Horizontal Directors and Investment Efficiency

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Abstract

Horizontal directors, board members who also hold board seats in other firms in the same industry, are surprisingly common in boards of U.S. public firms. Emerging scholarship has focused on the potentially detrimental or socially costly effects of horizontal directorships, such as collusion. This paper proposes a benefit of horizontal directorships hitherto not identified in the literature, namely that horizontal directors enhance the efficiency of corporate investment decisions. Horizontal directors enjoy access to valuable industry information, which helps the board fulfill its role of advising and monitoring management. Consistent with this argument, we find that the presence of horizontal directors is negatively related to investment inefficiency, and with over-investment in particular. This effect is stronger in industries with poor information environments and for firms with high free cash flow. An identification strategy based on shocks to board composition coming from events of director deaths and retirements provides a causal interpretation to our findings.

Keywords: horizontal directors; investment efficiency; over-investment

JEL codes: G31; G32; G34

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1. Introduction

The board of directors is the centerpiece of U.S. corporate governance. Boards actively participate in the most crucial business decisions of corporations, such as mergers, the issuance of securities, and key strategic initiatives. Directors contribute to decision-making with their insight and advice, obtained from their expertise and from their network. Boards also play a monitoring role of representing shareholders vis-à-vis management, thereby limiting management’s ability to make decisions that might not be in shareholders’ interests.

A surprising fact about the composition of U.S. boards has recently emerged, in the form of the increased prevalence of “horizontal directors”—directors that hold simultaneous appointments in the boards of same-industry firms (Nili, 2020). In our sample, 37% of public firms have at least one horizontal director in 2020, up from 25% in 2000. One controversial implication of this type of board connection is the possibility of anticompetitive behavior. Research has found that horizontal directorships are positively associated with firm profitability (Geng et al., 2022; Gopalan, Li, and Zaldokas, 2022), albeit at the expense of potentially lower incentives for innovation (Fich, Harford, and Tran, 2021; Cabezón and Hoberg, 2022). Horizontal directors might be particularly exposed to litigation risk, arising either from antitrust regulation or from claims of violation of the duty of loyalty, compared to directors with appointments in unrelated sectors. Nevertheless, the fact that horizontal directorships are widespread indicates that there might be several types of benefits of this practice, and that they might compensate its potential costs.

This paper proposes a benefit of horizontal directorships not identified in the literature until now, namely that horizontal directors might help increase the efficiency of firms’ investment decisions. It is well established, outside of the framework of frictionless capital markets, that moral hazard, information asymmetry, and uncertainty constitute sources of investment inefficiency. We argue that, by the virtue of their positions in same-industry boards, horizontal directors enjoy access to valuable and industry-relevant information flows that can be learned from industry peers. These flows help the board fulfill its advising and monitoring roles, mitigating investment-related frictions. For example, the board might be more effective at curbing managerial tendencies to over-invest in potentially negative net present value (NPV) projects. Alternatively, a better-informed board can help make the company’s strategy more transparent or more credible in the eyes of
outside investors, limiting under-investment problems. Based on this reasoning, we hypothesize that horizontal directorships are associated with enhanced investment efficiency.

To test our hypothesis, we collect a sample of 36,411 firm-year observations from 2000 to 2020. Using data from the BoardEx database, we define horizontal directors as the directors of the focal firm who simultaneously sit on the boards of at least one other firm in the same Fama-French 48 industry. We construct three measures of the prevalence of horizontal directors: a dummy variable if there is at least one horizontal director on the board of the focal firm in a given fiscal year; the number of horizontal directors in the board; and the number of unique same-industry peer firms that share a horizontal director with the focal firm. Regarding investment efficiency, we compute the expected level of investment based on a firm’s investment opportunities, using Richardson’s (2006) model, and use the observed deviation from this expected level as our measure of investment inefficiency.

Our baseline OLS regressions show that the presence and number of horizontal directors is associated with lower investment inefficiency in the subsequent year. Firms with horizontal directors have lower investment inefficiency of 0.5% of lagged firm assets, which represents approximately 6 percentage points of the average investment inefficiency. Univariate tests indicate that, compared to “non-horizontal” directors (who simultaneously serve in multiple boards outside the focal firm’s industry), horizontal directors have more CEO experience. Horizontal directors also serve in more boards of more firms, but their experiences occur more often in single-segment firms and in a more limited number of industries. This suggests that horizontal directors have a profile of strong industry-level ability and expertise.

To provide a causal interpretation to our findings, we employ an identification strategy based on shocks to board composition coming from events of director deaths and retirements. We identify treated firms as those firms that experience a death/retirement event of a horizontal director. As control firms, we use those firms that contend with a death/retirement event of a non-horizontal director that also holds multiple appointments, but not within the same industry as the focal firm. This difference-in-differences (DiD) design makes sure that we capture the differential impact of the departure of a horizontal director, compared to non-horizontal directors with similar levels of busyness and network. We find that the departure of a horizontal director increases investment inefficiency, with larger point estimates than for the OLS regressions.
We test alternative mechanisms for our results in three robustness checks. We add to the baseline regression proxies for the presence of non-horizontal directors. If improvements in investment efficiency are driven by the unconditional size of board members’ networks, rather than specifically by their within-industry connections, we should find that presence of non-horizontal directors should also explain investment efficiency. We find instead that only measures related to horizontal directors are statistically significant. In a second test, we add two additional control variables to the baseline specification. The first variable is firm-level cross-ownership. The literature has suggested that common institutional owners are likely to possess valuable industry expertise (e.g., He and Huang, 2017; He, Li, and Yeung, 2020) and horizontal directorships could potentially be due to common owners (Azar, 2022). We find that this variable has no significant explanatory power in our regressions. The second variable is a measure of the focal firm’s quality of financial reporting (Biddle and Hilary, 2006; Biddle, Hilary, and Verdi, 2009). We find that, although financial reporting quality is strongly negatively related to investment inefficiency, the coefficients for the horizontal director variables are unchanged. In a third test, we change the definition of our dependent variable and exclude R&D from the calculation of investment inefficiency. Fich, Harford, and Tran (2021) and Cabezon and Hoberg (2022) argue that directors with larger networks are more likely to leak intellectual property to competitors, dampening the focal firm’s incentives to produce R&D. We find unchanged results using the modified definition of inefficiency, indicating that our results are driven by changes in overall investment policy.

We then turn our attention to understanding the mechanisms behind our findings and conduct several falsification tests as supporting evidence of our hypothesis.

The ability of information flows from horizontal directors to affect investment efficiency can arise from two channels: mitigating over-investment by enhancing the board’s capacity due to monitoring management, or mitigating under-investment by reducing adverse selection problems. We follow the literature and decompose investment inefficiency into over-investment (positive deviations from the expected level of investment) and under-investment (negative deviations). We find that the presence of horizontal directors is strongly negatively associated with over-investment. In contrast, horizontal directorships do not seem to influence under-investment. Horizontal directors’ informational advantages seem particularly effective at addressing moral hazard and allowing the board to monitor managers more effectively.
Our hypothesis predicts that the importance of horizontal directors’ informational advantage should be higher in industries characterized by lower information production. We split the sample into groups according to industry-level analyst coverage and industry-level percentage of firms that issue capital expenditure forecasts, both of which have been shown to affect investment efficiency (Chen, Xie, and Zhang, 2017; Bae, Biddle, and Park, 2020). The results confirm our prediction that the impact of horizontal directors is more important in industries with lower analyst coverage and in industries with lower frequency of capital expenditure guidance.

The information channel also predicts that horizontal directors’ private signals should be more important for firms with differentiated products, rather than firms that have commodity-like product portfolios for which there is probably a significant amount of information that is readily available from public sources. Splitting the sample firms into groups according to their product differentiation (Hoberg and Phillips, 2016), and R&D intensity, we find that the relation between horizontal directors and investment inefficiency is stronger for firms that have a more differentiated product portfolio and higher R&D intensity, the firms for which information sharing by horizontal directors is potentially more valuable at the margin.

Given our finding that horizontal directors play an important role in mitigating over-investment, we expect that this role is stronger for firms that generate higher free cash flow or that charge higher margins, a sign of a potentially protected market position. Our results show that horizontal directors reduce investment inefficiency in firms with above-median free cash flow generation and above-median price-cost margins. These would presumably be the firms for which moral hazard problems are more significant and in which the monitoring role of the board can be more important.

Our last test uses state-level passage of corporate opportunities waivers to generate cross-sectional variation in the likelihood that horizontal directors share information gathered from their networks. The “corporate opportunity” doctrine is a legal standard that regulates possible financial conflicts of interest between directors and the firms they serve. Its aim is to make sure that directors abide by the duty of loyalty. Horizontal directors are particularly exposed to legal risks regarding this component of fiduciary duty (Nili, 2020). Starting in 2000, Delaware and other states have allowed public firms to execute waivers of corporate opportunity, and a significant number of large corporations used this opportunity (Rauterberg and Talley, 2017). We find that the explanatory
power of horizontal directors regarding investment inefficiency in the focal firm is higher when the industry peer firms, on which these directors sit, operate in states that allow for corporate opportunity waivers. By shielding directors from possible liability, these waivers make it more likely that directors would share valuable industry information from peer firms.

We contribute to the literature on investment inefficiency and on the types of institutional arrangements that can mitigate investment frictions. Taken as a whole, our findings suggest that horizontal directors can play an important informational role that enables boards to learn valuable information from industry peers and use it to monitor management more effectively. This information channel of horizontal directorships had not, as far as we know, been identified in the literature. This finding complements other mechanisms affecting investment efficiency that have been pointed out in the literature, such as auditor quality (Bae et al., 2017), financial reporting quality (Biddle and Hilary, 2006; Biddle, Hilary, and Verdi, 2009), accounting conservatism (García Lara, García Osma, and Penalva, 2016), media coverage (Gao et al., 2021) and competition (Stoughton, Wong, and Yi, 2017).

Our paper also contributes to the emerging literature on horizontal directors. By identifying a benefit of horizontal directorships, our paper contributes to the understanding of why this type of directorships seems increasingly prevalent in public firms. We acknowledge that we do not contend to construct a full theory for the adoption of horizontal directorships. The benefit we identify can coexist with other impacts of horizontal directorships that have been suggested in the literature. Some of these impacts might be privately optimal from the firm’s perspective but socially costly, such as collusive behavior (Geng et al., 2022; Gopalan, Li, and Zaldokas, 2022), or be detrimental to firm value, such as intellectual property misappropriation (Fich, Harford, and Tian, 2021; Cabezon and Hoberg, 2022). All these mechanisms can be seen as a manifestation of horizontal directors’ access to valuable industry information flows, which we argue can be used to, among other things, mitigate investment frictions.

The paper is organized as follows. Section 2 develops our hypotheses. Section 3 focuses on sample construction and characteristics of horizontal directors. Section 4 exposes the baseline findings and our strategy to address causality. Section 5 proposes further tests by splitting investment inefficiency and by looking at cross-sectional heterogeneity in industry and firm characteristics. Section 6 concludes.
2. Hypothesis Development

2.1 Investment efficiency

In a neoclassical world of perfect capital markets, investment choices are solely driven by value maximization. Firms invest until the marginal value of one additional unit of capital equals the marginal adjustment cost of integrating that extra unit. Cash generated by operations is used primarily to fund positive net present value (NPV) investment opportunities; an eventual surplus of generated cash is distributed back to investors, while any shortfall is covered by raising cash from external capital markets. In this frictionless framework, investment would always be efficient.

Outside of this framework, frictions such as moral hazard and adverse selection, as well as uncertainty about key economic parameters, can affect the efficiency of investment. The separation of corporate ownership and control, coupled with differences in the objective function between shareholders and managers, implies that managers might over-invest in negative NPV projects and resist returning cash to investors (e.g., Jensen and Meckling, 1976; Jensen, 1986; Shleifer and Vishny, 1997). The over-investment problem is increasing in the amount of free cash flow that operations render at the management’s disposal (Richardson, 2006). Over-investment will also depend on the extent to which the monitoring by the company’s board of directors will be able to moderate managerial tendencies for excessive investment.

Although moral hazard can also lead to under-investment (Stulz, 1990), the latter is typically explained by adverse selection theories. The lemons problem associated with raising capital might be so severe as to cause credit rationing (e.g., Stiglitz and Weiss, 1981). In equity markets, managers who act in their shareholders’ interest might decide to pass on valuable investment opportunities if raising the necessary equity leads a discounting of the firm’s securities and to transfers of value to outside investors (Myers and Majluf, 1984). Once again, mechanisms that address information asymmetry might help moderate under-investment problems.

More generally, even in situations of reduced moral hazard and low information asymmetry, managers face significant uncertainty about investment outcomes. The latter might depend on macro-, industry-, and firm-specific factors, which might be hard or costly to observe. The extent to which managers can learn about these factors (from peer disclosures, financial analysts, or other information sources) plays an important role in limiting inefficient investment.
2.2 Horizontal directors and information flows

By virtue of their board positions in other economically related firms, horizontal directors have access to information about industry business conditions. For example, horizontal directors may possess direct insights about rivals’ input costs, operations, and performance. These insights might allow a better view of overall industry demand, supply chain risks, or resource constraints. Moreover, horizontal directors might have access to estimates of future earnings, sales growth, and capital expenditures. All these elements imply that horizontal directors can help managers of the focal firm develop more precise estimates of future demand, identify new investment opportunities, and ultimately make more informed investment decisions. Such information flows can also reduce uncertainty about expected investment payoffs and thereby decrease the response time to emerging investment opportunities.

The informational advantages of horizontal directors can be interpreted as a form of learning from peers (Roychowdubry, Shroff, and Verdi, 2019). The literature has documented that peer-firm disclosures affect investment efficiency.¹ One caveat is that peer-firm disclosures can also mislead managers if peer firms misreport performance.² We argue that there is however an important difference between horizontal directors’ information versus peer-firm disclosure information: the former has the advantage that it is more likely to be accurate. The reason for this is that director reputation is a powerful motive of directors’ actions (Masulis and Mobbs, 2014). Horizontal directors’ desire to protect their reputation in the board of the focal firm will very probably lead these directors to filter out misleading or inaccurate information that might be observed from rivals’ disclosures.

The literature has also pointed out at least two other consequences of horizontal directors’ informational advantages. First, horizontal directorships may serve as a coordination device between rival firms, leading to collusion in product markets. Gopalan, Li, and Zaldokas (2022) find that margins increase after a director becomes horizontal due to an indirect board connection, while Geng et al. (2022) report a similar result after the passage of corporate opportunity waiver

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¹ Durnev and Mangen (2020) find that investment efficiency increases when the tone of its rivals’ disclosures carries more news, while Badertscher, Shroff, and White (2013) show that the enhanced disclosure requirements of public firms generate positive externalities that facilitate efficient investment by private firms.
² Durnev and Mangen (2009) find that accounting restatements by peers lead firms to revise their investment decisions, while Beatty, Liao, and Yu (2013) find that fraudulent overstatement of earnings by peers leads managers to mistakenly believe that investment opportunities are excessively favorable, leading to over-investment.
state laws. Second, horizontal directors might wish to capture private benefits associated with informational advantages, namely from intellectual property. Fich, Harford, and Tian (2021) find that public firms decrease investments in innovation after states pass corporate opportunity waiver laws, presumably because horizontal directors face less risk in capturing proprietary information. Cabezón and Hoberg (2022) report that high densities of director networks lead to a higher likelihood of intellectual property leakage. These two effects are not necessarily directly linked to investment efficiency, and they might occur simultaneously with the theory we propose in this article. It is an empirical question if the positive effects of horizontal directors in terms of investment efficiency dominate any negative effects. Nevertheless, in the analysis we examine if efficiency effects are exclusive of changes in R&D, as a way to make sure that we are not only capturing an IP leakage effect.

2.3 Horizontal directors and investment inefficiency

Based on the discussion above, we hypothesize that the presence of horizontal directors in the board can enhance investment efficiency. By collecting and disseminating information from within-industry peers, horizontal directorships contribute to the board’s ability to be an effective monitor of managerial investment activities, reducing moral hazard. To the extent that their contribution to the board might make the communication of the firm or its investment policy more understandable or credible in the eyes of investors, horizontal directors may also help address adverse selection problems, mitigating under-investment. Specifically, we formulate the following main testable hypothesis:

H1. Horizontal directorships are negatively associated with investment inefficiency.

We leave open the possibility that horizontal directorships might contribute to alleviate either over- or under-investment. We therefore break down our main hypothesis in the following two associated testable hypotheses:

H2a. Horizontal directorships are negatively associated with over-investment.

H2b. Horizontal directorships are negatively associated with under-investment.
3. Sample and Research Design

3.1 Sample

Our sample starts with all U.S. public firms with non-missing accounting data that are included in the merged Center for Research in Security Prices (CRSP) and Compustat database. To be included in our sample, we require a firm-year to have positive values for total assets and sales. We further exclude firms in financial industries (Standard Industrial Classification, or SIC, codes 6000–6999) and utility industries (SIC codes 4900-4999). Then, we merge the resulting sample with the BoardEx database to obtain board director information. We require each firm-year to have non-missing board data from the BoardEx database and have at least five board directors. Finally, after removing observations without data to construct key variables for our regressions, our sample consists of 36,411 firm-year observations associated with 3,970 unique firms from 2000 to 2020.

3.2 Variable measurement

3.2.1 Investment inefficiency

We follow the method of Richardson (2006) to construct our measure of investment inefficiency. We first calculate each firm’s yearly investment in new projects, \( I_{New,t} \), by subtracting maintenance investment (proxied by Depreciation and Amortization) from total investment, as follows:

\[
I_{New,t} = \left( \frac{CAPEX_t + Acquisitions_t + RD_t - SalePPET_t}{Total\ Assets_{t-1}} \right) - \left( \frac{Depreciation\ and\ Amortization_t}{Total\ Assets_{t-1}} \right).
\]

We then regress \( I_{New} \) on the determinants of investment decisions, including measures of growth opportunities (\( B2M \)), leverage (\( Leverage \)), cash holdings (\( Cash \)), firm age (\( Firm\ Age \)), firm size (\( Size \)), stock market performance (\( Stock\ Return \)), lagged new investment (\( I_{New,t-1} \)), as well as year and industry fixed effects:

\[
I_{New,t} = \alpha + \beta_1 B2M_{t-1} + \beta_2 Leverage_{t-1} + \beta_3 Cash_{t-1} + \beta_4 Firm\ Age_{t-1} + \beta_5 Size_{t-1} + \beta_6 Stock\ Return_{t-1} + \beta_7 I_{New,t-1}
\]

\( ^3 \) We multiply the investment measure by 100 to express it as a percentage of lagged total assets.
\[ + Year \text{ } FE + Industry \text{ } FE + \varepsilon_t, \]  

*Investment Inefficiency* is defined as the absolute value of the residuals \( \varepsilon_t \) obtained from this regression.

### 3.2.2 Horizontal directors

We define horizontal directors as the directors who simultaneously sit on the boards of more than one firm from the same industry (Nili, 2020). Specifically, a director of firm \( i \) in year \( t \) is considered as a horizontal director if she/he also sits on the board of firm \( j \) in the same year, and firm \( i \) and firm \( j \) are from the same Fama-French 48 industry.

To capture the status of a firm’s horizontal directors in a given fiscal year, we construct three measures. The first measure, *Dummy Horizontal Director*, is a dummy variable that equals one if the firm has at least one horizontal director sitting on the board in a fiscal year, and zero otherwise. The second measure, *Num Horizontal Director*, is the number of horizontal directors sitting on the board of the firm. Both measures capture the presence of horizontal directors on a firm’s board. The third measure, *Num Horizontal Firm*, is the number of unique same-industry peer firms that share any horizontal director with the firm. This measure captures the extent to which a firm is connected to other same-industry peers through horizontal directors.

[Insert Figure 1 here]

Figure 1 shows the pattern of horizontal directors over our sample period. The fraction of U.S. public firms with at least one horizontal director has increased from around 25\% in 2000 to 37\% in 2020, indicating that the presence of horizontal directors has become more widespread. Similarly, during our sample period the average number of horizontal directors per firm has more than doubled from 0.37 to 0.79, while the average number of board directors per firm is relatively stable over time, fluctuating mostly between 8 and 9. As horizontal directors have become more prevalent on the board of U.S. public firms, it is likely that their impact on corporate decisions has become more influential. The average number of same-industry peer firms that are connected via horizontal directors has increased from 0.32 in 2000 to 0.95 in 2020, indicating that a firm’s within-industry connections due to horizontal directors have risen significantly in past decades.
The summary statistics for the sample are displayed in Panel A of Table 1. *Investment Inefficiency* represents on average 7.7% of lagged firm assets. Approximately 32% of sample firm-years have horizontal directors.

[Insert Table 1 here]

Based on prior work experience before joining the current position, Panel B of Table 1 compares the characteristics of horizontal directors to two other director groups: directors that serve in other boards outside the focal firm’s industry (“Non-Horizontal Director”) and directors that only serve in the focal firm’s board (“Single Board Director”). Horizontal directors are more likely to have CEO experience, serve in more boards, and serve in more firms than non-horizontal directors (both differences strongly statistically significant at the 1% level). Due to these features, horizontal directors also show higher index scores of general managerial ability (Custódio, Ferreira, and Matos, 2013). At the same time, compared to non-horizontal directors, horizontal directors have experience in a lower number of industries and less experience of working in conglomerates. These findings indicate that horizontal directors are likely to be industry-level specialists.

3.3 Research design

To examine the effect of horizontal directors on firms’ investment inefficiency, we estimate the following specification using ordinary least squares (OLS):

\[
Investment \text{ Inefficiency}_{i,t+1} = \alpha + \beta \cdot \text{Horizontal Directors}_{i,t} + \gamma \cdot \text{Controls}_{i,t} + \text{Firm FE} + \text{Industry} \times \text{Year FE} + \epsilon_{i,t+1},
\]

in which the dependent variable is a firm’s one-year-ahead investment inefficiency (*Investment Inefficiency*), and the independent variable of interest is one of the three measures for horizontal directors for firm \(i\) in year \(t\). For the two continuous variables, *Num Horizontal Director* and *Num Horizontal Firm*, we use the natural logarithm of one plus the raw values of these measures in the regressions. This also allows us to read the coefficient estimates for these two variables as the unit change in inefficiency caused by a percentage change in the number of horizontal directors.

Regarding the control variables, we incorporate two variables related to a firm’s board structure, board size (*Board Size*) and board independence (*Board Independence*). In addition, we control for a set of variables used in previous studies on investment inefficiency (e.g., Richardson,
2006; Biddle, Hilary, and Verdi, 2009): sales growth (*Sales Growth*), tangible assets (*Tangibility*), the frequency of losses (*Loss*), dividend payout (*Dividend*), financial distress (*Zscore*), operating cash flow (*CFO*), institutional ownership (*Institutional Ownership*), the length of operating cycle (*Operating Cycle*), investment volatility (*SD_Investment*), operating cash flow volatility (*SD_CFO*), and sales volatility (*SD_Sales*). Furthermore, since we use a residual as the dependent variable, we include the first-step regressors in Equation (2) as additional controls to avoid introducing bias into the second-step estimation (Chen, Hribar, and Melessa, 2018).

Finally, we include firm fixed effects to control for unobservable time-invariant within-firm factors and industry-year fixed effects to control for time-varying factors at the industry level that may affect firms’ investment. We cluster standard errors at the firm level.

## 4. Empirical Results

### 4.1 Baseline results

Table 2 presents the baseline results of estimating Equation (3). In Column (1), we use *Dummy Horizontal Director* as the measure for horizontal directors. Its estimated coefficient is negative and statistically significant at the 5% level, suggesting that the presence of horizontal directors on a firm’s board is associated with a lower level of investment inefficiency in the following year. In terms of economic significance, the one-year-ahead investment inefficiency is lower by 0.5% (in percentage of lagged assets) for firms with horizontal directors than for firms without horizontal directors. This estimate represents approximately 6 percentage points of the average investment inefficiency in our sample (equal to 7.7% of lagged assets from Table 1) and approximately 7 percentage points of the interquartile range in investment inefficiency (equal to 7% of lagged assets from Table 1).

[Insert Table 2 here]

In Columns (2) and (3) of Table 2, we report the OLS results using the other two measures of horizontal directors, *Num Horizontal Director* and *Num Horizontal Firm*. The coefficient estimates of both measures are negative and significant at the 5% level. Given that the independent variables are measured in logs, an increase of 100% in *Num Horizontal Director* (going say from

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4 For brevity, we do not report the estimated coefficients for the first-step regressors in our tables.
one horizontal director to two horizontal directors) represents a decrease of 0.47% in one-year-ahead investment inefficiency. A similar result holds when we look at firms being connected to more same-industry peers via horizontal directors.

4.2 Addressing endogeneity issues

Although our baseline results suggest that firms with horizontal directors make more efficient investment decisions, it is possible that our results may stem from endogenous matching between firms and directors. For example, horizontal directors may refrain from sitting on the board of firms making inefficient investment decisions due to reputation concerns within their industry, leading to reverse causality. In addition, even though the baseline specification controls for firm fixed effects and industry-year fixed effects, our results may still be biased due to unobservable time-varying omitted variables that could simultaneously determine the presence of horizontal directors and firms’ investment decisions, such as corporate culture.

To further address these endogeneity issues, we employ a difference-in-differences (DiD) research design based on the events of director deaths and retirements that generate plausible exogenous variation in the level of a firm’s horizontal directors.

We collect data from the BoardEx database on director death and retirement events (a retirement event occurs when an incumbent director departs the focal firm at age 70 or older; e.g., Cai, Nguyen, and Walkling, 2022). Following Fracassi and Tate (2012), we only focus on events affecting independent directors and exclude the events associated with executive directors. The latter are responsible for firms’ daily operations, and a death or retirement of these executive directors could have a direct impact on the decisions directly relevant to operations, such as investment. In contrast, the primary role of independent directors is to monitor and advise management rather than to make operational decisions. Hence, the death or retirement events of independent directors are unlikely to cause changes in firms’ strategic choices that could confound our estimates.

We identify treated firms as those firms that experience a director death/retirement event and the departing director is a horizontal director, and control firms are those firms that undergo a death/retirement event of a non-horizontal director. This design implies that we are capturing the differential impact of the departure of a horizontal director relative to a non-horizontal director,
not the direct impact of the director death or retirement event on its own. Moreover, since horizontal directors hold multiple board seats simultaneously, we exclude from the set of control firms those events for which the departing director is a “single board director”, that is, the director only sits on the focal firm’s board. This makes sure that we are comparing directors with similar levels of busyness and network across treated and control firms. Our sample for this quasi-experiment contains 103 treated firms and 468 control firms.

We perform our DiD estimation using the following specification:

\[
Investment\ Inefficiency_{it+1} = \alpha + \beta_1 \cdot \text{Treat}_i \cdot \text{Post}_t \\
+ \beta_2 \cdot \text{Treat}_i \cdot \beta_3 \cdot \text{Post}_t + \gamma \cdot Controls_{it} \\
+ \text{Firm FE} + \text{Industry} \times \text{Year FE} + \epsilon_{it+1},
\]

(4)

where \text{Treat} is a dummy variable that equals one if the firm \(i\) is identified as a treated firm, and zero otherwise, and \text{Post} is a dummy variable that equals to one if the fiscal year \(t\) is after the event year of director death or retirement, and zero otherwise. We consider a symmetric [-2, +2] window centered on the event year and exclude the event year from the estimation. Table 3 presents the DiD estimation results.

[Insert Table 3 here]

In Columns (1) to (3), we use each of our three horizontal director measures as the dependent variable, respectively. The estimated coefficients of the DiD estimator (\text{Treat} \times \text{Post}) are all significantly negative, which confirm that our identification strategy does enable us to capture the departure of horizontal directors for treatment firms versus control firms. More importantly, in Column (4) where the dependent variable is the measure of investment inefficiency, the coefficient of the DiD estimator (\text{Treat} \times \text{Post}) is positive and significant at the 5% level. The coefficient estimate, 3.5% of lagged assets, is larger than the one found in the OLS results, representing about half of the average Investment Inefficiency. This result might be due to the fact that the event might often represent the loss of the single horizontal director present in the board. Nevertheless, the results indicate that, after the departure of horizontal directors due to death or retirement, treatment firms experience a higher level of investment inefficiency relative to control...
firms in the following year. Overall, our results suggest a causal effect of horizontal directors on firms’ investment inefficiency.

4.3 Robustness tests

We conduct three types of robustness tests, whose results are presented in Table 4.

[Insert Table 4 here]

Our first test examines if the improvement in investment efficiency is driven by the extent to which horizontal directors are connected, rather than driven by horizontal directors’ information advantage within the industry. To examine this possibility, we include in our baseline model measures related to non-horizontal directors and accordingly conduct a horse race. Recall that non-horizontal directors are directors of the focal firm that sit on boards of at least another firm in a different Fama-French 48 industry (and simultaneously do not have any board seat in a firm that operates in the same industry as the focal firm). If the improvements in investment efficiency are driven by the amount of board members connections, then we should find that the presence of non-horizontal directors also explains investment efficiency.

The results, shown in Panel A of Table 4, indicate that the effect of horizontal directors on investment inefficiency remains negative and statistically significant, while non-horizontal directors play an insignificant role in alleviating firms’ investment inefficiency. This suggests that the effect of horizontal directors in mitigating firms’ investment inefficiency is more likely to come from an industry-specific information advantage channel rather than through other aspects of director connectedness. Although prior studies show that director busyness due to multiple directorships might be detrimental to firms (e.g., Falato, Kadyrzhanova, and Lel, 2014; Hauser, 2018), our findings suggest that information advantage obtained from multiple directorships can outweigh the busyness factor when directors are on the board of same-industry firms.

Our second test introduces two additional control variables that have been shown to impact investment efficiency. The first variable is suggested by Azar (2022), who shows that firms owned by common institutional shareholders are more likely to have same directors on their boards. It is therefore possible that our findings are driven by common owners’ (rather than directors’) information sharing. Cross-owners have been found to possess enhanced industry expertise and
produce more relevant industry-specific information (e.g., He and Huang, 2017; He, Li, and Yeung, 2020). We construct a measure of firm-level cross-ownership, defined as the percentage of a firm’s shares outstanding held by all institutional shareholders that simultaneously hold shares of other firms from the same industry. The second variable relates to the work of Biddle, Hilary, and Verdi (2009), who show that the quality of financial reporting is negatively related to investment inefficiency, presumably through a reduction of moral hazard and asymmetric information frictions. We therefore include as control variable the standard deviation of discretionary accruals from Dechow and Dichev (2002).

The results in Panel B of Table 4 show that, after including the cross-ownership and financial reporting quality measures, the estimated coefficients of horizontal director measures remain negative and statistically significant, with similar coefficient estimates. Of the two additional controls, the coefficient of financial reporting quality is strongly negative and statistically significant, while the coefficient of cross-ownership has the expected negative sign but is indistinguishable from zero. The impact of horizontal directors therefore occurs beyond the possible revelation of additional information occurring through earnings quality.

Our third and final test in this section repeats the analysis removing R&D expenditures from the calculation of $I_{New}$, and hence of Investment Inefficiency. Fich, Harford, and Tran (2021), and Geng et al. (2022) argue that horizontal directors’ divided loyalties will lead to lower incentives for investment in R&D in the focal firm, since the possibility of intellectual property leakage is increasing in the number of directors who have overlapping seats in rival firms. It could therefore be the case that our results are driven by changes in R&D, and not by changes in overall investment policy.

The results excluding R&D from the definition in Investment Inefficiency are shown in Panel C of Table 4. The coefficient estimates are slightly lower than the baseline regression (e.g., -0.429 vs. -0.511 in the case of Dummy Horizontal Director), but the statistical significance is basically unchanged. Results on the relation between horizontal directors and investment

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5 Following prior studies on cross-ownership (e.g., He and Huang, 2017; He, Huang, and Zhao, 2019), we only consider institutional shareholders who hold blocks (i.e., equity stakes of 5% or more) in the firms.
efficiency are therefore not driven only by changes in R&D, but reflect broader decisions related to capital expenditures.

5. Further Results

5.1 Over-investment versus under-investment

The ability of information flows from horizontal directors to affect investment efficiency can arise from two channels. On the one hand, more informed directors can mitigate management’s tendencies to engage in negative net present value projects that maximize firm size rather than firm value. On the other hand, enhanced information flows can allow financially constrained firms to attract more capital by reducing adverse selection problems. The first channel would lead to a mitigation of over-investment, the second channel to a mitigation of under-investment.

To investigate whether the effect of horizontal directors on investment inefficiency is manifested mainly by mitigating over-investment or under-investment, we construct two new variables. Over-investment (resp., Under-investment) is equal to the residual from the Equation (2) when the residual is larger (smaller) than zero and set to zero otherwise. Panels A and B of Table 5 present the estimation results with respectively over-investment and under-investment as the dependent variable.

[Insert Table 5 here]

The coefficients of horizontal director measures are all negative and significant at the conventional levels in Panel A. The coefficient estimates (e.g., -0.520 in the case of Dummy Horizontal Director) are very similar to those of the baseline regression. In contrast, the estimates in Panel B are economically and statistically undistinguishable from zero. The results indicate that the overall effect of horizontal directors comes largely from mitigating over-investment tendencies rather than under-investment.

5.2 Cross-sectional tests

In the light of our previous findings, we perform a series of cross-sectional tests as supporting evidence of our hypothesis. The first subsection looks at heterogeneity in the firm’s within-industry information environment. Our hypothesis predicts that the impact of information
flows from horizontal directors should be more important in situations of lower information production at the industry level. The second subsection examines heterogeneity in product market differentiation. Several papers in the existing literature point out that the effects of information sharing by horizontal directors should be stronger for firms that rely on intellectual property as a means to differentiate from competitors (e.g., Cabezon and Hoberg, 2022). The underlying intuition is that for commoditized products there is probably a lot of information that is readily available, while for differentiated products directors’ private signals might be more informative at the margin. The third subsection looks at cash flow generation and margins. If horizontal directors play a role in mitigating over-investment, as shown in the previous section, we expect that this mitigating effect is more important for firms that generate higher free cash flow or that operate from a protected market position.

5.2.1 Information environment

To investigate whether the effect of horizontal directors on investment inefficiency is moderated by the quality of the surrounding industry information environment, we use two variables: Industry-Level Analyst Coverage, defined as the percentage of firms that are followed by at least one financial analyst within the Fama-French 48 industry in a given year, and Industry-Level Capital Expenditure Forecast, defined as the percentage of firms that issue capital expenditure (capex) forecasts within the Fama-French 48 industry in a given year. The former variable is inspired the work of Chen, Xie, and Zhang (2017), while Bae, Biddle, and Park (2020) show that the availability of capex guidance is positively associated with investment efficiency, in part because of analysts’ reactions to those capex disclosures.6

For each one of these variables, we split the sample according to their yearly medians, and run separately our baseline model for “High” (above median) and “Low” (below median) firm-years. The results are presented in Table 6.

[Insert Table 6 here]

The results confirm our earlier predictions. Panel A shows that the impact of horizontal directors is more important in industries with low analyst coverage. The magnitude of the

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6 See also Choi et al. (2020) for evidence on the relation between analysts’ capex forecasts and investment efficiency.
coefficients is larger than in the baseline results, almost doubling for the variables *Num Horizontal Director* and *Num Horizontal Firm* (e.g., -0.902 vs. -0.471 in the case of *Num Horizontal Director*). The bottom row presents a formal statistical test of the difference in the coefficient of the main independent variable across the High and Low groups, confirming that they are statistically different.\(^7\) In Panel B, we also find evidence that it is in the case of poor information environments, epitomized in this case by the relative absence of industry-wide availability of capex guidance, that horizontal directors play a stronger role in mitigating investment inefficiency.

### 5.2.2 Product market differentiation

We follow a similar strategy regarding product differentiation, using two variables to cut our sample into groups. Our first variable (*Product Differentiation*) is based on the product similarity measure of Hoberg and Phillips (2016), which is a total similarity score of a firm’s product with its closest competitors. We multiply the similarity measure by \(-1\) to capture product differentiation. The second variable is *R&D Intensity*, computed as R&D expenditure divided by total assets, which we take as a measure of firm-specific intellectual property. Table 7 presents the results of estimating the baseline model for above median and below median observations for each one of these variables.

[Insert Table 7 here]

Panel A shows that the relation between horizontal directors and investment inefficiency is stronger for firms that have a more differentiated product portfolio. The estimates are again substantially larger coefficients than in the baseline results (e.g., -0.756 vs. -0.511 for the dummy variable *Dummy Horizontal Director*, which would represent 9.8% of the unconditional average *Investment Inefficiency*). In Panel B, results are more balanced in terms of magnitude, and the bottom row shows that two of the three coefficient differences are significant at the 10% level. Nevertheless, the statistical significance of the horizontal director variables is concentrated in the group of high *R&D Intensity*, presumably the group of firms for which information sharing would be potentially more valuable at the margin.

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\(^7\) We follow Cleary (1999) and use a bootstrapping procedure to calculate the p-value for the significance of observed differences in coefficient estimates.
5.2.3 Cash generation and margins

Our third cross-sectional test divides our sample into groups formed on the basis of above/below median Free Cash Flow (defined as operating income before depreciation minus interest expense minus income taxes minus capital expenditures, divided by total assets) and above/below median Markup (the logarithm of sales divided by cost of goods sold). All else equal, firms with higher cash generating capacity or that benefit from protected market positions are more likely to suffer from managerial tendencies for over-investment, enhancing the potential role of horizontal directors in mitigating those tendencies. The results are presented in Table 8.

The test results are in accordance with our predictions and the previous findings on over-investment. Horizontal directors contribute to reduce Investment Inefficiency in firms with above-median Free Cash Flow generation and above-median margins, with again slightly higher coefficients relative to the baseline regressions. All differences in coefficient estimates of the horizontal director variables are significantly different at the 6% level or better. The results confirm that horizontal directors’ information sharing might play a role in mitigating moral hazard problems for firms whose businesses generate significant resources that managers can use to pursue their private goals.

5.3 Horizontal directors and Corporate Opportunities Waivers (COW)

A key Delaware legal doctrine regarding directors’ duty of loyalty is the “corporate opportunity” doctrine, which forbids corporate fiduciaries from personally appropriating business opportunities without offering them to the company (Rauterberg and Talley, 2017). Historically, this doctrine imposed potential legal liability for directors appointed to multiple boards, if directors acquired information as part of their duties in a focal board that could potentially be relevant for another corporation on whose board they would happen to have a seat. The requirement of undivided loyalty was penalizing for business groups or situations in which directors simultaneously held seats in the parent company and in some of the parent company’s subsidiaries or joint-ventures. As a result, starting in 2000, Delaware and other U.S. states provided corporations the right to waive corporate opportunity for their directors, and “thousands of public corporations” have since then adopted them (Rauterberg and Talley, 2017).
Although measuring the existence of COW at the firm-level is difficult, state-level passage of COW laws has been used in the literature to study the implications of corporate opportunity waivers on innovation and competition (Fich, Harford, and Tran, 2021; Cabezon and Hoberg, 2022; Geng et al., 2022; Gopalan, Li, and Zaldokas, 2022). In states that have implemented COW laws, directors face reduced legal risk and are therefore more likely to potentially share information that is relevant for investment decisions. This might be particularly important in the case of horizontal directors, who have overlapping mandates in the focal and in rival firms, because these positions would be the ones most likely to come under scrutiny regarding the duty of loyalty.

For these reasons, we expect that the effect of horizontal directors is more strongly concentrated in states with decreased legal risk, that is, states that passed COW laws. We re-run the baseline regression splitting each horizontal director variable into two parts: one related to horizontal directors for which the connected firms (not the focal firms) are incorporated in states that allow for COW, and a second one measuring horizontal directors for which the connected firms are incorporated in states without COW laws. For example, the variable *Num Horizontal Director with COW* only counts horizontal directors of firm *i* for which the horizontally connected firm *j* is incorporated in a state that has already passed COW legislation in a given year. The results are presented in Table 9.

[Insert Table 9 here]

Across the three measures, we find that both the coefficients of horizontal directors in states with and without COW laws have a negative loading on *Investment Inefficiency*. However, the explanatory power of horizontal directors is concentrated in the set of directors whose connections rely on firms incorporated in states that have passed COW laws. This reinforces the argument that information sharing is the channel through which horizontal directors enhance investment allocation.

### 6. Conclusion

One of the most surprising trends in U.S. corporate governance over the last decades is the increased frequency with which directors of public corporations hold overlapping appointments in the boards of potential industry rivals. Horizontal directors are probably skilled individuals whose
industry-level expertise is in high demand (their brief characterization provided in this paper supports this possibility, as we find that they are more likely to have prior experience as CEOs and less likely to have worked in conglomerates). But their main advantage is that, compared to other directors who might have substantial networks in other industries, horizontal directors have access to particularly valuable and industry-relevant information flows because of the board positions that they occupy. Boards might therefore choose to have horizontal directors among their midst because they consider that the benefits of this institutional arrangement outweigh their potential disadvantages.

Most of the emerging literature on horizontal directors focuses on possible controversial or detrimental consequences of horizontal directorships, such as the possibility of market collusion (Geng et al., 2022; Gopalan, Li, and Zaldokas, 2022), intellectual property leakage (Cabezon and Hoberg, 2022) and lower incentives to engage in R&D activities (Fich, Harford, and Tian, 2021). These effects are a direct consequence of horizontal directors’ access to industry information flows. The question is whether directors would use such information to the benefit of the focal firm (e.g., as a collusive device), or to their own private benefit (e.g., to prey on innovative opportunities).

This paper provides evidence of a more positive channel hitherto not identified in the literature, namely the fact that horizontal directors might help increase the efficiency of firms’ investment decisions. Our argument is that, by producing and collecting information from other within-industry sources, horizontal directorships contribute with valuable information to board of the focal firm, helping address managerial moral hazard and information asymmetry problems.

We find that the presence and number of horizontal directors are associated with lower investment inefficiency. Using retirement and death events, we find support for a causal interpretation of our findings. Horizontal directors seem to be particularly effective at mitigating over-investment tendencies, which is consistent with addressing moral hazard behavior by agency conflicted managers. We find that the effect of horizontal directorships is stronger in industries with poor information environment, firms for which product differentiation is important, and firms with high cash flow generation capacity. The effect is present even if we exclude R&D spending from the investment inefficiency measure, indicating that the effect we are documenting is complementary to problems of intellectual property leakage. Finally, we observe that the impact of horizontal directorships is stronger for the case of peer firms located in states that allow for
corporate opportunity waivers. By shielding directors from possible liability, these waivers make it more likely that directors would share valuable industry information.

Our analysis only points out one possible benefit of horizontal directorships, brought about by their information capabilities. Our empirical analysis is therefore reduced-form and partial equilibrium in nature. A full overview of all the benefits and costs of horizontal directorships, and how companies might decide to accept them, is outside the scope of our paper. One possible avenue for future research would be to study possible complementarities between horizontal directorships and other governance mechanisms in limiting moral hazard problems. We leave this possibility for future work.
References


## Appendix A. Variable Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age of the director in years.</td>
</tr>
<tr>
<td>Board Independence</td>
<td>The percentage of independent directors on the board.</td>
</tr>
<tr>
<td>CEO Experience</td>
<td>A dummy variable that equals one if a director held a CEO position at another firm during past work experience in publicly traded firms, and zero otherwise.</td>
</tr>
<tr>
<td>CFO</td>
<td>Operating cash flow divided by sales.</td>
</tr>
<tr>
<td>Conglomerate Experience</td>
<td>A dummy variable that equals one if a director worked at a multi-segment firm during past work experience in publicly traded firms, and zero otherwise.</td>
</tr>
<tr>
<td>Cross Ownership</td>
<td>The percentage of a firm’s shares outstanding held by all institutional shareholders that simultaneously hold shares of other firms from the same industry, and we only consider institutional shareholders who hold blocks (i.e., equity stakes of 5% or more) in the firms.</td>
</tr>
<tr>
<td>Dividend</td>
<td>A dummy variable that equals one if the firm pays dividend, and zero otherwise.</td>
</tr>
<tr>
<td>Dummy Horizontal Director</td>
<td>A dummy variable that equals to one if a firm has at least one horizontal director, and zero otherwise. A director of firm i at year t is considered as a horizontal director if this director also sits on the board of firm j at the same year, and firm i and firm j are from the same Fama-French 48 industry.</td>
</tr>
<tr>
<td>Dummy Horizontal Director with COW</td>
<td>A dummy variable that equals to one if at least one of the firm’s horizontal directors sit on the same-industry firm that is incorporated in a state with COW legislation in a given year, and zero otherwise.</td>
</tr>
<tr>
<td>Dummy Horizontal Director without COW</td>
<td>A dummy variable that equals to one if none of the firm’s horizontal directors sit on the same industry-firm that is incorporated in a state with COW legislation in a given year, and zero otherwise.</td>
</tr>
<tr>
<td>Dummy Non-Horizontal Director</td>
<td>A dummy variable that equals to one if a firm has at least one non-horizontal director, and zero otherwise. A director of firm i at year t is considered as a non-horizontal director if this director also sits on the board of firm j at the same year, and firm i and firm j are from different Fama-French 48 industries.</td>
</tr>
<tr>
<td>Female</td>
<td>A dummy variable that equals to one if the director is female, and zero otherwise.</td>
</tr>
<tr>
<td>Financial Reporting Quality</td>
<td>Standard deviation of discretionary accruals over years $t-5$ to $t-1$ (Biddle, Hilary, and Verdi, 2009). The discretionary accruals are estimated using the Dechow and Dichev (2002) model.</td>
</tr>
<tr>
<td>Firm Age</td>
<td>The natural logarithm of the number of years that the firm has appeared in Compustat.</td>
</tr>
<tr>
<td>Free Cash Flow</td>
<td>Operating income before depreciation minus interest expense minus income taxes minus capital expenditures, divided by total assets.</td>
</tr>
<tr>
<td>GAI Index</td>
<td>First factor from applying principal components analysis to five variables, including Num Position, Num Firm, Num Industry, CEO Experience, and Conglomerate Experience. Following Custódio, Ferreira, and Matos (2013), the index is standardized to have zero mean and a standard deviation of one.</td>
</tr>
<tr>
<td>$I_{New}$</td>
<td>Total investment expenditure minus maintenance investment expenditure, where total investment expenditure is calculated as the sum of capital expenditure,</td>
</tr>
</tbody>
</table>
acquisition expenditure, and R&D expenditure minus sale of property, plant and equipment, and maintenance investment expenditure is proxied by depreciation and amortization. The investment measure is scaled by lagged total assets and then expressed as a percentage of lagged total assets by multiplying it by 100.

<table>
<thead>
<tr>
<th>Industry-Level Analyst Coverage</th>
<th>The percentage of firms that are followed by at least one financial analyst within the Fama-French 48 industry in a given year.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry-Level Capital Expenditure Forecast</td>
<td>The percentage of firms that issue capital expenditure forecasts within the Fama-French 48 industry in a given year.</td>
</tr>
<tr>
<td>Investment Inefficiency</td>
<td>The absolute value of residuals from regressing investment expenditure on new projects ($I_{New}$) on a set of firm characteristics, including book-to-market ratio ($B2M$), leverage ($Leverage$), cash holding ($Cash$), firm age ($Firm Age$), size ($Size$), stock returns ($Stock Return$), and lagged new investment (Richardson, 2006).</td>
</tr>
<tr>
<td>Institutional Ownership</td>
<td>The percentage of a firm’s shares outstanding held by institutional investors.</td>
</tr>
<tr>
<td>Leverage</td>
<td>The ratio of total debt to total assets.</td>
</tr>
<tr>
<td>Ln(Num Size)</td>
<td>The natural logarithm of one plus the number of directors on the board.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td>The natural logarithm of one plus the number of horizontal directors.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Director with COW)</td>
<td>The natural logarithm of one plus the number of horizontal directors who sit on the same-industry firm that is incorporated in a state with COW legislation in a given year.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Director without COW)</td>
<td>The natural logarithm of one plus the number of horizontal directors who sit on the same-industry firm that is incorporated in a state without COW legislation in a given year.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td>The natural logarithm of one plus the number of firms connected via horizontal directors.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm with COW)</td>
<td>The natural logarithm of one plus the number of firms that are incorporated in states with COW legislation connected via horizontal directors in a given year.</td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm without COW)</td>
<td>The natural logarithm of one plus the number of firms that are incorporated in states without COW legislation connected via horizontal directors in a given year.</td>
</tr>
<tr>
<td>Ln(Num Non-Horizontal Director)</td>
<td>The natural logarithm of one plus the number of non-horizontal directors.</td>
</tr>
<tr>
<td>Ln(Num Non-Horizontal Firm)</td>
<td>The natural logarithm of one plus the number of firms connected via non-horizontal directors.</td>
</tr>
<tr>
<td>Loss</td>
<td>A dummy variable that equals one if net income before extraordinary items is negative, and zero otherwise.</td>
</tr>
<tr>
<td>Markup</td>
<td>The logarithm of sales divided by cost of goods sold.</td>
</tr>
<tr>
<td>Num Firm</td>
<td>The number of firms where a director has worked during past work experience in publicly traded firms.</td>
</tr>
<tr>
<td>Num Industry</td>
<td>The number of Fama-French 48 industries where a director has worked during past work experience in publicly traded firms.</td>
</tr>
<tr>
<td>Num Other Board</td>
<td>The number of other firms where the director sits on the board.</td>
</tr>
<tr>
<td>Num Position</td>
<td>The number of positions a director has had during past work experience in publicly traded firms.</td>
</tr>
<tr>
<td>Operating Cycle</td>
<td>The natural logarithm of receivables to sales plus inventory to cost of goods sold multiplied by 360.</td>
</tr>
<tr>
<td>Over-Investment</td>
<td>The residual from the Richardson (2006) model if the residual is larger than zero, and zero otherwise.</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Product Differentiation</td>
<td>The total similarity measure of a firm’s product developed by Hoberg and Phillips (2016). We multiple the similarity measure by -1 to capture product differentiation.</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>R&amp;D expenditure divided by total assets.</td>
</tr>
<tr>
<td>Sales Growth</td>
<td>Annual growth of sales from the prior year.</td>
</tr>
<tr>
<td>SD_CFO</td>
<td>Standard deviation of the operating cash flows divided by average total assets over years t-5 to t-1.</td>
</tr>
<tr>
<td>SD_Investment</td>
<td>Standard deviation of investment over years t-5 to t-1.</td>
</tr>
<tr>
<td>SD_Sales</td>
<td>Standard deviation of the sales divided by average total assets over years t-5 to t-1.</td>
</tr>
<tr>
<td>Size</td>
<td>The natural logarithm of total assets.</td>
</tr>
<tr>
<td>Stock Return</td>
<td>Annual cumulative return of the firm’s stock.</td>
</tr>
<tr>
<td>Tangibility</td>
<td>Net property, plant, and equipment divided by total assets.</td>
</tr>
<tr>
<td>Under-Investment</td>
<td>The residual from the Richardson (2006) model if the residual is smaller than zero, and zero otherwise.</td>
</tr>
<tr>
<td>Zscore</td>
<td>Z-Score is calculated as 3.3*(EBIT/total assets) + 1.0*(sales/total assets) + 0.6*(market value of equity/liabilities) + 1.2*(working capital/total assets) + 1.4*(retained earnings/total assets).</td>
</tr>
</tbody>
</table>
Figure 1. Frequency Distribution of Horizontal Directorships Over Time

This figure plots the annual percentage of sample firms with at least one horizontal director throughout our sample period (solid line). The figure also shows on the right-hand axis the average number of horizontal directors sitting on the board of the firm (dashed line) and the number of unique same-industry peer firms that share any horizontal director with the firm (dotted line). Horizontal directors are defined as those directors of the focal firm who simultaneously sit on the boards of at least one other firm in the same Fama-French 48 industry.
Table 1. Summary Statistics

Panel A presents the summary statistics for the regression sample. The sample consists of 36,411 firm-year observations from 2000 to 2020. Please refer to the Appendix for detailed definitions of variables. Panel B presents the univariate comparison of personal characteristics for three types of directors: horizontal directors, non-horizontal directors, and single board directors. A director is considered as a horizontal director if the director simultaneously sits on the boards of at least one other firm that operates in the same Fama-French 48 industry as the focal firm in a given year. A director is considered as a non-horizontal director if the director also sits on boards of at least another firm in a different Fama-French 48 industry in a given year (and simultaneously do not have any board seat in a firm that operates in the same industry as the focal firm). A director is considered as a single board director if the director only sits on the board of the focal firm in a given year. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

### Panel A

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>P25</th>
<th>P50</th>
<th>P75</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{New}</td>
<td>36,411</td>
<td>9.262</td>
<td>16.095</td>
<td>0.092</td>
<td>4.107</td>
<td>12.454</td>
</tr>
<tr>
<td>Dummy Horizontal Director</td>
<td>36,411</td>
<td>0.328</td>
<td>0.469</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Num Horizontal Director</td>
<td>36,411</td>
<td>0.595</td>
<td>1.088</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Num Horizontal Firm</td>
<td>36,411</td>
<td>0.665</td>
<td>1.383</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Board Size</td>
<td>36,411</td>
<td>8.392</td>
<td>2.211</td>
<td>7.000</td>
<td>8.000</td>
<td>10.000</td>
</tr>
<tr>
<td>Board Independence</td>
<td>36,411</td>
<td>0.819</td>
<td>0.097</td>
<td>0.778</td>
<td>0.857</td>
<td>0.889</td>
</tr>
<tr>
<td>Sales Growth</td>
<td>36,411</td>
<td>0.127</td>
<td>0.429</td>
<td>-0.025</td>
<td>0.068</td>
<td>0.183</td>
</tr>
<tr>
<td>Tangibility</td>
<td>36,411</td>
<td>0.238</td>
<td>0.220</td>
<td>0.073</td>
<td>0.161</td>
<td>0.334</td>
</tr>
<tr>
<td>Loss</td>
<td>36,411</td>
<td>0.311</td>
<td>0.463</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Dividend</td>
<td>36,411</td>
<td>0.406</td>
<td>0.491</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Zscore</td>
<td>36,411</td>
<td>0.360</td>
<td>3.908</td>
<td>0.026</td>
<td>0.088</td>
<td>0.160</td>
</tr>
<tr>
<td>CFO</td>
<td>36,411</td>
<td>0.111</td>
<td>0.150</td>
<td>0.106</td>
<td>-0.039</td>
<td>0.006</td>
</tr>
<tr>
<td>Institutional Ownership</td>
<td>36,411</td>
<td>0.311</td>
<td>0.463</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Operating Cycle</td>
<td>36,411</td>
<td>0.238</td>
<td>0.220</td>
<td>0.073</td>
<td>0.161</td>
<td>0.334</td>
</tr>
<tr>
<td>SD_Investment</td>
<td>36,411</td>
<td>0.311</td>
<td>0.463</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>SD_CFO</td>
<td>36,411</td>
<td>0.311</td>
<td>0.463</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>SD_Sales</td>
<td>36,411</td>
<td>0.311</td>
<td>0.463</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

### Panel B

<table>
<thead>
<tr>
<th></th>
<th>Horizontal Director (N=21,657)</th>
<th>Non-Horizontal Director (N=88,067)</th>
<th>Single Board Director (N=195,819)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>Num Position</td>
<td>4.369</td>
<td>4.090</td>
<td>1.608</td>
</tr>
<tr>
<td>Num Firm</td>
<td>4.586</td>
<td>3.830</td>
<td>1.224</td>
</tr>
<tr>
<td>Num Industry</td>
<td>2.377</td>
<td>2.786</td>
<td>0.898</td>
</tr>
<tr>
<td>CEO Experience</td>
<td>0.306</td>
<td>0.290</td>
<td>0.082</td>
</tr>
<tr>
<td>Conglomerate Exp.</td>
<td>0.890</td>
<td>0.948</td>
<td>0.482</td>
</tr>
<tr>
<td>Num Other Board</td>
<td>1.698</td>
<td>1.481</td>
<td>--</td>
</tr>
<tr>
<td>Age</td>
<td>61.727</td>
<td>63.040</td>
<td>61.261</td>
</tr>
<tr>
<td>Female</td>
<td>0.406</td>
<td>0.491</td>
<td>0.224</td>
</tr>
<tr>
<td>GAI Index</td>
<td>0.761</td>
<td>0.748</td>
<td>0.012</td>
</tr>
</tbody>
</table>

The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.
Table 2. Baseline Results

This table presents the results of the baseline model. The dependent variable is the measure of investment inefficiency, which is calculated as the absolute value of residuals from the Richardson (2006) model. In Column (1), **Dummy Horizontal Director** is a dummy variable that equals to one if a firm has at least one horizontal director, and zero otherwise. In Column (2), **Ln(Num Horizontal Director)** is the natural logarithm of one plus the number of horizontal directors. In Column (3), **Ln(Num Horizontal Firm)** is the natural logarithm of one plus the number of firms connected via horizontal directors. For control variables, we include a set of firm characteristic variables as well as the regressors used in the Richardson (2006) model. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

<table>
<thead>
<tr>
<th>Dependent Variable: Investment Inefficiency</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.511**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td></td>
<td>-0.471**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.97)</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td></td>
<td>-0.523**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-2.24)</td>
</tr>
<tr>
<td>Ln(Board Size)</td>
<td>0.293</td>
<td>0.315</td>
<td>0.320</td>
</tr>
<tr>
<td></td>
<td>(0.53)</td>
<td>(0.57)</td>
<td>(0.58)</td>
</tr>
<tr>
<td>Board Independence</td>
<td>-1.118</td>
<td>-1.125</td>
<td>-1.113</td>
</tr>
<tr>
<td></td>
<td>(-1.06)</td>
<td>(-1.07)</td>
<td>(-1.06)</td>
</tr>
<tr>
<td>Sales Growth</td>
<td>0.059</td>
<td>0.058</td>
<td>0.059</td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td>(0.34)</td>
<td>(0.34)</td>
</tr>
<tr>
<td>Tangibility</td>
<td>0.537</td>
<td>0.525</td>
<td>0.529</td>
</tr>
<tr>
<td></td>
<td>(0.44)</td>
<td>(0.43)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Loss</td>
<td>-0.549***</td>
<td>-0.551***</td>
<td>-0.549***</td>
</tr>
<tr>
<td></td>
<td>(-3.33)</td>
<td>(-3.34)</td>
<td>(-3.33)</td>
</tr>
<tr>
<td>Dividend</td>
<td>0.688***</td>
<td>0.691***</td>
<td>0.689***</td>
</tr>
<tr>
<td></td>
<td>(3.02)</td>
<td>(3.04)</td>
<td>(3.03)</td>
</tr>
<tr>
<td>Zscore</td>
<td>-0.022</td>
<td>-0.022</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(-0.98)</td>
<td>(-0.98)</td>
<td>(-0.99)</td>
</tr>
<tr>
<td>CFO</td>
<td>0.025</td>
<td>0.025</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>(0.80)</td>
<td>(0.81)</td>
<td>(0.81)</td>
</tr>
<tr>
<td>Intuitional Ownership</td>
<td>0.780</td>
<td>0.777</td>
<td>0.783</td>
</tr>
<tr>
<td></td>
<td>(1.26)</td>
<td>(1.26)</td>
<td>(1.26)</td>
</tr>
<tr>
<td>Operating Cycle</td>
<td>-0.012</td>
<td>-0.008</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-0.06)</td>
<td>(-0.04)</td>
<td>(-0.03)</td>
</tr>
<tr>
<td>SD_Investment</td>
<td>-0.079***</td>
<td>-0.079***</td>
<td>-0.079***</td>
</tr>
<tr>
<td></td>
<td>(-8.82)</td>
<td>(-8.84)</td>
<td>(-8.85)</td>
</tr>
<tr>
<td>SD_CFO</td>
<td>-1.399</td>
<td>-1.407</td>
<td>-1.425</td>
</tr>
<tr>
<td></td>
<td>(-0.68)</td>
<td>(-0.69)</td>
<td>(-0.69)</td>
</tr>
<tr>
<td>SD_Sales</td>
<td>0.503</td>
<td>0.509</td>
<td>0.508</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(1.03)</td>
<td>(1.03)</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.235</td>
<td>0.235</td>
<td>0.235</td>
</tr>
<tr>
<td>N</td>
<td>36,411</td>
<td>36,411</td>
<td>36,411</td>
</tr>
</tbody>
</table>


This table presents the results using a difference-in-differences (DiD) setting to address endogeneity issues. We employ a DiD setting based on the events of director deaths and retirements that generate plausibly exogenous variation in the status of a firm’s horizontal directors. Specifically, we identify treated firms as the firms that experience a director death/retirement event and the departing director is a horizontal director, and control firms are the firms that undergo a death/retirement event of a non-horizontal director. Treat is a dummy variable that equals one if the firm is identified as a treated firm, and zero otherwise. Post is a dummy variable that equals to one if the fiscal year is after the event year of director death or retirement, and zero otherwise. We consider a symmetric [-2, +2] window centered on the event year and exclude the event year from the DiD estimation. In Columns (1) to (3), the dependent variable is one of the three horizontal director measures, respectively. In Column (4), the dependent variable is the measure of investment inefficiency. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Dummy Horizontal Director</th>
<th>Ln(Num Horizontal Director)</th>
<th>Ln(Num Horizontal Firm)</th>
<th>Investment Inefficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Treat × Post</td>
<td>-0.305***</td>
<td>-0.430***</td>
<td>-0.433***</td>
<td>3.518**</td>
</tr>
<tr>
<td></td>
<td>(-4.25)</td>
<td>(-5.74)</td>
<td>(-5.60)</td>
<td>(1.97)</td>
</tr>
<tr>
<td>Treat</td>
<td>0.242***</td>
<td>0.271***</td>
<td>0.337***</td>
<td>1.076</td>
</tr>
<tr>
<td></td>
<td>(4.11)</td>
<td>(5.35)</td>
<td>(4.55)</td>
<td>(0.58)</td>
</tr>
<tr>
<td>Post</td>
<td>-0.005</td>
<td>0.005</td>
<td>0.003</td>
<td>-0.991</td>
</tr>
<tr>
<td></td>
<td>(-0.19)</td>
<td>(0.26)</td>
<td>(0.13)</td>
<td>(-1.43)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.726</td>
<td>0.821</td>
<td>0.822</td>
<td>0.246</td>
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<tr>
<td>N</td>
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<td>1,651</td>
<td>1,651</td>
<td>1,651</td>
</tr>
</tbody>
</table>
Table 4. Robustness Tests

This table presents the results of robustness tests. In Panel A, we include in our baseline model three measures related to non-horizontal directors and accordingly conduct a horse race between horizontal directors and non-horizontal directors. In Panel B, we include additional control variables in our baseline specification. Cross Ownership is the percentage of a firm’s shares outstanding held by all institutional shareholders that simultaneously hold shares of other firms from the same industry, and we only consider institutional shareholders who hold blocks (i.e., equity stakes of 5% or more) in the firms. Financial Reporting Quality is the standard deviation of discretionary accruals over years $t-5$ to $t-1$. In Panel C, we exclude R&D expenditures from the calculation of firms’ yearly investment in new projects, $I_{\text{new}}$, and hence of Investment Inefficiency. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

<table>
<thead>
<tr>
<th>Panel A. Non-Horizontal Directors</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Investment Inefficiency</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.510**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.44)</td>
<td></td>
</tr>
<tr>
<td>Dummy Non-Horizontal Director</td>
<td>-0.123</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.52)</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td>-0.476**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.99)</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Non-Horizontal Director)</td>
<td>0.321*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td>-0.529**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-2.27)</td>
</tr>
<tr>
<td>Ln(Num Non-Horizontal Firm)</td>
<td></td>
<td>0.238</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.45)</td>
</tr>
<tr>
<td>Controls</td>
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<td>Yes</td>
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<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.235</td>
<td>0.235</td>
</tr>
<tr>
<td>N</td>
<td>36,411</td>
<td>36,411</td>
</tr>
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</table>
### Table 4. Robustness Tests (continued)

#### Panel B. Additional Controls

<table>
<thead>
<tr>
<th>Dependent Variable: Investment Inefficiency</th>
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<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.455**</td>
<td>-0.421*</td>
<td>(-2.09)</td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td></td>
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<td>(-1.69)</td>
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<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td></td>
<td>-0.500**</td>
</tr>
<tr>
<td>Cross Ownership</td>
<td>-0.394</td>
<td>-0.385</td>
<td>-0.391</td>
</tr>
<tr>
<td>Financial Reporting Quality</td>
<td>-5.567**</td>
<td>-5.526*</td>
<td>-5.493*</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.231</td>
<td>0.231</td>
<td>0.231</td>
</tr>
<tr>
<td>N</td>
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#### Panel C. Exclude R&D

<table>
<thead>
<tr>
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<th>(1)</th>
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<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.429**</td>
<td>-0.382*</td>
<td>(-2.40)</td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td></td>
<td></td>
<td>(-1.89)</td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td></td>
<td>-0.459**</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.160</td>
<td>0.160</td>
<td>0.160</td>
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<tr>
<td>N</td>
<td>36,411</td>
<td>36,411</td>
<td>36,411</td>
</tr>
</tbody>
</table>
Table 5. Over-Investment vs. Under-Investment

This table presents the results with over-investment (Panel A) and under-investment (Panel B) as the dependent variable, respectively. Over-Investment (Under-Investment) is equal to the residual from the Richardson (2006) model when the residual is larger (smaller) than zero, and set to zero otherwise. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

### Panel A

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.520**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td></td>
<td>-0.460*</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td></td>
<td>-0.525**</td>
</tr>
<tr>
<td>Controls</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.150</td>
<td>0.150</td>
<td>0.150</td>
</tr>
<tr>
<td>N</td>
<td>36,411</td>
<td>36,411</td>
<td>36,411</td>
</tr>
</tbody>
</table>

### Panel B

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy Horizontal Director</td>
<td>-0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Director)</td>
<td></td>
<td>0.011</td>
<td></td>
</tr>
<tr>
<td>Ln(Num Horizontal Firm)</td>
<td></td>
<td></td>
<td>-0.003</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regressors in Richardson (2006) model</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry × Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.514</td>
<td>0.514</td>
<td>0.514</td>
</tr>
<tr>
<td>N</td>
<td>36,411</td>
<td>36,411</td>
<td>36,411</td>
</tr>
</tbody>
</table>
**Table 6. Cross-Sectional Tests: Information Environment**

This table presents the results of cross-sectional tests based on the firm’s within-industry information environment. In Panel A, for each year, the sample is partitioned based on the yearly median of *Industry-Level Analyst Coverage*, which is calculated as the percentage of firms that are followed by at least one financial analyst within the FF48 industry in a given year. In Panel B, for each year, the sample is partitioned based on the yearly median of *Industry-Level Capital Expenditure Forecast*, which is calculated as the percentage of firms that issue capital expenditure forecasts within the Fama-French 48 industry in a given year. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. *t*-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

<table>
<thead>
<tr>
<th>Panel A. Industry-Level Analyst Coverage</th>
<th>Dependent Variable: Investment Inefficiency</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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37
Table 7. Cross-Sectional Tests: Product Market Differentiation

This table presents the results of cross-sectional tests based on firms’ product market differentiation. In Panel A, for each year, the sample is partitioned based on the yearly median of Product Differentiation, which is calculated as the total similarity measure of a firm’s product developed by Hoberg and Phillips (2016), multiplied by -1. In Panel B, for each year, the sample is partitioned based on the yearly median of R&D Intensity, which is calculated as R&D expenditure divided by total assets. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

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Table 8. Cross-Sectional Tests: Cash Generation and Margins

This table presents the results of cross-sectional tests based on firms’ cash generation capacity and margins. In Panel A, for each year, the sample is partitioned based on the yearly median of Free Cash Flow, which is calculated as operating income before depreciation minus interest expense minus income taxes minus capital expenditures, divided by total assets. In Panel B, for each year, the sample is partitioned based on the yearly median of Markup, which is calculated as the logarithm of sales divided by cost of goods sold. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A. Free Cash Flow

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<tr>
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Panel B. Markup

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Table 9. Corporate Opportunity Waivers (COW)

This table presents the results after considering whether the horizontal director also sits on the board of another firm that is incorporated in a state with COW legislation in a given year. *Dummy Horizontal Director with COW (Dummy Horizontal Director without COW)* is a dummy variable that equals to one if at least one (none) of the firm’s horizontal directors sit on the same-industry firm that is incorporated in a state with COW legislation in a given year, and zero otherwise. *Num Horizontal Director with COW (Num Horizontal Director without COW)* is the number of horizontal directors who sit on the same-industry firm that is incorporated in a state with (without) COW legislation in a given year. *Num Horizontal Firm with COW (Num Horizontal Firm without COW)* is the number of firms that are incorporated in states with (without) COW legislation connected via horizontal directors in a given year. Please see Appendix A for details regarding variable definitions. Firm and industry-year fixed effects are included in all specifications. Standard errors are clustered at firm level. t-statistics are reported in parentheses. The ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

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