Does Board Overlap Promote Coordination Between Firms?

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Abstract

We investigate how board overlap affects coordination and performance among public firms. Our identification exploits the staggered introduction of Corporate Opportunity Waivers (COWs) in nine U.S. states since 2000. By reducing legal risk to directors serving on multiple boards, the COW legislation increased intra-industry board overlap for those firms that benefit most from the information flow facilitated by board overlap. We find that more board overlap improves firm profitability but also reduces investment, product overlap, and innovation. Our findings support the notion that board overlap curtails firm rivalry.

Keywords: Board overlap, corporate opportunity waivers, firm coordination, market power
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1 Introduction

Board overlap is a common feature of modern corporations and has been the subject of policy debate since the early 20th century. Predicated on the notion that board overlap between competing firms impedes competition, the Clayton Act of 1914 outlawed board overlap between direct competitors. But social science research has struggled to produce convincing evidence on whether board overlap limits firm competition. The early empirical literature on the consequences of board overlap suffered from data and measurement shortcomings due to limited board and corporate data. Since the 1980s, these issues have been superseded by methodological concerns about proper identification stemming from the endogenous nature of board composition (Mizruchi, 1996; Hermalin and Weisbach, 2001). While a more recent debate has centered on the controversial coordinating role of overlapping shareholders (Azar, Schmalz, and Tecu, 2018; Eldar, Grennan, and Waldock, 2020), much less attention has been devoted to the question of whether board overlap, in and of itself, can facilitate firms' cooperation in pursuit of higher firm profitability.

This paper systematically investigates whether and how board overlap influences firm coordination and performance. We develop two hypotheses based on the impact board overlap has on two countervailing types of externalities (Bloom, Schankerman, and van Reenen, 2013; Antón, Ederer, Giné, and Schmalz, 2021). First, *positive* firm externalities consist in the flow of information about technological and commercial opportunities. Board overlap can potentially facilitate these information flows (Srinivasan, Wuyts, and Mallapragada, 2018). The *opportunity hypothesis* states that, rather than impeding competition, board overlap can help coordinate the efficient allocation, fast adoption, and frictionless financing of new corporate opportunities. Second, *negative* externalities refer to firms' competition in the product market. Board overlap can attenuate negative firm externalities intrinsic to firm rivalry. For example, it can foster research specialization, avoid duplication of investment activity, prevent the pursuit of rival patents, and seek mutual accommodation through market segmentation. Such coordination can extend to tacit market carve-outs and anti-competitive collusion on prices. The *market power hypothesis* refers to a situation where board overlap enables firms' coordination, which preserves or extends their market power.

For both hypotheses, board overlap is important to maintain the stability of the coordination in at least two aspects. First, the industrial organization literature has highlighted that stable firm coordination requires firms not to undertake hidden actions that contravene the collaboration (Harrington and Skrzypacz, 2011). Board overlap can increase the mutual observability of strategic decision-making and thus stabilize cooperative behavior essential to both the opportunity and the market power hypotheses. Second, board overlap can mitigate frictions related to contractual incompleteness. It is difficult to foresee and contract on all contingencies in a way that an *ex ante* agreement is enforceable in courts. Board overlap can stabilize firm coordination by facilitating continuous adaptation and re-negotiation.

A key obstacle to understanding the causal effects of board overlap on corporate outcomes is the difficulty of isolating exogenous influences (Hermalin and Weisbach, 2001). Our paper overcomes this challenge by exploiting a major change in U.S. corporate law, namely the introduction of Corporate Opportunity Waivers (COWs), which removed a roadblock for establishing board overlap between U.S. firms. Before the law change, corporate directors were bound by the corporate opportunity doctrine, which prohibits directors from pursuing outside corporate opportunities without first presenting them to the company the directors serve. The doctrine poses a legal liability for directors serving on multiple boards—also known as interlocked directors. To see why this is the case, consider an interlocked director who simultaneously sits on the boards of two firms. If any business opportunity that this director learns about in his or her capacity as the director of the first firm can also affect the second firm, questions arise as to whether this interlocked director can fulfill the fiduciary duties to both firms. The New York supreme court judge Bernard Shientag highlights this legal conflict as follows: "It is only when a business opportunity arises which places the director in a position of servicing two masters, and when, dominated by one, he neglects his duty to the other, then a wrong has been done."[1] The introduction of COWs explicitly allows the suspension of the corporate opportunity doctrine by means of private contracting, thus eliminating an important deterrence for the establishment of board overlap.

We advance two reasons why the introduction of the COW legislation is exogenous to firm performance and product market structure in our setting. First, the COW legislation itself occurred in response to two specific Delaware court decisions,[2] which highlighted that directors'

[1] See *Singer et al. v. Carlisle et al.*, 26 N.Y.S.2d 172, 182. Supreme Court, New York, 1940.
[2] See page 15 in Rauterberg and Talley (2017).

fiduciary duty could only be made contractible if changes to state corporate law would explicitly allow this. The particular timing of these verdicts is related to Delaware's legal history, and unlikely to be related to any macroeconomic events—making the COW legislation exogenous to macroeconomic conditions. Second, board overlap among public firms does not appear to have been the legal intent behind the COW legislation. Prior to the legislation, the debate focused on how the fiduciary duty of loyalty had adversely impacted financing for small private firms, and public firms were seldom concerned.[3] Also, examining the lobbying scripts for COWs, Eldar, Grennan, and Waldock (2020) do not find evidence of lobbying by public firms. In Section 3.5, we discuss in more detail the exogenous nature of the corporate law change.

The corporate opportunity doctrine represents an effective obstacle to board overlap only if such board overlap occurs between firms with overlapping lines of business, such as firms in the same industry. Generally, courts require a director's breach of fiduciary duty to occur in the firm's line of business (Talley, 1998). This requirement implies that, within overlapping business lines, any corporate opportunity developed by one firm can be alleged to result from a fiduciary failure with respect to the second firm by the interlocked director. Hence, our subsequent analysis focuses on the effect of the COW legislation on intra-industry board overlap.

In addition, our conceptual framework suggests that the analysis should focus on firms in the same industry and R&D-intensive firms. Firms operating in common product markets experience not only similar corporate opportunities, but also encounter more intense firm rivalry due to similar product offerings. Our focus on R&D-intensive firms is motivated by a greater prevalence of both positive and negative spillovers highlighted by Bloom *et al.* (2013): A firm's R&D expenditure can benefit other firms' productivity through knowledge spillovers and new opportunities, but can also hurt rival firms if product cycles accelerate and their products become obsolescent. Therefore, our analysis focuses on intra-industry board overlap involving R&D-intensive firms for which, *a priori*, the benefit from coordination should be most pronounced.

To isolate the causal effect of board overlap, we use an instrumental variable approach. We instrument the change in intra-industry board overlap in the first stage and relate the instrumented board overlap to a variety of firm outcome variables in the second stage. To

[3] Critics of the corporate opportunity doctrine argue that the duty of loyalty impedes firms' ability to raise capital. However, these critics point towards small private firms that are often held by venture capital and private equity, which found it difficult to invest in multiple firms in the same industry prior to the COW legislation. Consistent with this line of argument, Eldar, Grennan, and Waldock (2020) find that the COW legislation significantly improves startup financing ability and contributes to startup success.

construct our instrument, we use the staggered adoption of the COW legislation across nine U.S. states. A first dummy variable identifies whether the state in which a firm is incorporated has adopted COW legislation in a given year. This dummy allows us to compare intra-industry board overlap for firms before and after the COW legislation and relative to peer firms not covered by the legislation. To account for our focus on R&D-intensive firms, we interact the first dummy with a second dummy for R&D-intensive firms. This interaction term represents the final instrument used in the first-stage regression.

Our study contains several interesting results, and we highlight four of them here. First, the corporate liability reform triggered an economically significant increase in *intra-industry* board overlap by 2.7 percentage points among firms with high R&D intensity, but not for firms with low R&D intensity. Given a mean corporate board size of eight members, this corresponds to roughly one new intra-industry board overlap for every fifth firm ($0.027 \times 8 = 21.6\%$). The concentration of intra-industry board overlap strongly correlates with R&D intensity, suggesting that the benefits of board overlap relate to R&D-specific firm spillovers.

Second, firms experiencing an increase in intra-industry board overlap show systematically higher profitability as measured by a higher return on assets (*ROA*), a higher gross profit margin, a bigger operating margin, increased sales revenue, reduced costs, and a lower cost share relative to sales. The estimated effects suggest a 5.3% average increase in sales revenue and a simultaneous reduction in costs of goods sold (*COGS*) by 5.2% for an additional one percentage point of intra-industry board overlap. The positive effect of board overlap on profitability is consistent with both hypotheses: Either more efficient exploitation of corporate opportunities or greater market power could account for the increased firm profitability.

Third, we seek to disentangle whether board overlap in R&D-intensive firms reinforces positive (commercial or technological) externalities or attenuates negative (competitive) market externalities between firms. If board overlap strengthens positive externalities, in accordance with the opportunity hypothesis, we expect to see accelerated capital expenditures and technology investment, as proxied by R&D expenditure, patent frequency, and patent citations. Alternatively, if board overlap can reduce product market rivalry through firm coordination, it should result in reduced investment activities and less innovation because more investment tends to accentuate firm rivalry through shorter product cycles, product obsolescence, increased fixed costs, and the risk of financial distress in a winner-takes-all market (Aoki, 1991).

We find economically and statistically strong adverse effects of increased board overlap on general investment expenditure, R&D expenditure, and the measures of innovation output. Our findings are consistent with the market power hypothesis that board overlap reduces dynamic (Schumpeterian) competition in new products and product innovation. However, the evidence of reduced investment and innovation is difficult to reconcile with the opportunity hypothesis that board overlap promotes positive commercial or technological spillovers.

Finally, we seek to understand how firms coordinate in pursuit of market power. They may engage in a segmentation strategy that avoids similar products and diminishes the overlap in the common product spaces (Bailey and Friedlaender, 1982). This strategy can entail an agreement like 'you produce product A and I produce product B'—whereas independent and competitive decisions imply that both firms produce both products. Using firm sales by product market segments and linguistic measures of product similarity (Hoberg and Phillips, 2010, 2016), we show that firms that experience an increase in board overlap following COW legislation also feature a reduction in product market segment overlap with rival firms and simultaneously show lower product similarity in their regulatory filings.

It is plausible that larger product segmentation results alternatively from firms shifting their strategic focus to new product market segments as opposed to consolidating market shares within existing segments. However, this argument is difficult to reconcile with the evidence of reduced investment and innovation after the COW legislation. Moreover, in additional analyses, we find no evidence that firms benefiting from the COW legislation expand into new product segments or offer more new products. In sum, our product market evidence supports the hypothesis that board overlap reduces firm rivalry through segmentation in existing markets.

Board overlap can not only promote firm coordination, but may also influence the intrinsic quality of boards. In particular, board overlap can emerge due to a limited talent pool for competent board members. By allowing more firms to share the expertise of high-quality directors, board overlap could contribute to better governance and improve firms' strategic decision-making. However, this human resource view of board overlap appears to contradict the findings in various previous studies (Fich and Shivdasani, 2006; Core, Holthausen, and Larcker, 1999). These studies find that the so-called busy directors serving on multiple boards have limited commitment to their monitoring role, thus compromising firm performance. Field, Lowry, and Mkrtchyan (2013) take a more nuanced view of the intrinsic quality of busy directors. While they acknowledge potential monitoring deficiencies of busy directors, they consider them nevertheless particularly valuable to young firms because of their unique "advisory role" for management. Consistent with their findings, we also show that firms with a recent IPO feature a relatively larger increase in intra-industry board overlap. However, among the firms for which intra-industry board overlap expands most significantly after COWs, we find more old and established firms than young firms. This evidence suggests that the advisory function of busy directors operates independently from the opportunity and market power hypothesis examined in our paper.

Our paper relates to Eldar, Grennan, and Waldock (2020). Using the same sequence of law changes, they examine a sample of startups and find that common ownership by venture capital investors has a significant positive impact on startup growth. They document that interlocked directors, often appointed by overlapping venture capital investors, represent an important channel of influence emanating from ultimate investors. Like Eldar, Grennan, and Waldock (2020), we show that public firms with high research intensity also benefit from board overlap, as evidenced by their improved profitability. However, we find that board overlap among public firms is unrelated to common institutional ownership, and thus is quite distinct from board overlap among startups.

Our inquiry into board overlap could raise questions about its relationship with shareholder overlap by institutional investors (Azar, 2012, chapter 5; Azar, Schmalz, and Tecu, 2018; Eldar, Grennan, and Waldock, 2020). We find that the effects of board overlap identified in our natural experiment are not the proximate cause of institutional shareholder overlap. Apart from a few rare exceptions, the interlocked directors of publicly listed firms do not feature any professional links (as reported in SEC filings) to large institutional investors, which account for the bulk of shareholder overlap. Section 5.1 provides a more detailed discussion of this issue.

Two papers investigate a related question concerning the valuation implications of the COW legislation. Consistent with our evidence, Rauterberg and Talley (2017) show that COW adoption at the firm level increases firms' equity value. Fich, Harford, and Tran (2021) document that the COW legislation is associated with reduced R&D investment and decreased firm valuation. They attribute their findings to COW legislation allowing for more self-dealing activities by disloyal managers. While firm valuation is not the focus of our paper, we find that the COW legislation shows the positive valuation effect for R&D-intensive firms using an improved

Q measure called Macro Q.[4] This evidence is again consistent with our findings of increased firm profitability following new intra-industry board overlap.

2 Hypotheses Development

As Rauterberg and Tallsey (2017) remark, in U.S. law, the directors' duty of loyalty has been a centerpiece of their fiduciary obligation for centuries. This duty of loyalty also entails that directors cannot share information about corporate opportunities with outsiders or exploit them in their own interest—a legal obligation referred to as the corporate opportunity doctrine. However, Delaware departed from this tradition in year 2000, granting incorporated entities a statutory right to waive this obligation by creating Corporate Opportunity Waivers (COWs).[5]

The widespread adoption of COWs signals an enormous appetite for contracting out of the duty of loyalty when freed to do so. One reason for this might be what legal observers have termed the "unpredictability" of the corporate opportunity doctrine in more complicated governance settings. COWs provide a simple tool to reduce legal uncertainty and potential legal liabilities. But a more fundamental benefit of COWs could be their enabling power for new forms of active governance by venture capital and private equity firms, which benefit from an unbridled information exchange about corporate opportunities. Freed from the constraints of the corporate opportunity doctrine, these investors can play an active role in discovering, allocating, and financing corporate opportunities across their portfolio firms.[6]

Board overlap facilitates information exchange about corporate opportunities, and we refer to this as the *opportunity hypothesis* of board overlap. Eldar, Grennan, and Waldock (2020)

[4]The valuation result is tabulated in the Internet Appendix, Table A10. Macro Q is defined as the sum of debt and equity less inventory divided by the start-of-period capital stock (Salinger and Summers, 1983). This measure is recommended by Erickson and Whited (2000) and Chava and Roberts (2008) as superior to Tobin's Q. We also note that market-based valuation effects could be confounded by the bursting of the dotcom bubble in 2001, and should therefore be interpreted with caution.

[5]For a recent international comparison of this duty of loyalty across different countries, see Helleringer and Corradi (2021).

[6]See, for example, Coonrod and Larson (2015), who state, "Venture capital and private equity firms commonly finance multiple investments in the same area of activity and require a seat on the board of directors as a condition to their investment." The corporate lawyers Austin and Gottlieb note in 'Renouncing Corporate Opportunities in Spin-offs, Carve-out IPOs and Private Equity Investments' (https://vcexperts.com/buzz_articles/320): "In the private equity or financial investor context, funds that make multiple investments in the same or similar industries may want to avoid any undue restrictions imposed by the duty of loyalty on their ability to pursue other investments, even competing ones, or to direct a particular opportunity to the entity for which it is best suited."

show that startups financed by venture capitalists indeed operated more successfully under the COW legislation. But more efficient exploitation of corporate opportunities could extend beyond the realm of startups and venture capital. Generally, industries with high R&D intensity should be characterized by positive technological spillovers that can be strengthened by board overlap (Bloom, Schankerman, and van Reenen, 2013; Antón, Ederer, Giné, and Schmalz, 2021). Accordingly, we expect board overlap to have a positive impact on investment, R&D expenditure, patent success, and consequently on profitability.

H1: Opportunity Hypothesis

Board overlap facilitates information sharing about new corporate opportunities (particularly for R&D-intensive firms) and accelerates their exploitation. As a result, COW legislation (i) generates more (intra-industry) board overlap; (ii) increases firm profitability; and (iii) implies more investment, higher R&D expenditure, and greater patent success.

Alternatively, board overlap can attenuate product market rivalry through more cooperative firm behavior. The *market power hypothesis* conjectures that new board overlap following COWs enables firms to coordinate in pursuit of preserving or extending market power.

The coordination conveyed in the market power hypothesis can take on different forms that may or may not raise legal antitrust concerns.[7] Legitimate coordination can take the form of joint product development and research specialization, which avoids the duplication of R&D expenditure and pools resources in pursuit of a better product. The more pernicious form of firm coordination entails rent extraction from third parties. Such coordination seeks to reduce competition by increasing product prices or reducing the pace of innovation. Firms' market power can also be consolidated by reduced product overlap across market segments and increased product differentiation.

Like the opportunity hypothesis, the market power hypothesis also predicts increased profit margins. It contends that board overlap helps to enhance market power and profitability for existing products. This type of coordination seeks to attenuate the dynamic dimension of firm rivalry and consolidate market shares.

H2: Market Power Hypothesis

[7]We are primarily concerned with economic effects and try to avoid terms like "collusion", which have legal connotations and definitions that vary by jurisdiction. Empirically, we cannot distinguish the legal from the illegal pursuit of market power.

Board overlap fosters coordination of corporate decisions across firms in an effort to increase market power. COW legislation (i) generates more (intra-industry) board overlap; (ii) increases firm profitability; and (iii) increases profit margin. In addition, such coordination attenuates firm rivalry (iv) through less investment, lower R&D expenditure, and fewer patent filings; as well as (v) reduced product market overlap and product similarity.

For both hypotheses, board overlap helps to expand and stabilize firm coordination. Theoretical work stresses the difficulty of maintaining coordination discipline if unobservable actions allow firms to deviate profitably from the coordinated course of action. Radner, Myerson, and Maskin (1986) show that cooperation is impossible if the deviator cannot be identified via a public signal. Thus, the exchange of firm-specific information becomes an essential condition for coordinated actions (Fudenberg et al., 1994; Athey and Bagwell 2001; Aoyagi, 2002; Harrington and Skrzypacz, 2011; Awaya and Krishna, 2016; Aryal, Ciliberto, and Leyden, 2021). Board overlap can institutionalize such information exchange and help both firms stabilize coordination.[8]

Moreover, contractual incompleteness denotes the difficulty of stipulating all aspects of cooperation *ex ante* and making them enforceable in court (Geng, Hau, and Lai, 2021). Board overlap may represent a more flexible and less costly mechanism to mitigate such contracting frictions and stabilize firm cooperation. For example, prior studies have shown that director networks can indeed alleviate contracting frictions along supply chains (Dasgupta, Zhang, and Zhu, 2021).

Our paper differs from the literature on board overlap. Research seeking to measure board quality has often interpreted board interlock as a *negative* signal for poor governance, either because of compromised director independence or limited time commitments. Various studies on corporate boards in the U.S. (Hallock, 1997; Core *et al.*, 1999; Guedj and Barnea, 2009), Germany (Handschumacher *et al.*, 2019) and Australia (Fernández Méndez *et al.*, 2015) show that board overlap correlates positively with higher management compensation and lower executive turnover. Unlike our paper, these prior studies do not distinguish between intra-industry and inter-industry board overlap. Moreover, these studies are concerned with the correlation

[8]Harrington (2006) and Marshall and Marx (2008) highlight that even third parties like industry boards can facilitate collusion through information exchange. According to Marshall and Marx (2008), in at least 11 of the 22 European anti-trust cases, collusion was facilitated by third parties, based on illicit information exchange.

between board overlap and governance quality. In contrast, our analysis focuses on the causal effects of intra-industry board overlap on firm coordination and firm performance.

3 Institutional Background and Research Design

3.1 Corporate Law Reform as a Natural Experiment

A cornerstone of U.S. corporate law has been the fiduciary duty of loyalty by directors towards the company they serve. This fiduciary obligation has long been viewed as an underpinning of credible conflict-of-interest management barring directors from pursuing or representing outside interests that can diverge from the commercial interests of the company. The fiduciary duty of loyalty prevents, in particular, the appropriation of any business opportunity without first offering it to the company. This so-called corporate opportunity doctrine can create serious legal conflicts for interlocked corporate directors serving on multiple corporate boards if the respective companies pursue similar lines of business. As such, the fiduciary duty of loyalty creates a backstop for intra-industry board overlap because of the legal liability that could ensue.

To determine whether an opportunity belongs to a corporation, the courts inside or outside Delaware employ a four-factor model set forth by *Guth v. Loft* and its progeny. The courts will examine whether (1) the corporation had adequate financial resources to undertake the opportunity, (2) the opportunity was within the lines of business for the corporation, (3) the corporation had an interest and reasonable expectancy in the opportunity, and (4) the director's interest conflicts with that of the corporation if the director pursues the opportunity. Condition (2) is more likely to be met if interlocked directors occur between firms in the same industry.

In legal practice, the courts constantly encountered difficulties in delineating corporate opportunities in the context of fiduciary duty. For example, Walter F. Rogosheske wrote in the case of *Miller v. Miller*: "We have searched the case law and commentary in vain for an all inclusive or 'critical' test or standard by which a wrongful appropriation can be determined and are persuaded that the doctrine is not capable of precise definition." In his textbook of corporate law, Clark (1986) claims that "the traditional tests are extremely ambiguous and uncertain in their application." More recent work by Rauterberg and Talley (2017) remarks that "The law's attempt to regulate fiduciaries' independent pursuit of business opportunities has produced a doctrine of startling complexity and unpredictability."

To eliminate the legal liabilities for the breaches of the corporate opportunity doctrine, some companies attempted to contract on the fiduciary duty privately. But this practice quickly met a legal challenge. In the famous case *Siegman v. Tri-Star Pictures, Inc.* in 1989, a Delaware court ruled against the private contractual suspension of the corporate opportunity doctrine on the basis that the duty of loyalty should be "immutable"—immune to private efforts to dilute or eliminate it.

The verdict in *Siegman v. Tri-Star Pictures, Inc.* thus maintained the corporate opportunity doctrine with its inherent ambiguities in situations where board overlap or shareholder overlap cannot be avoided. A notable example is small private firms controlled by venture capital and private equity firms. These investors usually seek representation on the board of their portfolio firms. Without waiving the corporate opportunity doctrine, these investors find it hard to invest in multiple firms in the same industry. The challenge posed by the corporate opportunities in the situation of overlapping boards or overlapping ownership was also recognized in the opinions of two Delaware cases (*Thorpe v. CERBCO* and *In Re Digex*), which are considered as a catalyst for the law change examined in this paper.

In the year 2000, Delaware dramatically departed from this tradition by allowing companies to contract on and limit directors' fiduciary duties. In particular, they could wave the requirement of loyalty with respect to corporate opportunities, thereby lowering the legal standard to which directors were held with respect to conflicts of interest. Over the next two decades, other states followed the example of Delaware and made a previously "immutable" fiduciary standard contractible. Table 1 provides an overview of the statutory changes enabling corporations to waive the corporate opportunity doctrine for directors and officers by changes in their corporate charter or bylaws. The corporate law reforms had a narrow scope in the sense that they only concerned this particular option to waive the fiduciary liability of directors, corporate officers, or shareholders.

The opportunity of granting directors a corporate opportunity waiver was widely embraced by U.S. corporations, as documented by Rauterberg and Talley (2017). For example, the state of Delaware had an adoption rate for COWs of approximately 52% of corporations. As Delaware incorporates a large share of all American corporations, the new contractibility of fiduciary standards represents a significant "regime change" for a large number of firms across all industries. We document that this regime change lowered the barriers for intra-industry board overlap. On average, intra-industry board overlap made up 4.4% of board directors in the year before the legislation, and significantly increased to 8.2% five years after the legislation. In contrast, the change in inter-industry board overlap was more moderate: The average inter-industry board overlap increased from 37% to 41.6% over the same period.

3.2 Sample Selection and Summary Statistics

We retrieve board director information of U.S. publicly listed firms in the period 1998–2019 from the BoardEx database. BoardEx covers the educational background, prior employment, and connections of directors and executives for publicly listed firms and notable private firms across the globe. The database has been widely used in prior studies for research related to corporate board directors (see, e.g., Cohen, Frazzini, and Malloy, 2008; Adams and Kirchmaier, 2016). The director employment information permits the identification of cases where a firm's board director sits concurrently on the boards of external firms. For example, from the database, we can see Marc Andreessen (director id: 337150) simultaneously sat on the boards of Facebook and eBay in the years 2012–2014. Aggregating the individual director information to the firm level, we can construct firm-level board overlap.

Our baseline data set comes from the intersection of Compustat and BoardEx. After we drop financial firms (SIC: 6000-6999) and utility firms (SIC: 4900-4999), the baseline sample comprises $49,957$ firm-year observations of $4,251$ distinct firms covering the period 1998–2019. Table 2, Panel A, reports the summary statistics. The median firm observation has US$461 million in assets [$ln(Assets) = 6.133$], US$470 million in sales [$ln(Sales) = 6.152$], and employs $1,782$ workers [$1000 \times e^{0.578}$].

A firm's *Board Size* measures the number of board directors with a mean (median) value of 8.5 (8); firms at the 25% (75%) quartile of *Board Size* have 7 (10) directors. In light of the variation in board size, we define various measures of board overlap as the ratio of the number of external board seats by board members and *Board Size*. Otherwise, larger boards are (*eo ipso*) more likely to feature interlocked board members. The overall board overlap (*All_ OvLapDir*) is defined as the number of all (intra- and inter-industry) external board seats by all board members relative to *Board Size*. If a single board member is affiliated with multiple other boards, we count each overlap separately.

The overall board overlap (*All_ OvLapDir*) has a mean value of 45%, suggesting the mean board with 8 board members features 3.6 (0.45×8) board overlaps with other companies. Decomposing the 45% overall board overlap, we find that intra-industry board overlap (*Intra_ OvLapDir)* constitutes 6.8% and inter-industry board overlap (*Inter_ OvLapDir)* 38.1%. Inter-industry director overlap is thus five times more common than intra-industry director overlap.

3.3 Board Overlap and R&D Intensity

Before moving to regression analysis, we first investigate the relation between board overlap and R&D intensity using univariate analysis. We sort firms by their R&D intensity into four quartiles. The three largest industries to which a high number of firms in the top quartile (Q4) are assigned are Drugs, Computer and Data Processing Services, and Electronic Components and Accessories (see Table A1 of the Internet Appendix for details). Table 2, Panel B, shows that intra-industry board overlap is strongly conditioned by the level of R&D intensity. As we consider firms featuring progressively more R&D intensity in quartiles Q1 to Q4, the mean intra-industry board overlap (*Intra_ OvLapDir*) increases monotonically from a relatively low level of 2.2% in Q1 and Q2, to 5.8% in Q3, and to 20.9% in Q4. This implies that the 25% most R&D-intensive firms have roughly ten times more intra-industry board overlap than the 25% least R&D-intensive firms.

To better characterize those firms in Q4, we further compare the R&D-intensive firms in Q4 to those in Q3: Their average *R&D intensity* is four times larger, their average value for *ln*(*Assets*) is 17% lower, their average market-to-book ratio (*MTB ratio*) is 51% higher, their average sales-to-asset ratio is 31.6% lower, and their average *operating margin* is only −13.4% compared with 5.9% for firms in Q3. These accounting measures indicate that firms in Q4 (despite their stock market listing) appear to be at an early development phase with high growth potential. Also, the 25% most research-intensive firms seem to operate in more competitive industries, evidenced by a four-times larger Hoberg-Philips product similarity score (Hoberg and Phillips, 2010, 2016) and a much lower average Herfindahl-Hirschman-Index (HHI_SIC3).

Table 2, Panel B, Columns (7) and (8) condition the Q4 firm sample further on the existence of intra-industry board overlap and its absence, respectively. We find that firms with intra-industry board overlap show a very negative *operating margin* at −16.3% compared with −9.8% for firms without it. We also note that research-intensive firms in Q4 show a three-times larger Hoberg-Philips product similarity score ($HPSS$) if they feature intra-industry board overlap than otherwise. We conclude that a lack of profitable sales revenue and strong competitive pressure from firms with similar products are important covariates for the prevalence of intra-industry board overlap.

The distribution of intra-industry board overlap is visualized in Figure 1, Panel A, where we break down the board overlap in each quartile into three roughly equal periods 1998–2003, 2004–2009, and 2010–2016. We observe a substantial increase in the average intra-industry board overlap over time across all R&D intensity quartiles. However, the most pronounced inter-temporal increase occurs in quartile Q4.

Figure 1, Panel B, shows that the frequency of inter-industry board overlap is less sensitive to the level of R&D intensity. Only firms in quartile Q4 feature a significantly lower inter-industry board overlap, and a downward time trend. Table A2 in the Internet Appendix reveals that this downward adjustment of inter-industry overlap is a *response to previous increases* in intra-industry overlap among treated firms. In particular, Panel A of Table A2 shows that, in response to a prior increase in intra-industry overlap, firms in Q4 feature a switching probability of 46% for a *decrease* in inter-industry board overlap as opposed to 41% for an *increase* in the subsequent three years. No such asymmetry in switching probabilities is found when we analyze the adjustment in inter-industry board overlap in response to decreased or unchanged intra-industry board overlap, as shown in Table A2, Panels B and C, respectively. This evidence suggests that the adoption of more intra-industry board overlap crowded out inter-industry board overlap.

The frequency of intra-industry board overlap appears surprising in light of existing antitrust laws. Section 8 of the Clayton Act of 1914 explicitly prohibits any interlocked directorates between competing firms. Notwithstanding this statutory prohibition, enforcement action was sporadic and ineffective. According to a staff report by the Antitrust Subcommittee of the House Judiciary Committee in 1965, the Federal Trade Commission (FTC) filed only 13 complaints under Section 8 of the Clayton Act in the first 50 years after the law's enactment in 1914, of which one complaint resulted in a cease-and-desist order. The Department of Justice undertook its first investigation with respect to Section 8 only in 1952. In the following decades, enforcement of the Clayton Act hardly improved, and even declined in the late 1970s. Stucke and Ezrachi (2017) note that even horizontal corporate mergers have rarely been challenged in the past five decades. Similarly, in a legal briefing, Bailey (2020) highlights that the FTC only occasionally investigates and pursues violations of Section 8 of the Clayton Act.

3.4 Empirical Design

Our empirical specification combines a difference-in-difference estimator with a two-stage least squares (2SLS) model to establish the causal effect of board overlap. The first-stage regression examines how the staggered adoption of COW legislation across nine U.S. states changed the incidence of intra-industry board overlap. The second stage then explores how predicted changes in board overlap affect firm outcomes.

We define a treatment dummy (*Treat*) equal to one (and zero otherwise) if corporate state law permits a firm i to opt out of the corporate opportunity doctrine in year t. The *Treat* dummy allows us to compare firms (treatment firms) incorporated in COW states with those (control firms) in non-COW states before and after the law change. Following the suggestion of Baker, Larcker, and Wang (2021), we consider as control observations all firm-years before the COW legislation, and also all firm-years for those firms incorporated in U.S. states that have never adopted COW legislation. We interact this treatment effect with a set of dummies *R&D_ Qx* marking the xth quartile of a firm's R&D intensity. For example, *R&D_ Q4* denotes the fourth firm quartile of R&D intensity. To alleviate concerns that the sorting into four quartiles could itself be subject to endogenous changes related to the corporate law changes, we categorize firms based on their initial R&D intensity in the first sample year of 1998 (or when they enter the sample), and then leave the quartile affiliation unchanged.[9]

[9] We confirm that annual dynamic updating of the quartiles yields quantitatively similar results. This suggests that the endogeneity concern with respect to quartile classification is of minor quantitative importance.

The first-stage regression for board overlap takes the linear form,

$$Intra\_OvLapDir_{i,t} = \sum_{x=1}^{4} \alpha_x \; R\&D\_Qx_i \times Treat_{i,t} + Z_{i,t}\gamma' + \eta_{I\times t} + \theta_i + \epsilon_{i,t}. \tag{1a}$$

$$Intra\_OvLapDir_{i,t} = \alpha_4 \; R\&D\_Q4_i \times Treat_{i,t} + Treat_{i,t} + Z_{i,t}\gamma' + \eta_{I\times t} + \theta_i + \epsilon_{i,t}. \tag{1b}$$

The regression in Eq. (1a) produces the estimated treatment effect for each of four R&D quartiles, whereas the regression in Eq. (1b) generates the incremental estimate (triple difference) for $R\&D\_Q4_i$ relative to the average effect of the four quartiles, which $Treat_{i,t}$ measures. Our second-stage analysis is based on the first-stage regression in Eq. (1b), where the instrumental variable is $R\&D\_Q4_i \times Treat_{i,t}$. As shown in Section 4.1, this triple difference approach is justified because the treatment effect on intra-industry board overlap expansion is concentrated among Q4 firms only.

The dependent variable *Intra_ OvLapDir* is the ratio of interlocked director positions with other companies in the same three-digit SIC industry relative to the firm's board size. In the analysis, we also construct the variable *Inter_ OvLapDir,* which measures director overlap across industries, and the variable *All_ OvLapDir*, which is the sum of *Inter_ OvLapDir* and *Intra_ OvLapDir*. The interaction term *R&D_ Qx* × *Treat* captures the effect of the law on firms in quartile *Qx.* The vector of control variables $Z_{i,t}$ comprises the log assets [*ln(Assets)*], asset tangibility (*Tangibility*), and the market-to-book ratio (*MTB ratio*). All panel specifications include firm dummies so that identification is based only on the inter-temporal regime change defined by the availability of the COW legislation in the state of incorporation. We note that the state of legal incorporation often differs from the geographic location of firm headquarters. Our results are robust to including headquarter-state-by-year fixed effects as discussed in Section 5.3. To account for time-varying industry trends, we also include industry-by-year dummies as additional controls.

The second-stage regression examines the effect of intra-industry board overlap on firm outcome variables. The variables we investigate include firm profitability, investment and employment, and product market overlap. The second-stage regression takes the form,

$$y_{i,t} = \delta_1 \widehat{Intra\_OvLapDir}_{i,t} + \delta_2 Treat_{i,t} + Z_{i,t}\gamma' + \eta_{I\times t} + \theta_i + \vartheta_{i,t}. \tag{2}$$

$\widehat{Intra\_OvLapDir}$ is the instrumented intra-industry board overlap. The control variables and fixed effects are the same as those in Eq. (1b).

As board overlap always concerns two firms, and the dummy instrument $R\&D\_Qx$ marks only the first firm conditional on high R&D intensity in quartile Q4, it is natural to ask about the research intensity of the second (or partner) firm. Figure A1, Panel A, in the Internet Appendix, shows a histogram of the research intensity of all firms with $R\&D\_Qx \times Treat = 1$, and Panel B the research intensity of their partner firms with which board overlap occurs. Panel C shows the histogram of the R&D intensity of all sample firms for comparison. Partner firms feature a considerably higher mean (median) R&D intensity at 15.67% (10.52%) compared with 8.13% (1%) in the full firm sample. We conclude that the observed board overlap increase occurs primarily between firm pairs in which both firms feature high R&D intensity.

3.5 Exclusion Restriction

Our identification strategy hinges on the staggered adoption of the COW legislation in nine U.S. states. For the setting to be valid, it is important that the timing of COW legislation in any given state is exogenous and unrelated to any cyclical economic variable that could simultaneously influence firm performance.

The adoption of COW legislation in Delaware resulted from specific legal events. This makes the required temporal exogeneity highly plausible. According to Rauterberg and Talley (2017), the introduction of the COW legislation in Delaware represents a reaction to judicial decisions by a Delaware court. As recognized in court opinions, the two cases *Thorpe v. CERBCO* and *In Re Digex* highlight the intractable challenges posed by corporate opportunity claims in cases involving overlapping ownership and boards. Both cases made apparent the value for a law change to explicitly allow parties to waive corporate opportunities. The same case-based judicial developments could have occurred 10 or 15 years later. The legislation of COWs in eight other states appears to fit with a general pattern of corporate law diffusion across U.S. states: Delaware advances a legal innovation, which is subsequently copied by other states (Romano, 2006). However, our baseline results are robust to the exclusion of subsequent COW adoptions by other states.

We also note that the COW legislation does not appear to have been concerned with board overlap between public firms. The primary intent of the law change was to facilitate the financing for small privately held companies, which are usually invested by venture capital or private equity firms (Grossman, 2009; Rauterberg and Talley, 2017). These investors often hold overlapping ownership or overlapping boards in multiple firms, making their compliance with the corporate opportunity doctrine highly challenging. Generally, the lobbying transcripts also show little evidence of corporate lobbying before the law change (Eldar, Grennan, and Waldock, 2020). This all supports a narrative in which the legal repercussions for public firms occurred in an unintended and accidental manner.

The 2SLS regressions in our analysis seek to identify the precise transmission channel through which COW legislation influences firm outcomes. Yet this benefit comes at the price of more stringent exclusion restrictions than for simple reduced form regressions: We require here that the effect of COW legislations on firm performance does not bypass the channel of new board overlap and influences firm outcomes through other channels. Specifically, if the COW legislation also provides pre-existing board overlap with a more effective coordination mechanism, this exclusion restriction is violated, and the second-stage coefficients are biased (upwards). We verify in Section 5.2 the robustness of our findings by excluding firms with pre-existing board overlap from our sample.

4 Main Results

In this section, we present the regression results. We begin with the first-stage results validating that COW legislation increases the board overlap between firms in the same industries defined by the three-digit SIC code. We then move to the second stage to explore the effects of such new intra-industry board overlap on firm outcomes.

4.1 Corporate Law Reform and Its Impact on Board Overlap

In Table 3, Panel A, we present the first-stage regression with intra-industry board overlap ($Intra\_OvLapDir$) as the dependent variable. For notational convenience, we scale up the outcome variable (i.e., percentage of board members with other board seats) by a factor of 100. The first two regressions in Columns (1) and (2) follow the specification in Eq. (1a). The positive coefficient for the term $Treat \times R\&D\_Q4$ is statistically significant and implies an increase in intra-industry board overlap for firms with high research intensity (i.e., $R\&D\_Q4$). In contrast, no statistically significant change is observed for firms of lower research intensity (i.e., $R\&D\_Q1$ to $R\&D\_Q3$). This finding is consistent with our argument that corporate externalities are strongest among intra-industry firms and for R&D-intensive firms. The surge of board overlap among firms in the same industry after COW legislation is also consistent with the fact that violations of fiduciary duty are easier to prosecute if board overlap concerns firms in similar lines of business.

Columns (3) and (4) of Panel A report the more parsimonious specification in Eq. (1b). Here we distinguish firms of high research intensity (in a triple difference) and include a $Treat$ dummy, which captures a general treatment effect across all firms. Since the treatment effect is concentrated among firms in Q4, we use this specification in Eq. (1b) for the subsequent second-stage analyses.

The first-stage result is economically sizable. For example, in Column (4), the point estimate for the interaction term $Treat \times R\&D\_Q4$ implies an intra-industry board overlap increase of 2.7 percentage points after COWs. It amounts to a 12.9% overlap increase relative to the mean intra-industry overlap value of 20.9% among firms of high research intensity in quartile Q4. As the average board has 7.7 members for these firms, a 2.7 percentage point increase in overlap per average board member aggregates to 20.8% ($= 0.027 \times 7.7$) at the firm level, or roughly one new interlocked board member for every fifth firm.

Table 3, Panel B, reports in Columns (1)-(2) and (3)-(4) the regression results for overall board overlap ($All\_OvLapDir$) and inter-industry overlap ($Inter\_OvLapDir$), respectively. Overall, board overlap in Columns (1) and (2) shows no statistically significant change after the COW legislation. By contrast, inter-industry board overlap decreases for the firms in the two highest quartiles of R&D intensity following the COW legislation. In many cases, intra-industry board overlap appears to substitute for (presumably less valuable) inter-industry board overlap. To verify this substitution effect, we carry out a separate test in Table A2 of the Internet Appendix. We demonstrate that a firm is more likely to reduce inter-industry overlap after a recent increase in intra-industry overlap compared with situations where intra-industry overlap was stable or declined. This evidence is consistent with a substitution effect between inter- and intra-industry board overlap. We discussed Table A2 in more detail in Section 3.3.

An important validity check for our empirical design is the absence of diverging trends in intra-industry board overlap between treated and non-treated firms prior to the COW legislation. Any differential surge in intra-industry board overlap (among treated firms in quartile Q4) should occur only after the COW legislation is passed. To empirically check the pre-trending of board overlap, we run a dynamic version of the first-stage regression given by

$$Intra\_OvLapDir_{i,t} = \sum_{k=-4}^{7} \alpha_k \; R\&D\_Q4_i \times Years_{i,t}(k) + \delta \, Treat_{i,t} + Z_{i,t}\gamma' + \eta_{I\times t} + \theta_i + \epsilon_{i,t}, \quad (3)$$

where the dummy $Years_{i,t}(k)$ is equal to one if firm i becomes subject to COW legislation k $(-k)$ years after (before) its introduction in year t and zero otherwise. Firm observations that concern years more than three years prior to COW legislation are pooled as $k = Before$ and those more than six years later are pooled as $k = After$. For firms incorporated in states without any COW legislation, the dummy $Years_{i,t}(k)$ is always zero. Like the specification in Eq. (1b), this dynamic model controls for the same set of control variables $Z_{i,t}$ and the same interacted industry-year fixed effects $\eta_{I\times t}$ and individual firm fixed effects θ_i.

Figure 2 describes the dynamic evolution of intra-industry firm overlap relative to the reference year of its introduction in year $k = 0$, by depicting in solid red dots the point estimates $\widehat{\alpha}_k$. The vertical bars around each point estimate $\widehat{\alpha}_k$ represent a 95% confidence interval. We find that the coefficient estimates in the pre-legislation period are statistically indistinguishable from zero. For year $k = -3$ and before, we obtain large standard errors due to a lack of observations. This is illustrated by the grey-shaded histogram, which denotes the number of sample observations entering the estimation of $\widehat{\alpha}_k$. The lack of observations in the earlier period is because Delaware, where a significant portion of sample firms are incorporated, passed COW legislation in the year 2000. Unfortunately, this is only two years after the starting year of BoardEx data in 1998, limiting the time window of any pre-trend analysis. Yet, the three years $(t = -2, -1, 0)$ do not indicate any pre-trend growth in intra-industry board overlap.

Figure 2 also shows that board overlap gradually picks up after $k = 0$ and steadies only in year $k = 4$, and thereafter, suggesting that board changes adjusted only slowly to the new legal environment. The lagged adjustment of board overlap is consistent with the finding by Rauterberg and Talley (2017) of delayed firm-level adoptions of COWs. Such a delayed response is not surprising, as the required changes to corporate statutes and the new board appointments have implementation lags.

4.2 Board Overlap Effects on Firm Outcomes

Next, we explore the second-stage effect of intra-industry board overlap on firm outcomes. As the treatment effect concentrates in quartile Q4, we use the instrumented intra-industry board overlap obtained from the specification in Eq. (1b) for the subsequent second-stage analyses. We consider sales and cost variables: return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log of the sales [*ln(Sales)*], the log of costs of goods sold [*ln(COGS)*], and the log of cost share [*ln(COGS/Sales)*].

The regression results are reported in Table 4. For each outcome variable, we report alternatively two regression specifications controlling for log assets only (suffixed as Column Xa) or the full set of control variables $Z_{i,t} = \{ln(Assets), Tangibility, MTB\ ratio\}$ (suffixed as Column Xb). The Montiel Olega-Pflueger (MOP) effective F-statistics are above 20, suggesting that our estimation does not suffer from a weak instrument problem.

Table 4, Column (1b), reports a statistically highly significant increase in *ROA* by 2.74 percentage points for every one-percentage-point increase in intra-industry board overlap. An average 2.7-percentage-point increase in intra-industry overlap for firms in quartile Q4 [see Table 3, Panel A, Column (4)] then implies an increase in *ROA* by 7.4 percentage points, which is a large improvement on the average negative ROA of -11.9% for firms operating in the high-R&D-intensity quartile Q4. Thus, the corporate law change and the associated board overlap increase significantly improve firm profitability. The relationship between predicted intra-industry board overlap and ROA after filtering for firm and industry-by-year fixed effects and the three firm controls is depicted in the scatter plot in Figure 3. The graph uses red dots to distinguish treated firm observations in quartile Q4 from all other observations in blue; the former, located to the northeast, combine both higher predicted board overlap and a higher *ROA* value. The histograms in red and blue depict the shift in the distribution of board overlap triggered by COW legislation.

Examining other outcome variables also shows improved performance following an increase in intra-industry board overlap. For a one-percentage-point increase in intra-industry board overlap, Columns (2b) and (3b) in Table 4 show an increase in the gross profit margin and in the operating margin by 4.4 and 2.5 percentage points, respectively. Therefore, the profit margin increase exceeds the increased return on assets, which suggests that the profitability increase is not generated by higher sales quantities, but rather by higher product prices and/or lower production costs. Columns (4b) and (5b) show a corresponding increase in log sales (value) [*ln(Sales)*] of 5.3% and an equally large cost decrease [*ln(COGS)*] of −5.2%. This implies that the log cost share of sales [i.e., *ln(COGS)−ln(Sales)*] decreases by a total of 10.5%, which matches the point estimate of −10.3% in Column (6b).[10]

The substantial reduction in the cost share is particularly informative. As shown in Appendix A, a cost share increase is consistent with a decreasing elasticity of demand, and therefore an increase in a firm's market power following increased intra-industry board overlap. It cannot be explained by either increases in firm productivity in general (i.e., a larger Solow residual) or an increase in the marginal labor productivity. Such positive productivity effects of board overlap are inconsistent with the evidence on the cost share.

As a robustness exercise, we also undertake reduced form regressions, which relate firm outcomes directly to the treatment dummy *Treat* × *R&D_ Q4*. The results reported in the Internet Appendix, Table A4, confirm that firm outcome changes are concentrated in the high-R&D-intensity quartile *R&D_ Q4*, as the treatment dummy *Treat* itself is small and statistically insignificant. This confirms that only firms with high R&D intensity experienced any change as a consequence of the COW legislation.

In sum, the profitability surge following increased board overlap is broadly consistent with both hypotheses developed in Section 2. In the next section, we disentangle the two hypotheses more rigorously by analyzing the effect of board overlap on firm investment and innovation.

4.3 Board Overlap and Firm Investment

In this section, we seek to distinguish the corporate opportunity and market power hypotheses. The market power hypothesis states that firms coordinate in an attempt to mutually reduce investment and innovation. High levels of both investment and innovation tend to accentuate firm competition, and increase the risk of firm distress. By contrast, the corporate opportunity hypothesis predicts that board overlap, by facilitating the sharing of corporate opportunities between firms, enhances investment and innovation. Therefore, examining how an increase in

[10] We report the OLS estimates corresponding to Table 4 in Table A3 of the Internet Appendix. The Hausman test for equality of the OLS and IV estimates is generally rejected, which we attribute to the endogeneity of the board overlap measures.

board overlap influences firm investment in fixed assets and R&D allows us to distinguish the two hypotheses.

We examine investment in both tangible and intangible assets. The former is measured by $ln(Capex)$, and the latter by a set of firm innovation variables, including *R&D intensity* (measured as R&D expenditure relative to assets), the (log) of successful patent filings [*ln(1+Patents)*], and the dollar value of all successful patents divided by contemporaneous assets (*Patent Value*) (Kogan *et al.*, 2017). Table 5 reports the regression results. We find that board overlap has an economically and statistically strong negative effect on tangible and intangible capital investment. In Column (1), a one-percentage-point increase in intra-industry board overlap is associated with a decrease in capital expenditure [*ln(Capex)*] by 7.06%. The reduced investment is also observed for intangible capital. In Column (3), *R&D intensity* decreases by 1.64 percentage points for each additional percentage point of intra-industry overlap among firms in the high-R&D-intensity quartile Q4. This implies a 7.5% reduction relative to an average R&D intensity of 0.218 for firms in quartile Q4. The negative effect is also strong on (log) patent output [*ln(1+Patents)*] and the dollar value of firm patents (*Patent Value*).

We also explore if the reduced firm investment is accompanied by changes in employment. The regression result in Column (2) indicates that employment effects are statistically and economically insignificant. The absence of an employment response under increased sales and profitability points toward high sales prices (due to increased market power) rather than higher sales volumes, which require more labor input to match. Unfortunately, we do not observe sales prices directly, and we cannot control for potential changes in product quality. Adverse effects of board overlap on (static) consumer welfare are therefore difficult to demonstrate.

Importantly, Table 5 provides little support for the opportunity hypothesis whereby firms make more investment as the increased board overlap facilitates better allocation and exploitation of corporate opportunities. Instead, the evidence is consistent with the market power hypothesis, according to which board overlap attenuates firm rivalry through reduced capital expenditure and reduced innovation. The ensuing reduction in firm investment most certainly has adverse long-run effects on consumer welfare.

4.4 Board Overlap and Product Market Rivalry

Product market segmentation and product differentiation represent additional channels through which firms can reduce firm rivalry. We construct a measure for product market overlap based on industry segment sales retrieved from Compustat. Starting with a total of P product segments, we can characterize firm i's product market position by the vector $S_i = [s_{i,1}, s_{i,2}, s_{i,3}, .., s_{i,P}]$, where $s_{i,p}$ denotes the fraction of the firm's sales in segment p. We define as product market overlap between firms i and j the cosine similarity ($COS_{i,j}$) of S_i and S_j, formally

$$COS_{i,j} = \frac{\sum_p s_{i,p} s_{j,p}}{\sqrt{\sum_p s_{i,p}^2}\sqrt{\sum_p s_{j,p}^2}}.$$

Next, we define the average product overlap for firm i as its average cosine similarity with all other firms j in the same three-digit SIC industry,

$$OvLapProd_{i,t} = w_j \sum_j COS_{i,j},$$

where w_j denotes the sales share of firm j relative to the aggregate sales for all same-industry firms paired with firm i.

Our proxy for product differentiation is a text-based measure of product similarity developed by Hoberg and Phillips (2010). Here, the pairwise similarity score is based on the overlapping unique words in the 10-K business description of two firms. A higher similarity score indicates that two firms engage in more similar commercial activities. We obtain a firm-level product similarity score (*HPSS*) from the Hoberg-Phillips Data Library.[11]

Table 6 relates both measures to the (instrumented) board overlap, where we report only the second stage of the regression. Intra-industry board overlap (*Intra_ OvLapDir*) shows a negative effect on both product market overlap and product similarity. A 2.7% increase in board overlap [i.e., the treatment effect implied in the first stage shown in Table 3, Panel A, Column (4)] is associated with a decrease by 2.1 percentage points in product market overlap and by 63.5 percentage points in product similarity, which amounts to 7.9% of the standard deviation of product overlap and 7.2% of the standard deviation of product similarity, respectively.

One could argue that the evidence on increased product segmentation is also consistent

[11] The website for the data library is https://hobergphillips.tuck.dartmouth.edu

with the opportunity hypothesis. In particular, a reduced market segment overlap and reduced product similarity could result from a firm expanding into new market segments or developing new products. However, this alternative interpretation is difficult to reconcile with the previous evidence of reduced investment and innovation following COW legislation.

But we can push the analysis of product market structure one step further. We examine the number of product segments a firm operates in [i.e. $ln(\#Segments)$] and thus assess if a firm expands its product space after the COW legislation. In addition, we follow Hoberg and Phillips (2018) and quantify the depth of a firm's product offering using the word count in its 10-K business description. The variable *Product Offering Growth* gauges the degree to which a firm increases its annual product offering. In Table 6, Panel B, we find that new board overlap is not significantly related to either $ln(\#Segments)$ or *Product Offering Growth*, which is again inconsistent with the corporate opportunity hypothesis.

Overall, the evidence on more product market differentiation following board overlap increase provides further support for the market power hypothesis. It shines a light on an additional dimension of firm coordination and is fully consistent with the higher firm profitability reported in Sections 4.2 and 4.3.

5 Additional Explanations

5.1 Board Overlap and Common Ownership

Does new board overlap associated with the COW legislation reflect increased shareholder overlap or does board overlap constitute an independent phenomenon? The recent finance literature has linked the rise of common (institutional) ownership (Elhauge, 2017; Dallas, 2018) to increased firm profitability, and reduced investment and R&D expenditure (Azar, Schmalz, and Tecu, 2018; Gutiérrez and Philippon, 2020; Grullon, Larkin, and Michaely, 2019). The similarity with our findings for board overlap gives importance to this question, which we approach from three angles: First, we use BoardEx data and examine how often interlocked directors are categorized as "independent directors," and are therefore not linked to any specific shareholder. Second, we undertake a text analysis of SEC filings by institutional investors and identify all directors named therein as having a link to the investment company. Third, we examine if the observed increase in board overlap is matched by an economically or statistically significant increase in institutional shareholder overlap.

Using BoardEx data, we observe that 89% of all the interlocked directors hold non-executive positions. Among those interlocked non-executive directors, 86% are labeled as "independent directors," and only 14% potentially represent "specific" shareholders. This suggests that interlocked directors only rarely represent common shareholders directly, even if shareholder overlap by itself should align the interests of the respective firm owners.

We further probe 13F filings by institutional investors to check if board overlap features considerable independence from institutional cross-ownership in firms.[12] Our corporate sample contains a total of $10,259$ cases of firm-pair-years with an interlocked director. Surprisingly few are named in the 13F filings as "related" to the investment company: Only 326 director-years match ($3.2\% = 326/10,259$), and this number drops further to only 187 director-years (1.8%) if we require a minimum investment share of 1% in both firms on the board of which the director sits. We perform an additional study on these 187 cases, and categorize the institutional investor by type. The overwhelming majority of 143 directors (1.4%) are related to private equity or venture capital firms, 34 directors (0.3%) show a link to a general investment company, and 10 directors (0.1%) to banks. The "big three" passive asset managers (Blackrock, Vanguard, and State Street) report only five links to interlocked directors in their regulatory filings. While it is possible that some of the board overlap is related to private investors' overlap, the 13F data suggest that common institutional ownership, which is the center of the debate, is not strongly associated with board overlap. Accordingly, we conclude that board overlap represents a governance feature largely independent from common institutional ownership.

Lastly, we repeat the first-stage regressions in Table 3, using different measures of shareholder overlap instead of board overlap as the dependent variable. We define as $AvCO$ the average common shareholder overlap a firm has with all other firms in the same industry with which it also shares a director. We can measure common ownership for an institutional investor s with portfolio weights $w_{s,i}$ and $w_{s,j}$ in firm pair (i, j) (i) either by the minimum function of portfolio shares [i.e. $overlap(s, i, j) = min(w_{s,i}, w_{s,j})$] or (ii) by the product of the portfolio shares [i.e. $overlap(s, i, j) = w_{s,i} \times w_{s,j}$], respectively. Formally, for institutional investors $s \in S$ investing

[12] Cross-checking the data in the 13F filings against data from LinkedIn confirms the accuracy of the reported data. Moreover, 13F data exceed those from LinkedIn in terms of comprehensiveness of coverage.

in firms j in industry I, the *average common ownership* for firm $i \in I$ is defined as

$$AvCO_{i,t} = \sum_{j \in I \setminus \{i\}} \omega_j \sum_{s \in S} overlap(s, i, j) \times D_{i,j}^{OvLapDir},$$

where the dummy variable $D_{i,j}^{OvLapDir}$ is equal to one if firms i and j share an intra-industry director and the weight ω_j is defined as the relative market share $\omega_j = Mktsh_j / \sum_{k \in I \setminus \{i\}} Mktsh_k$ of firm j relative to all other firms $j \in I \setminus \{i\}$.

Table A5 in the Internet Appendix reports the effect of *Treat*$\times$ *R&D_ Qx* on the two different measures of average common ownership. Irrespective of the exact definition of the overlap function (as minimum or product of ownership shares), average shareholder overlap $AvCO_{i,t}$ bears no statistically significant relationship with *Treat* $\times$ *R&D_ Qx*. We conclude that board overlap and shareholder overlap are distinct phenomena with respect to our natural experiment. The board overlap expansion under COW legislation is *not* aligned with a parallel increase in shareholder overlap, which establishes board overlap as distinct from shareholder overlap.

5.2 Pre-Existing Board Overlap

The exclusion restriction for the 2SLS regression requires that COW legislation does not change firm behavior and outcomes through channels other than new intra-industry board overlap. This raises the question of how the law changes affect pre-existing intra-industry board overlap. If such pre-existing board overlap has already fully exhausted the scope of firm coordination, then the COW legislation should not have any incremental effect on firm behavior in these cases and the exclusion restriction is fulfilled. Yet, it is also plausible that pre-existing interlocked directors become more active in inter-firm coordination once the legal risk is removed. Such an effect would bypass the predicted change in new board overlap and violate the exclusion restriction.

We note that only 233 firms had at least one intra-industry director overlap in the year before the introduction of COWs. However, many of these firms experienced additional intra-industry director overlap in the five years following the COW legislation, which further diminishes the number of firm observations for which the exclusion restriction is potentially violated. We remove all firms from our sample which feature pre-existing board overlap prior to the COW legislation and maintain their level of board overlap thereafter. We explore the robustness of our results for this filtered sample in Table A6 of the Internet Appendix. The new regression results are qualitatively and quantitatively similar to Table 4.

5.3 More Robustness Analyses

Board overlap could result from the fact that specific human capital is concentrated among a small number of highly qualified industry experts. If the director choice is further constrained by the professional networks of the respective CEOs, an even more limited choice set of potential directors can emerge with numerous interlocked directors. Therefore, it seems plausible that the improved firm performance reflects higher board quality after COWs if the reduced legal risk allows more firms to share the talent of high-quality directors through board overlap.

But a review of the literature suggests that board overlap is often associated with reduced governance quality (Fich and Shivdasani, 2006; Core, Holthausen, and Larcker, 1999). Rather than improving firm governance, interlocked directors compromise a board's monitoring role, as multiple board appointments dilute their limited attention.

By contrast, Field, Lowry, and Mkrtchyan (2013) emphasize that interlocked (or "busy") directors indeed excel as advisors to management, particularly for young firms that recently had an IPO. To test the existence of such advisory effects in our sample, we label with the dummy $PostIPO$ all firm-years for which an IPO occurred in the last three years, and repeat the baseline specification with a triple interaction term $Treat \times R\&D\_Q4 \times PostIPO$. Table A7 in the Internet Appendix reports the corresponding results. First, the positive coefficient for the interaction term $PostIPO \times Treat$ in Column (2) indicates that young firms (marked by $PostIPO$) show a more pronounced increase in their intra-industry board overlap following the COW legislation. This is consistent with the finding of Field, Lowry, and Mkrtchyan (2013). Second, the negative coefficient of the triple interaction term indicates that the advisory effect of board overlap is less pronounced among research-intensive firms. Therefore, we conclude that the market power hypothesis of board overlap characterizes a distinct aspect of corporate governance.

A more general concern about our statistical inference is that state law changes correlate inter-temporally with changes in the local business environment. To address this issue, we include in the 2SLS regression of Table 4 head-quarter-state-by-year fixed effects, which can absorb observable and unobservable time-variation in the local business conditions at the state level. As shown in Table A8 of the Internet Appendix, our results remain qualitatively and quantitatively unchanged.

Lastly, we note that a significant fraction of sample firms (68%) are incorporated in the state of Delaware. A robustness check excluding all Delaware incorporated firms shows that our results are not specific to this particular state. The regression results for this reduced sample are presented in Table A9. We find that the coefficients for $Treat \times R\&D\_Q4$ remain significant and are consistent with those reported in Table 4.

6 Conclusion

This paper addresses the important question of whether and how board overlap facilitates firm coordination. Our hypotheses development is based on theoretical work that emphasizes two countervailing corporate externalities: positive externalities, which refer to firms' information exchange on corporate opportunities, and negative externalities, which refer to product market rivalry. We develop the opportunity and the market power hypotheses based on how board overlap interacts with each type of spillover.

We seek to establish the causal effect of board overlap on firm coordination using the staggered introduction of corporate opportunity waivers (COWs) in nine U.S. states. The law change reduced the fiduciary duty for corporate directors and triggered more intra-industry board overlap—mostly in firms with high R&D intensity. Firms that increased their intra-industry board overlap in response to the new legislation show a sizeable increase in corporate profitability. The increased firm profitability is consistent with the opportunity and market power hypotheses.

We carry out further analyses to distinguish both hypotheses. We find that an increase in intra-industry board overlap following COW legislation is associated with reduced investment in capital expenditure and firm innovation. This evidence is consistent with the market power hypothesis, but inconsistent with the opportunity hypothesis: The former predicts that board overlap reduces investment to soften firm rivalry, whereas the latter predicts that board overlap facilitates more efficient exploitation of opportunities, which increases investment. As an additional channel, we show that new board overlap reduces a firm's product market overlap and product similarity with its peers. This evidence further corroborates the market power hypothesis.

In light of the overall evidence, board overlap represents a socially undesirable governance feature for publicly traded companies. The contractibility of directors' fiduciary duties introduced by COW legislation appears to have backfired due to its unanticipated adverse effects on competition in R&D-intensive sectors. Corporate law changes thus contributed to the paradoxical combination observed for U.S. listed firms after 2000 of simultaneously low investment levels and high firm profitability (Gutiérrez and Philippon, 2016; Grullon, Larkin, and Michaely, 2019).

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Appendix: Interpreting Cost Share Changes

Intra-industry board overlap can potentially increase firm coordination, which in turn can enhance a firm's market power or alternatively contribute to greater production efficiency. It is useful to contrast these two effects in a simple monopolistic firm model. Assume a firm faces a price inelastic demand where we denote the price elasticity as

$$\epsilon = -\frac{\frac{dy}{y}}{\frac{dp}{p}} > 1.$$

A low price elasticity corresponds to high market power. In the perfect competition case, we have $\epsilon \longrightarrow \infty$ as the market demand becomes (infinitely) insensitive to price variations. For simplicity, we consider production function $y = f(L) = \alpha L^{\beta}$ with labor L as the only input available at price w. The parameter α represents total factor productivity and β the elasticity of output with respect to labor input.

Board overlap can simultaneously change all three parameters α, β, and ϵ. We denote by $z =$ *Intra_ OvLapDir* the degree of intra-industry board overlap of a firm with its competitors. *Market power enhancing coordination* suggests that board overlap reduces the demand elasticity for the firm product, hence $\frac{d\epsilon}{dz} < 0$. Alternatively, the *productivity enhancing coordination* can increase total factor productivity α, that is $\frac{d\alpha}{dz} > 0$, or improve the elasticity β output with respect to labor input, that is $\frac{d\beta}{dz} > 0$. Next, we highlight that both versions of the coordination hypothesis yield different predictions for the change in the cost share.

A profit maximizing firm will choose product supply, such that

$$p\frac{dy}{dL} + y\frac{dp}{dy}\frac{dy}{dL} - w = 0, \quad (4)$$

which implies for the optimal price p and cost share of sales

$$p = \frac{\epsilon}{\epsilon - 1}\frac{w}{MPL} \quad (5)$$

$$\frac{wL}{py} = \beta\frac{\epsilon - 1}{\epsilon}, \quad (6)$$

where we denote as the marginal productivity $MPL = \alpha\beta L^{\beta-1}$. In Eq. (5) we see that the product price p exceeds the competitive price $\frac{w}{MPL}$ by the factor term $\frac{\epsilon}{\epsilon-1} > 0$. Higher marginal (labor) productivity MPL (at constant wages) decreases the optimal product price. A lower ϵ (i.e. a more inelastic demand) increases it. We can define the non-competitive (percentage) price markup as

$$\mu = \frac{1}{\epsilon - 1} \geq 0. \quad (7)$$

Eq. (6) links the cost share to the percentage (non-competitive) price markup and the marginal productivity parameter β. Higher marginal productivity of labor increases the cost share, but more market power decreases it. The effect of board overlap on the cost share $\frac{wL}{py}$ allows us to discriminate between the two versions of the coordination hypothesis. Any change in the cost share can be decomposed into a productivity effect and into a market power effect, i.e.,

$$\frac{d}{dz}\ln\frac{wL}{py} = \frac{1}{\beta}\frac{d\beta}{dz} + \frac{1}{(\epsilon-1)\epsilon}\frac{d\epsilon}{dz}. \tag{8}$$

This implies that under *market power enhancing coordination*, we find that the change in the cost share with respect to board overlap changes is negative (i.e. $\frac{d}{dz}\ln\frac{wL}{py} < 0$). By contrast, the *productivity enhancing coordination* predicts that the cost share increases (i.e. $\frac{d}{dz}\ln\frac{wL}{py} > 0$ if $\frac{d\beta}{dz} > 0$). The empirical evidence in Section 4 is clearly in favor of the former and not the latter.

If we linearize Eq. (7) and substitute Eq. (8), we obtain

$$\frac{d\mu}{dz} = -\frac{1}{(\epsilon-1)^2}\frac{d\epsilon}{dz} = \frac{\epsilon}{(\epsilon-1)}\left[-\frac{1}{\beta}\frac{d\beta}{dz} + \frac{d}{dz}\ln\frac{wL}{py}\right]. \tag{9}$$

Around the competitive benchmark ($\epsilon \to \infty$) with $\epsilon/(\epsilon-1) \approx 1$, we find for the change in the profit markup $d\mu$ under changes dz in board overlap

$$\frac{d\mu}{dz} \approx \frac{1}{\beta}\frac{d\beta}{dz} - \frac{d}{dz}\ln\frac{wL}{py}. \tag{10}$$

For a constant elasticity parameter β with $\frac{d\beta}{dz} = 0$, any increase in the price markup $\frac{d\mu}{dz}$ is proportional to the decrease in the log cost share of sales. In this case, the observed changes in the log cost share of sales in Table 4, Columns (6a)–(6b), allow us to infer the price increase under *market power enhancing coordination.* In contrast, if board overlap generates *productivity enhancing coordination* with an increase in total factor productivity α, we expect to observe no change in the cost share of sales or in the price markup.

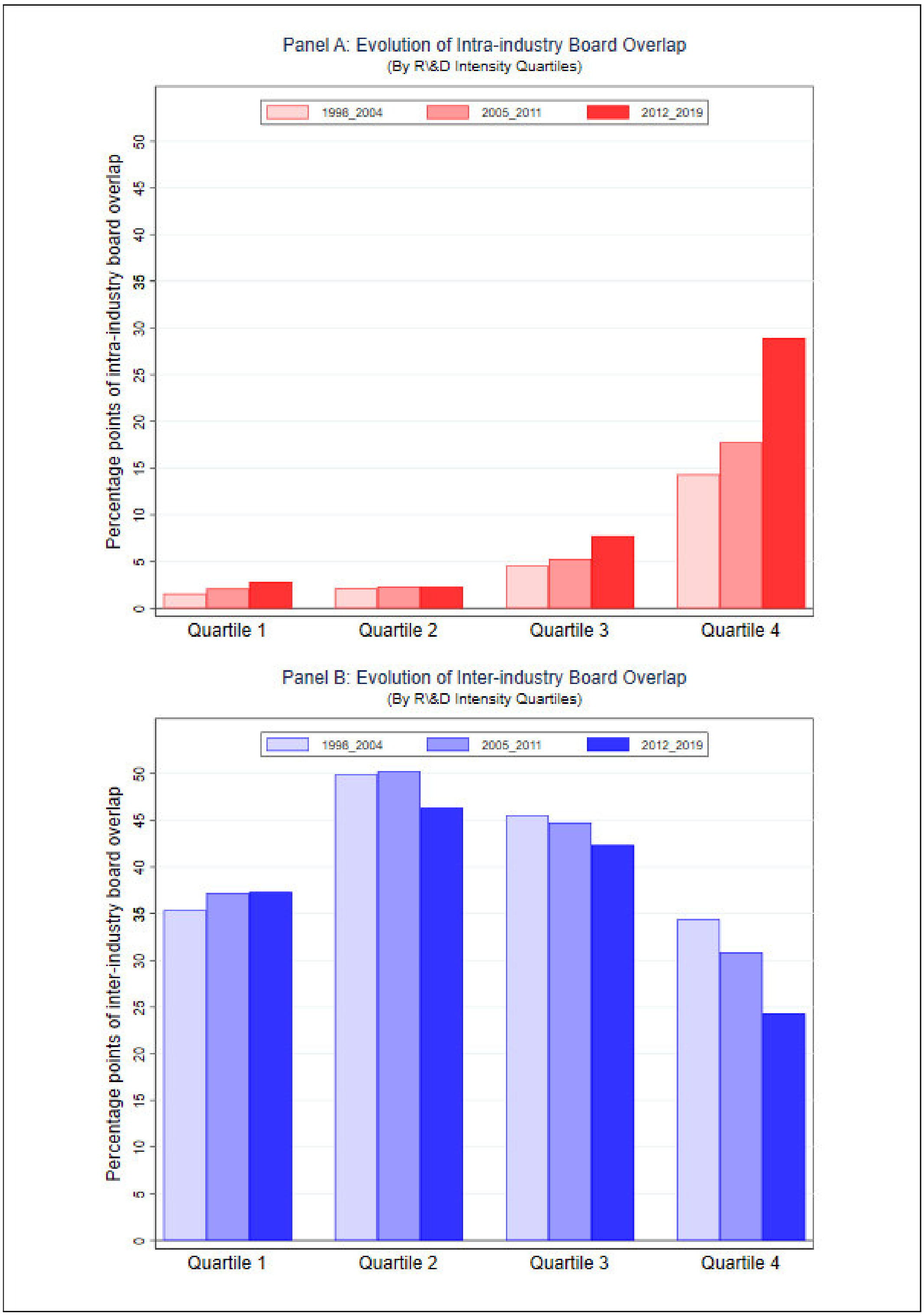

Figure 1: The evolution of intra-industry board overlap (Panel A) and inter-industry board overlap (Panel B) is depicted for three time periods and by the level of a firm's R&D intenstiy (Q1: low; Q4: high). Board overlap is the averge percentage of board members serving on at least one other corporate board.

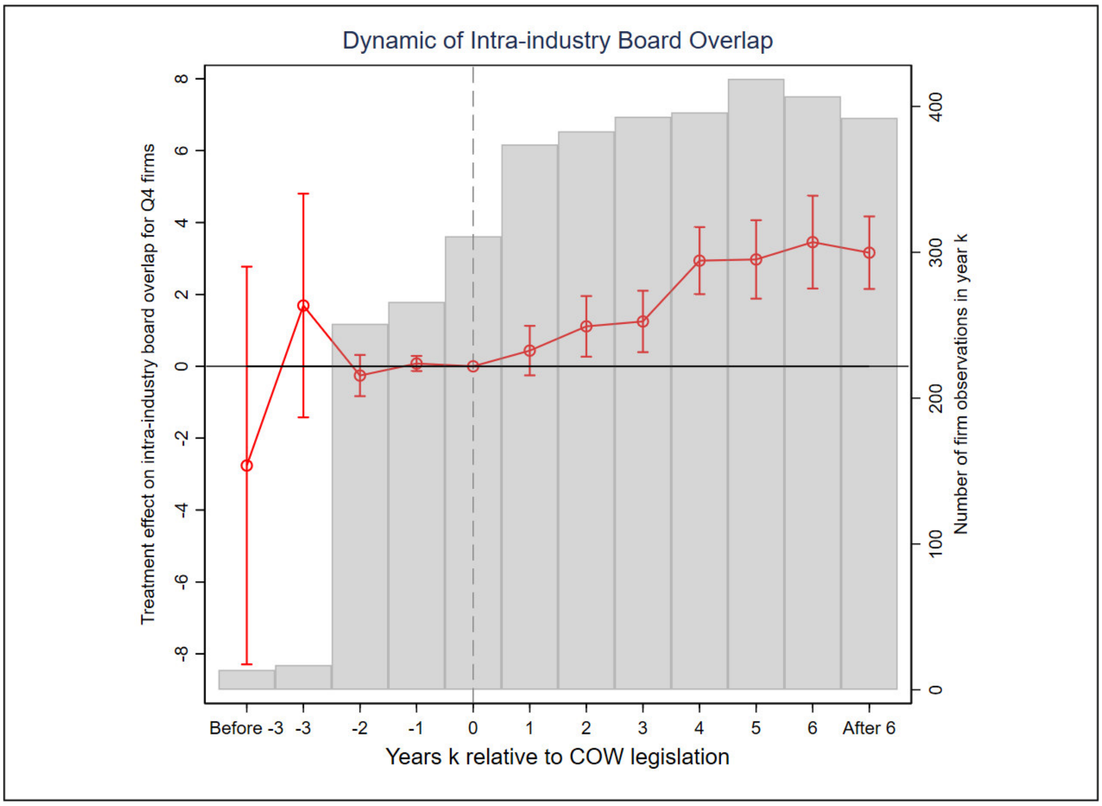

Figure 2: We plot the dynamics of intra-industry board overlap for firms with high R&D intensity (Q4) relative to the year $k = 0$ when COW legislation was introduced into U.S. state corporate law. Depicted by the red line is the coefficient estimate $\widehat{\alpha}_k$ in Eq. (3) with the vertical bars representing a 95% confidence interval. The grey histogram in the background represents the number of firm observations entering the estimation of $\widehat{\alpha}_k$.

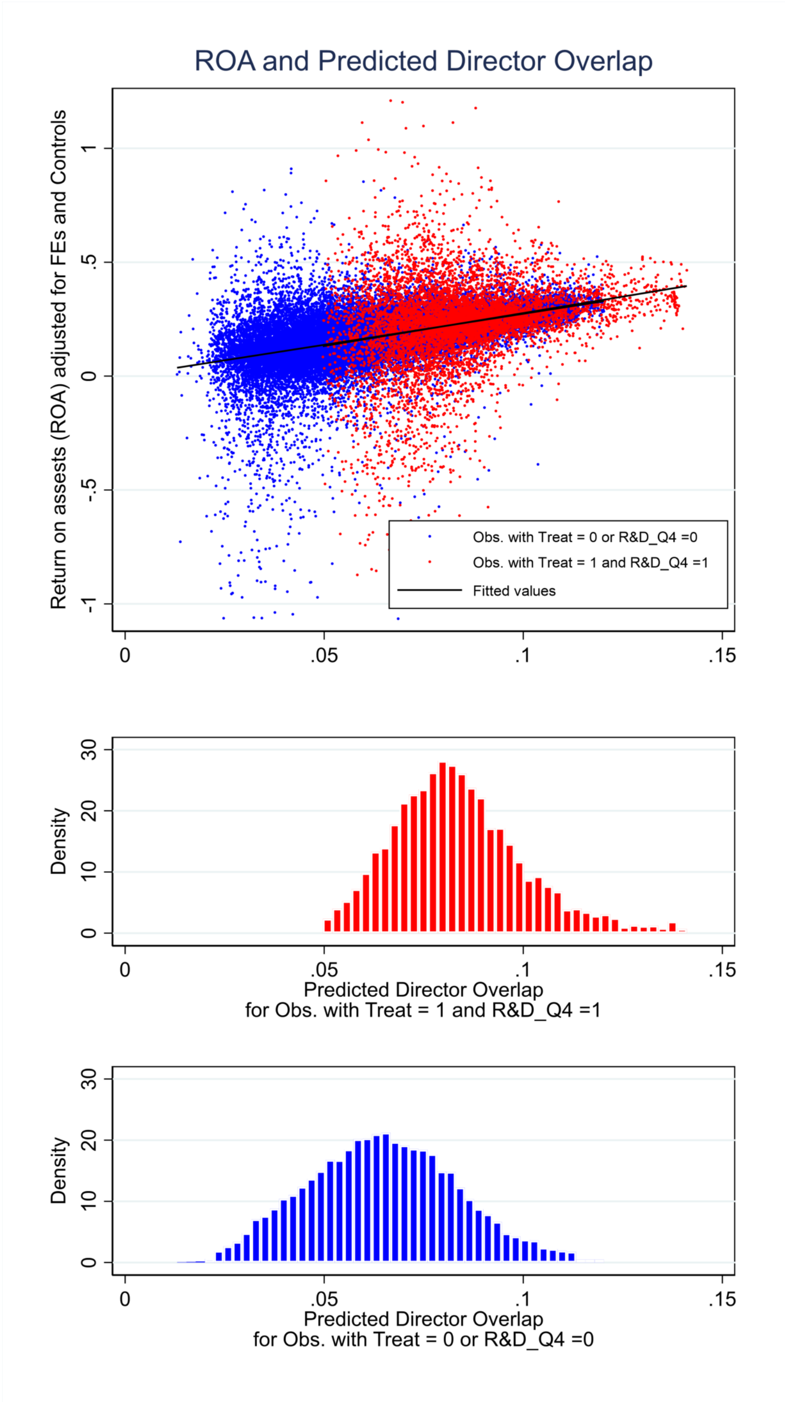

Figure 3: We graph a scatter plot of 49,957 firm-year observations for the return on assets (ROA) on the y-axis against the predicted (intra-industry) director overlap ($\widehat{Intra\_OvLapDir}$) on the x-axis, where we filter (subtract) firm and industry-by-year fixed effects and the three control variables based on the regression in Table 4, Column (1b). Firms in the high R&D intensity quartile Q4 ($R\&D\_Q4$ = 1) and observations simultaneously subject to COW legislation ($Treat = 1$) are marked by a red dot, and all other observations by blue dots. We show their corresponding histograms below the scatter plot.

Table 1: Corporate Law Changes by State

We list changes in state law that allow for corporate opportunity waivers relaxing the fiduciary duties of board members. Listed are the state, the specific statute, the date of effectiveness of corporate law changes, and the scope or coverage of the waiver. Rautenberg and Talley (2017) is the source for the information.

Corporate Law Change			Scope/Coverage (of)		
State (1)	Statute (2)	Date (3)	Directors (4)	Officers (5)	Shareholders (6)
DE	Code Ann. tit. 8, §122(17)	01/07/2000	Yes	Yes	Yes
OK	Ann. tit. 18, §1016(17)	01/11/2001	Yes	Yes	Yes
MO	Ann. Stat. §351.385(16)	01/10/2003	Yes	Yes	Yes
KS	Stat. Ann. §17-6102 (17)	01/01/2005	Yes	Yes	Yes
TX	Bus. Orgs. Code Ann. §2.101(21)	01/01/2006	Yes	Yes	Yes
NV	Rev. Stat. Ann. §78.070(8)	01/10/2007	Yes	Yes	No
NJ	Stat. Ann. 14A:3-1(q)	11/03/2011	Yes	Yes	Yes
MD	Code Ann., Corps. & Ass'ns §2-103(15)	01/10/2014	Yes	Yes	Yes
WA	Code Ann. §23B.02.020(5)(k)	01/01/2016	Yes	Yes	Yes

Table 2: Descriptive Statistics

Panel A reports summary statistics on all variables. The accounting variables are return on assets (*ROA*), the *Gross (Profit) Margin* [i.e. *(Sales-COGS)/Sales*], *Operating Margin* (i.e. *Operating Profit/Sales*), the ratios of sales and costs of goods sold (*COGS*) to assets, the log values of sales and costs of goods sold (in USD millions), the log cost share [*ln(COGS/Sales)*], log assets [*ln(Assets)*], the log of firm employment [*ln(Employ)*], log capital expenditure [*ln(Capex)*], asset tangibility (*Tangibility*), and the market-to-book ratio(*MTB ratio*). Industry structure is captured by the Hoberg-Phillips similarity score (*HPSS*), a measure for the level of overlapping product segments (*OvLapProduct*), the log number of segments (*ln(#Segments)*), the *Product Offering Growth*, and a conventional Herfindahl–Hirschman index in terms of sales based on three-digit industry codes (*HHI_SIC3*). The governance variables comprise the number of board members (*Board Size*), the overall percentage of overlapping directors on a firm board (*All_OvLapDir*), the percentage of intra-industry overlapping directors (*Intra_OvLapDir*), and the percentage of inter-industry overlapping directors (*Inter_OvLapDir*). The patent data include the ratio of R&D expenditure and assets (*R&D Intensity*), the log (cumulative) patent count for a firm [*ln(1+Patents)*], and the (dollar) value of these patents scaled by total assets (*Patent Value*). In Panel B, we report mean values of all variables for the full sample and subsamples sorted according to *R&D Intensity* into quartiles Q1 to Q4 capturing different degrees of R&D expdenditure. Column (6) provides the variable difference between the means of Q4 and Q1, and tests for statistical difference based on a non-parametric rank test. Columns (7) and (8) split the sample Q4 of firms subject to high R&D intensity into those with (*Intra_OvLapDir* > 0) and without (*Intra_OvLapDir* $= 0$) intra-industry board overlap.

Panel A: Summary Statistics

	Obs. (1)	Mean (2)	S.D. (3)	Median (4)	P25 (5)	P75 (6)
Accounting						
ROA	49,957	0.068	0.213	0.111	0.049	0.166
Gross margin	49,957	0.367	0.287	0.365	0.222	0.549
Operating margin	49,957	0.031	0.206	0.068	0.006	0.133
Sales/Assets	49,957	1.07	0.755	0.909	0.547	1.398
COGS/Assets	49,957	0.725	0.646	0.547	0.27	0.962
ln(Sales)	49,957	6.05	2.212	6.152	4.648	7.555
ln(COGS)	49,957	5.544	2.167	5.555	4.008	7.065
ln(COGS/Sales)	49,957	−0.512	0.749	−0.454	−0.795	−0.25
ln(Employ)	49,199	0.552	2.067	0.578	−0.936	2.015
ln(Capex)	49,587	2.776	2.404	2.877	1.165	4.426
ln(Assets)	49,957	6.198	1.987	6.133	4.763	7.547
Tangibility	49,957	0.243	0.224	0.166	0.072	0.344
MTB ratio	49,957	1.86	1.666	1.315	0.877	2.166
Industry Structure						
HPSS	49,649	3.516	8.864	0.584	0.103	2.565
OvLapProd	49,957	0.455	0.265	0.428	0.238	0.651
HHI_SIC3	49,823	0.207	0.19	0.143	0.071	0.271
ln(#Segments)	49,463	0.319	0.465	0	0	0.693
Prod. Offering Growth	45,251	−0.001	0.395	0.01	−0.055	0.079
Governance						
Board Size	49,957	8.509	2.57	8	7	10
All_OvLapDir	49,957	0.45	0.401	0.375	0.143	0.667
Intra_OvLapDir	49,957	0.068	0.178	0	0	0
Inter_OvLapDir	49,957	0.381	0.371	0.286	0.1	0.583
Innovation						
R&D Intensity	49,957	0.06	0.118	0.007	0	0.071
ln(1+Patent)	45,443	0.778	1.372	0	0	1.099
Patent value	45,443	0.105	0.313	0	0	0.035

Table 2 continued

Panel B: Firm Variables Means by Level of R&D Intensity

	Full Sample	Subsamples by R&D Intensity Quartiles				Difference	Q4 Split	
		Q1 (Low)	Q2	Q3	Q4 (High)	Q4-Q1	*Intra_ OvLapDir* > 0 Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Accounting								
ROA	0.068	0.123	0.119	0.097	−0.119	−0.241***	−0.144	−0.088
Gross margin	0.367	0.330	0.329	0.445	0.364	0.034***	0.325	0.411
Operating margin	0.031	0.077	0.079	0.059	−0.134	−0.210***	−0.163	−0.098
Sales/Assets	1.070	1.304	1.059	0.969	0.663	−0.641***	0.543	0.811
COGS/Assets	0.725	0.939	0.747	0.573	0.418	−0.521***	0.364	0.484
ln(Sales)	6.050	6.601	6.917	6.106	4.365	−2.236***	4.449	4.261
ln(COGS)	5.544	6.144	6.487	5.431	3.937	−2.208***	4.107	3.728
ln(COGS/Sales)	−0.512	−0.457	−0.434	−0.676	−0.454	0.003	−0.373	−0.553
ln(Employ)	0.552	1.049	1.256	0.616	−0.936	−1.985***	−0.857	−1.034
ln(Capex)	2.776	3.350	3.516	2.700	1.249	−2.101***	1.472	0.976
ln(Assets)	6.198	6.520	6.966	6.209	5.144	−1.376***	5.473	4.740
Tangibility	0.243	0.337	0.255	0.179	0.101	−0.237***	0.091	0.113
MTB ratio	1.860	1.445	1.464	1.917	2.904	1.459***	3.064	2.707
Industry Structure								
HPSS	3.516	1.887	0.674	1.685	10.837	8.950***	15.781	4.746
OvLapProd	0.455	0.453	0.416	0.422	0.519	0.066***	0.542	0.490
HHI_ SIC3	0.207	0.249	0.285	0.194	0.099	−0.150***	0.074	0.129
ln(#Segments)	0.319	0.361	0.523	0.370	0.079	−0.281***	0.062	0.101
Prod. Offering Growth	−0.001	0.005	−0.001	−0.001	−0.014	−0.020***	−0.020	−0.008
Governance								
Board Size	8.509	8.704	9.123	8.573	7.741	−0.963***	8.196	7.183
All_ OvLapDir	0.450	0.388	0.508	0.500	0.504	0.115***	0.672	0.296
Intra_ OvLapDir	0.068	0.022	0.022	0.058	0.209	0.187***	0.379	0.000
Inter_ OvLapDir	0.381	0.367	0.486	0.442	0.295	−0.072***	0.294	0.296
Innovation								
R&D Intensity	0.060	0.002	0.012	0.055	0.218	0.216***	0.243	0.187
ln(1+Patent)	0.778	0.155	0.838	1.459	1.310	1.155***	1.454	1.144
Patent value	0.105	0.008	0.040	0.159	0.286	0.278***	0.330	0.234

Table 3: Corporate Law Change and Board Overlap

We report the first-stage regression of various types of board overlap. The "treatment dummy" marks firm i incorporated in states that in a given year t is allowed for a corporate opportunity waiver for board members ($Treat = 1$). The dummy takes on the value of zero if the state law does not provide this option ($Treat = 0$). We measure the treatment effect for different quartiles Qx of R&D intensity by using the interaction term *R&D_ Qx*×*Treat*. The quartile dummy *R&D_ Qx* takes on the value of one for firms in the x-th quartile of the R&D intensity. The R&D intensity used to construct *R&D_ Qx* is measured at the year when a firm first appears in the sample. The missing R&D is replaced to zero and marked by a dummy. The interaction of the missing R&D dummy and *Treat* is included in all specifications. Panel A reports regressions of the percentage of intra-industry overlapping directors on a firm's board (*Intra_ OvLapDir*), and Panel B reports regressions of the overall percentage of overlapping directors on a firm board (*All_ OvLapDir*) and the percentage of inter-industry overlapping directors (*Inter_ OvLapDir*). The dependent variables are expressed in percentages (×100). Control variables for various specifications are the log of total assets [*ln(Assets)*], the asset tangibility (*Tangibility*) (i.e., property, plant, and equipment relative to total asset), and the market-to-book ratio (*MTB ratio*). All specifications control firm fixed effects and industry-by-year fixed effects. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Panel A: Intra-Industry Board Overlap

Dep. Variables:	*Intra_ OvLapDir*			
	(1)	(2)	(3)	(4)
Treat×*R&D_ Q4*	2.8025***	2.8626***	2.6259***	2.6718***
	(0.5871)	(0.5705)	(0.5811)	(0.5511)
Treat×*R&D_ Q3*	0.2753	0.3084		
	(0.4428)	(0.4482)		
Treat×*R&D_ Q2*	−0.2322	−0.2640		
	(0.7879)	(0.7889)		
Treat×*R&D_ Q1*	0.1655	0.1477		
	(0.3749)	(0.3662)		
Treat			0.1661	0.1757
			(0.4213)	(0.4234)
Controls				
ln(Assets)	0.8642***	0.9233***	0.8646***	0.9233***
	(0.1166)	(0.1395)	(0.1171)	(0.1402)
Tangibility		1.3416*		1.3307*
		(0.7009)		(0.6910)
MTB ratio		0.1258		0.1252
		(0.0857)		(0.0860)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Adjusted R^2	0.746	0.746	0.746	0.746
Observations	49,957	49,957	49,957	49,957

Table 3 continued

Panel B: Overall and Inter-Industry Board Overlap

Dep. Variables:	*All_ OvLapDir*		*Inter_ OvLapDir*	
	(1)	(2)	(3)	(4)
Treat×R&D_ Q4	−0.5868	1.4626	−3.4494***	−1.2093*
	(1.2470)	(0.9403)	(1.0134)	(0.6991)
Treat×R&D_ Q3	−2.8804*		−3.1888**	
	(1.4487)		(1.2948)	
Treat×R&D_ Q2	−3.3711		−3.1070	
	(3.0071)		(2.7072)	
Treat×R&D_ Q1	2.2598		2.1121	
	(2.3824)		(2.0890)	
Treat		−1.6387		−1.8144*
		(1.2532)		(1.0803)
Controls				
ln(Assets)	4.2007***	4.2195***	3.2774***	3.2961***
	(0.2396)	(0.2425)	(0.2044)	(0.2038)
Tangibility	−2.7407	−2.7611	−4.0822*	−4.0918*
	(2.6325)	(2.6647)	(2.1780)	(2.2179)
MTB ratio	0.1172	0.1232	−0.0087	−0.0020
	(0.1697)	(0.1715)	(0.0916)	(0.0930)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Adjusted R^2	0.707	0.707	0.716	0.716
Observations	49,957	49,957	49,957	49,957

Table 4: Corporate Law Change and Firm Outcomes

We report the second-stage regressions on how firm outcomes respond to predicted change in intra-industry board overlap. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)-(6a) only include *In(Assets)* as the control variable and (1b)-(6b) include the all control variables. The variable of interest is the predicted (instrumented) intra-industry board overlap ($Intra\_OvLapDir_{i,t}$). The corresponding first-stage regressions with partial control variables and full control variables are separately stated in Table 3, Panel A, Columns (3) and (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
$\widehat{Intra\_OvLapDir}$	2.6082***	2.7448***	4.3025***	4.3623***	2.3497***	2.5271***
	(0.5936)	(0.5870)	(0.9116)	(0.8797)	(0.5252)	(0.5352)
Treat	−0.0200*	−0.0193*	−0.0190	−0.0187	−0.0118	−0.0108
	(0.0109)	(0.0115)	(0.0167)	(0.0171)	(0.0097)	(0.0103)
Controls						
ln(Assets)	−0.0136	−0.0111	−0.0266**	−0.0257**	−0.0111	−0.0083
	(0.0085)	(0.0094)	(0.0114)	(0.0120)	(0.0093)	(0.0098)
Tangibility		−0.0113		−0.0278		−0.0628**
		(0.0261)		(0.0585)		(0.0301)
MTB ratio		0.0099**		0.0044		0.0129***
		(0.0042)		(0.0043)		(0.0033)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,957	49,957	49,957	49,957	49,957	49,957
MOP effective F-stats	20.42	23.50	20.42	23.50	20.42	23.50

Dep. Variables:	*ln(Sales)*		*ln(COGS)*		*ln(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
$\widehat{Intra\_OvLapDir}$	4.4289***	5.2686***	−5.8462***	−5.1869***	−10.1961***	−10.3426***
	(0.9196)	(0.9954)	(1.2909)	(1.0424)	(1.8058)	(1.7633)
Treat	−0.0442**	−0.0407*	−0.0079	−0.0054	0.0374	0.0366
	(0.0219)	(0.0241)	(0.0320)	(0.0280)	(0.0388)	(0.0396)
Controls						
ln(Assets)	0.6555***	0.6749***	0.7074***	0.7239***	0.0552**	0.0531**
	(0.0188)	(0.0210)	(0.0111)	(0.0106)	(0.0219)	(0.0231)
Tangibility		0.4503***		0.5099***		0.0752
		(0.0846)		(0.0744)		(0.1621)
MTB ratio		0.0603***		0.0472***		−0.0107
		(0.0047)		(0.0050)		(0.0090)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,957	49,957	49,957	49,957	49,957	49,957
MOP effective F-stats	20.42	23.50	20.42	23.50	20.42	23.50

Table 5: Firm Investment and Board Overlap

We report the second-stage regression on how firm outcomes respond to predicted change in intra-industry board overlap ($\widehat{Intra\_OvLapDir}$). The dependent variables are log capital expenditure [*ln(Capex)*], log employment [*ln(Employ)*], the *R&D Intensity*, a firm's (log) patent count (plus 1) [*ln(1+Patents)*], and the (dollar) value of these patents scaled by total assets (*Patent Value*). The variable of interest is the predicted (instrumented) intra-industry board overlap ($\widehat{Intra\_OvLapDir}$). The corresponding first-stage regression with full control variables is stated in Table 3, Panel A, Column (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ln(Capex)*	*ln(Employ)*	*R&D Intensity*	*ln(1+Patents)*	*Patent Value*
	(1)	(2)	(3)	(4)	(5)
$\widehat{Intra\_OvLapDir}$	-7.0633^{***}	0.0161	-1.6410^{***}	-8.7708^{***}	-10.0825^{***}
	(1.7639)	(0.3847)	(0.4927)	(2.2900)	(2.9610)
Treat	0.0051	-0.0108	0.0127^{*}	-0.0135	0.0161
	(0.0315)	(0.0183)	(0.0075)	(0.0489)	(0.0441)
Controls					
ln(Assets)	0.9530^{***}	0.6437^{***}	0.0008	0.2215^{***}	0.0245
	(0.0389)	(0.0078)	(0.0060)	(0.0277)	(0.0293)
Tangibility	0.8705^{***}	0.6575^{***}	0.0425^{***}	0.2971^{***}	0.1897^{***}
	(0.0905)	(0.0541)	(0.0102)	(0.0546)	(0.0334)
MTB ratio	0.1562^{***}	0.0481^{***}	0.0012	0.0296^{***}	0.0219^{**}
	(0.0108)	(0.0019)	(0.0019)	(0.0090)	(0.0099)
Firm FEs	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes
Observations	49,587	49,199	49,957	45,443	45,443
MOP effective F-stats	23.42	19.43	23.50	19.70	19.70

Table 6: Product Market Structure and Board Overlap

In Panel A, we report evidence on changes in product market segmentation following changes in board overlap. The dependent variables of the second-stage regression are (i) the average product market overlap (*OvLapProd*) measured (at the level of the four-digit SIC) for firm i with all rival firms j, and (ii) the Holberg-Phillips measure of product similarity (*HPSS*) based on textual analysis of regulatory filings. The control variables are the same as in Table 3; we include firm and industry-by-year fixed regressions in all specifications. In Panel B, we examine product market expansion, where (i) the dependent variable *ln(#Segments)* represents the log number of product market segments of a firm, and (ii) the Holberg-Phillips measure of *Product Offering Growth* captures changes in product variety — again infered from the textual analysis of regulator filings. The corresponding first-stage regressions with partial control variables and full control variables are separately stated in Table 3, Panel A, Columns (3) and (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Panel A: Product Market Segmentation Measures

Dep. Variables:	*OvLapProd*		*HPSS*	
	(1)	(2)	(3)	(4)
$Intra\_\widehat{OvLapDir}$	-0.8021^{**}	-0.7781^{**}	-26.0145^{***}	-23.5244^{***}
	(0.3375)	(0.3212)	(8.3389)	(7.0231)
Treat	-0.0019	-0.0019	-0.3115^{***}	-0.2977^{***}
	(0.0056)	(0.0055)	(0.1071)	(0.1030)
Controls				
ln(Assets)	-0.0017	-0.0008	0.5325^{***}	0.5794^{***}
	(0.0023)	(0.0025)	(0.1373)	(0.1498)
Tangibility		0.0528^{***}		-0.3619
		(0.0148)		(0.4290)
MTB ratio		0.0017^{**}		0.1895^{***}
		(0.0008)		(0.0622)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Observations	49,957	49,957	49,649	49,649
MOP effective F-stats	20.42	23.50	22.09	25.55

Table 6 continued

Panel B: Product Market Expansion Measures

Dep. Variables:	*ln(#Segments)*		*Product Offering Growth*	
	(1)	(2)	(3)	(4)
$Intra\_\widehat{OvLap}Dir$	0.6424	0.5900	−0.0028	0.0957
	(0.6247)	(0.6043)	(0.2302)	(0.2385)
Treat	0.0006	0.0004	−0.0053	−0.0051
	(0.0159)	(0.0157)	(0.0067)	(0.0069)
Controls				
ln(Assets)	0.0418***	0.0404***	−0.0194***	−0.0171***
	(0.0084)	(0.0083)	(0.0033)	(0.0033)
Tangibility		−0.0487		0.0209
		(0.0349)		(0.0128)
MTB ratio		−0.0037***		0.0070***
		(0.0011)		(0.0008)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Observations	49463	49463	45251	45251
MOP effective F-stats	19.90	22.88	17.46	19.80

Internet Appendix

Not for Journal Publication

Table A1: Top Ten R&D-Intensive Industries

This table reports the top 10 three-digit SIC industries according to the number of firms assigned to R&D quartile Q4. For each industry tabulated in Column (1), Column (2) reports the total number of firm-years in the sample during 1998–2019, Column (3) the number of firm-years assigned to quartile Q4, and Column (4) the share of R&D-intensive firms (= (3)/(2)).

Industry (1)	All firms-year obs. (2)	R&D-intensive firms-year obs. (3)	Percentage share (4)
Drugs	4,202	3,158	75%
Computer and data processing services	5,418	2,308	43%
Electronic components and accessories	2,522	955	38%
Medical instruments and supplies	2,034	723	36%
Measuring and controlling devices	1,514	615	41%
Computer and office equipment	1,224	566	46%
Communications equipment	1,095	530	48%
Special industry machinery	570	270	47%
Research, development, and testing services.	366	128	35%
Electrical industrial apparatus	306	54	18%

Table A2: Conditional Distribution of Inter-Industry Board Overlap Adjustment

This table characterizes the distribution of variation in inter-industry board overlap conditional on prior increase in intra-industry board overlap (Panel A), conditional on prior unchanged intra-industry board overlap (Panel B), and conditional on prior decrease in intra-industry board overlap (Panel C) for firms assigned to Quartile Q4 of product similarity. For each year, we sort each firm into one of three groups reflecting its variation of the intra-industry board overlap. Conditional on each type of variation for intra-industry board overlap in the prior year, we summarize the distribution of inter-industry board overlap variation over the subsequent three-year period by subtracting the beginning-period value from the ending-period one. The last row provides a t-test for the null of equally frequent upward (A) and downward (C) adjustments in inter-industry board overlap.

	Three-year adjustment in inter-industry board overlap					
	Panel A Conditional on prior increase in intra-industry board overlap		Panel B Conditional on prior unchanged intra-industry board overlap		Panel C Conditional on prior decrease in intra-industry board overlap	
	Obs.	Percentage	Obs.	Percentage	Obs.	Percentage
	(1)	(2)	(3)	(4)	(5)	(6)
(A) Upward	560	41%	1421	39%	568	46%
(B) Unchanged	178	13.1%	748	22%	133	11%
(C) Downward	617	46%	1431	39%	547	44%
Total	1,355		3,600		1,248	
Difference (C)−(A)		5%		0%		−2%
P-value		0.0272		0.4048		0.801

Table A3: OLS Regressions for Firm Outcomes

We report the OLS regression on how firm outcomes respond to changes in intra-industry board overlap. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)-(6a) only include *In(Assets)* as the control variable and (1b)-(6b) include the all control variables. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
$Intra\_OvLapDir_{i,t}$	−0.0025	−0.0049	0.0489***	0.0471***	−0.0055	−0.0080
	(0.0102)	(0.0092)	(0.0082)	(0.0081)	(0.0136)	(0.0118)
Controls						
ln(Assets)	0.0097***	0.0149***	0.0115***	0.0153***	0.0100***	0.0158***
	(0.0019)	(0.0019)	(0.0020)	(0.0025)	(0.0027)	(0.0022)
Tangibility		0.0249*		0.0292		−0.0295
		(0.0136)		(0.0392)		(0.0197)
MTB ratio		0.0131***		0.0093***		0.0158***
		(0.0014)		(0.0006)		(0.0008)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.699	0.704	0.754	0.756	0.694	0.701
Observations	49957	49957	49957	49957	49957	49957

Dep. Variables:	*ln(Sales)*		*ln(COGS)*		*ln(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
$Intra\_OvLapDir_{i,t}$	0.1018***	0.0867***	−0.0399	−0.0502*	−0.1279***	−0.1236***
	(0.0226)	(0.0200)	(0.0289)	(0.0281)	(0.0199)	(0.0201)
Controls						
ln(Assets)	0.6944***	0.7243***	0.6555***	0.6752***	−0.0349***	−0.0440***
	(0.0110)	(0.0095)	(0.0148)	(0.0149)	(0.0061)	(0.0077)
Tangibility		0.5192***		0.4426***		−0.0598
		(0.0553)		(0.0511)		(0.1056)
MTB ratio		0.0665***		0.0415***		−0.0225***
		(0.0015)		(0.0016)		(0.0017)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.963	0.964	0.964	0.965	0.725	0.726
Observations	49957	49957	49957	49957	49957	49957

Table A4: Reduced Form Estimates for Firm Outcomes

We report the reduced form regressions of firm outcomes directly on the treatment dummy *Treat×R&D_ Q4*. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)-(6a) only include *In(assets)* as the control variable and (1b)-(6b) include the all control variables. The variable of interest is the treatment dummy *Treat×R&D_ Q4*. The robust standard errors are clustered at the state level.***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Treat×R&D_ Q4	0.0685***	0.0733***	0.1130***	0.1166***	0.0617***	0.0675***
	(0.0053)	(0.0054)	(0.0071)	(0.0071)	(0.0045)	(0.0045)
Treat	−0.0157***	−0.0145***	−0.0119**	−0.0110**	−0.0079	−0.0063
	(0.0054)	(0.0052)	(0.0049)	(0.0049)	(0.0050)	(0.0048)
Controls						
ln(Assets)	0.0090***	0.0142***	0.0106***	0.0146***	0.0092***	0.0150***
	(0.0020)	(0.0019)	(0.0019)	(0.0024)	(0.0028)	(0.0023)
Tangibility		0.0252*		0.0303		−0.0292
		(0.0140)		(0.0396)		(0.0202)
MTB ratio		0.0133***		0.0098***		0.0161***
		(0.0014)		(0.0006)		(0.0008)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.700	0.705	0.756	0.757	0.695	0.703
Observations	49,957	49,957	49,957	49,957	49,957	49,957

Dep. Variables:	*ln(Sales)*		*In(COGS)*		*In(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
Treat×R&D_ Q4	0.1163***	0.1408***	−0.1535***	−0.1386***	−0.2677***	−0.2763***
	(0.0288)	(0.0267)	(0.0174)	(0.0172)	(0.0385)	(0.0379)
Treat	−0.0369*	−0.0315	−0.0176	−0.0145	0.0205*	0.0184
	(0.0205)	(0.0194)	(0.0156)	(0.0147)	(0.0114)	(0.0113)
Controls						
ln(Assets)	0.6938***	0.7236***	0.6569***	0.6761***	−0.0329***	−0.0424***
	(0.0108)	(0.0093)	(0.0143)	(0.0145)	(0.0060)	(0.0075)
Tangibility		0.5204***		0.4409***		−0.0625
		(0.0554)		(0.0514)		(0.1064)
MTB ratio		0.0669***		0.0407***		−0.0236***
		(0.0016)		(0.0016)		(0.0017)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.963	0.964	0.964	0.965	0.726	0.727
Observations	49,957	49,957	49,957	49,957	49,957	49,957

Table A5: Corporate Law Change and Common Ownership

We repeat the first-stage regressions reported in Table 3 except that the outcome variable is replaced to a measure for common ownership. *AvCO* measures the average common shareholder overlap a firm has with all other firms in the same industry with which it also shares a director overlap. The subscript *min* in Columns (1a) and (1b) denotes that the ownership overlap of firm pairs is calculated as the minimum function of portfolio shares [i.e. $Overlap(A, B) = min(w_A, w_B)$], whereas the subscript *prod* implies that ownership overlap is calculated as the product of the portfolio shares [i.e. $Overlap(A, B) = w_A \times w_B$]. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	$AvCO_{min}$ (×100)		$AvCO_{prod}$ (×10000)	
	(1a)	(1b)	(2a)	(2b)
Treat×R&D_Q4	0.0085	0.0095	0.0199	0.0237
	(0.0078)	(0.0075)	(0.0268)	(0.0255)
Treat×R&D_Q3	0.0212	0.0218	0.0411	0.0430
	(0.0140)	(0.0140)	(0.0482)	(0.0480)
Treat×R&D_Q2	−0.0058	−0.0063	0.1656***	0.1647***
	(0.0039)	(0.0041)	(0.0533)	(0.0542)
Treat×R&D_Q1	−0.0125	−0.0128	−0.0783	−0.0794
	(0.0179)	(0.0180)	(0.0809)	(0.0812)
Controls				
ln(Assets)	0.0117***	0.0127***	0.0671***	0.0703***
	(0.0019)	(0.0021)	(0.0137)	(0.0143)
Tangibility		0.0183		0.0242
		(0.0135)		(0.0864)
MTB ratio		0.0022***		0.0078**
		(0.0008)		(0.0035)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Adjusted R^2	0.382	0.382	0.246	0.246
Observations	49,954	49,954	49,954	49,954

Table A6: Pre-Existing Director Overlap

We report the second-stage regression of firm outcomes in a sample that excludes firms that have intra-industry board overlap in the year before the COW legislation and simultaneously observe a change in board overlap over the five-year period following the COW. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)–(6a) exclude the control variables and (1b)–(6b) include them. The variable of interest is the predicted (instrumented) intra-industry board overalp (*Intra_ OvLapDir*). The corresponding first-stage specifications are consistent with those in Table 3, Panel A, Columns (3) and (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
$\widehat{Intra\_OvLapDir}$	2.5676***	2.6987***	4.0825***	4.1419***	2.3371***	2.5062***
	(0.5614)	(0.5563)	(0.8263)	(0.8013)	(0.5021)	(0.5124)
Treat	−0.0204*	−0.0197*	−0.0196	−0.0192	−0.0124	−0.0114
	(0.0107)	(0.0114)	(0.0159)	(0.0163)	(0.0097)	(0.0103)
Controls						
ln(Assets)	−0.0135	−0.0110	−0.0255**	−0.0244**	−0.0113	−0.0084
	(0.0083)	(0.0091)	(0.0107)	(0.0113)	(0.0092)	(0.0097)
Tangibility		−0.0040		−0.0150		−0.0557
		(0.0288)		(0.0628)		(0.0334)
MTB ratio		0.0099**		0.0045		0.0130***
		(0.0041)		(0.0040)		(0.0032)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,760	49,760	49,760	49,760	49,760	49,760
MOP effective F-stats	22.20	25.45	22.20	25.45	22.20	25.45

Dep. Variables:	*ln(Sales)*		*In(COGS)*		*In(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
$\widehat{Intra\_OvLapDir}$	4.2583***	5.0834***	−5.5610***	−4.9125***	−9.7488***	−9.8920***
	(0.8997)	(0.9606)	(1.1944)	(0.9653)	(1.6834)	(1.6521)
Treat	−0.0445**	−0.0411*	−0.0067	−0.0043	0.0389	0.0380
	(0.0216)	(0.0236)	(0.0311)	(0.0273)	(0.0370)	(0.0379)
Controls						
ln(Assets)	0.6565***	0.6760***	0.7062***	0.7224***	0.0531**	0.0506**
	(0.0183)	(0.0203)	(0.0109)	(0.0104)	(0.0208)	(0.0218)
Tangibility		0.4658***		0.4953***		0.0454
		(0.0881)		(0.0783)		(0.1703)
MTB ratio		0.0605***		0.0471***		−0.0110
		(0.0045)		(0.0047)		(0.0085)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,760	49,760	49,760	49,760	49,760	49,760
MOP effective F-stats	22.20	25.45	22.20	25.45	22.20	25.45

Table A7: Corporate Law Change and Board Overlap in Young Firms

In this table, we interact key variables in the first stage regression with the dummy variable *PostIPO,* which marks marks firms with observations at most 3 years after their IPO and zero otherwise. The dependent variable *Intra_ OvLapDir* is the percentage of intra-industry overlapping directors and is expressed in percentages (×100). The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variable:	*Intra_ OvLapDir*	
	(1)	(2)
PostIPO×Treat×R&D_ Q4		-1.1102^{*}
		(0.6229)
PostIPO×R&D_ Q4		-2.0664^{***}
		(0.6733)
PostIPO×Treat		0.5349^{**}
		(0.2306)
Treat×R&D_ Q4	3.0025^{***}	2.4536^{***}
	(0.4926)	(0.4811)
PostIPO		-0.6390^{***}
		(0.2267)
Treat	-0.2286	-0.1969
	(0.3229)	(0.3178)
Controls		
ln(Assets)	0.9173^{***}	0.8923^{***}
	(0.1393)	(0.1374)
Tangibility	1.3223^{*}	1.1521
	(0.6954)	(0.7049)
MTB ratio	0.1231	0.1388
	(0.0855)	(0.0829)
Firm FEs	Yes	Yes
Industry-by-year FEs	Yes	Yes
Adjusted R^2	0.746	0.746
Observations	49,957	49,957

Table A8: Corporate Law Change and Firm Outcomes with Additional Fixed Effects

We report the second-stage regression on how firm outcomes respond to predicted change in intra-industry board overlap. We extend the regressions in Table 4 by including additional headquarter-state-by-year fixed effects. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)–(6a) exclude the control variables and (1b)–(6b) include them. The variable of interest is the predicted (instrumented) intra-industry board overalp ($Intra\_OvLapDir$). The corresponding first-stage regressions with partial control variables and with full control variables are separately stated in Table 3, Panel A, Columns (3) and (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
$\widehat{Intra\_OvLapDir}$	2.7760***	3.9601***	4.5875***	6.0678***	2.8416***	3.6981***
	(0.4120)	(0.7452)	(0.6119)	(1.1609)	(0.3363)	(0.6384)
Treat	−0.0050	−0.0108	−0.0077	−0.0137	−0.0001	−0.0044
	(0.0067)	(0.0113)	(0.0108)	(0.0174)	(0.0074)	(0.0112)
Controls						
ln(Assets)	−0.0180***	−0.0232**	−0.0371***	−0.0433**	−0.0183**	−0.0202*
	(0.0059)	(0.0111)	(0.0086)	(0.0162)	(0.0073)	(0.0117)
Tangibility	−0.0053	−0.0159	−0.0200	−0.0319	−0.0652**	−0.0690*
	(0.0225)	(0.0303)	(0.0555)	(0.0645)	(0.0298)	(0.0355)
MTB ratio	0.0088**	0.0081	0.0021	0.0015	0.0114***	0.0115**
	(0.0035)	(0.0051)	(0.0037)	(0.0059)	(0.0032)	(0.0043)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
HQ-state-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	No	Yes	No	Yes	No	Yes
Observations	49,875	49,875	49,875	49,875	49,875	49,875
MOP effective F-stats	103.2	33.55	103.2	33.55	103.2	33.55

Dep. Variables:	*ln(Sales)*		*In(COGS)*		*In(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
$\widehat{Intra\_OvLapDir}$	4.5114***	7.7975***	−6.2195***	−6.7837***	−10.6450***	−14.3244***
	(1.5404)	(1.8170)	(0.9898)	(1.4885)	(1.9767)	(2.8144)
Treat	−0.0030	−0.0237	0.0119	−0.0001	0.0132	0.0233
	(0.0156)	(0.0254)	(0.0217)	(0.0252)	(0.0258)	(0.0426)
Controls						
ln(Assets)	0.6727***	0.6465***	0.7455***	0.7382***	0.0768***	0.0941***
	(0.0155)	(0.0242)	(0.0132)	(0.0154)	(0.0187)	(0.0322)
Tangibility	0.4404***	0.4250***	0.4778***	0.4950***	0.0556	0.0831
	(0.0582)	(0.0950)	(0.0930)	(0.0847)	(0.1537)	(0.1803)
MTB ratio	0.0593***	0.0570***	0.0519***	0.0508***	−0.0050	−0.0040
	(0.0026)	(0.0065)	(0.0053)	(0.0061)	(0.0074)	(0.0121)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
HQ-state-by-year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year FEs	No	Yes	No	Yes	No	Yes
Observations	49,875	49,875	49,875	49,875	49,875	49,875
MOP effective F-stats	103.2	33.55	103.2	33.55	103.2	33.55

Table A9: Regression Results When Excluding Delaware Firms

This table reports the robustness test for the sample excluding firms incorporated in the state of Delaware. We use the reduced-form specification that directly links firm outcomes to the treatment dummy *Treat×R&D_Q4*. The dependent variables are the return on assets (*ROA*), the *Gross (Profit) Margin*, the *Operating Margin*, the log sales [*ln(Sales)*], the log costs of goods sold [*In(COGS)*], and the log cost share [*In(COGS/Sales)*]. Specifications (1a)-(6a) only include *In(assets)* as the control variable and (1b)-(6b) include the all control variables. The variable of interest is the treatment dummy *Treat×R&D_Q4*. The robust standard errors are clustered at the state level.***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*ROA*		*Gross Margin*		*Operating Margin*	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
$Treat_{i,t} \times R\&D\_Q4_{i,t}$	0.1117*	0.1149*	0.1799**	0.1799**	0.0857*	0.0874*
	(0.0579)	(0.0619)	(0.0859)	(0.0871)	(0.0467)	(0.0500)
$Treat_{i,t}$	−0.0144*	−0.0119	−0.0110	−0.0107	−0.0084	−0.0068
	(0.0083)	(0.0071)	(0.0078)	(0.0075)	(0.0109)	(0.0102)
Controls						
ln(Assets)	0.0102	0.0143*	0.0088	0.0098	0.0153**	0.0183***
	(0.0072)	(0.0073)	(0.0059)	(0.0061)	(0.0058)	(0.0058)
Tangibility		−0.0088		−0.0809*		−0.0851***
		(0.0251)		(0.0408)		(0.0306)
MTB ratio		0.0181***		0.0091***		0.0182***
		(0.0026)		(0.0021)		(0.0024)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.623	0.635	0.727	0.729	0.611	0.625
Observations	16,070	16,070	16,070	16,070	16,070	16,070

Dep. Variables:	*ln(Sales)*		*In(COGS)*		*In(COGS/Sales)*	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
$Treat_{i,t} \times R\&D\_Q4_{i,t}$	0.4787***	0.4993**	−0.2274	−0.2071	−0.6929***	−0.6916***
	(0.1749)	(0.1899)	(0.1456)	(0.1349)	(0.2476)	(0.2498)
$Treat_{i,t}$	−0.0279	−0.0138	0.0004	0.0135	0.0332*	0.0332*
	(0.0737)	(0.0695)	(0.0622)	(0.0576)	(0.0174)	(0.0167)
Controls						
ln(Assets)	0.7297***	0.7504***	0.7045***	0.7226***	−0.0228	−0.0241
	(0.0208)	(0.0204)	(0.0167)	(0.0163)	(0.0159)	(0.0163)
Tangibility		0.4229***		0.6157***		0.2532***
		(0.0794)		(0.0793)		(0.0937)
MTB ratio		0.0644***		0.0412***		−0.0212***
		(0.0056)		(0.0066)		(0.0055)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.974	0.975	0.972	0.972	0.707	0.709
Observations	16,070	16,070	16,070	16,070	16,070	16,070

Table A10: Firm Value and Board Overlap

We report the second-stage regression on how firm value respond to predicted change in intra-industry board overlap ($\widehat{Intra\_OvLapDir}$); and reduced form regressions on how firm value respond to the treatment dummy. The dependent variables are *Macro Q*, and *ln(Macro Q)* suggested by Erickson and Whited (2000) and Chava and Roberts (2008). The explanatory variables of interest are the predicted (instrumented) intra-industry board overlap ($\widehat{Intra\_OvLapDir}$) and the treatment dummy given by *Treat* ×*R&D_ Q4*. The corresponding first-stage regression with all control variables is reported in Table 3, Panel A, Column (4). We report the Montiel Olea-Pflueger (MOP) effective F-statistics as a test for weak instruments. The robust standard errors are clustered at the state level. ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

Dep. Variables:	*Macro Q*		*ln(Macro Q)*	
	2SLS	Reduced form	2SLS	Reduced form
	(1)	(2)	(3)	(4)
$\widehat{Intra\_OvLapDir}$	120.4001*		1.1093*	
	(66.8484)		(0.6364)	
Treat ×*R&D_ Q4*		3.2169**		0.0296*
		(1.3652)		(0.0169)
Treat	−4.6646***	−4.4531***	0.0217	0.0236
	(1.1826)	(1.1037)	(0.0285)	(0.0299)
Controls				
ln(Assets)	−8.3498***	−7.2381***	−0.1977***	−0.1874***
	(1.9386)	(1.2467)	(0.0175)	(0.0128)
Tangibility	−114.0394***	−112.4373***	−4.3927***	−4.3779***
	(13.1685)	(12.9878)	(0.1476)	(0.1491)
MTB ratio	10.5583***	10.7090***	0.2282***	0.2296***
	(0.3177)	(0.3964)	(0.0105)	(0.0093)
Firm FEs	Yes	Yes	Yes	Yes
Industry-by-year FEs	Yes	Yes	Yes	Yes
Observations	49957	49957	49957	49957
MOP effective F-stats	23.50		23.50	

Table A11: Variable Definitions

Variable	Description
ROA	The return on assets is calculated as operating income before depreciation (OIBDP) divided by total assets (AT). Source: Compustat
Gross Margin	Sales (SALES) less cost of goods sold (COGS), then divided by sales (SALES). Source: Compustat
Operating Margin	The ratio of operating profit to sales. Operating profit is defined as sales (SALES) - cost of goods sold (COGS) - SG&A (XSGA) - depreciation (DP). Source: Compustat
Sales/Assets	Sales (SALES) divided by total assets (AT). Source: Compustat
ln(Sales)	The natural logarithm of sales (SALES). Source: Compustat
COGS/Assets	Cost of goods sold (COGS) divided by total assets (AT). Source: Compustat
ln(COGS)	The natural logarithm of cost of goods sold (COGS). Source: Compustat
ln(Employ)	The natural logarithm of employees (EMP). Source: Compustat
ln(Capex)	The natural logarithm of capital expenditure (CAPEX). Source: Compustat
R&D Intensity	The amount of R&D expenditure (XRD) divided by total assets (AT). Source: Compustat
R&D_ Qx	A quartile dummy set equal to one for firms assigned to the x-th quartile of the R&D intensity, and set to 0 otherwise. Source: Compustat
ln(1+Patent)	The natural logarithm of one plus the number of patents applied by a firm in a year. Source: Kogan *et al* (2017)
Patent Value	The estimated dollar value of patents applied by a firm in a year divided by total assets (AT). Source: Kogan *et al* (2017) and Compustat
Treat	A dummy variable that equals to one for firms incorporated in states that have already passed COW legislation in a given year. Source: Compustat
HPSS	A firm's total Hoberg-Phillips similarity score that is customized based on the TNIC-3 industry classification. TNIC-3 classification records firms having pairwise similarities with a given firm i that are above a threshold as required based on the coraseness of the three digit SIC classification. Source: Hoberg and Phillips (2010, 2016)
HHI_ SIC3	Herfindahl-Hirschman index in terms of sales (SALES) based on three-digit SIC industry classifications. Source: Compustat
ln(Assets)	The natural logarithm of total assets (AT). Source: Compustat
Tangibility	It is defined as net fixed assets (PPENT) divided by total assets (AT). Source: Compustat
MTB ratio	Market to book ratio. It is defined as the market value of assets divided by the book value of assets (AT). The market value of assets is the sum of short-term debt (DLC) , long-term debt (DLTT), preferred stock (PSTK), and market value of equity (MKVALT) and then minus deferred taxes and investment tax credit (TXDITC). Source: Compustat
Board Size	The number of directors on a firm's board. Source: BoardEx
All_ OvLapDir	The overall percentage of overlapping directors on a firm board. We first count external board director positions concurrently held by a firm's board directors, and then divide the count by the number of board directors on the firm's board. Source: BoardEx
Intra_ OvLapDir	The percentage of intra-industry overlapping directors on a firm board. It is calculated as the number of overlapping directorships a firm has with external firms assigned to the same three-digit SIC code, then divided by the number of board directors on the firm's board. Source: BoardEx and Compustat
Inter_ OvLapDir	The percentage of inter-industry overlapping directors on a firm board. It is calculated as the number of overlapping directorships a firm has with external firms assigned to different three-digit SIC code, then divided by the number of board directors on the firm's board. Source: BoardEx and Compustat
OvLapProd	The average product overlap for firm i as its average cosine similarity with all other firms j in the same three-digit SIC industry, which is based on industry segment sales retrieved from Compustat
ln(#Segments)	The log number of product market segments of a firm, which is retrieved from Compustat
Product Offering Growth	The changes in product variety, which is measured as the log of the number of words in the business description in year t divided by the number of words in the business description in year t-1

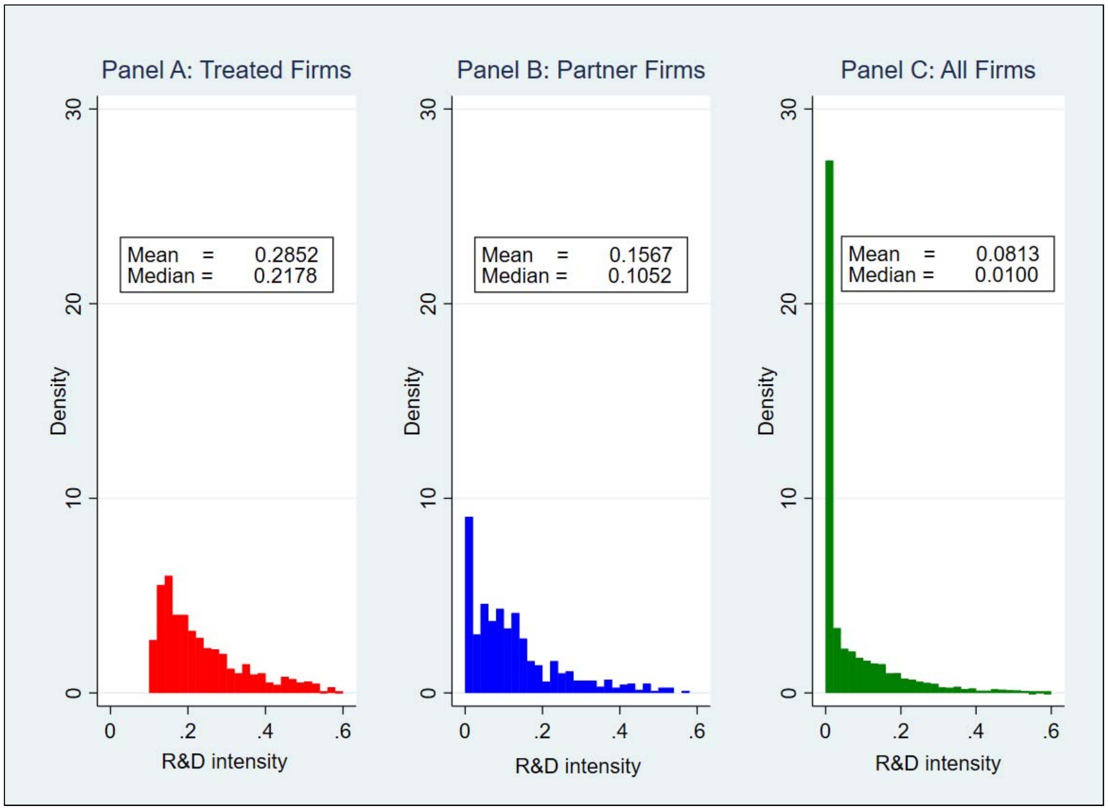

Figure 1: We plot histograms for the *R&D intensity* of different firm samples. Panel A shows the density distribution for all treated firms with *R&D_ Q4* = 1 and *Treat* = 1, Panel B for the partner firms in which board overlap occurs, and Panel C for all firms in the sample.