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ARTICLE

# Across the Boards: Explaining Firm Support for Climate Policy

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## Abstract
When do corporations stop ignoring or opposing climate action and start to go green? We focus on the role of corporate boards of directors, which shape firms' positions on internal and external issues of corporate governance and public policy. We argue that board decisions to engage constructively on climate issues are likely to be influenced by the choices and experiences of other firms. Learning, socialization, and competitive dynamics are especially important in highly salient and rapidly evolving policy areas, such as climate change. To test this theory, we construct the network of board memberships for US public corporations and uncover robust evidence that climate innovations diffuse among companies that share board members in common and among companies whose board members interact at separate boards. Understanding the unfolding dynamics of corporate climate action requires examining corporate boards and their social context.

**Keywords:** climate change; lobbying; corporate political behavior; diffusion; board interlocks; corporate sustainability

Climate change is primarily the result of greenhouse gases (GHG) emitted by private sector firms. A robust literature shows that the firms most reliant on continuing to emit GHG tend to be those most resistant to effective climate action (see, for example, Brulle 2021; Cheon and Urpelainen 2013; Genovese and Tvinnereim 2019; Kelsey 2018; Kim, Urpelainen, and Yang 2016; Meckling 2011; Oreskes and Conway 2011). These arguments provide a compelling framework for understanding corporate resistance, enriched by Kennard's (2020) argument that firms with relatively low emissions abatement costs may support climate policy as a strategy for gaining market share. However, because the distribution of abatement costs changes slowly, additional factors must be operative in the rapidly evolving dynamics of corporate support for climate action (Sullivan and Gouldson 2013). What explains the dramatic recent advances in firms' support for climate action?

In this article, we focus on corporate board interlocks, that is, instances in which an individual manages or serves on the board of directors for multiple firms at the same time. Organization and management scholars have long observed that board interlocks function as formal social ties between firms (Koenig and Gogel 1981; Koenig, Gogel, and Sonquist 1979), affecting firms' corporate structure and practices, information access, and financial performance.[1] More recent work has demonstrated that firms with greater numbers of interlocks have lower GHG emissions and better environmental performance (Lu et al. 2021; Ortiz-de Mandojana and Aragon-Correa 2015). Our analysis is the first to directly investigate the role of interlocks with climate-innovating firms in shaping corporate political behavior toward climate change. The social dynamics

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[1] For reviews, see Mizruchi (1996) and Lamb and Roundy (2016).

unleashed by interlocks help explain the now rapid changes that have occurred in corporate support for climate action, especially among the public corporations where climate innovation (and interlocks) prevail (Graham, Shipan, and Volden 2013; Simmons, Dobbin, and Garrett 2006).

To test this argument, we follow nearly all publicly traded US firms over several decades. Public firms account for 40 per cent of global GHG emissions (Preston and Ward 2021); thus, examining these firms focuses on some of the most important actors in the climate debate. We conceptualize two types of corporate climate action: "internal" actions reduce firms' GHG emissions, whereas "external" actions support effective and timely climate policy. To capture this diversity, we examine four outcomes: creation of an executive-level corporate sustainability officer (CSO) (internal); submission of reports to the Carbon Disclosure Project (CDP) (internal); firm membership in ad hoc groups supporting climate action (external); and lobbying on climate change bills (external) (Brulle 2018). We collected information on each of the four behaviors at the firm-year level and analyze these data in a network autocorrelation model using weights from the board interlock network (Hadden and Jasny 2019).

We find that board interlocks play an important role in transmitting both internal and external pro-climate corporate behaviors. Starting with internal behaviors, firms have a 2.0 per cent greater percentage chance of appointing an executive-level CSO when they go from zero interlocked firms with a CSO in the prior year to one, and they have a 1.4 per cent greater chance of reporting to the CDP when the number of interlocked firms doing so moves from zero to one. Since these activities are relatively rare (occurring in well under 10 per cent of firms in our sample), these effects are quite large in relative terms. Board interlocks also matter for external behaviors. Firms are 1.1 per cent more likely to join pro-climate coalitions if an interlocked firm joined a coalition in the prior year, while the probability of a firm lobbying the federal government on climate issues increases by 3.0 per cent when an interlocked firm lobbied on climate issues.

We find these effects conditional on an array of potential confounders, many addressed with high-dimensional fixed effects. Our core findings are highly robust across different specifications and approaches to handling firm and industry factors. We also uncover similar findings when examining indirect interlocks, where two firms' board members are interlocked with a common third firm. These results are particularly valuable because the board members of indirectly interlocked firms can only influence each other through interaction at the third firm, whereas firms with a direct interlock might engage in similar behavior simply because they share a decision maker in common (and thus decision-maker preferences, rather than diffusion, could drive shared outcomes). Moreover, the risk of selection bias is less plausible in the context of indirect interlocks: it seems exceptionally unlikely that firms would select their board members because they also serve on a board with a director of a climate-innovating firm.

Our article makes three primary contributions to the literature. First, we go beyond prior work on the relationship between interlocks and firm ideological orientation (Clawson and Neustadtl 1989; Mizruchi 1989; Mizruchi 1990), providing the first network-based demonstration of the importance of board interlocks for understanding the positions firms take on specific policy issues. The extant literature has shown only that firms with more interlocks adopt greener commitments (Lu et al. 2021; Ortiz-de Mandojana and Aragon-Correa 2015), not that those interlocks (whether direct or indirect) must be with firms that have adopted similar commitments. In emphasizing the social ties between firms, our analysis complements existing explanations that emphasize market forces and economic ties among firms to explain corporate climate actions (see, for example, Bayer and Aklin 2020; Cory, Lerner, and Osgood 2021).

Secondly, we follow recent literature in highlighting the important role that corporate boards play in firms' environmental policies and political action (Lagasio and Cucari 2019; Post, Rahman, and Rubow 2011; Rao and Tilt 2016). Scholars and activists have recently focused on corporate boards as key sites for the oversight and influence of corporate environmental governance (Disparte 2017; King 2016). Our work contributes to this by examining a rich set of corporate environmental activities, spanning internal governance, collective forms of private governance,

and public campaigns and lobbying. Our evidence on the social influence of other boards on these disparate outcomes illustrates an additional reason why boards are important: they shape not just their own company's environmental trajectory, but other companies' trajectories as well.

Finally, the private sector is largely responsible for causing climate change, but it will likely also take a central role in mitigating and adapting to its effects. This article joins a growing movement to shift focus away from explanations of corporate resistance to climate action and toward a more solutions-oriented perspective that aims to uncover the mechanisms that prompt firms to weigh in on the side of climate action (see, for example, Genovese 2021; Kennard 2020). Our research suggests that cultivating interaction between firms that are climate leaders and firms that are latently supportive of climate action but lack sufficient information, socialization, or competitive pressure in the marketplace for status could contribute positively to firms adopting pro-climate policies. At the same time, deeper connections with firms that are inert or actively hostile to climate action could slow the spread of pro-climate policies and corporate governance and reinforce climate policy "backwaters" in the corporate network. Firms, nongovernmental organizations (NGOs), and activists might consider strategies to facilitate interactions among latent and active pro-climate firms to spread commitments to address climate change.

## Theory

Private sector companies, particularly large and often public companies, are primarily responsible for the GHG emissions that cause climate change. The very same companies must play a crucial role in mitigating climate change and transitioning to a greener global economy. A large literature has examined competing explanations for why corporations resist or embrace climate action, focusing on anticipated economic consequences of policy changes, political and institutional forces and pressures, and social forces operating within and beyond the firm. Our focus lies primarily in the third category, as we examine the social influence of firms' boards of directors on one another. We introduce boards' role in climate governance, focusing on the rules, practices, and recent events in the United States, and then examine the diffusion of climate practices across boards that share members in common.

### The Role of Corporate Boards in Climate Governance

Boards of directors ('boards') at US corporations are committees that provide general oversight of the corporation's activities and usually control or provide significant input into the hiring of executive officers and their compensation, dividends, and other payouts, as well as broad elements of corporate strategy.[2] The board's power and remit may be affected by both corporate by-laws and national regulations. In the United States, boards typically represent the interests of ownership and management (which for public corporations, are usually separate groups).[3] Representing this division, some board members may be executive officers (or nominated by them directly), while other members are nominated and elected by owners. This distinction is captured in the jargon of "inside" and "outside" directors, respectively. At US public corporations, board members are elected by shareholders, whether directly or through a system of proxy voting. Nominees for the board are usually chosen by nominating committees composed of existing board members and top executive officers.

The role of corporate boards in environmental, sustainability, and governance (ESG) issues has provoked enormous interest, especially over the past five years (see, for example, Lagasio and Cucari 2019; Post, Rahman, and Rubow 2011; Rao and Tilt 2016). On the one hand, ESG issues

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[2]Boards of directors may take different structures in other countries. For example, separate boards may split managerial and more broadly supervisory functions.

[3]It may also be required or customary in other countries for employees to be represented.

implicate many of the board's core functions, including protecting short- and long-run profitability, as well as managing the firm's reputation with customers, employees, and investors. US Securities and Exchange Commissioner Allison Herren Lee summarized this evolution in a June 28, 2021, speech: "Increasingly, boards of directors are called upon to navigate the challenges presented by climate change, racial injustice, economic inequality, and numerous other issues that are fundamental to the success and sustainability of companies, financial markets, and our economy."[4] On the other hand, corporate boards are viewed by many as slow to react to evolving social standards. Some board members question whether they have a duty or right to pursue ESG concerns not traditionally viewed as part of the fiduciary duty to shareholders. Board members, often retired executives or successful entrepreneurs, tend to be conservative, both temperamentally and ideologically (Kim, Pantzalis, and Park 2013). Unlike some countries, the US Securities and Exchange Commission (SEC) does not require public companies' boards to report on ESG in public disclosures (though this situation is in flux, with proposed new rules on climate risks and impacts issued in March 2022).

The role of boards in corporate policies around climate change has been particularly noteworthy. Boards have been strongly encouraged to take a more active role in corporate climate governance, for example, in a widely read 2019 World Economic Forum white paper.[5] Business press and academic journals have made similar arguments (see, for example, Disparte 2017; King 2016). In the United States, board nominations and elections have become important sites for debates on climate change, most publicly with the startling election of three dissident shareholder candidates for ExxonMobil's board in May 2021, each of whom pledged to push the company on transitioning away from fossil fuels.

While such events are dramatic, they can be seen as punctuated moments of change in a more gradual process of increasing board interest in the environment and climate change over the past twenty years. In 2004, DuPont became the first publicly traded firm to name an executive-level CSO,[6] a practice that has since become common. Of the 500 largest publicly traded firms in 2021, 191 have appointed an executive-level CSO. Similarly, boards have expanded their role in monitoring firms' climate commitments by, among other actions, joining voluntary environmental reporting initiatives like the CDP, greening their supply chains, and reallocating investment portfolios. Furthermore, as with other forms of political activity, boards have encouraged or discouraged the diverse forms of political action that firms take on climate change issues, including joining public advocacy coalitions, issuing public statements on policy proposals, and lobbying politicians. As a result of these trends, corporate board supervision of climate change-related issues has become a ubiquitous practice across the private sector.[7]

## Diffusion of Climate Practices across Boards

### Boards and board interlocks

What forces shape boards' evolution on climate governance? Scholars have identified a variety of plausible factors across scales. At a macro-level, firms may decide to embrace the need for climate

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[4]See: https://www.sec.gov/news/speech/lee-climate-esg-board-of-directors (last accessed 12 October 2022).

[5]See: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf (last accessed 12 October 2022).

[6]See: https://www.forbes.com/sites/edfenergyexchange/2017/09/28/raising-the-bar-on-corporate-sustainability-a-one-on-one-with-former-dupont-cso-linda-fisher/ (last accessed 12 October 2022).

[7]Of the 215 largest public firms that reported to the CDP in 2019, 205 (95 per cent) stated that their board of directors provided oversight of the organization's climate-related issues. For example, Accenture's submission to the CDP states that "Accountability to advance environmental performance at Accenture starts at the top, with our Board" (CDP 2019 Accenture Response) and Clorox stated: "The highest level of responsibility for climate change at The Clorox Company rests with the Board of Directors' Nominating, Governance and Corporate Responsibility Committee, which oversees Clorox's environmental matters and compliance" (The Clorox Company CDP Climate Change Questionnaire 2020). Looking beyond the largest firms, 1901 of all 2013 firms reporting to the CDP in 2019 stated that their boards exercised oversight over climate-related issues.

action due to perceptions of regulatory inevitability (see, for example, Bumpus 2015; Hale 2011; Kolk and Levy 2001; Okereke and Russel 2010) or discourses of "corporate citizenship" (see, for example, Jones and Levy 2007; Nyberg, Spicer, and Wright 2013). At the sector and firm level, firms may be quicker to support climate action if they have relatively climate-friendly products and operations,[8] low prospective adjustment costs relative to their competitors,[9] and high exposure to the physical effects of climate change.[10] At the level of a board of directors, member characteristics (ideology, age, gender, experience, and so on), size, balance between internal and external members, shareholder activism, and receptiveness to employees, customers, and civil society stakeholders could all plausibly also affect board support for engaging on climate change.[11]

While these explanations are compelling and extend across a variety of scales, they tend to evolve too slowly to explain why a particular firm would *change* its position on climate change at a particular point in time. Moreover, existing explanations generally fail to characterize how corporate orientations toward climate change spread among firms, overlooking the extent to which firms observe the actions of their peers and learn, compete, or are socialized into changing their climate positions. Social forces are likely to be especially important in areas of rapid change, such as climate change, where science, technology, public policy, and politics have dramatically evolved over the past twenty-five years. As a result, there is an outstanding need to engage with the social drivers of corporate position taking on climate policy, especially interfirm social dynamics.

The most powerful and increasingly prominent channel of interaction between firm boards is the board interlock. Board interlocks, also known as "interlocking directorates," occur where a board member or members are on the boards of two separate companies at the same time. These members are sometimes called "multiple directors." Companies are *directly* interlocked when one company shares a board member with another company. An alternative relationship is the *indirect* interlock, that is, when two companies share a direct interlock with a common third company but with two different board members (Mizruchi 1989). Directly interlocked companies, therefore, have a clear and permanent conduit between the two boards; indirectly interlocked companies have a potential conduit that depends on the active interaction of board members at a third company.

Interlocks are the subject of considerable interest and have provoked competing interpretations. Some view interlocking directorates as an antitrust issue, as sharing board members might promote collusion or diminish competition.[12] Others view interlocks as both a cause

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[8]On this, see, for example, Markussen and Svendsen (2005), Cho, Patten, and Roberts (2006), Martin and Rice (2010), Cheon and Urpelainen (2013), and Aklin and Urpelainen (2018).

[9]On this, see, for example, Okereke and Russel (2010), Paul, Lang, and Baumgartner (2017), Meng and Rode (2019), and Kennard (2020). It should be noted that these adjustment costs may reflect strategic bargaining between regulators and firms (Layzer 2012; Meckling 2019).

[10]On this, see, for example, Jones and Levy (2007) and Paul, Lang, and Baumgartner (2017).

[11]Most of the literature on the effect of director characteristics on corporate climate behavior has focused on sustainability reporting. On this, see, for example, Kolk (2008), Kolk and Pinkse (2010), Amran, Periasamy, and Zulkafli (2014), and Kouloukoui et al. (2020). Other work, such as that of Bechtel, Genovese, and Scheve (2019), reverses the causal relationship to examine the effect of corporate ESG performance on individual climate preferences.

[12]It is important to note that some firms are not permitted by law to have interlocking boards. Section 8 of the Clayton Act prohibits horizontal interlocks, that is, the practice of directors serving on the boards of competing corporations at the same time, to prevent purposeful or inadvertent anticompetitive behavior. Despite this ban, horizontal directorships are widespread in practice. As of 2016, Nili (2019) finds that 49.7 per cent of S&P 1500 directors on multiple boards serve two firms in the same industry and 11.3 per cent serve two firms in the same four-digit Standard Industrial Classification code. Moreover, even if Section 8 of the Clayton Act has some residual impact on interlocks, we would expect the ban to bias against observing an effect of interlocks on firm climate positions because firms that compete tend to be more similar to each other than to other firms.

and symptom of class politics, as they reflect and reinforce linkages and shared identity among economic and sociopolitical elites (see, for example, Domhoff 1970).

We focus instead on interlocks as a vector for spreading information, practices, norms, and a sense of community among corporations. In this view, board interlocks are a particular instance of the complex network structure of relationships among large public corporations, and one that defines an important group of peer firms (Koenig and Gogel 1981; Koenig, Gogel, and Sonquist 1979). Board interlocks are relatively common among public firms, especially among large public firms. In 2015, the 500 largest public firms averaged 4.18 interlocks and over 87 per cent had at least one interlock. Accordingly, board interlocks would seem a potentially important feature of network linkages among corporations.

### Diffusion processes

Board interlocks may serve to diffuse corporate climate actions, practices, governance, or political engagement. This diffusion process may work through a variety of causal processes (Dobbin, Simmons, and Garrett 2007; Graham, Shipan, and Volden 2013; Simmons and Elkins 2004), but we focus our discussion on three key mechanisms: learning, socialization, and competition. While their end results may be similar, these processes differ in our context in whether they view a commitment to corporate climate governance as pre-existing (but lacking sufficient know-how to be effectuated), emerging (as a result of persuasion and norm evolution), or grudgingly adopted (due to rivalry with innovating firms).

First, and we suspect most importantly, board interlocks may facilitate learning about the climate initiatives of other firms. In this view, members of one corporate board are open to taking climate action but are incompletely informed about the options that are available to them to do so. This is likely to be important in climate governance because innovation and experimentation are high. Alternatively, boards may be aware of possible actions but remain uncertain about their costs, benefits, risks, or feasibility. Observing the actions of other corporations, or receiving testimony from a fellow board member who has participated in such actions, may empower board members to take strong action.[13]

Secondly, board interlocks may contribute to socialization into norms of appropriate conduct, where firms become convinced of the rightness of climate action. Seeing—and being directly notified—that peer firms are engaging in climate actions viewed as laudable by society may inspire firms to take similar actions. Resisting climate actions adopted by other firms may provoke cognitive dissonance or shame. More neutrally, it may simply be that corporations naturally emulate one another, much as fashions and fads pass through society. Importantly, the actions of firms connected via interlocks should have a larger normative or socializing effect on corporate climate behavior than the actions of other firms, or information communicated via the media and other channels, because firms with shared directors are likely to both see each other as peers and be aware of their respective actions (Koenig and Gogel 1981). Interlocking directors may also act as evangelists for the actions taken by their other employers.

Thirdly, board interlocks may also contribute to the adoption of climate policies through competitive dynamics, in which firms are not morally committed to climate action, but rather pushed to it by rivalry with other firms. For example, firms may be forced to adopt climate actions to attract green consumers. Corporations also compete with one another in labor markets, particularly for executive or managerial talent. Demonstrating that a corporation is on the right side of an issue or at the cutting edge of corporate governance may help attract that talent. Corporations are also competing for investments from green investors, inclusion in green exchange-traded

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[13]We highlight that information acquired via interlocks is likely to be more decisive for the *initial* adoption of climate practices than for the subsequent readoption of these practices, when corporations already have relevant firsthand experience. For this reason, we conduct a supplementary analysis focusing solely on initial adoptions in our robustness checks (see Tables A18–A21 in the Online Appendix).

funds, and other investment vehicles. Finally, corporations seek to attract status and regard, which are, to some extent, zero-sum goods. While interlocking directorates are certainly not the only vector by which these competitive pressures will spread, interlocked firms do represent one important set of peer firms by which efforts to compete for customers, talent, investment, and regard are benchmarked.

If any or all of these mechanisms are operative, we would then expect that corporate practices and political action around climate change tend to diffuse along the network of board interlocks. We describe a variety of corporate actions that might spread along this network when we introduce our data in the following. For now, we summarize our prediction in one encompassing hypothesis:

Hypothesis 1: Corporations are more likely to engage in pro-climate behaviors when firms with which they share board members have already adopted those behaviors.

Our main hypothesis emphasizes pro-climate behaviors spreading across linked boards, but could it also be that acts in opposition to climate change mitigation or effective regulation of GHG emissions and energy usage could diffuse across corporate boards? This is possible because board interlocks may serve to spread information and practices regardless of their political direction. However, we are also doubtful for several reasons. Opposition to climate change mitigation may be viewed as antisocial (especially recently), reducing its spread by social channels. Firms are also not generally in competition with one another to be seen as publicly opposing climate action. Perhaps most importantly, participation in anti-climate action activities is gradually waning over the period we examine and not a site for major innovation in corporate governance or public political activity. Nonetheless, we do test in the Online Appendix whether anti-climate action diffuses across linked boards using one systematic measure of anti-climate activity that is available to us: membership in anti-climate action coalitions. We report these findings later in the main text.

We also highlight that some of the seemingly pro-climate actions we examine may not ultimately accelerate effective action to mitigate climate change. This is so for two reasons. First, all of the behaviors we study hold the potential for use in greenwashing or shallow symbolic corporate environmentalism (Lyon and Maxwell 2008). Appointing a CSO or reporting GHG emissions is no guarantee of improved climate performance (Belkhir, Bernard, and Abdelgadir 2017; Peters, Romi, and Sanchez 2019) and may instead reflect an attempt to deflect pressure for concrete improvements in climate performance (Delmas and Burbano 2011).[14] Similarly, many firms strategically combine public support for climate policy with more genuine expressions of opposition through other channels (Green et al. 2021; Meckling 2015). While the outcomes we study do come with real financial and reputational costs, and they may provide opportunities for more meaningful commitments in the future, we view these behaviors as preliminary steps toward more substantial forms of climate action. Secondly, firms may adopt greener private governance initiatives and public postures to forestall more impactful, and more costly, regulation from the state (Kolcava, Rudolph, and Bernauer 2021; Malhotra, Monin, and Tomz 2019). While such a motive is not always operative among firms, it certainly is in some instances; therefore, we should not be too sanguine about the net social benefits of the activities we examine.

### Alternative explanations

We argued earlier that board interlocks tend to spread corporate climate policies and actions via learning, socialization, and competitive dynamics. As a result, we expect firms tend to share the pro-climate behaviors of other firms with whom they have board interlocks. We highlight four

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[14]As with other norm-based voluntary reporting schemes, carbon disclosure programs risk merely providing reputational benefits to participants without meaningful improvements in performance (Berliner and Prakash 2015).

other explanations with a similar set of empirical implications and then discuss how we might account for these alternative explanations as a theoretical matter and in our empirical testing.

First, a straightforward explanation for why board interlocks would transmit climate positions across firms is those businesses share one or more board members who vote consistently across their board postings. This is an entirely plausible mechanism that would generate a correlation in the policies of interlocked companies, not because of the diffusion of ideas, but instead because of overlapping memberships. To address this, we consider an alternative channel for diffusion: indirect interlocks. It should be recalled from earlier that an indirect interlock occurs when two firms are both interlocked with the same third firm. Thus, indirectly interlocked firms do not share a board member in common, but their interlocking board members actively work together, providing a site for the diffusion processes we described earlier. Accordingly, we examine in supplementary tests whether indirect interlocks may also serve to transmit climate policies.

Secondly, firms in the same or similar industries may share board members (despite rules discouraging this practice) and have similar incentives to adopt particular climate policies because of the structural features of their industries. These incentives shared across firms in similar industries are also likely to drive the selection of board members. To address this concern, we include models with industry-year fixed effects, which partial out any industry-specific drivers of climate policies, including those that change over time. For example, if pressure on fossil-fuel electricity-generation companies or auto companies to adopt climate policies evolves in a manner that is relatively uniform across the industry-year, then we can focus only on the variation within the industry-year to identify the effect of boards interlocks.

Thirdly, in our theoretical elaboration, we highlighted that pre-existing board interlocks may be a path for the spread of climate policies. However, it could also be the case that firms bring on board members from other firms who have a reputation for forward-thinking on climate matters. In this way, a firm's pre-existing commitment to climate action would drive interlocks, and interlocks with green firms/board members would serve to reinforce, but not generate, these commitments. To guard against this, we consider only interlocks that also existed in the prior year in our analyses. We find it less plausible that a board member would be brought on to spearhead a climate governance push that is going to happen at another company *in the future*. Our supplementary tests using indirect interlocks also avoid this issue by focusing only on interactions among directors from two firms who were already working together at a third firm. It is unlikely that firms would select board members based on the potential for creating indirect ties.

Finally, firms have other sites for socialization and the diffusion of knowledge. Most prominently, firms may receive guidance from, or share info with, their industry trade association. Moreover, if board interlocks are more likely within the same industry, any common policies among interlocked firms may actually be a result of a shared industry. While we find the argument that associations are sites for diffusion to be entirely plausible, we do not think it accounts for our findings. Across all of the board member interlocks in our data, only 14.1 per cent occur among firms in the same four-digit North American Industrial Classification System (NAICS) industry. In fact, more than 71 per cent occur among firms that are not even in the same broadly defined sector (two-digit NAICS level). We also use industry and industry-year fixed effects to control for industry-level factors.

## Data and Empirical Strategy
### Sample, Data Sources, and Dependent Variables
#### Data on firms
We begin our empirical analysis by developing a sample of firms. We focus on publicly traded firms because they: provide public data on board members; are vastly more likely to have outside members (and so interlocks); and have well-measured data on other important firm

characteristics, like revenues, employees, and industries. To build our dataset, we obtain a panel of all publicly traded firms in North America from Compustat–Capital IQ, which is hosted by Wharton Research Data Services. We use the "Fundamentals Annual" data, which record annual observations for these firms. We initially downloaded the entire data from 1986 to 2020, but we drop all firms that are not located in the US and all firms that have no data on firm revenues (which we view as a core covariate).[15] Data availability on our outcomes further restricts the size of the sample, particularly over time. We make note of the different available years for each outcome as we introduce them in the following.

Compustat provides information on public firms' financial performance and operations, which we use as covariates in the various models described in the following. Firms' six-digit NAICS codes are supplied by Compustat in the variable *naics*. Compustat includes the country of location for firms (*loc*), which we used to create the sample, as described earlier. Compustat also provides information on firms' total annual revenues (*revt*) and total number of employees (*emp*). Compustat contains a wealth of other information on firms, but we found that rates of missingness were often severe for these measures, especially further back in time. This fact informs our decision to use a relatively small number of firm-level features in our models.

### Corporate climate engagement outcomes

We collect data on four varieties of corporate engagement with climate change and private environmental governance. These variables serve as the outcomes for individual firms that we seek to explain. These variables are also critical inputs to our main explanatory variables, which measure the prevalence of these climate actions at other firms with shared board members. Our choices for these outcomes are driven by substance—they are all potentially meaningful actions corporations take to improve their environmental governance or sway climate policy—and availability.

The first measure of corporate environmental engagement we collect is whether a firm has appointed an executive-level CSO or other similar executive position. The decision to create a CSO position is a public commitment to private environmental governance, one that is increasingly attracting high-profile leaders from environmental agencies and civil society groups (Vandenbergh, Gilligan, and Feuerman 2019). To measure the creation of CSO positions, we collect data from the BoardEx–North America database, which is supplied by Wharton Research Data Services. We identified CSO positions by matching role titles to a dictionary of terms relating to corporate sustainability constructed by Fu, Tang, and Chen (2020).[16] This variable, $CSO_{it}$, indicates whether a firm had an appointed CSO officer in year $t$. This variable is available from 2004 (the year before the creation of the first CSO position) to 2020.[17] We treat the appointment of a CSO as a repeated decision, rather than a single event, because approximately 29 per cent of the firms in our sample that ever had a CSO subsequently eliminated the position.

Our second outcome is when the corporation began reporting its GHG emissions to the CDP. The CDP is the largest voluntary GHG emissions reporting initiative, accounting for nearly one fifth of all global emissions. Although CDP reports are typically discussed as tools for sustainable investing, reporting to the CDP is an example of participation in a norm-based voluntary

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[15]We investigate models where we include firms without revenue data in the Online Appendix. We focus on US-based companies because two of our outcomes—coalition memberships and lobbying—are collected systematically for US firms only. In general, focusing on firms from a single economy may be valuable to the extent that those firms share similar regulatory, market, and social pressures, as well as networks of board members. Future work ought to investigate the reach of our findings outside the United States.

[16]These terms were "sustainability," "sustainable," "responsibility," "ethics," "environment," "csr," and "climate change."

[17]A small number of managers ($N = 41$) were in other manager roles before 2004 and later transitioned to a CSO role without a break in their employment. Since we lack information on the exact timing of when these managers took on their CSO responsibilities, we treat these individuals as starting their CSO roles in 2004 (the earliest known appointment of a CSO by a publicly traded firm).

environmental governance initiative.[18] The decision to report to the CDP entails substantial costs. Firms are often obliged to hire dedicated staff to complete the CDP's long, highly detailed reports and to create complex internal monitoring and reporting systems that require substantial coordination and commitment throughout the firm's organization. The variable $CDP_{it}$ indicates whether a firm filed a report with the CDP for each year between 2006 and 2019, the most recent year available. As with appointing CSOs, reporting to the CDP is an ongoing decision: approximately 42 per cent of firms in our sample that ever report to the CDP subsequently failed to do so at least once.

Our third outcome examines whether the corporation has joined a pro-climate coalition of firms (and possibly other organizations like trade associations, NGOs, universities, and so on). Public coalitions are an important site for corporate climate politics. For example, a very large coalition called "We Are Still In" formed in the wake of the Trump administration's withdrawal from the Paris Climate Accords. These coalitions are convenient vehicles to express sincerely held beliefs and to show important constituencies that the firm is on the right side of an issue. Coalitions also take action to encourage politicians or other interest groups to alter their behavior in line with the coalition's aims (Brulle 2021; Mahoney 2007). Therefore, we construct an outcome variable relating to corporate participation in pro-climate coalitions using data gathered in Cory, Lerner, and Osgood (2021). The variable *Climate coalitions*$_{it}$ is equal to 1 if a firm is a member of at least one pro-climate action coalition in a given year.[19] This variable is measured from 1995 to 2019.

Finally, we examine whether a corporation lobbied on climate change issues through the formal lobbying procedures of the Lobby Disclosure Act. These data come from the Center for Responsive Politics, and we use keyword and bill-based queries to ascertain which firms lobbied on climate issues in a given year. The variable *Climate lobbying*$_{it}$ is equal to 1 if a firm lobbied in a given year, and is measured from 2000 to 2017.[20] Unlike participation in pro-climate coalitions (or the other outcomes outlined earlier), it should be noted that lobbying on climate issues does not necessarily have a green intent: firms might lobby for or against specific climate legislation, or may simply be seeking congenial implementation or low compliance costs without supporting or opposing the overall intent of legislation or regulation. We nonetheless examine this outcome because lobbying is an important area where firms undertake costly investments revealing genuine interest in climate issues. We also discuss an approach for assigning a direction to lobbying activities in the following.

### Board interlocks

To measure board interlocks across firms over time, we again use data from BoardEx–North America. We initially identified interlocks as two companies that, in the same year, share a board member with the same DirectorID, an identification variable used within BoardEx to follow specific directors.

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[18]Other norm-based voluntary governance programs include, among many others, Responsible Care (King and Lenox 2000), ISO 14001 (Potoski and Prakash 2005), and the United Nations Global Compact (Berliner and Prakash 2015).

[19]Membership in climate coalitions is measured roughly every three to four years, as available. A firm is counted as a member of a given coalition if it was a member in the last observed membership roster. It should be noted that the underlying data permit us to make *Climate coalitions*$_{it}$ a count variable because a firm might be a member of several such coalitions in any given year. We have chosen to use a dichotomous variable only to preserve comparability across our models. Models with a count-variable operationalization yield very similar results.

[20]Our measure of lobbying on climate-related issues is built off of two approaches to querying the lobby data. First, we used keywords in the specific issue field on the lobbying reports. The keywords we employed are "climate," "Paris agreement," "global warming," "Kyoto," "greenhouse gas," "clean power plan," "carbon emission," and "clean energy." We also incorporate lobbying on three specific climate bills: the American Clean Energy and Security Act, a cluster of contemporaneous alternatives from the Senate, and the Climate Stewardship Acts of 2003–8. The carbon-pricing schemes proposed in these bills generated substantial lobbying activity, as would be expected for policies with substantial distributional implications (Milner and Tingley 2015).

We then construct two variables with these data. $Interlocks_{ijt}$ is a count variable equal to the number of shared directors between firms $i$ and $j$ that endure over the years $t-1$ and $t$. We focus on this two-year time span for two reasons. One reason is that we think it is necessary to lag by one year the outcome variables at other firms while not lagging the interlocking directorate variable. By having the variable equal 1 only if the interlock is "on" at both times $t-1$ and $t$, we ensure the interlock was active both when the alter firm $j$ took a given action (year $t-1$) and when the ego firm $i$ had the opportunity to follow suit (year $t$). Another reason is that these enduring interlocks make it less likely our findings could be driven by firms adding "green" board members at the exact same time that they undertake major actions on environmental governance. We use the $Interlocks_{ijt}$ variable (and the matrix of board interlocks in year $t$, $Interlocks_t$) to construct our core explanatory variables.

The second variable we construct using the interlocks data is $Number\ of\ interlocks_{it}$, equal to the total number of interlocks, as defined earlier, for a firm in one year. In other words:

$$Number\ of\ interlocks_{it} = \sum_{j \neq i} Interlocks_{ijt},$$

where all $Interlocks_{ijt}$ also exist at $t-1$. $Number\ of\ interlocks_{it}$ is used as a control variable in our following models. It should be noted that this measure is the network degree of a given firm, and so is one classic measure of network centrality. Since it is right-skewed, we transform this variable with the inverse hyperbolic sine function.

### Explanatory Variables and Other Covariates

We wish to examine the evolution of firms' climate actions over time as a function of similar actions taken by other public corporations with whom they share direct ties. As our primary explanatory variables, we construct measures of the extent to which interlocked firms have adopted climate innovations in the previous year. All of our explanatory variables take the following form, illustrated here with the $CSO$ variable:

$$CSO,\ interlock\text{-}weighted_{it} = \sum_{j \neq i} CSO_{j,t-1} \cdot Interlocks_{ijt},$$

where the summation operator acts over all firms $j$ that are present in year $t$. The variable $CSO$, $interlock\text{-}weighted_{it}$ therefore counts the number of CSOs in the previous year at corporations with which a firm is interlocked.[21] Note that this is weighted by the number of interlocks, so two shared board members contribute more to the count than a single interlock. As with $Number\ of\ interlocks_{it}$, we transform this variable with the inverse hyperbolic sine function to address skewness. The interlock-weighted measures are defined analogously for each of the other outcomes, and these variables are called $CDP$, $interlock\text{-}weighted_{it}$, $Climate\ coalitions$, $interlock\text{-}weighted_{it}$, and $Lobbying$, $interlock\text{-}weighted_{it}$.

The construction of these variables means that our main statistical model is a panel network autocorrelation model. For example, a simple bivariate model for the case of the CSO variable might be expressed in two equivalent ways:

$$CSO_{it} = \beta_0 + \beta_1 \cdot CSO,\ interlock\text{-}weighted_{it} + \epsilon_{ijt} = \beta_0 + \beta_1 \cdot \mathbf{CSO}'_{t-1}\mathbf{Interlocks}_t + \epsilon_{ijt},$$

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[21]It should further be noted that the vector of this variable in a given year is simply $\mathbf{CSO}'_{t-1}\mathbf{Interlocks}_t$, where $\mathbf{CSO}_{t-1}$ is a column vector of indicators for whether each firm has a CSO in a given year and $\mathbf{Interlocks}_t$ is a symmetric matrix of firms' interlocks, in which the number of interlocks $\in \{0, 1, 2, 3, 4, \ldots\}$ is recorded in each entry (and the diagonal entries are set to 0).

where the second formulation emphasizes the network-weighted lags. In line with the literature on these models, and particularly following Hadden and Jasny (2019), we consider several additional measures of network structure as controls. First, we construct a measure of structural equivalence between firms' interlock networks. Two firms possess structurally similar networks if they are interlocked to similar sets of firms (though they may not be directly interlocked themselves). This means structural equivalence measures the similarity of the roles that firms play within a social network. Structurally similar firms may be relevant peers with which to make comparisons for firms thinking about their climate commitments. To construct this measure, we start with the matrix of Hamming distances between the interlock vectors of all firms in a given year and then convert to a similarity matrix using the formulae described in Leenders (2002, 29) and based on code in Hadden and Jasny (2019). The resulting measure (in the case of the CSO variable) is:

$$\text{CSO, structural eqv. weighted}_{it} = \sum_{j \neq i} \text{CSO}_{j,t-1} \cdot \text{Structural Equivalence}_{ijt},$$

though we refer to these variables as a *Structural eqv. wtd. DV*$_{it}$ in tables to conserve space.

Secondly, we measure the eigenvector centrality of each firm within the interlock network to capture another important feature of network structure. Firms that are more central might gather more information on evolving best practices, for example. We call this measure *Eig. Centrality*$_{it}$. Finally, we include the raw count of each firm's interlocks in a given year using the variable *Number of interlocks*$_{it}$ described earlier. Firms with more interlocks might be more attuned to corporate America's evolving practices and standards absent any influence of connected firms' specific environmental policy moves. This might create an unwarranted correlation between our interlock-weighted dependent variables (DVs) and the environmental policy outcomes purely by chance. Controlling for the number of interlocks precludes this possibility.

We include a second class of control variables that measure firms' exposure to climate risk and political activities in opposition to action on climate change. To measure firms' exposure to climate risk, we use a measure of concerns about exposure to environmental policy risk or direct environmental risk as expressed in corporate earnings calls from Hassan et al. (2019).[22] We calculate average annual risk by firm-year, merge it with our data, and refer to it as *Env. risk*$_{it}$ in our tables. This measure only goes back to 2013, so we incorporate it into supplemental models provided in the Online Appendix. We also measure firms' negative political activities around climate change. This measure is identical in construction to *Climate coalitions*$_{it}$ but instead is a count of the coalitions a firm was a member of in a given year that oppose climate action. This variable is called *Num. opp. coalitions*$_{it}$. Finally, and most importantly, we lack time-varying measures of firms' carbon intensity (and even of their industry's carbon intensity), whether direct or indirect. Therefore, instead of using non-time-varying measures of these concepts, we use firm fixed effects and industry-year fixed effects in our models. The industry-year fixed effects are particularly valuable in capturing the evolution of exposure to regulatory risk and changing technology and norms over time.

We include a final set of control variables that are important firm-level features. From Compustat, we use the measure of firm revenues in our models (*Revenue*), as well as a measure of the number of firm employees (*Employees*). Both of these (right-skewed) variables are transformed using an inverse hyperbolic sine transformation, which can handle years where firms have negative revenues, for example. We again highlight that many important firm and industry factors, including industry factors changing over time, are partialed out with the firm and industry-year fixed effects in our preferred specification. For example, firm fixed effects control for all unchanging features of firms over time, including a firm's industry, products, unchanging production practices, input matrix, and so on. Industry-year fixed effects account for an industry's trade competitiveness, production costs, regulation, and any other shared industry-level feature that changes over time.

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[22]The specific variable from the dataset is called *PRiskT_environment*.

### Models

With our variables defined, we can now describe our models and broader empirical approach. Our outcome variables are dichotomous in all instances. Generally, this would lead us toward some variety of generalized linear model with a non-linear link function. However, our research design relies critically on high-dimensional fixed effects, which induce bias in non-linear models (Greene 2002; Wright and Douglas 1977). Thus, we rely throughout on linear regression models, where the inclusion of fixed effects generates no such bias. We also subsequently include generalized linear models without fixed effects as robustness checks to ensure that decisions about functional forms are not driving our findings.

Our preferred specification is the following model, which has been written as if the $CSO_{it}$ variable is under consideration:

$$
\begin{aligned}
CSO_{it} =& \beta_0 + \beta_1 \cdot CSO, \text{ interlock-weighted}_{it} + \beta_2 \cdot \text{Structural wtd. DV}_{it} \\
&+ \beta_4 \cdot \text{Num. interlocks}_{it} + \beta_5 \cdot \text{Eig. Centrality}_{it} + \beta_6 \cdot \text{Num. opp. coalitions}_{it} \\
&+ \beta_7 \cdot \text{Employees} + \beta_8 \cdot \text{Revenue} + \mu_{s,t} + \mu_i + \epsilon_{it}.
\end{aligned}
$$

It should be noted that this model comes in four different iterations—one for each of the main outcome variables where both the outcome variable and the interlock-weighted and structural equivalence-weighted independent variables are changed. As noted earlier, we also include the measure of firm-level political risk (which is not available before 2013) in supplementary models as an additional covariate. Here, $\mu_{s,t}$ refers to the industry-year fixed effects, while $\mu_i$ refers to the firm fixed effects. It should be noted that the industry-year fixed effects partial out all time trends common across firms and unchanging industry features too and so also act as year fixed effects and industry fixed effects. We provide the results using these main specifications in Table 1.

Interpreting the predicted effects of changes in the variables is straightforward. To avoid too many decimals, we multiply all of our outcome variables by 100. The coefficient $\beta_1$ then represents roughly the increase in the percentage chance of the outcome if the number of interlock-weighted outcomes increases from 0 to 1.[23] For each of our measures of corporate climate actions, 0 and 1 are the two most common interlock-weighted measures (though higher numbers are possible and do occur). Thus, an increase of 1 in an interlock-weighted outcome is significant and represents the most important counterfactual.

The fixed effects provide important controls for firm and industry-year features. However, fixed effects can also throw out meaningful variation, and estimates are always variable across different types of specifications. For these reasons, we examine five other model specifications to see if our findings are similar. First, we examine the bivariate relationship between each of our DVs and their interlock-weighted counterparts. Then, we examine models with separate industry and year fixed effects, along with our main covariates. Then, we include the industry-year fixed effects but leave out the firm fixed effects. Finally, we also examine logistic regression models, both with and without covariates. We provide the results of these additional models in Table 2.

### Results

#### Descriptive Findings

We begin the discussion of our empirical results with simple descriptive findings before moving on to our main models and robustness checks. For each of our outcome variables, we give

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[23]The exact effect is $\beta_1 \cdot \sinh^{-1}(1) = \beta_1 \cdot 0.88$. Here, 1's account for 74 per cent of all non-0 values for *CSOs, Interlock wtd.*$_{it}$ and 72 per cent, 54 per cent, and 85 per cent for the interlock-weighted CDP reporting, climate coalitions, and climate lobbying variables, respectively. The average values for the four (untransformed) dependent variables, in order of their presentation, are 0.163, 0.095, 0.084, and 0.026. After 2015, the averages are 0.295, 0.264, 0.248, and 0.023.

**Table 1.** Results of firm-level models

| Outcome | 1<br>CSO | 2<br>CDP | 3<br>Coals | 4<br>Lobby |
|---|---|---|---|---|
| CSOs, interlock wtd. | 2.29***<br>(0.13) | | | |
| CDP reporting, Interlock wtd. | | 1.42***<br>(0.13) | | |
| Climate coalitions, Interlock wtd. | | | 1.07***<br>(0.08) | |
| Climate lobbying, Interlock wtd. | | | | 2.97***<br>(0.15) |
| Structural eqv. wtd. DV | 0.00***<br>(0.00) | 0.00***<br>(0.00) | 0.00***<br>(0.00) | 0.00***<br>(0.00) |
| Num. interlocks | −1.14***<br>(0.09) | −0.79***<br>(0.09) | −0.37***<br>(0.04) | −0.28***<br>(0.05) |
| Eig. centrality | 2.56***<br>(0.28) | 1.23***<br>(0.28) | 0.59***<br>(0.13) | 0.15<br>(0.16) |
| Num. opp. coalitions | −0.73<br>(0.49) | −1.29**<br>(0.49) | 5.11***<br>(0.24) | −3.24***<br>(0.29) |
| Employees | 2.30***<br>(0.20) | 1.11***<br>(0.18) | 1.16***<br>(0.08) | 0.06<br>(0.11) |
| Revenue | −0.08<br>(0.07) | −0.08<br>(0.07) | 0.01<br>(0.03) | 0.06<br>(0.04) |
| N | 88,470 | 74,972 | 158,292 | 109,540 |
| Industry-year fixed effects | Yes | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes | Yes |

*Notes*: All coefficients are multiplied by 100 for ease of interpretation. The following variables are transformed with the inverse hyperbolic sine function in all tables: all interlock-weighted variables; number of interlocks; employees; and revenue. All models are linear probability models with firm and industry-year fixed effects and ordinary least squares (OLS) standard errors. Industry-year fixed effects also partial out unchanging industry factors and yearly time trends. $+ p < 0.10$; $* p < 0.05$; $** p < 0.01$; $*** p < 0.001$.

**Table 2.** Results of firm-level models

| | Linear models | | | | Logit models | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| DV: CSO | | | | | | |
| CSO, Interlock wtd. | 10.22***<br>(0.16) | 4.46***<br>(0.18) | 4.54***<br>(0.18) | 2.29***<br>(0.13) | 1.43***<br>(0.03) | 0.35***<br>(0.03) |
| DV: CDP reporting | | | | | | |
| CDP reporting, Interlock wtd. | 12.80***<br>(0.18) | 5.52***<br>(0.18) | 5.86***<br>(0.18) | 1.42***<br>(0.13) | 1.51***<br>(0.03) | 0.41***<br>(0.03) |
| DV: Climate coalitions | | | | | | |
| Climate coalitions, Interlock wtd. | 3.98***<br>(0.09) | 1.78***<br>(0.10) | 1.78***<br>(0.10) | 1.07***<br>(0.08) | 1.11***<br>(0.03) | 0.19***<br>(0.04) |
| DV: Climate lobbying | | | | | | |
| Climate lobbying, Interlock wtd. | 6.48***<br>(0.17) | 3.76***<br>(0.17) | 3.67***<br>(0.17) | 2.97***<br>(0.15) | 1.84***<br>(0.06) | 0.60***<br>(0.07) |
| Controls | No | Yes | Yes | Yes | No | Yes |
| Year fixed effects | No | Yes | No | No | No | No |
| Industry fixed effects | No | Yes | No | No | No | No |
| Industry-year fixed effects | No | No | Yes | Yes | No | No |
| Firm fixed effects | No | No | No | Yes | No | No |

*Notes*: All coefficients are multiplied by 100 for ease of interpretation. Models 1–4 are linear probability models with OLS standard errors and with controls and fixed effects as described at the bottom of the table. Models 5–6 are logistic regression models with (Column 6) and without (Column5) controls. $+ p < 0.10$; $* p < 0.05$; $** p < 0.01$; $*** p < 0.001$.

descriptive statistics about its variation, noting that most of these climate outcomes are rare in absolute terms but grow over time and become common among the largest public firms. Then, we consider firms when they decide to move from not participating to participating in each of our outcomes, for example, when they hire a CSO or go from being in no pro-climate

coalitions to being in one or more. We show that these moves are much more likely among firms that are interlocked with other firms that have taken similar steps. Of course, these descriptive patterns have many possible explanations, which motivates our move to models with extensive sets of conditioning factors.

Starting with CSOs, only about 4 per cent of firm-year observations from 2004 to 2019 have a CSO; however, the number increases over time from only 0.7 per cent of firms in 2004 to 8.3 per cent in 2019. Establishing a CSO position is much more common among large firms: across all years, 15 per cent of firms above the 80 per cent percentile in revenue have a CSO. What about interlocks with firms with CSOs? Of the 676 instances of newly created CSO positions in our data, around 39.0 per cent occur at firms interlocked with another firm with a CSO. Given the relative sparsity of the interlock network and the adoption of a CSO position, this is a large figure. Even more striking, firms interlocked with another firm with a CSO are 4.64 times more likely to adopt a CSO than firms that are not.

Firms that opt into reporting their emissions to the CDP follow similar patterns, increasing from less than 3.5 per cent of firms in 2007 to nearly 7 per cent of firms in 2019 (and with the largest 20 per cent of firms participating at a rate of 18 per cent overall). Of the 711 instances of firms opting into CDP reporting, 43.7 per cent occur among firms interlocked with another firm that has opted in. Firms that are interlocked with another CDP-reporting firm are over 4.0 times likelier to report to the CDP themselves.

Publicly traded firms joining public coalitions is somewhat rarer than the previous two outcomes, though more than 1.8 per cent of our firms are in at least one such coalition by 2019. Climate lobbying by firms is also quite rare. Both behaviors are particularly concentrated among the largest quintile of firms, 2.2 per cent of whom are in a coalition and 4.5 per cent of whom lobby on climate-related issues in any given year. Among the 392 and 384 respective instances of firms opting to join a coalition or lobby after having not done so in the previous year, 23.7 per cent and 22.2 per cent, respectively, occur among firms interlocked with another firm that has done that behavior in the previous year. Firms that are interlocked with another coalition-joining firm are almost 6.6 times likelier to join a coalition themselves. The same ratio for lobbying is 7.6.

We therefore see two strong patterns. First, firms that undertake new climate innovations have high rates of interlocks with firms undertaking those same actions in an absolute sense. Since both interlocks and the actions themselves are rare, these high rates are striking. Secondly, firms that are interlocked with other firms taking climate actions are vastly more likely to take those actions themselves. The risk ratios are on the order of 5–10 across all of the outcomes. However, these strong findings likely relate to obvious confounders, of course, such as firm size and secular trends over time. Controlling for these factors is therefore imperative.

### Main Results

We present the results from our main empirical models in Table 1; these are illustrated visually in Figure 1. We go through each of our dependent variable–explanatory variable pairs one at a time. First, interlock-weighted *CSOs* are positively and significantly associated with the *CSO* outcome variable. Thus, a firm in a board interlock with other firms that had a CSO in the previous year is more likely to then appoint a CSO themselves. The size of the effect is meaningful. Increasing the number of interlocked firms with a CSO by one increases the predicted percentage chance of a firm adopting a CSO by 2 per cent. As shown in the leftmost pair of bars in Figure 1, this is an increase from a 4.1 per cent chance to a 6.1 per cent chance for a typical firm, a dramatic increase in the relative chances of adopting a CSO.[24]

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[24]These predicted differences are generated by randomly drawing from the sampling distribution of the coefficients in Model 1 of Table 1. These are multiplied by an adjusted model matrix, plus random draws from the error distribution, to generate predicted values. The model matrix is adjusted to set the interlock-weighted variable to either all 0's or all 1's.

**Predicted outcomes increasing interlock wtd. measures from 0 to 1**
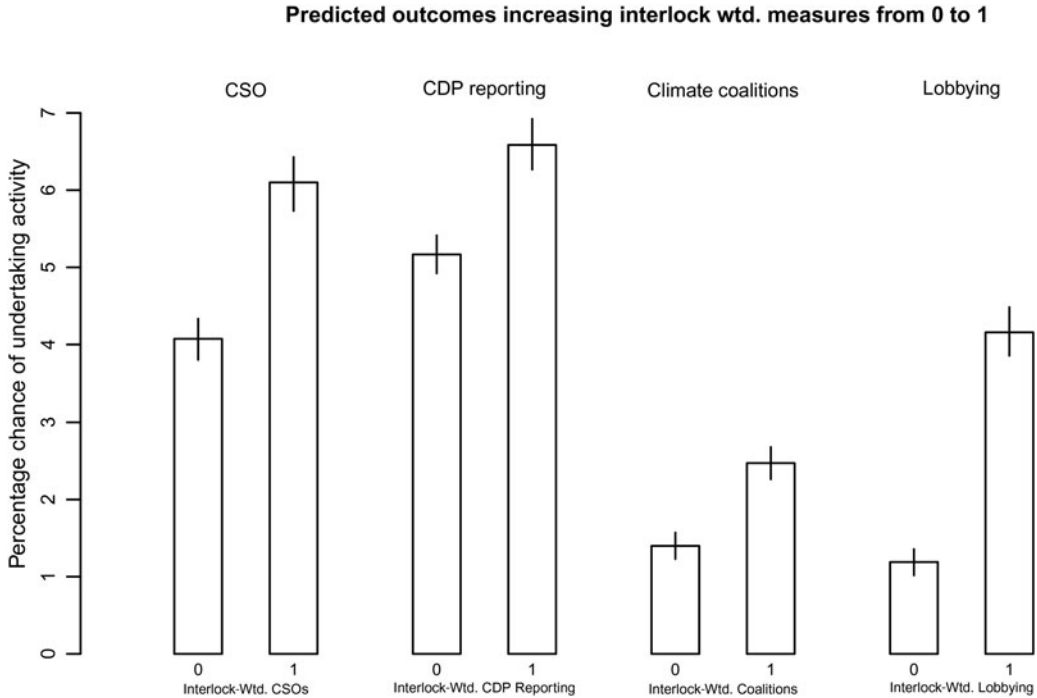


Fig. 1. Average predicted values from Table 1. Bars indicate the predicted percentage chance of adopting a pro-climate innovation for firms that had zero or one interlock with firms that undertook the innovation in the previous year. The variables are (L-R) appointing an executive-level Corporate Sustainability Officer (CSO), reporting greenhouse gas emissions to the Carbon Disclosure Project (CDP), joining a pro-climate coalition, and lobbying the US Congress on climate policy. All covariates are held at their mean values and error bars represent 95% confidence intervals.

Column 2 in Table 1 shows that firms that are interlocked with other firms participating in the CDP are more likely to do so themselves. We again see a positive and significant association between our interlock-weighted *CDP* variable and the *CDP* outcome variable. The predicted effect of one extra interlocked firm joining the CDP is 1.4 per cent. For a typical firm in the data, this means raising the chance of joining the CDP from 5.2 per cent to 6.6 per cent.

We look at our two lobbying-related outcomes in Models 3 and 4. In Model 3, we see that membership in pro-climate action coalitions is associated with similar behavior among interlocked firms. The coefficient on interlock-weighted *Coalitions* is positive and significant, and increasing the number of such coalition memberships among interlocked firms by one increases the chance a firm participates in at least one such coalition from 1.4 per cent to 2.5 per cent. We see a similar pattern with the interlock-weighted *Climate lobbying* variable in Model 4. In that case, one additional interlocked firm engaging in lobbying increases the probability of lobbying from 1.2 per cent to 4.2 per cent. We find the relative increases in these activities to be striking.[25]

Summarizing our main results, firms are significantly more likely to adopt climate measures when their board-interlocked peers undertake similar activities. Each of these outcomes can represent an important, meaningful step that firms take to influence the climate debate generally and their own impact on climate change. Therefore, understanding whether social forces can influence these key decisions is valuable.

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Average predicted values are represented by the rectangles, and 95 per cent confidence intervals for the predicted values are represented by the black lines.

[25]The coefficients for firm revenue and employees are generally positive and statistically significant, indicating that pro-climate actions tend to be adopted by larger firms.

We also examined as an empirical question whether membership in anti-climate coalitions spread across interlocked firms. We could see sound reasons why this activity both might and might not do so. We report the results of these tests in Table A1 in the Online Appendix. Summarizing briefly, we see a relatively consistent but generally modest diffusion of participation in anti-climate coalitions. This is suggestive that anti-climate action activities may also spread via the diffusion dynamics that are seen with pro-climate actions. The relatively smaller size of the effect, however, may occur because anti-climate action is seen as counter-normative and so less prone to spread by social suasion, either because firms are not competing with one another to appear against climate action, or because anti-climate action is not growing over the period we examine and is not a major site for innovation.

In a similar fashion, we also examine in Table A2 in the Online Appendix whether lobbying that is likely to be for or against climate action diffuses along the interlock network. To do so, we combined our data on lobbying with our data on coalition memberships to assign a "direction" to the lobbying, that is, lobbying firms that are in pro-climate groups but no anti-climate groups might be more likely to be lobbying for effective climate action. Overall, we found that both pro-climate and anti-climate lobbying diffuses along the network of board interlocks in most of our specifications. The results on the spread of anti-climate activity across interlocks are important because they suggest that interlocking directorates on their own are neither uniformly positive nor uniformly negative in terms of spreading corporate policies that lower emissions or mitigate climate change.

## Robustness

We now discuss the robustness of our main findings, beginning with the value of our controls and fixed effects. In our main models in Table 1, we include controls for various features of firms' network structure, each of which might confound the relationship between our network-lagged outcomes and the outcomes themselves. Our structurally lagged DVs (which consider the possibility of peer effects on firms who are similarly situated in the board network but not necessarily interlocked) are positively conditionally correlated with our outcomes, while a measure of firms' centrality in the board network has no consistent relationship with our outcomes. Our hypothesized effects of interest are still observed despite these controls. Most importantly, the effects of board interlocked-weighted DVs survive conditional on the number of total interlocks, meaning that we are not merely observing a simple association between the number of social contacts and climate actions. Rather, it is what the socially connected firms are doing that matters.

We also include in our models a measure of firms' other climate-related political activities. Unsurprisingly, the number of opposing coalitions is generally negatively correlated with our pro-climate action activities, except for one: joining pro-climate coalitions. It seems likely this result reflects the effect of climate "hedgers" among very large firms (Meckling 2015). In the Online Appendix, we also examine a second measure of firms' exposure to climate change policy risks, based on their self-reported concern in corporate earnings reports (Hassan et al. 2019). This variable is usually positively correlated with our outcomes, suggesting that it provides a useful control for another driver of firms' political behavior. Nonetheless, our hypothesized effects are still clearly and consistently observed in the altered sample with this additional control added (see Tables A3–A5 in the Online Appendix).

We also note the robustness of our main findings to the inclusion of several firm-level variables, the firm fixed effects, and the industry-year fixed effects. Our main time-varying measures for firms are both measures of size. Larger firms may have greater board size or numbers of interlocks, and are also plausibly more likely to be early adopters of climate innovations, so it is reassuring that our hypothesized effects are robust to these measures. Our firm fixed effects are extremely beneficial because they control for unchanging firm- (and industry-)level features that might contribute to climate activities, such as exposure to costs of climate regulation, input requirements, trade exposure, multinationalization, and corporate culture. Moreover, our identifying variation then becomes

just the change in the number of interlock-weighted DVs *within firms* over time. Finally, we think our industry-year fixed effects are particularly valuable because they partial out changing industry features over time, especially the ability of firms in an industry to adopt pro-climate innovations. Industries share common trajectories in terms of their evolution on climate change issues (and, of course, firms in similar industries may be more likely to share board members). It is reassuring that all of our main claims survive the inclusion of these fixed effects.

That being said, fixed-effect specifications can have undesirable elements. For example, it might be that a given firm in our data has relatively little variation in the number of board interlocked DVs over time in our data (and that those interlocked DVs have a positive effect on their decision to pursue some climate measure). A similar idea might hold for industries in a given year. Our fixed-effects models would throw that meaningful variation out. More generally, high dimensional fixed effects are demanding, so it is useful to see how robust our main results are to alternative specifications. We do so in Table 2. Column 4 recreates our main estimates from Table 1, focusing only on the estimates for the interlocked-weighted DVs. Column 1 provides estimates of these variables from a simple bivariate regression with no controls or fixed effects. Column 2 introduces the controls and separate year and industry fixed effects. Column 3 includes our industry-year fixed effects (but no firm fixed effects). We find the extent to which our main estimates are consistent with our hypotheses across the specifications striking and encouraging. There is some natural reduction in the estimates as more fixed effects are included, but this is expected, as various confounding factors and elements of variation are sequentially partialed out. In Columns 5 and 6, we consider alternative empirical models using logistic regression. We do not employ any fixed effects due to the incidental parameters problem (Greene 2002; Wright and Douglas 1977). Overall, we find effects of the main variables that are entirely consistent with our hypotheses.

Earlier, we described a concern that the effects of interlock-weighted variables may represent the mechanical effect of sharing a board member (who has the same or similar preferences across their board memberships and thus creates some correlation in all policies across interlocked firms). For this reason, we consider indirect interlocks, which also address concerns about unobserved firm-level commitments to going green that manifest as new board members and new green initiatives. This form of confounding is vastly less plausible in the case of indirect interlocks, while the diffusion mechanisms are entirely plausible with those types of social linkages. We recreate our models from Table 1 in Table 3, which uses our main measure of indirect interlocks (it should be noted that the direct interlock-weighted variables are also included in the model but collapsed to one row in the table to preserve space). We note two things: first, indirect interlocks are positively associated with the diffusion of pro-climate activities, in line with our expectations; and, secondly, the overall size of the indirect interlock effect is somewhat smaller than the direct interlock effect.[26]

In a further series of robustness checks, we examine only the initial adoption of our outcomes (see Tables A18–A21 in the Online Appendix). The first instance of adopting a pro-climate corporate behavior may be the most revealing for learning about diffusion, as the initial decision could be the most affected by new information and its subsequent repetition could plausibly be attributed to path dependence, rather than an affirmative decision in light of ongoing information acquisition. We find effects that are consistent with our hypotheses across all specifications.

We also examine alternative formulations of the models where we employ lagged dependent variables in Tables A22–A25 in the Online Appendix. These variables are each lagged by one year. We find that nearly all of our interlock-weighted variables remain positive and significant

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[26]In the Online Appendix, we replicate all of the models from Table 2 using the indirect interlock variables in Tables A6–A9 (which exclude direct interlocks as controls) and Tables A10–A13 (which include them). We find that all of our results are similar. In addition, some indirectly interlocked firms may also share direct interlocks; therefore, we consider an alternative operationalization of indirect interlocks that counts firms that are both directly and indirectly interlocked as being not indirectly interlocked (see Tables A14–A17 in the Online Appendix). We again see strikingly similar results across all specifications.

**Table 3.** Models with indirect interlocks and direct interlocks

| Outcome | 1<br>CSO | 2<br>CDP | 3<br>Coals | 4<br>Lobby |
|---|---|---|---|---|
| CSOs, indirect interlock wtd. | 1.77***<br>(0.07) | | | |
| CDP reporting, indirect interlock wtd. | | 0.92***<br>(0.06) | | |
| Climate coalitions, indirect interlock wtd. | | | 0.82***<br>(0.03) | |
| Climate lobbying, indirect interlock wtd. | | | | 1.75***<br>(0.05) |
| Direct interlock wtd. DV | 1.78***<br>(0.14) | 0.99***<br>(0.13) | 0.87***<br>(0.08) | 2.16***<br>(0.15) |
| Structural eqv. wtd. DV | 0.00***<br>(0.00) | 0.00***<br>(0.00) | 0.00***<br>(0.00) | 0.00**<br>(0.00) |
| Num. interlocks | −1.34***<br>(0.09) | −0.81***<br>(0.09) | −0.47***<br>(0.04) | −0.29***<br>(0.05) |
| Eig. centrality | 2.60***<br>(0.28) | 1.14***<br>(0.28) | 0.74***<br>(0.13) | 0.07<br>(0.16) |
| Num. opp. coalitions | −0.79<br>(0.49) | −1.30**<br>(0.49) | 5.00***<br>(0.24) | −3.07***<br>(0.29) |
| Employees | 1.94***<br>(0.20) | 0.88***<br>(0.18) | 0.96***<br>(0.08) | −0.14<br>(0.11) |
| Revenue | −0.09<br>(0.07) | −0.08<br>(0.07) | 0.00<br>(0.03) | 0.06<br>(0.04) |
| N | 88,470 | 74,972 | 158,292 | 109,540 |
| Industry-year fixed effects | Yes | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes | Yes |

*Notes*: All coefficients are multiplied by 100 for ease of interpretation. Direct interlock wtd. DV refers to the main explanatory variables of Table 1, which vary by outcome. $+ p < 0.10$; $* p < 0.05$; $** p < 0.01$; $*** p < 0.001$.

predictors of our outcomes despite the inclusion of the lags. The sole exception is the interlock-weighted CDP variable, which turns negative in the specification with firm fixed effects. We also looked at differenced models where we take first differences of the outcome and the main explanatory variables (see Tables A26–A27 in the Online Appendix). In other words, we attempt to explain year-over-year changes in climate outcomes with year-over-year changes in those outcomes at interlocked firms (as well as changes in the structure of interlocks themselves). We examine these differenced models both with and without covariates. We find effects that are consistent with our hypotheses in all cases.

Finally, we explore whether firms that face high prospective costs from climate action, and therefore view climate policy as an existential threat to their business models (Colgan, Green, and Hale 2021), are less responsive to the pro-climate behaviors of interlocked firms. We identified firms with more to lose from climate action in terms of the intensity of their direct carbon emissions.[27] In models that interact our interlock-weighted outcomes with the measure of firm costs from climate action, we find that pro-climate behavior diffuses across interlocks for even the most carbon-intense firms, with carbon intensity only slightly strengthening or slightly weakening these relationships for different outcomes (see Tables A28–A30 in the Online Appendix). Although we caution that we are not able to run our most stringent model specification because the carbon intensity measure does not have usable variation over time, these results provide suggestive evidence that board interlocks could change the behavior of some of the most stalwart opponents of climate action.

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[27]We use average estimates of direct carbon emissions from 1998, 2002, and 2006 for each six-digit NAICS industry level (excluding utilities) derived from Henry, Khan, and Cooke-Hull (2010). For further details on these data, see Cory, Lerner, and Osgood (2021).

## Conclusion

We conclude by summarizing our findings and characterizing our contributions to the literature, as well as the ongoing process of encouraging private actors to contribute to environmental governance. We find robust evidence that firms whose directors simultaneously govern companies engaged in a wide range of climate action are more likely to adopt pro-climate behaviors themselves. Not only are our results in the hypothesized direction, but they are also of substantively meaningful magnitudes. In light of the many other influences on firm decision making, it is striking that we find a strong social influence of interlocking directorates on corporate climate behavior. Since we only examine one type of formal social tie among firms in this analysis, a full accounting of the formal and informal social drivers of corporate climate action would likely be even larger than what we find here.

We investigated several types of heterogeneity in how board interlocks diffuse pro-climate corporate behaviors. Our findings hold not only for public expressions of support for climate action (public coalitions and lobbying), but also for actions to manage firms' own GHG emissions (CSOs and CDP reporting). These results indicate that interlocks diffuse both social and technical/managerial forms of pro-climate behavior. It is also notable that even those with the most to lose from climate action—highly carbon-intensive firms—respond positively to pro-climate actions by interlocked firms. While not all firms engage in these behaviors with sincerity, they are relatively costly, hold the potential to produce meaningful reductions in GHG emissions, and provide entry points for more substantial commitments in the future (for example, net-zero pledges).

It is worth emphasizing the robustness of our results, even in our most stringent model specifications. These specifications include both firm fixed effects, which account for the many measured (and unchanging) characteristics of firms that might influence their climate action over time, and industry-year fixed effects, which account for changes with respect to climate issues that affect entire industries over time. To account for the threat of reverse causation, we only consider interlocks that persisted from the prior year to rule out the possibility that board interlocks form in response to past climate actions. Our findings remain robust when we only consider indirect interlocks, providing assurance that our findings reflect the diffusion of information via interlocking directorates, rather than the more mechanical implication of individual directors voting consistently across firms. Likewise, it is much less likely that unobserved firm-level commitments to climate action could drive indirect interlocks.

We also highlight several limitations in our analysis that point toward future research. Due to coverage limitations in our outcomes (and data availability around board memberships), we have focused on a subset of corporate climate governance activities among public US firms. It is therefore important to consider how our findings might externalize to other policies, types of firms, and countries. It would be valuable to examine other forms of climate activity that are dramatically evolving right now, for example, the growth in net-zero commitments. While we see no theoretical reason why diffusion would not be operative, the potency of social forces may diminish as the costs of commitments increase. Scholars should investigate that question. It is encouraging that we see such similar effects across the four distinct outcomes considered in this article. Private firms are not mandated to have outside directors in the US and generally have far fewer outside directors (especially at smaller firms). Future work might examine the diffusion of climate innovations through trade associations, an important site where firms' leaders socialize and learn. We also recognize that there are substantial differences in how corporate boards operate in other places. Corporate boards in many European countries, for example, are structured in a different fashion, mandate the inclusion of employees, and have faced disclosure requirements around ESG issues for many years. These firms may also face stronger antitrust regulations that limit the formation of horizontal interlocks. We do not think that these differences would fundamentally upend our main argument, though they could modify the strength of the cross-board social ties we emphasize here and unlock new avenues for cross-board socialization, for example, across

employees' organizations and via mandatory disclosures. Future research ought to examine these channels.

Our findings make three distinct contributions to the literature on corporate climate governance. First, we show that board interlocks facilitate the diffusion of corporate climate commitments; extant literature has shown only that firms with more interlocks might adopt greener commitments, not that those interlocks must be with firms that have adopted similar commitments (Lu et al. 2021; Ortiz-de Mandojana and Aragon-Correa 2015). More broadly, we illustrate how firms' social networks influence their decision making on key issues of public concern, including issues where private incentives might lead in another direction. Secondly, we follow recent literature in emphasizing the importance of boards in corporate ESG activities. In our story, the influence of corporate boards on the firm's trajectory is paired with their influence on other firms, with the former critically reinforcing the latter, as only an internally impactful board will successfully demonstrate innovative practices to other boards. Finally, our findings illustrate a different dimension to the intra-industry firm competition examined by Kennard (2020). In that study, firms that are harmed less by climate commitments make them, as they benefit in relative terms over competitors. In our rendering, firm competition—for customers, employees, or reputation—may lead them to consonant actions on climate change; therefore, intra-industry competition may operate in a more uniformly prosocial fashion.

Our findings also have implications for the process and progress of securing corporate commitments to climate change mitigation. For example, activists who succeed in persuading one corporation to make a new commitment or undertake some new action to support the climate may naturally turn to that firm's competitors in the same industry as a next "target." Our findings suggest an alternative (or, at least, complementary) strategy: the next best target may be a firm that is socially connected to the initial firm. At the same time, activists may consider targeting socially influential firms that have not adopted climate innovations (or are actively hostile to climate action). Such firms may be important targets because their policies contribute not only to their own inaction, but also to the inaction of others. A second implication of our findings is that interlocks, though perhaps contributing to negative outcomes like anticompetitive practices or a lack of diversity, may also have positive effects in transmitting practices across firms. That being said, we must be cautious in assessing the net benefit of the corporate policies we examine because some of these may reflect greenwashing, rather than sincere commitment, while others may reflect a desire to ward off more stringent regulation (Kolcava, Rudolph, and Bernauer 2021; Malhotra, Monin, and Tomz 2019). Our results on anti-climate action coalitions show that other forms of anti-climate action might spread via interlocks too. More generally, interlocks among firms that are simply inactive on, or disinterested in, climate action may reinforce a lack of progress. Finally, our research may suggest a possible tactic for activist investors pushing for board changes. Making latent social connections active—with meetings, conferences, events, and other official forums for interaction—might help to spread positive innovations in corporate environmental responsibility. The public benefits of one firm adopting an innovative approach to climate action are far greater than the individual contributions of that firm to the environment because that firm's actions can spread to other socially connected firms.

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