship between both ownership concentration and state ownership and technological innovation performance. Similarly, Rong et al. (2017) documented that the positive effect of monitoring institutional ownership on firm innovation performance does not exist among majority state-owned enterprises (SOEs), suggesting that SOEs impede the effective external governance from institutional monitoring. They also find that due to the small ownership, only when QFII (Qualified Foreign Institutional Investor) rely on mutual funds (independent institutional investors), the positive effect on firm innovation is significant. We contribute to these studies, which do not consider corporate governance, by suggesting that weak corporate governance under the absolute ownership foster short-termism and hinder monitoring. When the absolute ownership limit opportunities to exert governance by monitoring, institutional blockholders no longer serve in

monitoring role to promote R&D activities but engage in myopic behavior by encouraging manager to reduce R&D investment and boost short-term earnings, supporting Bushee (1998, 2001). This is why institutional investors prefer firms with good corporate governance.

4.3. Robustness tests

In this section, we perform two robustness checks of the primary findings in the previous sections. First, we analyze institutional blockholders' monitoring behavior by liquidity level in the Korean market. In general, institutional blockholders face a dilemma when they sell their blockholdings owing to the block size. In the case of low liquidity, institutional blockholders find it difficult to exit their position when they are not satisfied with the management of a firm. This motivates institutional blockholders to monitor actively. However, in the Korean market, foreign short-term blockholders have strong short-termism and a significantly negative influence on firms' R&D. Hence, we suppose that the negative relation between foreign short-term blockholding and R&D intensity is still prominent in the case of a low liquidity level.

We substantiate this argument using Amihud's (2002) illiquidity ratio as a proxy for a firm's level of liquidity. We calculate the annual average of Amihud's (2002) daily illiquidity ratios as follows:

$$Amihud_i = \frac{\sum_{t=1}^{D_{i,y}} \frac{R_{i,y,d}}{Vol_{i,y,d}}}{D_{i,y}},$$

where $R_{i,y,d}$ is the return on stock i on day d of year y; $Vol_{i,y,d}$ is the dollar value of the trading volume of stock i on day d of year y; and $D_{i,y}$ is the number of days for stock i in year y. Based on this ratio, firms are sorted into five quintiles for each year, where firms in fifth (first) quintile are grouped into the bottom (top) liquidity subsample. For each sample, we re-estimate Equation (8) and provide the results in Table 11.

We again find that foreign short-term blockholders have a negative influence on R&D intensity, significant at the 5% level for the low liquidity subsample. However, in the high liquidity subsample, the relation is not significant. These results support the previous results: even at low liquidity levels, the short-termism of foreign short-term institutional blockholders dominates their monitoring incentives

and has a negative influence on firms' R&D activities.

[Insert Table 11 about here]

Second, we revisit the reverse-causality concern. The findings thus far may be attributed to the possibility that foreign institutional blockholders with short-term investment horizons prefer to invest in firms that do not invest in R&D or in non-R&D-intensive-firms. To address this concern, we consider an instrumental variable approach, following Liu et al. (2015). We calculate the industry average blockholding, which we employ as the instrumental variable. Specifically, for each type of institutional blockholder, we compute the average blockholding of other firms in the same industry in the same year. The rationale is that institutional blockholding in a firm is likely to be correlated with the average blockholding in the industry to which it belongs, because firms in the same industry have similar investment opportunities and business environments. However, the industry average is not likely to influence a firm's R&D intensity directly.

Using these instrumental variables, we re-investigate Equation (5), (6), (7), and (8) and provide the results in Table 12. Model 2 presents the results using the industry average of institutional blockholdings when considering the national origin of the blockholders, and Model 4 considers both the national origin and the investment horizon of blockholders. The results are generally consistent with the previous results, indicating a significantly negative relation between the industry average of foreign institutional blockholdings and firms' R&D intensity. More importantly, we find that the industry average of foreign short-term blockholdings is significantly and negatively related to firms' R&D intensity. This suggests there is a negative causal relationship between foreign short-term institutional blockholdings and firms' R&D intensity, supporting their short-termism.

[Insert Table 12 about here]

5. Conclusion

Given that R&D is essential to a firm's sustainability and long-term growth, it is imperative to understand which institutional blockholders motivate R&D behavior. To do so, this study investigates the effects of heterogeneous institutional blockholders on firms' R&D intensity.

We test whether monitoring by institutional blockholders enhances firms' R&D activities. To test this hypothesis, the aggregate institutional blockholder ownership is divided according to the nationality and the investment horizon of institutional blockholders. Contrary to the view that monitoring by institutional investors boosts firms' R&D and/or innovation performance, we find that institutional blockholdings induce managers to have a short-term focus. This tendency is stronger for foreign rather than domestic institutional blockholders, and for short-term rather than long-term investors. Foreign short-term institutional blockholders' ownership has the strongest negative influence on firm's R&D intensity.

To investigate why active monitoring is not effective and why institutional blockholders show short-termism, we consider overall corporate governance quality using various governance variables. The results indicate that the behavior of institutional blockholders may vary depending on the governance quality of the firms in which they have invested. In the presence of powerful owner-managers and weak governance in Korea, institutional blockholders' monitoring might not be effective, which induces a short-term focus in institutional blockholders. This short-term focus outweighs the monitoring effect and reinforces the short-termism of institutional blockholders. In the Korean market, the short-termism encourage managers to sacrifice R&D expense to achieve short-term performance goal, consistent with Bushee (1998, 2001).

This study contributes to the extant literature by offering new evidence on the effect of heterogeneous institutional blockholders on firms' R&D activities. In particular, we highlight the importance of the role of internal corporate governance. Building a corporate environment favorable to institutional investors, including transparent corporate decision-making, strong investor protection, and good disclosure standards, will ensure that institutional monitoring is effective, leading to greater R&D investment by firms. This is also important to regulators, because R&D at the firm level is fundamental to innovation at the governance level, which demands legal support for a transparent and fair market.

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Appendix. Definitions of the variables

Variable	Definition
RNDS	R&D expenditure divided by sales
BLOCK_IO	Total shares owned by institutional blockholders divided by the total number of shares outstanding
BLOCK_IO_D	Institutional ownership by domestic blockholders
BLOCK_IO_F	Institutional ownership by foreign blockholders
LIO	Institutional ownership by long-term blockholders, as in Yan and Zhang (2009)
LIO_D	Institutional ownership by domestic long-term blockholders
LIO_F	Institutional ownership by foreign long-term blockholders
SIO	Institutional ownership by short-term blockholders, as in Yan and Zhang (2009)
SIO_D	Institutional ownership by domestic short-term blockholders
SIO_F	Institutional ownership by foreign short-term blockholders
LEV	The ratio of the book value of debt to total assets
SIZE	The natural logarithm of total assets
AGE	The natural logarithm of years since a firm was established
ROA	The ratio of operating income to total assets
BM	The ratio of book value to market value
TOBQ	The ratio of the stock market value and total debt to total assets
TGBT	The ratio of tangible assets to total assets
KCGS	The overall corporate governance score, as per the Korea Corporate Governance Service
BOD_SIZE	The natural logarithm of the total number of directors
IND_PCT	The ratio of independent directors to the total number of directors
Chaebol_D	Dummy variable, taking the value one if a firm is a *Chaebol*-affiliate, and zero otherwise

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	5%	25%	Median	75%	95%	Max
RNDS	0.0151	0.0325	0.0000	0.0000	0.0000	0.0017	0.0143	0.0722	0.2220
BLOCK_IO	0.0417	0.0802	0.0000	0.0000	0.0000	0.0000	0.0620	0.2122	0.3900
BLOCK_IO_D	0.0309	0.0676	0.0000	0.0000	0.0000	0.0000	0.0000	0.1738	0.3458
BLOCK_IO_F	0.0092	0.0310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0830	0.1670
LIO	0.0159	0.0522	0.0000	0.0000	0.0000	0.0000	0.0000	0.1057	0.3188
LIO_D	0.0088	0.0389	0.0000	0.0000	0.0000	0.0000	0.0000	0.0637	0.2628
LIO_F	0.0052	0.0216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0585	0.1204
SIO	0.0136	0.0358	0.0000	0.0000	0.0000	0.0000	0.0000	0.1026	0.1618
SIO_D	0.0118	0.0334	0.0000	0.0000	0.0000	0.0000	0.0000	0.0970	0.1558
SIO_F	0.0014	0.0096	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0723
LEV	0.4462	0.2054	0.0619	0.1215	0.2804	0.4481	0.5991	0.7844	0.9523
SIZE	25.8142	1.4486	22.7073	23.9897	24.8334	25.5119	26.4777	28.9199	30.4902
AGE	3.1514	0.6524	0.6931	2.0794	2.7081	3.2581	3.6636	4.0254	4.1897
ROA	0.0365	0.0801	-0.2651	-0.1105	0.0061	0.0386	0.0775	0.1559	0.3212
TOBQ	1.1755	0.6804	0.4654	0.5838	0.7921	0.9710	1.2933	2.4867	4.7367
TGBT	0.3148	0.1864	0.0055	0.0232	0.1740	0.3065	0.4403	0.6398	0.8144
BM	1.3335	0.9935	0.1017	0.2579	0.6284	1.0847	1.7338	3.2744	5.5705

This table presents the mean, standard deviation, minimum, 5th percentile, 25th percentile, median, 75th percentile, 95th percentile, and maximum values of the main variables for the sample for March 2005 to September 2015, after winsorizing at the level of 1% and 99%.

Table 2. Correlations

	RNDS	BLOCK_IO	BLOCK_IO_D	BLOCK_IO_F	LIO	LIO_D	LIO_F	SIO	SIO_D	SIO_F
RNDS		-0.0501***	-0.0352***	-0.0449***	-0.0331***	-0.0128	-0.0351***	-0.0454***	-0.0339***	-0.0375***
BLOCK_IO	-0.0462***		0.8679***	0.5006***	0.6063***	0.4339***	0.4011***	0.6342***	0.5902***	0.2240***
BLOCK_IO_D	-0.0432***	0.8767***		0.0742***	0.4061***	0.5000***	0.0502***	0.6437***	0.6804***	0.0322***
BLOCK_IO_F	-0.0144	0.4723***	0.0207**		0.5241***	-0.0259***	0.7968***	0.2172***	0.0634***	0.4530***
LIO	-0.0169*	0.7149***	0.5442***	0.4180***		0.7179***	0.6628***	0.0347***	0.0275***	0.0298***
LIO_D	-0.0186**	0.5718***	0.6535***	-0.0342***	0.8132***		-0.0259***	-0.0133	-0.0115	-0.0095
LIO_F	0.0019	0.3857***	0.0116	0.8062***	0.5074***	-0.0310***		0.0634***	0.0504***	0.0544***
SIO	-0.0403***	0.5541***	0.5689***	0.1859***	-0.0081	-0.0264***	0.0497***		0.9292***	0.3535***
SIO_D	-0.0299***	0.5187***	0.6008***	0.0378***	-0.0104	-0.0230**	0.0361***	0.9392***		0.0068
SIO_F	-0.0361***	0.1882***	0.0116	0.4346***	0.0063	-0.0140	0.0504***	0.3303***	0.0035	

This table presents the correlations between R&D intensity and the main ownership variables. The figures below (above) the diagonal represent the Pearson (Spearman) contemporaneous correlation coefficients. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Influence of institutional blockholdings on firms' R&D activities (logit regression)

	Model 1	Model 2	Model 3	Model 4
Constant	-3.8887***	-4.0909***	-3.6836***	-3.8746***
	(-3.2020)	(-3.3495)	(-2.9599)	(-3.0821)
$BLOCK\_IO_{t-1}$	-1.2498**			
	(-2.4873)			
$BLOCK\_IO\_D_{t-1}$		-1.1117**		
		(-1.9922)		
$BLOCK\_IO\_F_{t-1}$		-3.1285**		
		(-2.2958)		
LIO_{t-1}			-0.8626	
			(-1.1757)	
SIO_{t-1}			-2.2059**	
			(-2.3905)	
LIO_D_{t-1}				-0.8653
				(-0.9716)
LIO_F_{t-1}				-2.9804
				(-1.6290)
SIO_D_{t-1}				-1.5893
				(-1.6062)
SIO_F_{t-1}				-6.6194***
				(-2.7602)
LEV_{t-1}	-0.0726	-0.1044	-0.0653	-0.0827
	(-0.2992)	(-0.4273)	(-0.2717)	(-0.3429)
$SIZE_{t-1}$	0.1889***	0.1976***	0.1806***	0.1885***
	(4.3261)	(4.4900)	(4.0283)	(4.1577)
AGE_{t-1}	-0.4980***	-0.4999***	-0.4960***	-0.4975***
	(-6.2001)	(-6.2280)	(-6.1657)	(-6.1925)
ROA_{t-1}	-1.4767***	-1.4591***	-1.4399***	-1.4284***
	(-2.8342)	(-2.8003)	(-2.6990)	(-2.6796)
$TOBQ_{t-1}$	0.2922***	0.2926***	0.2891***	0.2929***
	(4.4645)	(4.4655)	(4.4038)	(4.4525)
$TGBT_{t-1}$	-0.3519	-0.3558	-0.3565	-0.3599
	(-1.2531)	(-1.2674)	(-1.2658)	(-1.2780)
BM_{t-1}	-0.1200**	-0.1225***	-0.1165**	-0.1175**
	(-2.5644)	(-2.6121)	(-2.4967)	(-2.5199)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	11,497	11,497	11,497	11,497

This table reports the estimation results for the logit regression of institutional blockholding on R&D intensity. The *t*-statistics are provided in parentheses, clustered at the firm and year levels, following Petersen (2009). *** and ** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Influence of total institutional blockholdings on firms' R&D activities

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama–MacBeth	Clustered	Pooled OLS	Fama–MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0186**	0.0202**	0.0186	0.0295	0.0372**	0.0295*
	(2.0604)	(2.4105)	(1.5578)	(1.0387)	(2.9780)	(1.7586)
$BLOCK\_IO_{t-1}$	-0.0100***	-0.0177**	-0.0100**	-0.0173***	-0.0164***	-0.0173***
	(-2.5860)	(-2.5861)	(-2.1533)	(-3.2313)	(-5.1761)	(-2.6885)
LEV_{t-1}	-0.0327***	-0.0358***	-0.0327***	-0.0355***	-0.0327***	-0.0355***
	(-20.9906)	(-9.7790)	(-9.9822)	(-13.3169)	(-10.4461)	(-7.0693)
$SIZE_{t-1}$	0.0003	0.0009*	0.0003	-0.0000	0.0004	-0.0000
	(1.3413)	(1.9527)	(0.6909)	(-0.0661)	(0.7862)	(-0.0335)
AGE_{t-1}	-0.0064***	-0.0075***	-0.0064***	-0.0068***	-0.0068***	-0.0068***
	(-14.5256)	(-5.3677)	(-7.1245)	(-9.9776)	(-19.4982)	(-5.6816)
ROA_{t-1}	-0.0568***	-0.0677***	-0.0568***	-0.0891***	-0.0839***	-0.0891***
	(-15.2614)	(-5.0862)	(-6.0413)	(-12.4986)	(-9.4560)	(-6.4447)
$TOBQ_{t-1}$	0.0076***	0.0058***	0.0076***	0.0080***	0.0069***	0.0080***
	(14.6371)	(3.5146)	(4.6475)	(9.4116)	(4.2833)	(4.9053)
$TGBT_{t-1}$	-0.0118***	-0.0103***	-0.0118***	-0.0131***	-0.0134***	-0.0131***
	(-6.8271)	(-5.2271)	(-4.0155)	(-4.4578)	(-8.7355)	(-3.0026)
BM_{t-1}	-0.0020***	-0.0026***	-0.0020***	-0.0024***	-0.0027**	-0.0024**
	(-5.5816)	(-5.3147)	(-3.5020)	(-3.9689)	(-2.8005)	(-2.2946)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,535	11,535	11,535	3,494	3,494	3,494
R-squared	0.1610	0.2018	0.1610	0.2058	0.3005	0.2058

This table reports the estimation results for the regression of total institutional blockholding on R&D intensity. The columns show the results of the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample, and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Influence of institutional blockholdings on firms' R&D activities, by national origin

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama–MacBeth	Clustered	Pooled OLS	Fama–MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0189**	0.0198**	0.0189	0.0296	0.0358**	0.0296*
	(2.0919)	(2.3568)	(1.5828)	(1.0407)	(2.6832)	(1.7643)
$BLOCK\_IO\_D_{t-1}$	-0.0114**	-0.0173**	-0.0114**	-0.0183***	-0.0165***	-0.0183**
	(-2.5089)	(-2.4807)	(-2.1570)	(-2.9849)	(-3.8366)	(-2.3271)
$BLOCK\_IO\_F_{t-1}$	-0.0049	-0.0185*	-0.0049	-0.0158	-0.0177***	-0.0158
	(-0.5376)	(-2.1483)	(-0.3399)	(-1.5204)	(-4.3246)	(-0.9959)
LEV_{t-1}	-0.0327***	-0.0358***	-0.0327***	-0.0354***	-0.0325***	-0.0354***
	(-20.8796)	(-9.7710)	(-10.0343)	(-13.1745)	(-10.3698)	(-7.1347)
$SIZE_{t-1}$	0.0003	0.0009*	0.0003	-0.0000	0.0004	-0.0000
	(1.2691)	(1.9330)	(0.6571)	(-0.0731)	(0.8080)	(-0.0371)
AGE_{t-1}	-0.0064***	-0.0075***	-0.0064***	-0.0068***	-0.0068***	-0.0068***
	(-14.5326)	(-5.3676)	(-7.1320)	(-9.9973)	(-19.2797)	(-5.6862)
ROA_{t-1}	-0.0568***	-0.0676***	-0.0568***	-0.0886***	-0.0833***	-0.0886***
	(-15.2466)	(-5.0772)	(-6.0308)	(-12.4329)	(-9.4798)	(-6.4420)
$TOBQ_{t-1}$	0.0076***	0.0057***	0.0076***	0.0080***	0.0069***	0.0080***
	(14.6325)	(3.5024)	(4.6414)	(9.3855)	(4.2918)	(4.8850)
$TGBT_{t-1}$	-0.0118***	-0.0103***	-0.0118***	-0.0132***	-0.0135***	-0.0132***
	(-6.8352)	(-5.1069)	(-4.0229)	(-4.4889)	(-8.8283)	(-3.0272)
BM_{t-1}	-0.0020***	-0.0027***	-0.0020***	-0.0024***	-0.0027**	-0.0024**
	(-5.5740)	(-5.3366)	(-3.5031)	(-3.9780)	(-2.8809)	(-2.2927)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,535	11,535	11,535	3,494	3,494	3,494
R-squared	0.1609	0.2020	0.1609	0.2055	0.3011	0.2055

This table reports the estimation results for the regression of institutional blockholding on R&D intensity by national origin. Institutional blockholder ownership is decomposed into domestic (BLOCK_IO_D) and foreign (BLOCK_IO_F) ownership by the national origin of institutional blockholders. The columns show the results of the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Influence of institutional blockholding on firms' R&D activities, by investment horizon

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama-MacBeth	Clustered	Pooled OLS	Fama-MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0209**	0.0240**	0.0209*	0.0326	0.0387**	0.0326*
	(2.3365)	(3.1985)	(1.7509)	(1.1467)	(3.0221)	(1.9064)
LIO_{t-1}	0.0038	-0.0029	0.0038	-0.0016	-0.0061	-0.0016
	(0.6879)	(-0.5943)	(0.5902)	(-0.2529)	(-1.7551)	(-0.2158)
SIO_{t-1}	-0.0249***	-0.0278***	-0.0249**	-0.0228**	-0.0234***	-0.0228**
	(-2.9762)	(-5.2305)	(-2.3913)	(-2.3374)	(-6.5368)	(-2.2905)
LEV_{t-1}	-0.0327***	-0.0353***	-0.0327***	-0.0357***	-0.0326***	-0.0357***
	(-21.0002)	(-10.8371)	(-9.9560)	(-13.3740)	(-10.7270)	(-7.0113)
$SIZE_{t-1}$	0.0002	0.0007	0.0002	-0.0001	0.0003	-0.0001
	(0.9567)	(1.7951)	(0.4816)	(-0.3623)	(0.4921)	(-0.1786)
AGE_{t-1}	-0.0064***	-0.0074***	-0.0064***	-0.0068***	-0.0068***	-0.0068***
	(-14.4485)	(-5.6201)	(-7.0985)	(-9.8894)	(-19.0251)	(-5.6209)
ROA_{t-1}	-0.0560***	-0.0665***	-0.0560***	-0.0855***	-0.0806***	-0.0855***
	(-14.9465)	(-5.0424)	(-5.9247)	(-11.7679)	(-9.6236)	(-6.1695)
$TOBQ_{t-1}$	0.0076***	0.0057***	0.0076***	0.0079***	0.0067***	0.0079***
	(14.6052)	(3.4729)	(4.6830)	(9.2067)	(4.2972)	(4.9183)
$TGBT_{t-1}$	-0.0119***	-0.0109***	-0.0119***	-0.0133***	-0.0136***	-0.0133***
	(-6.8772)	(-6.9846)	(-4.0492)	(-4.5161)	(-8.4030)	(-3.0308)
BM_{t-1}	-0.0020***	-0.0027***	-0.0020***	-0.0023***	-0.0026**	-0.0023**
	(-5.4738)	(-5.2344)	(-3.4564)	(-3.8249)	(-2.7226)	(-2.2142)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,535	11,535	11,535	3,494	3,494	3,494
R-squared	0.1612	0.2016	0.1612	0.2048	0.3001	0.2048

This table reports the estimation results for the regression of institutional blockholding on R&D intensity by the investment horizon. Institutional blockholder ownership is decomposed into long-term (LIO) and short-term (SIO) ownership by the investment horizon of institutional blockholders. The columns show the results of the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Influence of institutional blockholdings on firms' R&D activities, by both national origin and investment horizon

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama–MacBeth	Clustered	Pooled OLS	Fama–MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0206**	0.0266***	0.0206*	0.0318	0.0379***	0.0318*
	(2.2986)	(3.7732)	(1.7182)	(1.1205)	(3.2636)	(1.8395)
LIO_D_{t-1}	0.0034	0.1096	0.0034	-0.0016	-0.0071	-0.0016
	(0.4667)	(1.0623)	(0.3922)	(-0.2035)	(-1.5937)	(-0.1564)
LIO_F_{t-1}	0.0114	-0.3424	0.0114	0.0044	-0.0006	0.0044
	(0.8681)	(-1.0105)	(0.5644)	(0.3236)	(-0.0633)	(0.2294)
SIO_D_{t-1}	-0.0186**	-0.3069	-0.0186	-0.0146	-0.0138**	-0.0146
	(-2.0452)	(-1.0960)	(-1.6256)	(-1.3853)	(-2.6894)	(-1.2071)
SIO_F_{t-1}	-0.0766***	-0.1008***	-0.0766***	-0.0738***	-0.0955***	-0.0738***
	(-2.9159)	(-3.6199)	(-3.8435)	(-2.8349)	(-3.2557)	(-3.9972)
LEV_{t-1}	-0.0326***	-0.0356***	-0.0326***	-0.0354***	-0.0321***	-0.0354***
	(-20.8268)	(-9.8615)	(-10.1038)	(-13.1301)	(-10.6565)	(-7.1539)
$SIZE_{t-1}$	0.0002	0.0008	0.0002	-0.0001	0.0003	-0.0001
	(1.0181)	(1.8147)	(0.5155)	(-0.1796)	(0.5514)	(-0.0880)
AGE_{t-1}	-0.0064***	-0.0074***	-0.0064***	-0.0068***	-0.0068***	-0.0068***
	(-14.4353)	(-5.5131)	(-7.0975)	(-9.8916)	(-18.7131)	(-5.6132)
ROA_{t-1}	-0.0558***	-0.0691***	-0.0558***	-0.0853***	-0.0803***	-0.0853***
	(-14.9137)	(-4.4020)	(-5.9113)	(-11.7519)	(-9.5895)	(-6.1239)
$TOBQ_{t-1}$	0.0076***	0.0037	0.0076***	0.0080***	0.0070***	0.0080***
	(14.6912)	(1.1645)	(4.7161)	(9.3567)	(4.4313)	(5.0398)
$TGBT_{t-1}$	-0.0119***	-0.0093**	-0.0119***	-0.0134***	-0.0135***	-0.0134***
	(-6.8624)	(-3.1606)	(-4.0606)	(-4.5314)	(-8.4693)	(-3.0698)
BM_{t-1}	-0.0020***	-0.0033***	-0.0020***	-0.0023***	-0.0025**	-0.0023**
	(-5.4675)	(-3.4144)	(-3.4697)	(-3.8072)	(-2.7288)	(-2.2054)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,535	11,535	11,535	3,494	3,494	3,494
R-squared	0.1615	0.2058	0.1615	0.2057	0.3034	0.2057

This table reports the estimation results for the regression of institutional blockholding on R&D intensity by both national origin and investment horizon. Institutional blockholder ownership is decomposed into domestic long-

term (LIO_D), foreign long-term (LIO_F), domestic short-term (SIO_D), and foreign short-term (SIO_F) ownership by both the national origin and the investment horizon of institutional blockholders. The columns show the results of the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Influence of institutional blockholdings on firms' R&D activities, by both national origin and investment horizon, controlling for corporate governance quality

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama–MacBeth	Clustered	Pooled OLS	Fama–MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	-0.0086	0.0042	-0.0168	-0.0052	0.0013	-0.0215
	(-0.6653)	(0.2148)	(-1.2709)	(-0.2920)	(0.0809)	(-1.1411)
LIO_D_{t-1}	-0.0077	-0.0235*	-0.0077	-0.0087	-0.0124*	-0.0087
	(-0.9863)	(-2.0786)	(-0.8400)	(-0.8825)	(-2.1706)	(-0.7656)
LIO_F_{t-1}	-0.0084	0.0025	-0.0084	-0.0122	-0.0021	-0.0122
	(-0.6179)	(0.2751)	(-0.3837)	(-0.7221)	(-0.2805)	(-0.4893)
SIO_D_{t-1}	-0.0225***	-0.0308***	-0.0225***	-0.0203*	-0.0202	-0.0203*
	(-2.6454)	(-10.0893)	(-3.0187)	(-1.6475)	(-1.8974)	(-1.8977)
SIO_F_{t-1}	-0.1069**	-0.1092***	-0.1069***	-0.1093**	-0.1032***	-0.1093***
	(-2.5635)	(-5.5984)	(-3.4340)	(-2.2492)	(-5.8704)	(-2.9891)
$KCGS_{t-1}$	0.0001***	0.0001***	0.0001***	0.0001***	0.0001**	0.0001**
	(5.6047)	(8.0852)	(3.6849)	(3.0961)	(3.0430)	(2.4315)
BOD_SIZE_{t-1}	-0.0033***	0.0030	-0.0033**	-0.0028	-0.0021***	-0.0028
	(-2.9021)	(0.5210)	(-2.1604)	(-1.3694)	(-4.4093)	(-1.2744)
IND_PCT_{t-1}	-0.0037	0.0101	-0.0037	-0.0051	-0.0001	-0.0051
	(-1.3225)	(1.0386)	(-0.9134)	(-0.9516)	(-0.0245)	(-1.0075)
LEV_{t-1}	-0.0120***	-0.0039	-0.0120***	-0.0170***	-0.0118**	-0.0170***
	(-6.0379)	(-0.6032)	(-4.6033)	(-4.4701)	(-3.5402)	(-2.9015)
$SIZE_{t-1}$	0.0002	-0.0015	0.0002	0.0002	-0.0006	0.0002
	(0.5203)	(-1.0755)	(0.3152)	(0.3859)	(-0.5990)	(0.2454)
AGE_{t-1}	0.0008	0.0050	0.0008	-0.0002	0.0006	-0.0002
	(1.5538)	(1.5517)	(0.9341)	(-0.2255)	(0.5965)	(-0.1244)
ROA_{t-1}	-0.0298***	0.0052	-0.0298***	-0.0550***	-0.0399**	-0.0550**
	(-5.1898)	(0.2063)	(-3.2793)	(-3.9010)	(-3.1905)	(-2.5217)
$TOBQ_{t-1}$	0.0080***	-0.0024	0.0080***	0.0093***	0.0088**	0.0093**
	(9.7961)	(-0.2397)	(3.3094)	(6.6024)	(3.5568)	(2.1464)
$TGBT_{t-1}$	-0.0022	0.0038	-0.0022	0.0011	0.0021	0.0011
	(-1.0502)	(0.6752)	(-0.8112)	(0.2820)	(1.5140)	(0.2863)
BM_{t-1}	-0.0011***	-0.0031	-0.0011**	-0.0008	-0.0006	-0.0008

	(-2.9277)	(-1.4952)	(-1.9808)	(-1.0638)	(-1.2698)	(-0.7012)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,131	2,131	2,131	800	800	800
R-squared	0.1628	0.3277	0.1628	0.1867	0.2904	0.1867

This table reports the estimation results for the regression of institutional blockholding on R&D intensity by both the national origin and the investment horizon, controlling for corporate governance variables. The columns show the results based on the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9. Influence of heterogeneous institutional blockholdings on firms' R&D activities, depending on the overall corporate governance quality

	$RNDS_t$ (full sample)		$RNDS_t$ (subsample)	
	Lower $KCGS_{t-1}$	Higher $KCGS_{t-1}$	Lower $KCGS_{t-1}$	Higher $KCGS_{t-1}$
Constant	-0.0024	-0.0142	-0.0200	-0.0115
	(-0.1884)	(-0.7961)	(-0.9838)	(-0.3376)
LIO_D_{t-1}	-0.0105	0.0130	-0.0020	0.0202
	(-1.2170)	(0.6707)	(-0.1960)	(0.9062)
LIO_F_{t-1}	-0.0122	-0.0238	0.0077	-0.0461*
	(-0.6682)	(-1.2169)	(0.4188)	(-1.9539)
SIO_D_{t-1}	-0.0221***	-0.0178	-0.0113	-0.0265
	(-3.2546)	(-1.5218)	(-1.5506)	(-1.3984)
SIO_F_{t-1}	-0.0449*	-0.0227	-0.0460*	-0.0007
	(-1.7868)	(-0.6912)	(-1.7349)	(-0.0107)
LEV_{t-1}	-0.0055**	-0.0172***	-0.0117**	-0.0194***
	(-2.2023)	(-4.1300)	(-2.3579)	(-2.6402)
$SIZE_{t-1}$	0.0001	0.0004	0.0006	-0.0000
	(0.2565)	(0.7421)	(0.8197)	(-0.0219)
AGE_{t-1}	-0.0002	0.0013	-0.0033	0.0029*
	(-0.2518)	(1.1902)	(-1.4054)	(1.7023)
ROA_{t-1}	-0.0236***	-0.0462***	-0.0247*	-0.0819***
	(-4.1104)	(-3.1134)	(-1.6874)	(-2.7530)
$TOBQ_{t-1}$	0.0045***	0.0079**	0.0065**	0.0090
	(3.3714)	(2.0368)	(1.9640)	(1.6113)
$TGBT_{t-1}$	-0.0040	-0.0046	-0.0040	0.0016
	(-1.5105)	(-0.9102)	(-1.3503)	(0.1700)
BM_{t-1}	-0.0007**	-0.0016*	-0.0000	-0.0017
	(-2.0356)	(-1.6457)	(-0.0029)	(-1.1934)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	2,137	1,976	720	716
R-squared	0.1077	0.1691	0.1176	0.2212

This table reports the estimation results for the regression of heterogeneous institutional blockholding on R&D intensity, depending on KCGS. The lower (higher) KCGS columns show the results for firms with a lower (higher) KCGS than the median value. The left two columns are for the full sample and the right two columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses and are clustered at the firm and year levels, following Petersen (2009). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10. Influence of heterogeneous institutional blockholdings on firms' R&D activities considering the *Chaebol* effect

	$RNDS_t$ (full sample)			$RNDS_t$ (subsample)		
	Pooled OLS	Fama–MacBeth	Clustered	Pooled OLS	Fama–MacBeth	Clustered
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	-0.0107	0.0039	-0.0158	-0.0163	-0.0102	-0.0331*
	(-0.8201)	(0.1848)	(-1.1999)	(-0.8908)	(-0.9728)	(-1.7107)
LIO_D_{t-1}	-0.0117	-0.0241*	-0.0117	-0.0122	-0.0098**	-0.0122
	(-1.0679)	(-2.0345)	(-1.4063)	(-0.8788)	(-2.7580)	(-1.0444)
LIO_F_{t-1}	0.0173	0.0318	0.0173	0.0229	0.0339*	0.0229
	(1.1032)	(1.7245)	(0.6130)	(1.1563)	(2.1186)	(0.6955)
SIO_D_{t-1}	-0.0177*	-0.0276***	-0.0177**	-0.0107	-0.0102	-0.0107
	(-1.8085)	(-9.9393)	(-2.0830)	(-0.7716)	(-1.3660)	(-1.0442)
SIO_F_{t-1}	-0.1081*	-0.1086*	-0.1081*	-0.1294*	-0.1137**	-0.1294*
	(-1.7996)	(-2.5433)	(-1.9501)	(-1.7920)	(-2.6164)	(-1.7550)
$LIO\_D_{t-1} \times$	0.0078	0.0025	0.0078	0.0084	-0.0007	0.0084
$Chaebol\_D_{t-1}$	(0.5066)	(0.7457)	(0.4216)	(0.4642)	(-0.1859)	(0.3923)
$LIO\_F_{t-1} \times$	-0.0984***	-0.0987**	-0.0984***	-0.1151***	-0.1106**	-0.1151***
$Chaebol\_D_{t-1}$	(-3.2958)	(-3.7786)	(-3.0984)	(-3.4032)	(-4.0049)	(-2.9927)
$SIO\_D_{t-1} \times$	-0.0182	-0.0130	-0.0182	-0.0208	-0.0161**	-0.0208
$Chaebol\_D_{t-1}$	(-1.0688)	(-1.5795)	(-1.1592)	(-1.0621)	(-3.6275)	(-1.4733)
$SIO\_F_{t-1} \times$	0.0098	-0.0096	0.0098	0.0472	0.0138	0.0472
$Chaebol\_D_{t-1}$	(0.1197)	(-0.1481)	(0.1474)	(0.4998)	(0.1647)	(0.5890)
$KCGS_{t-1}$	0.0001***	0.0001***	0.0001***	0.0001***	0.0001**	0.0001**
	(5.5235)	(7.5008)	(3.6564)	(2.8257)	(3.1666)	(2.2695)
BOD_SIZE_{t-1}	-0.0036***	0.0026	-0.0036**	-0.0033	-0.0028***	-0.0033
	(-3.1715)	(0.4481)	(-2.3609)	(-1.6054)	(-7.7516)	(-1.5312)
IND_PCT_{t-1}	-0.0030	0.0107	-0.0030	-0.0032	0.0014	-0.0032
	(-1.0790)	(1.1162)	(-0.7254)	(-0.6023)	(0.3760)	(-0.6148)
LEV_{t-1}	-0.0119***	-0.0039	-0.0119***	-0.0169***	-0.0119**	-0.0169***
	(-5.9748)	(-0.6050)	(-4.5113)	(-4.4560)	(-3.3493)	(-2.8047)
$SIZE_{t-1}$	0.0003	-0.0013	0.0003	0.0007	0.0001	0.0007
	(0.9441)	(-0.8938)	(0.5590)	(1.1239)	(0.0954)	(0.7487)
AGE_{t-1}	0.0008	0.0050	0.0008	-0.0003	0.0007	-0.0003

	(1.4699)	(1.5382)	(0.8828)	(-0.2947)	(0.5665)	(-0.1608)
ROA_{t-1}	-0.0307***	0.0048	-0.0307***	-0.0560***	-0.0401**	-0.0560**
	(-5.3355)	(0.1889)	(-3.3881)	(-3.9922)	(-3.1206)	(-2.5793)
$TOBQ_{t-1}$	0.0079***	-0.0023	0.0079***	0.0092***	0.0087**	0.0092**
	(9.7076)	(-0.2353)	(3.3097)	(6.5094)	(3.6376)	(2.1338)
$TGBT_{t-1}$	-0.0017	0.0041	-0.0017	0.0025	0.0028*	0.0025
	(-0.7878)	(0.7483)	(-0.6217)	(0.6499)	(2.1829)	(0.6899)
BM_{t-1}	-0.0012***	-0.0032	-0.0012**	-0.0009	-0.0008	-0.0009
	(-3.1165)	(-1.5481)	(-2.1347)	(-1.2423)	(-1.8143)	(-0.8408)
Year dummies	Yes	No	Yes	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,131	2,131	2,131	800	800	800
R-squared	0.1679	0.3375	0.1679	0.2008	0.3156	0.2008

This table reports the estimation results for the regression of heterogeneous institutional blockholding on R&D intensity when including *Chaebol* interaction terms. The columns show the results based on the pooled ordinary least squares estimation approach, Fama and MacBeth (1973) cross-sectional regression approach, and two-way clustered standard errors approach, following Peterson (2009), respectively. The standard errors are based on Fama–MacBeth and are adjusted for Newey–West autocorrelations with three lags. The left three columns are for the full sample and the right three columns are for the subsample with positive lagged institutional blockholdings. The *t*-statistics are provided in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11. Influence of heterogeneous institutional blockholdings on firms' R&D activities depending on Amihud's (2002) illiquidity ratio

	Bottom liquidity	Top liquidity
Constant	0.0460	0.0401
	(1.0124)	(0.8911)
LIO_D_{t-1}	0.0056	-0.0201
	(0.3067)	(-1.0274)
LIO_F_{t-1}	-0.0005	0.0546
	(-0.0216)	(1.3135)
SIO_D_{t-1}	-0.0564**	-0.0045
	(-2.4808)	(-0.1534)
SIO_F_{t-1}	-0.1040**	-0.0393
	(-2.0869)	(-0.8202)
LEV_{t-1}	-0.0405***	-0.0248**
	(-4.7201)	(-2.2358)
$SIZE_{t-1}$	-0.0002	-0.0028
	(-0.1020)	(-1.5152)
AGE_{t-1}	-0.0091***	-0.0032*
	(-4.0819)	(-1.9103)
ROA_{t-1}	-0.0717***	-0.0598***
	(-2.8182)	(-2.5892)
$TOBQ_{t-1}$	0.0143***	0.0138**
	(2.9146)	(2.0547)
$TGBT_{t-1}$	-0.0187	-0.0111
	(-1.4654)	(-1.0872)
BM_{t-1}	-0.0016	0.0002
	(-1.2554)	(0.1301)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
Observations	691	694
R-squared	0.2438	0.2198

This table reports the estimation results for the regression of institutional blockholding on R&D intensity in firms with different liquidity. The Bottom (Top) liquidity columns show the results for firms with the highest (lowest) Amihud (2002) illiquidity ratio. The *t*-statistics are provided in parentheses and are clustered at the firm and year levels, following Petersen (2009). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12. Influence of heterogeneous institutional blockholdings on firms' R&D activities (instrument variable approach)

	Model 1	Model 2	Model 3	Model 4
Constant	0.0511***	0.0593***	0.0514***	0.0574***
	(3.0526)	(3.3745)	(3.0085)	(3.1448)
$IND\_BLOCK\_IO_{t-1}$	0.0659*			
	(1.7403)			
$IND\_BLOCK\_IO\_D_{t-1}$		0.0910***		
		(2.6725)		
$IND\_BLOCK\_IO\_F_{t-1}$		-0.0900**		
		(-2.2317)		
IND_LIO_{t-1}			0.0081	
			(0.2731)	
IND_SIO_{t-1}			0.1126**	
			(2.1280)	
$IND\_LIO\_D_{t-1}$				0.0493
				(1.2070)
$IND\_LIO\_F_{t-1}$				-0.0762
				(-0.9319)
$IND\_SIO\_D_{t-1}$				0.1289*
				(1.7829)
$IND\_SIO\_F_{t-1}$				-0.1315*
				(-1.8143)
LEV_{t-1}	-0.0367***	-0.0364***	-0.0363***	-0.0361***
	(-6.8284)	(-6.9788)	(-6.7995)	(-6.8538)
$SIZE_{t-1}$	-0.0003	-0.0004	-0.0001	-0.0003
	(-0.3864)	(-0.6198)	(-0.2105)	(-0.4188)
AGE_{t-1}	-0.0065***	-0.0066***	-0.0065***	-0.0066***
	(-5.4070)	(-5.5146)	(-5.4330)	(-5.5430)
ROA_{t-1}	-0.0869***	-0.0866***	-0.0895***	-0.0882***
	(-6.0362)	(-6.1806)	(-6.0313)	(-6.0674)
$TOBQ_{t-1}$	0.0070***	0.0073***	0.0072***	0.0073***
	(3.7569)	(3.9605)	(3.8190)	(3.8990)
$TGBT_{t-1}$	-0.0101**	-0.0110***	-0.0112***	-0.0120***
	(-2.4739)	(-2.8041)	(-2.9268)	(-3.1106)
BM_{t-1}	-0.0021**	-0.0022**	-0.0021**	-0.0022**
	(-2.0150)	(-1.9955)	(-2.0371)	(-2.0313)
Observations	3,494	3,494	3,494	3,494
R-squared	0.1639	0.1732	0.1641	0.1700

This table reports the estimation results for the regression of the industry average blockholding on R&D intensity. Instrumented institutional blockholdings are calculated as the industry average of the institutional blockholdings of other firms in the same industry in the same year, following Liu et al. (2015). The *t*-statistics are provided in parentheses and are clustered at the firm and year levels, following Petersen (2009). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.