# Renewable Governance: Good for the Environment?

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We conjecture that board renewal mechanisms—those substantive enough to renew the thinking of the board—are required before investors can address the mismatch between their preferences regarding environmental sustainability and what insiders at firms are actually doing. We identify the adoption of majority voting for directors and the introduction of a female director as two corporate governance mechanisms potentially strong enough to renew a board's thinking on sustainability. Using a sample of 3,293 firms from 41 countries, we find that both board renewal mechanisms significantly improve environmental performance, with greater improvements in countries with strong institutions and in settings with a more motivated institutional investor base. Quasi-exogenous shocks to board renewal mechanisms in Canada and France support the interpretation that these governance improvements drive environmental performance. These results suggest the importance of board renewal for alignment of firm policies with investor preferences around the world.

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*"Given the groundwork we have already laid engaging on disclosure, and the growing investment risks surrounding sustainability, we will be increasingly disposed to vote against management and board directors when companies are not making sufficient progress on sustainability-related disclosures and the business practices and plans underlying them."*

—Larry Fink, CEO of Blackrock, January 14, 2020

## 1. Introduction

Institutional investors are increasingly concerned about environmental sustainability and a lack of action by some firms to address it. In the institutional investor survey of Krueger, Sautner, and Starks [2020], investors state that environmental risks have financial implications for their portfolio firms and that these risks have begun to materialize. These investors also state that engagement is important to address these risks, and more so than divestment. This gap between the thinking of investors and boards is further highlighted in a KPMG survey of board members and executives from 41 countries, which finds that while major investors continue to emphasize the link between ESG issues and long-term firm performance, less than half of those surveyed believed that a focus on ESG issues improves company performance, and only 11% said their board oversight of ESG-related risks and opportunities was robust (KPMG [2018], p. 2).

A typical investor approach to improve sustainability is to request improvements in environmental performance directly and/or improvements in environmental disclosures (see Christensen, Hail, and Leuz [2021] for a comprehensive literature review). However, both the quotation cited above by the world's largest investor and the extensive international corporate governance literature shows that such an approach may not be enough. While better information allows outsiders to be more focused in the specific actions they demand, investors need effective governance mechanisms before boards will act on their requests.

We conjecture that board renewal mechanisms—those substantive enough to renew the thinking of the board—are required before investors can address the mismatch between their preferences regarding sustainability and what insiders at firms are actually doing. Replacing existing board members with new board members that reflect the mindset of a firm's investors is an integral component of activist campaigns (e.g., Brav, Jiang, Partnoy, and Thomas [2008], Becht,

Franks, Grant, and Wagner [2017]). Also, as noted by Bebchuk and Hamdani [2017], investor-friendly changes to the voting process force existing board members to pay greater attention to investors' preferences, as investors can more easily vote them out. In these papers, the demanded governance changes are driven by general investor desires to fix suboptimal firm policies, rather than specific concerns about environmental performance.

In our paper, we use a sample of 3,293 firms from 41 countries to test the hypothesis that board renewal is fundamental for improving environmental performance. We focus on two mechanisms powerful enough to renew the thinking of the board for which enough data are available globally and quasi-exogenous variation is available in our sample period.

The first mechanism is the adoption of majority voting rules. With majority voting, a board member needs to receive more than 50% of the votes cast to be elected, giving outside investors the power to prevent insiders' candidates from joining the board.[1] This increase in investor power to shape firms' decisions is associated with improved financial performance (e.g., Cuñat, Gine, and Guadalupe [2012], Ertimur, Ferri, and Oesch [2015], Doidge, Dyck, Mahmudi, and Virani [2019]). Absent majority voting rules, plurality voting rules generally apply. Under plurality voting, investors only vote 'for' directors or 'withhold' their vote. Thus, the opening quotation from Blackrock would have little impact absent majority voting, as they and other investors could not vote 'against' directors, and if they 'withhold' their votes, such votes simply would not be counted.

Our second mechanism is a proxy for forced board renewal, coming from regulators, investors, or societal pressures. A significant example of forced board renewal around the world is the concerted effort to increase female board representation. Using Norwegian data, Ahern and Dittmar [2012] find that female board members are less likely than male board members to be

[1] The majority voting rule we study is distinct from a majority-of-minority voting standard that has been studied within India by Li [2021].

insiders (and thus more independent). Several countries imposed minimum quotas for female board representation during our sample period.

To test whether board renewal mechanisms impact future environmental performance, we use ASSET4 ESG (now Refinitiv ESG), which offers comprehensive coverage of firms worldwide for a long time series. The line items in ASSET4 include $CO_2$ emissions, renewable energy use, waste recycling ratios, and so forth. Given extant measurement concerns with environmental scores, in all our tests we use both the proprietary-weighted ASSET4 *z*-score and an equal-weighted score that we construct from the line items. Further, we confirm that our results hold if we use an environmental performance score built using only line items for financially material issues for a company's particular industry as determined by the Sustainability Accounting Standards Board, as well as alternative environmental performance scores from other data providers (SAM S&P Global and Sustainalytics/Morningstar).

We find that board renewal is indeed a fundamental driver of environmental sustainability. In panel regressions with ASSET4 Environmental *z*-Scores as the dependent variable, we find that firms with majority voting provisions have 8% higher environmental scores and firms with female directors have 15% higher environmental scores. Traditional good-governance line items (such as board independence) also improve environmental performance, but have about one quarter the impact of our board renewal mechanisms. To account for the impact of time-invariant firm characteristics, we estimate firm fixed effect specifications. These models also show a positive and significant impact of board renewal—firms with majority voting or female directors have between 3% and 4% higher environmental performance.

To further help with identification, we utilize country-level examples of quasi-exogenous variation in board renewal. In France, we identify legislation that mandated quotas for female board representation, and in Canada we examine outside pressure that forced the adoption of majority voting rules. Importantly, we verify that these external pressures were not related to concurrent environmental concerns and, hence, are quasi-exogenous to our dependent variables.

Additionally, for female board representation, we find examples of external activism for a larger sample of nine countries (we do not find similar shocks for majority voting outside Canada).

We employ difference-in-differences specifications using firm fixed effects comparing the subsequent environmental performance of firms affected by the 'treatment' to otherwise similar unaffected firms. All of these quasi-exogenous shock tests find that board renewal positively and significantly impacts environmental performance. In terms of economic significance, the female director tests using the nine-country sample imply 8% greater environmental performance following the addition of the first female director, comparing the average environmental performance in the three years before the board renewal year to the environmental performance in the three years after.

We proceed to test whether the positive impact of board renewal on environmental performance continues to hold when we control for specific board member characteristics that themselves may be positively correlated with a commitment to environmental performance (e.g., age, experience, and education). Ahern and Dittmar [2012], for example, test six characteristics and find that, compared with existing male directors, new female directors have significantly less CEO experience, are younger, and are more highly educated. When we control for these six board-member characteristics, we obtain coefficient estimates for the positive impact of board renewal that are essentially unaltered in both significance and magnitude.

We make use of our international data to investigate whether board renewal mechanisms are more impactful in certain settings. Extant research shows that traditional governance mechanisms are more effective where country-level disclosure and investor protection rules are stronger (e.g., Hail and Leuz [2006], Doidge, Karolyi, and Stulz [2007], Lel and Miller [2019])—whether board renewal is impacted similarly by the institutional environment has not been studied. We segment our sample based on the strength of disclosure and investor protection at the country level, and test whether the impact of board renewal depends on a country's institutions, while also

controlling for traditional governance. The lesson we draw from these cross-country comparisons is that board renewal is more impactful in settings with strong institutions.

Next, we test whether board renewal has a greater impact on environmental performance when a firm has a greater concentration of motivated investors that have strong preferences for improvements in environmental performance. We use two approaches to identify motivated institutional investors: those from countries with high social norms towards the environment, and those from countries that have adopted stewardship codes that encouraged investors to step up their exercise of governance. We find that board renewal mechanisms are more strongly related to environmental performance in the presence of motivated investors.

Finally, we analyze whether the path from board renewal to improved environmental performance is associated with one or more specific actions over which the board has control: having a sustainability committee, producing annual sustainability reports, tying executive pay to sustainability targets, and disclosing how the firm engages with its stakeholders regarding sustainability. We estimate regression models using each of these four actions as dependent variables. In almost all tests we find a significant positive relation between majority voting or having a female board member and each of these four actions. These tests provide evidence of plausible channels through which environmental performance is improved.

We note here several points our paper does not focus upon. We choose not to include US firms in our tests as they would constitute 40% of the sample and make it difficult to generalize results around the world. Including US firms does not alter our results. We focus on environmental performance rather than social performance for two reasons: first, for environmental performance, investors almost unequivocally state that there is a significant gap between what they want and what the board actually delivers; second, Berg, Koelbel, and Rigobon [2022] show there is greater agreement amongst data providers on environmental than social items. Nevertheless, we test for the impact of board renewal on firms' social performance and find similarly significant effects. We also do not test whether improved environmental performance is NPV enhancing.

Environmental performance choices are complicated and there are at least two situations where there may be overinvestment: first, when directors' care more deeply about the environment than investors know, and those personal preferences drive their board decisions; second, when investors overestimate the importance of environmental performance for firm value.

Our findings speak to investors, analysts, and academics interested in understanding the specific reporting items that matter for both environmental and financial performance (e.g., Christensen, Hail, and Leuz [2021]). Our paper suggests that measured environmental performance is at least partly shaped by prior governance choices. Thus, for those inclined to use Environmental, Social, and Governance measures as independent constructs, our findings show that they instead should be considered as interrelated. Our contribution is to show that board renewal is a fundamental governance mechanism associated with improved environmental performance and sustainability-oriented actions taken by firms.

Our paper also adds to a growing literature on investor preferences and environmental sustainability (Hart and Zingales [2017], Friedman and Heinle [2016], Dyck, Lins, Roth and Wagner [2019], Pástor, Stambaugh and Taylor [2021]). These papers take the perspective that institutional investors are fully capable of internalizing both the costs and benefits of improved environmental performance for long run success. Many of these investors increasingly conclude that the aggregate benefits of increasing environmental performance outweigh the costs. In this light, our paper provides a roadmap for environmentally motivated investors, steering them to focus on board renewal. Further, our country subsample analysis suggests that governments can play a role. When countries with poor institutions strengthen them, this will better enable investor pressure to change the thinking of corporate boards, improving environmental sustainability and investor welfare.

Finally, our paper adds to the literature on the performance implications of majority voting rules (e.g., Cuñat, Gine, and Guadelupe [2012], Ertimur, Ferri, and Oesch [2015], Doidge et al. [2019]) and female board participation (e.g., Adams and Ferreira [2009], Adams and Funk [2012],

Ahern and Dittmar [2012], Kim and Starks [2016]). Our contribution is to show that these forms of board renewal have impacts that extend beyond financial performance. Of particular note, we find that adding a female director (arising from a quota or by choice) has a significant positive impact on environmental performance. Because we control for non-gender director characteristics, this suggests that director gender, on its own, influences a firm's environmental sustainability.

## 2. Theoretical Predictions

We assume the board has the ultimate authority to make environmental investments. Board members are motivated by a preference to retain their positions, which provide pecuniary and non-pecuniary benefits. We assume that board members are not perfect agents of investors. When it comes to the level of environmental investments they seek, board members balance *insiders'* preferences for environmental investment, *investors'* preferences for environmental investment, and since they also care about non-pecuniary factors, *board members' own* preferences regarding environmental investments.

We characterize an environmental investment as one that requires a current cash outlay for a long-term benefit. We assume that investors in aggregate value environmental performance. This arises in the models of Friedman and Heinle [2016] and Pástor, Stambaugh and Taylor [2021] when some proportion of investors have strong preferences for improving environmental performance (as they care about environmental externalities), while others do not. Further, based on Dyck et al. [2019], Krueger, Sautner, and Starks [2020], and KPMG [2018], we assume that investors in aggregate want greater environmental performance than is currently being provided by firms.[2] Thus, given these assumptions, how do investors interested in achieving better environmental performance in their portfolio firms obtain it?

[2] Sustainability concerns amongst investors are not restricted to firms in developed countries. Krueger, Sautner, and Starks [2020] provide evidence of sustainability preferences in some of the largest investors globally. Dyck et al. [2019] document that institutional ownership is predominantly non-domestic for firms in less-developed countries, thus, the sustainability preferences of investors from developed countries could affect environmental performance globally. In the KPMG [2018] survey, executives and board members report investor pressure to focus on ESG issues across all countries, with the greatest pressure recorded for firms in less-developed countries.

At its core, the key to obtaining better environmental policies is no different than the key to changing other operating and investment strategies investors find sub-optimal: they need more power so they can get boards to renew their thinking. Traditional governance mechanisms, that have been around for a long time, are apparently not sufficient to get boards to internalize investors' evolving preferences for greater environmental commitments. For example, many firms have required board independence along with an independent Chairperson for decades, and nonetheless are falling short of investors' preferences regarding environmental performance, as illustrated by our opening quote. One possible reason is that board members are frequently co-opted by insiders (e.g., Shivdasani and Yermack [1999], Coles, Daniel, and Naveen [2014], Bebchuk and Hamdani [2017]). Having a co-opted board plausibly matters for environmental performance—insiders suffer from short-termism stemming from compensation and career concerns, which lead them to place a disproportionate focus on current financial performance (e.g., Stein [1989], Edmans, Gabaix, and Jenter [2017], Flammer and Bansal [2017]). Hence, via traditional governance mechanisms, investors may find it difficult to get boards to fully internalize their thinking on environmental performance.

In this paper we focus on mechanisms powerful enough to renew the thinking of the board for which enough data are available to examine in an empirical setting. To achieve board renewal, Bebchuk and Hamdani [2017] note that investors have focused on three ways to refine the voting process for directors: nominating committees composed of independent directors, majority voting, and giving investors enhanced proxy access. Of these, we focus on the majority voting mechanism as we have available data around the world, there is significant variation in the use of this mechanism across firms, and, as described in Section 4, we have variation across time in firm adoption of this mechanism driven by external factors and not environmental performance concerns.[3]

[3] For mandatory nomination committee rule changes, we find that a mandatory nomination committee rule is positively associated with subsequent environmental scores in panel regressions, but we choose not to focus on this measure because there is minimal variation, and we cannot find quasi-exogenous shocks. A manual check of whether

With majority voting, a board member must obtain more than 50% of the votes cast to be elected (compared with a simple plurality of votes cast), giving investors the ability to renew the board by having their preferred candidates elected. Thus, once majority voting rules are in place, current directors interested in keeping their jobs will become more investor attentive. In today's climate, where investors see financial or non-financial benefits to improved environmental performance, directors subject to majority voting will focus more on investors' preferences rather than on insiders' reluctance to invest because of short-termism.

Society-driven reforms that affect board composition also have the potential to renew the thinking of the board. The most prominent of such reforms is forced board renewal stemming from the global effort to increase female board representation. This leads to a greater focus on environmental performance if female board members are less focused on insiders' preferences.

Adams and Ferreira [2009] suggest this is likely "because they do not belong to the 'old boys club,' female directors could more closely correspond to the concept of the independent director emphasized in theory" (p. 292). Among Norwegian firms, Ahern and Dittmar [2012] find that women added to the board are less likely than male board members to be insiders. In addition, the non-pecuniary preferences of women may align more with investors' preferences regarding environmental performance. Behavioral economics research supports this—women in general have stronger 'other regarding' preferences than men, such as a stronger concern for the environment (e.g., Andreoni and Vesterlund [2001], Adams and Funk [2012], Thaler [2016], Cronqvist and Yu [2017]). Practitioner surveys are consistent with this view, reporting that female directors are more likely than their male counterparts to say that ESG issues in general (60% vs. 46%) and climate change specifically (79% vs. 62%) should be incorporated in company strategy

mandatory nomination committee rule changes are introduced during our sample period yields no cases to exploit. For example, Hong Kong strengthened its definition of independence for nomination committee members in 2011, but we do not observe any significant change in director independence at that time. Germany in 2007 introduced a requirement that nominating committees consist of at least 50% independent directors, but our coverage of German firms at that time is small. Other countries such as Denmark or Italy introduced such requirements before the beginning of our sample period, while Portugal introduced them subsequently. We are unable to use enhanced proxy access, as it so far remains a focus for US firms and not elsewhere in the world.

(PwC [2021]). If a newly added female director arrives to the board with innately high non-pecuniary utility from making environmental investments, and her board moves to reflect the thinking of this new director, the firm will increase its environmental performance.

In conclusion, when boards are capable of renewing their thinking—as proxied by majority voting rules or greater female board representation—investors are able to get their environmental preferences represented on the board in a timely manner. As a result, the board's decisions going forward should better reflect the preferences of the firm's investors and, in turn, the firm invests more in environmental performance.

## 3. Sample and Summary Statistics

### *3.1. Environmental Performance*

At the time of writing our paper no apparent market leader exists for ESG data. We choose the ASSET4 ESG database (now Refinitiv ESG),[4] since it offers the broadest coverage of publicly-traded firms worldwide for the longest time series. ASSET4 analysts acquire information from annual reports, corporate sustainability reports, NGOs, and news sources at annual frequency. It evaluates firms' environmental commitments in three areas: Emission Reduction, Resource Reduction, and Product Innovation. Within each area, ASSET4 analysts identify specific line items (e.g., "Are the firm's greenhouse gas emissions/sales below the industry median in that year?"), with 70 items in total. Consistent coverage of firms begins in 2004, with coverage for a few countries starting in 2009. We use data from 2004 through year-end 2015 for our analysis. All variable definitions and data sources are provided in Appendix A.

Our first environmental performance measure is the proprietary-weighted aggregate scores that ASSET4 provides to investors (ASSET4 *z*-Scores). This is a rank-based score that ranges from 0 to 100 and measures the environmental performance relative to all other companies in a given

[4] We obtained the data from ASSET4 in February 2018. At that time, the ASSET4 database was offered by Thomson Reuters. In October 2018, Blackstone bought a majority stake in Thomson Reuters' Financial and Risk unit, which was renamed Refinitiv. The ESG database is currently being offered as Refinitiv ESG.

year. We note that the weighting scheme of ASSET4 is not transparent, raising the possibility that it may not sufficiently weight real effects. To help to mitigate concerns that a particular proprietary weighting drives results, as a second environmental performance measure we create a measure that equally-weights raw environmental data items provided by ASSET4. We first transform all line items into indicator variables such that a 'one' corresponds to better environmental performance (e.g., a below-median greenhouse gas emission firm would get a 'one') and then sum up the indicator variables in each of the three environmental categories, divide by the number of available indicators, and take an average across the three environmental categories (Online Appendix Table OA-1).

Additional measurement concerns include a disagreement between ESG data providers, (e.g., Christensen, Serafeim, and Sikochi [2022], Berg, Koelbel, and Rigobon [2022], Gibson, Krueger, and Schmidt [2019]) or that line items are often not material (Yang [2020]). To mitigate these potential concerns, we run a battery of tests with a variety of alternative environmental performance measures. Specifically, our alternative performance measures are: a materiality-weighted environmental score, in which we weight the raw environmental data items based on the materiality for that industry as determined by the Sustainability Accounting Standards Board (SASB) (see, e.g., Khan, Serafeim, and Yoon [2016])[5], aggregate environmental performance scores from SAM S&P Global and Sustainalytics (now Morningstar), and subcomponent scores from ASSET4. Our results obtain with all these alternative measures.

Finally, we note that environmental performance data differ from financial performance data in that disclosure is not mandatory, not required to be audited, and information may be missing.[6] Despite this, strong investor pressure exists to produce these data, and firms around the

[5] The SASB industry-based Materiality Map is, to our knowledge, the most comprehensive attempt yet to consider specifically those sustainability issues that are likely to affect the financial or operating performance of firms. The SASB classification was published in November 2018. We use the pre-publication online version as of December 2017 (see materiality.sasb.org).

[6] Another potential concern is that data providers may revise their historical scores. For example, Berg, Fabisik, and Sautner [2021] note a rewriting of the ASSET4 data in April of 2020. This concern does not apply to our analysis, as we obtained our ASSET4 data before the one-time methodology-related rewriting.

world are increasingly reporting against common standards and seeking external assurance that their environmental performance data are valid. Such concerns matter since Christensen, Serafeim, and Sikochi [2022] show that cross-sectional and time series differences in disclosure standards increase disagreement on ESG metrics between data providers. For robustness, we explore in Online Appendix Table OA-2 whether missing data for environmental scores is important for our sample. We find that more than 70% of ASSET4's line items are available in each year and that these high reporting percentages are relatively stable over time and across countries. This suggests that inconsistent reporting is unlikely to drive our empirical results.

*3.2. Board Renewal, Traditional Governance, and Ownership*

A contribution of our paper is that we explore board renewal mechanisms. There is growing academic evidence that investors are pushing for environmental performance improvements (e.g., Dyck et al. [2019], Krueger, Sautner, and Starks [2020]). As discussed in Section 2, we focus on two governance mechanisms powerful enough to renew the thinking of the board—majority voting rules and female board representation. We define Majority Election as an indicator variable that equals one if the company's board members are generally elected with a majority vote, and zero otherwise; and Female Director as an indicator variable that equals one if the firm has at least one female director, and zero otherwise. [7] We obtain these data from ASSET4 and BoardEx.

Given the longstanding research that documents the impact of traditional governance mechanisms for firms' choices, it is important that an assessment of the impact of board renewal allows traditional governance to have an impact as well.[8] Following Aggarwal, Erel, Stulz, and Williamson [2008], we construct an index, Traditional Governance, based on several governance mechanisms they argued, at that time, 'have received the most attention in the academic literature and from observers.' These mechanisms are Board Independence: the board has more than 50%

[7] In Online Appendix Table OA-3, we assess whether there is a greater impact if a firm has two or more female directors on the board, and find this to be the case.

[8] Papers that explore the relation between some form of traditional governance and CSR levels include Walls, Berrone, and Phan [2012], Krueger [2015], and Ferrell, Liang, and Renneboog [2016].

independent directors; Board Size: the board has more than five members but less than sixteen; CEO/Chairperson Separation: the roles of the CEO and Chairperson are separated; Board Structure: directors are elected individually (no staggered board); Audit Committee Independence: the audit committee is composed solely of independent directors; and Stock Classes: only one class of common stock (all shares have equal voting rights; no dual classes).[9] We obtain these data from ASSET4 and BoardEx.

We also control for ownership, by identifying firms that are blockholder controlled. We measure blockholder control by combining detailed firm-level ownership data from ASSET4, Datastream, Orbis (Bureau van Dijk), and the Global Family Business Index (obtained from Center for Family Business at the University of St. Gallen, Switzerland). We group blockholder-controlled firms into two categories: firms controlled by a family, and firms controlled by non-family blockholders. Controlling for family ownership is important, given the evidence showing that private benefits for families come from current cash flows or cash holdings. Thus, family insiders may be less willing to use current cash to make potential environmental investments, as such spending will limit their private benefits.[10]

### *3.3. Final Sample and Descriptive Statistics*

Our starting sample consists of 27,913 firm-year observations with ASSET4 Environmental *z*-Score data between 2004 and 2015. We exclude 430 observations by requiring at least 10 firms per country. We lose 506 observations by merging with Worldscope financial statement data. We lose 1,834 observations after merging with Factset to obtain institutional

[9] We do not include a measure (Auditor Ratification: auditors are ratified at most recent annual meeting) that was in the Aggarwal et al. [2008] index, as it is not available in ASSET4.

[10] For example, markets put a lower value on corporate cash holdings when firms have entrenched insider/family control, indicating a fear that cash will be consumed for private benefits (Kalcheva and Lins [2007]). Similarly, transfer pricing schemes that involve trading between public companies overwhelmingly have private benefits created from current (rather than future) cash flows (Cheung, Rau, and Stouraitis [2006], Desai, Dyck, and Zingales [2007], Jiang, Lee, and Yue [2010]). Further, family-controlled firms have been shown to both underperform and be unwilling to make current investments particularly during periods where cash holdings are most valuable (Lemmon and Lins [2003], Lins, Volpin, and Wagner [2013]).

holdings. We lose 4,397 observations after requiring majority election and traditional governance mechanism data from ASSET4. We lose 215 observations constructing Female Director from BoardEx and ASSET4. Finally, we exclude 84 singleton year-by-country or year-by-industry observations. Our final sample consists of 20,447 firm-year observations and covers 3,293 firms from 41 countries.

In Panel A of Table 1 we report summary statistics for firms' environmental performance, governance mechanisms, and other characteristics. Regarding firms' environmental performance, the average ASSET4 Environmental *z*-Score is 54.2 and the average ASSET4 Equal-weighted Environmental Score is 39.1, where a perfect score would be 100 for each of the two measures. Turning to the governance measures, firms have majority elections in 55% of our sample firm-years, and 60% of our firm-years have at least one female board member. The average firm has 3.7 out of the 6 traditional governance mechanisms (e.g., more than 50% of the board is independent, separation of Chairperson and CEO, etc.). In terms of ownership characteristics, 23% of firms are family-controlled, and 7% of firms are controlled by another type of blockholder.

In Panel B of Table 1 we report average environmental performance and governance measures for our sample firms by country. To facilitate comparisons across countries, we report summary statistics for the cross-section in year 2012. The countries where firms have the highest environmental performance are all European. Countries where firms' environmental scores are lowest are concentrated in Asia and Australia. Traditional Governance is strongest in Canada, the UK, and Finland. In more than 90% of firm-years are directors elected by majority vote in Denmark, Luxembourg, New Zealand, South Africa, and the UK, while no more than 30% are elected by majority vote in Egypt, Finland, Indonesia, and the Philippines. All firm-years in Finland, Israel, Norway, and Sweden have at least one female board member, while female board representation is lowest in Japan (12%) and South Korea (10%). In our subsequent tests, we include country-by-year fixed effects, amongst other fixed effects, to control for all such differences.

## 4. Is Board Renewal Related to Firms' Environmental Performance?

### *4.1. Baseline Tests*

Our baseline tests in models 1 through 4 of Table 2 examine the relation between corporate governance and firms' environmental performance using the following specification:

$$Log(Score_{i,t}) = \alpha + \beta' X_{i,t-1} + \gamma' Y_{i,t-1} + \Lambda + \varepsilon_{i,t}, \quad (1)$$

where the dependent variable is the log of one of the environmental scores of firm *i* in year *t*, $X_{i,t-1}$ are measures of board renewal or traditional governance in firm *i* in year *t-1*, $Y_{i,t-1}$ are a set of firm-level controls in year *t-1*, and Λ are year-by-country and year-by-industry fixed effects.[11] Given the substantial variation over time, across country, and across industry, such fixed effects guards against the possibility that our results are driven by a particular industry or country in a given year. We cluster standard errors by country.

We use logs of environmental scores to obtain better distributional properties and to reduce the impact of outliers.[12] For firm-level control variables we include firm size as prior literature has shown it to be related to ownership structures, and larger firms may be subject to more external pressures. Hong, Kubik, and Scheinkman [2012] suggest that financial slack also explains adoption of sustainability-oriented policies. Following them, we include cash, asset tangibility, and leverage to capture credit constraints, and profitability to capture the impact of performance. We include indicators for family and other blockholder-controlled firms as blockholders may be subject to short-termism. Institutional ownership is included as Dyck et al. [2019] find that institutional investors are a factor in environmental performance around the world. Finally, we include a cross-listing indicator to capture broad governance structures.

[11] Environmental variables reflect data available to ASSET4 analysts that covers the firm's fiscal year. A score for fiscal year 2010, for example, would reflect items that occurred during the 2010 fiscal year as well as information contained in the company annual report and any company sustainability reports published after the fiscal-year end early 2011. Thus, our baseline model with 2010 environmental scores would have fiscal-year-2009 right-hand-side variables.

[12] Our main results are unaffected if we use the raw scores rather than the log scores. Our results are also similar when we use industry-by-country-by-year fixed effects though we lose 10% of the sample due to singleton observations.

The tests in Table 2 show a significant and economically important relationship between board renewal mechanisms and firms' environmental performance. Panel A reports the results using ASSET4 Environmental *z*-Scores as the dependent variable. In model 1, we assess the importance of providing outside investors with the power to renew the thinking of the board through majority voting. We find a positive and significant coefficient on Majority Election (*p*-value < 1%), implying that, when investors have this power, firms have 9.3% higher environmental performance.[13] In model 2, we assess the importance of board renewal through female board representation. Again, we find a positive and significant coefficient on Female Director (*p*-value < 1%), indicating that having a female board member is associated with 15.3% higher environmental performance.

In model 3, we use the Aggarwal et al. [2008] traditional governance index. We find a positive and significant impact of Traditional Governance on environmental performance (*p*-value < 5%). The coefficient indicates that one additional traditional governance mechanism (e.g., separating the role of CEO and Chairperson) is associated with 3.0% higher environmental performance.

In model 4, we simultaneously include the two board renewal mechanisms and the traditional governance index. Including them all in one specification helps to assess whether each mechanism has a unique impact on firms' environmental performance. We find that all governance mechanisms have an independent and significant impact on firms' environmental performance. Of particular interest, however, the board renewal mechanisms of majority voting and female directors are estimated to provide incremental improvements in environmental performance beyond traditional governance mechanisms. When investors have greater control rights arising from majority voting, environmental scores are 8.3% higher. Firms with a female director have 14.7% higher environmental scores. Compared with traditional governance, the economic effects

[13] The coefficient is 0.089, and thus the implied economic magnitude is 9.3% (calculated as $e^{0.089} - 1 = 0.093$).

of board renewal mechanisms are between 3.4 (majority election) and 6.0 (female directors) times higher.[14]

We note here that we also obtain significant coefficients on board renewal mechanisms when we consider 'materiality' and industry-specific factors. First, the results obtain when we use the materiality-weighted environmental score based on items deemed material for an industry as determined by the Sustainability Accounting Standards Board (SASB). Second, we partition the sample into firms from 'dirty' and 'clean' industries, based on their ASSET4 aggregate industry environmental scores, and find significant coefficients on board renewal mechanisms in both partitions. This suggests board renewal can provide substantial improvements where environmental performance is weakest. Finally, we find that board renewal mechanisms are also significant if we use environmental performance scores obtained from SAM S&P Global and Sustainalytics/Morningstar or we use the summary scores from the three ASSET4 subcategories. We provide these results in Online Appendix Tables OA-4 and OA-5.[15] Thus, while there undoubtedly remain measurement concerns for environmental performance, such concerns do not drive the results in this paper.

An omitted factor could potentially affect both board renewal and a firm's environmental performance. The panel regressions so far address this concern by controlling for time-varying observable characteristics, including country-by-year and industry-by-year fixed effects. To further enhance identification, in model 5, we estimate firm fixed effects specifications that control for time-invariant unobservable firm characteristics. For these tests, we keep only those observations where at least one of the board renewable variables are time-varying during the

[14] The coefficient estimates on Majority Election and Female Directors are statistically different from Traditional Governance with *p*-values of 0.038 and 0.000, respectively.

[15] Because not all industries in our sample have a mapping into the Materiality Map and not all line items in SASB can be matched to ASSET4, the sample size for these tests is reduced to 12,837 observations. The sample sizes for S&P Global and Sustainalytics (now Morningstar) are also smaller as these data providers cover fewer firms over a shorter time horizon. We note that, in our sample period, there are relatively higher correlations across ASSET4 and these alternative data providers' aggregate scores, ranging between 0.62 and 0.70, than those reported by Gibson, Krueger, and Schmidt [2019] and Berg, Koebel, and Rigobon [2022].

sample period. We note that such a within-firm specification is relatively demanding in terms of power as governance structures are generally sticky over time.

The results in model 5 confirm our prior conclusions—board renewal mechanisms continue to be associated with significant improvements in firms' environmental performance. Once we account for time-invariant unobservable firm characteristics, firms with majority elections have 3.3% higher environmental scores and firms with a female director have 3.6% higher scores. These estimates, albeit smaller than those in the previous specifications, are still economically significant and potentially have more external validity as they account for many unobserved omitted firm-type variables.

Finally, we illustrate the year-by-year dynamics of the environmental performance of firms that experience changes in their board renewal mechanisms. For each firm, we introduce a set of time indicator variables for the five years before and the five years after the adoption of majority election rules and the appointment of female directors, respectively. These indicators capture the time distance from the board renewal events. We exclude the time indicator for the year before the event because of collinearity; hence, all time indicator estimates can be interpreted as changes relative to the year before the event.

These tests reinforce our findings from models 1 through 5. We provide results in models 6 and 7 of Table 2. The coefficient estimates before the adoption of majority voting or the appointment of female directors are statistically insignificant. After the adoption of majority voting or appointing a female director, all coefficients are positive and statistically significant. The coefficients after adoption rise practically monotonically for five years, suggesting larger impacts after board renewal has had a longer time to affect firm practices. For example, three years after board renewal firms have environmental performance levels that are around 20% greater relative to the year before board renewal for both measures. We also provide a graphic illustration of these coefficients in Figure 1. There is no indication of rising environmental performance prior to the adoption of majority voting, while there is a modest upward trend in mean environmental scores

prior to the appointment of a female director (albeit the coefficients are never significantly different from zero). When we estimate models with firm fixed effects, the implied increases associated with the adoption of majority voting and female director are 4.5% and 7.1%, respectively.[16]

In Panel B of Table 2 we use the ASSET4 Equal-weighted Environmental Score as our dependent variable and arrive at similar conclusions in all models. As for the control variables, in both panels we find that larger firms, more profitable firms, and firms with greater tangibility show stronger environmental performance. We also find that family-controlled firms have lower environmental performance and that firms with more institutional ownership have higher environmental performance.

Overall, our baseline tests show strong support for an association between board renewal mechanisms and firms' environmental performance. Majority elections and female directors have an incremental, statistically significant, and economically important impact on firms' environmental performance that goes beyond firms' traditional governance structures.

Finally, as noted in the introduction, our paper specifically focuses on environmental performance, rather than social performance. In Online Appendix Table OA-7 we report results for the impact of board renewal on firms' social performance and find similarly significant effects.[17]

*4.2. Board Renewal Shocks*

To further assuage concerns about the endogeneity of board renewal, we test our predictions in settings where there are quasi-exogenous shocks to board renewal mechanisms. We seek a setting that satisfies two conditions. First, there are outside pressures forcing the adoption

[16] Online Appendix Table OA-6 uses firm fixed effects and time indicator variables. Because of sample attrition (not all firms span over the five years before and after board renewal), we estimate these within-firm models for two years before and after the adoption of board renewal. For ASSET4 Environmental *z*-Scores, for example, the 4.5% effect for majority voting is calculated as $e^{0.10-0.056} - 1 = 0.045$.

[17] We note here that a substantial limitation in studying the impact of board renewal on firms' *social* scores is that female board representation is mechanically related to several line items comprising firms' social scores. As such, any observed correlations need to be interpreted carefully.

of majority voting rules or female board representation. Second, those outside pressures must not have had the explicit or implicit target of also changing firms' environmental performance.[18] Settings that satisfy these two conditions allow for a cleaner test of the relationship between board renewal and environmental performance.

Quotas that are mandated by legislation, and force some, but not all firms to add female directors provide an excellent opportunity for identification. The first such regulator-mandated female quota was introduced in Norway in 2003 (preceding our sample period). With a quota, firms are forced to add women to the board, independent of their beliefs regarding the importance of environmental performance. This allows us to examine whether the addition of one or more women to the board is related to subsequent improvements in environmental performance, by comparing the firms treated with the quota to those that were not (i.e., because they already had female board members).[19]

The best country in our dataset to explore the impact of quotas is France. In 2011, the French government passed legislation establishing female board quotas: a 20% minimum for both sexes by January 1, 2014 and a 40% minimum by January 1, 2016. This was a hard quota, in that firms faced significant penalties if they failed to comply. The quota was imposed in the middle of our sample period, allowing us to analyze multiple years of environmental performance data both before and after this 'shock.' We confirm that the regulatory change in France focused very specifically on gender—as confirmed by press coverage—and not on broader political objectives, which might otherwise mechanically link gender policies to environmental outcomes.[20]

[18] We could not find compelling exogenous shocks for the traditional governance mechanisms during our sample period. This is not unexpected, given that broad governance reforms across countries occurred in the late 1990s and early 2000s, and as such pre-date our sample period. See, e.g., Fauver, Hung, Li, and Taboada [2017], who provide data on board reforms across 41 countries.

[19] Our paper focuses solely on environmental performance. We note here that forced board turnover can potentially have undesirable outcomes such as lower status for audit committees relative to management (e.g., Badolato, Donelson, and Ege [2014]).

[20] Ginglinger and Raskopf [2021] obtain similar results of a purely environmental impact.

We illustrate the dynamics between the imposition of the board quota in France and improvements in environmental performance using a case study of the French oil and gas exploration and production firm Maurel et Prom SA. In 2009, the company had an entirely male board. By 2013, two out of eight board members were female, satisfying the 20% female representation rule. Coincident with the forced board renewal was significantly improved environmental performance. Maurel et Prom's ASSET4 Environmental *z*-Score effectively doubled over this period, including substantial reductions in its total equivalent emissions of $CO_2$, nitrogen oxides, sulphur oxides, volatile organic compounds, and particulate matter.

We provide more comprehensive analysis of the impact of the female board quota in France in Table 3. Here we use all French firms and conduct difference-in-differences analyses to test whether 'treated' firms like Maurel et Prom, that had no female directors from 2008 to 2010 and thus needed to move quickly to elect women to the board to meet the minimum requirement, improved their environmental performance more than 'control' firms that already had at least one female director. This test allows us to control for changes that affect all firms in France, as well as changes in a set of observable firm characteristics. There are a sizable number of firms from France in our dataset, allowing us to construct a treated group and a control group of sufficient size for empirical analysis in a single-country study.

In Panel A of Figure 2, we plot the ASSET4 Environmental *z*-Scores and the ASSET4 Equal-weighted Environmental Scores in the three years prior to the quota and in the three years after. We define 2011 and 2012 as the treatment years because the mandate was not binding for three years and it plausibly takes time to appoint new directors. We require that treated and control firms appear in at least six out of eight years. Both figures provide no indication of differences in pre-trends for environmental performance across these two groups. Treated firms have larger increases in environmental performance than control firms post-treatment.

In Panel A of Table 3, we use difference-in-differences specifications to test whether treated firms experience a significantly larger increase in environmental performance compared to

control firms. These tests mitigate the impact of other potentially confounding factors by limiting attention to a window centered around the quota event, by controlling for time-invariant firm characteristics with firm fixed effects, by controlling for time-varying firm characteristics using the same variables employed in our prior regressions, and by controlling for overall differences in environmental scores in the pre- and post-quota periods using a post-quota time dummy. We exclude firms in which there was a change in family control, other-blockholder control, or cross-listing status to make sure the results are not driven by other major firm changes. Standard errors are clustered at the 2-digit SIC level.

The positive and significant coefficients on the Post × Treated interaction in models 1 and 2 show that treatment is related to increases in environmental performance. The coefficients indicate that firms without any women on the board increase their environmental performance by 14% to 15% more than firms that already had women on the board. These results from the mandated quota in France support our argument that board renewal through the appointment of female directors leads to subsequent increases in firms' environmental performance.[21]

We find no similar legislated mandates for the adoption of majority voting provisions. Fortunately, Canada provides a good example of investor activism that we can use as a quasi-exogenous shock that leads to majority voting adoption. As detailed in Doidge et al. [2019], the majority voting shock was the creation of the Canadian Coalition for Good Governance (CCGG), an investor group whose first major campaign was a demand for firms to adopt majority voting as very few Canadian firms had this at year-end 2004. In 2005 and 2006 the CCGG contacted, through letters and phone calls, all publicly-traded firms that had not already adopted majority voting, requesting that they do so. Over the next two years, Doidge et al. [2019] report substantial increases in firm adoption and provide results that support a causal interpretation that majority voting

[21] We note that the magnitude of change implied by these French quota tests may not be readily generalizable: treated firms had lower initial environmental performance than control firms and thus had a greater scope to improve their environmental performance.

adoption was driven by the CCGG. Doidge et al. [2019] document that the CCGG investor group at this time made no requests for firms to increase their environmental performance.[22]

As a case example of the dynamics between changes in majority voting and improvements in environmental performance in Canadian firms, we use Shoppers Drug Mart, a full-service retail drug service chain. This was one of the Canadian firms targeted by CCGG. In March 2006, Shoppers Drug Mart announced that to enhance director accountability they would provide shareholders with the right to vote for individual directors rather than for a slate. Effective February 2007, they announced that to further enhance director accountability, they were adopting a majority voting policy that called for directors to submit their resignation to the Governance Committee if a majority of votes are 'withheld.' In the presence of these board renewal policies, the company improved both traditional governance (e.g., appointing an independent chair in March 2007), and environmental performance. In the 2007 Annual Report, published in March of 2008, for the first time they moved beyond their typical boilerplate statements of 'compliance with applicable environmental laws and regulations' to include a specific section on corporate social responsibility. This section reports new environmental initiatives including benchmarking studies and specific actions to address waste reduction and diversion, energy efficiency, and environmentally friendly products. Their ASSET4 Environmental *z*-Score more than tripled over this period.

To explore whether this positive dynamic between majority voting and subsequent environmental improvements is widespread in Canadian firms, Panel B of Figure 2, plots the environmental performance of treated firms compared to a control group. We define treated firms as those that adopted majority voting either in 2006 or 2007, and control firms as those that had already adopted majority voting or did not adopt majority voting in the 2004 to 2009 period. Treated firms that adopted majority voting start with higher initial environmental performance, but

[22] The first public indication the investor group took in environmental engagement was a process that began more than a decade later in 2016, to develop E&S guidelines, published in 2018, outside of our sample period https://www.ccgg.ca/wp-content/uploads/2019/01/The-Directors-ES-Guidebook-2018.pdf.

trends appear parallel across treated and control firms prior to adoption. Post adoption we see a substantial increase in environmental performance for treated firms and, more importantly, we see that the gap between treated and control firm grows.

We test whether the shock that increased majority voting adoption is related to subsequent increases in environmental performance in models 3 and 4 of Table 3, where we use difference-in-differences specifications spanning the 2004 to 2009 period, that is, two years before and three years after the initiative to push firms to adopt majority voting policies.[23] We require that treated and control firms have at least one observation before and after the adoption years. As before, we exclude firms in which there was a change in family control, other-blockholder control, or cross-listing status, we include firm fixed effects in all specifications as well as the control variables employed in our prior regressions and a post-adoption time dummy. Again, we find a positive and significant coefficient on the Post × Treated interaction. The coefficients indicate that firms that adopt majority voting increase their environmental performance by 26%.[24] Again, these results support our interpretation that board renewal via majority voting leads to increases in firms' environmental performance.

To increase confidence that these results are generalizable, we search for similar shocks or pressures across all countries in our sample. In nine countries we find examples of external activism pushing for female board representation (Online Appendix Table OA-8).[25] These include some legislated mandates very similar to hard quotas, quotas that are softer as they are less binding, as well as pressure coming from investor groups. For example, in the UK in 2011, Lord Davies published his Women on Boards review that made ten recommendations regarding disclosure and policies on diversity, including a recommendation that FTSE 100 firms should have 25% female

[23] Our sample starts in 2004 requiring an unbalanced panel if we want to include 3 years post adoption.
[24] These economic magnitudes may not be generalizable: in 2005, Canadian firms had environmental scores (controlling for industry and size) ranked in the lowest quintile across all countries and thus both treated and control firms had abnormal scope to improve their environmental performance; additionally, there was outside pressure but no mandate to adopt majority voting, leaving open the possibility that treated firms were already more likely to respond to pressure for improved governance.
[25] In our sample period, we do not find any countries that had majority voting shocks other than Canada.

board representation no later than the year 2015. The effort was supported by investor groups such as the Association of British Insurers which disclosed that it would now start monitoring female board representation.

We use these female board representation "shocks" from multiple countries to conduct similar difference-in-differences analyses in Panel B of Table 3. Models 1 and 2 focus exclusively on the seven countries that legislated a quota for female board representation. Models 3 and 4 additionally include Germany and the UK where there was substantial pressure from large investor groups. Our empirical approach is the same as in the France single-country example. Treated firms are those without female board representation prior to the mandate. We include firm fixed effects, the control variables employed in our prior regressions, and year fixed effects. Standard errors are clustered by industry (2-digit SIC code).

We find that board renewal via adding a female director is related to improved environmental performance across all countries with an identifiable shock. In all specifications we find a positive and significant coefficient on the Post × Treated interaction. In terms of economic significance, the ASSET4 Environmental *z*-scores for the female director tests using the nine-country sample imply 8% greater environmental performance following the addition of the first female director, comparing the average environmental performance in the three years before the board renewal year to the environmental performance in the three years after.

*4.3. Director Characteristics*

In this section, we explore the extent to which director characteristics account for the observed effects of board renewal mechanisms on firms' environmental performance. First, we consider our result that majority voting rules are related to environmental performance. With majority voting rules in place, directors will focus more on investors' demands for investment to improve environmental performance rather than on insiders' reluctance to invest because of short-termism. But while majority voting rules will make current directors care more about investors' preferences, they could also lead to the introduction of directors with characteristics that correlate

positively with a commitment to environmental performance (e.g., age, experience, and education). We wish to identify which effect is at play.

Second, we consider the positive relation between female board representation and firms' environmental performance. This result could be driven by gender itself, and/or it could be obtained because the introduction of new (female) directors with characteristics that, again, correlate positively with a commitment to environmental performance. Ahern and Dittmar [2012], for example, document that new female directors have significantly less CEO experience, are younger, and are more highly educated.

In Table 4 we estimate regression models that include director characteristics for each firm. If firms that adopt majority voting or appoint a female director exhibit systematically different board characteristics, which in turn are related to environmental performance, those characteristics should subsume the direct effect of the change in governance. For these tests we obtain director characteristics for each director in our sample from BoardEx. The requirement to have board characteristic data from BoardEx lowers the sample size from 20,447 to 15,881 observations. Following Ahern and Dittmar [2012], we explore six director characteristics: whether the director has CEO experience; if the director has a higher education degree other than an MBA; if the director has an MBA degree; director age; tenure as a board member; and whether the director shares a last name with someone else on the board (a rough measure of whether a firm has family members on the board). We then average the director characteristics at the firm-year level.

In Panel A, which uses the ASSET4 Environmental *z*-Score, model 1 explores the impact of director characteristics alone. Greater director CEO experience and attainment of higher education other than an MBA are associated with significantly stronger environmental performance. None of the other director characteristics matter for environmental performance. To establish a baseline impact of board renewal in this smaller subsample, we next estimate models 2 and 3, without and with fixed effects, corresponding to models 4 and 5 of Table 2, respectively.

Our key findings are provided in models 4 and 5 that additionally include director characteristics alongside the board renewal variables. We find that director characteristics do not in any way subsume the stand-alone board renewal effects of Majority Voting and Female Director, and this is true both with and without firm fixed effects. The coefficients on board renewal in models 4 and 5 are positive and significant, and virtually identical to those in models 2 and 3 that are estimated without director characteristics. Panel B shows that results are similar if we use ASSET4 Equal-weighted Environmental Scores.

These results suggest that majority voting is related to environmental performance specifically through changing the incentives for directors to consider investors' preferences, rather than through changing the characteristics of those directors. Further, the results suggest that female directors affect environmental performance for reasons related specifically to their gender, rather than based on other characteristics in which female directors differ from male directors. Additionally, because our tests show that a number of observable director characteristics do not explain the treatment effect, this mitigates a concern that our results are driven by selection on unobservables correlated with the observable variables.

We further explore the role of gender for environmental performance in models 6 and 7. Because more CEO experience and higher education other than an MBA are associated with higher environmental performance, we focus specifically on those female directors that have *low* levels of CEO experience and *low* levels of higher education. We use below-median (above-median) indicator variables that are equal to one if a female director's CEO experience or higher education levels are lower (higher) than the median of all other board members in a given firm-year, and zero otherwise. If CEO experience and higher education drive the results, gender should have no direct impact for female directors with relatively low levels of either of these. In all models we find a positive and strongly significant coefficient on the b*elow-median* CEO experience indicator and the *below-median* higher education indicator. This suggests that a female director, independent of her other characteristics, influences a firm's environmental performance.

Based on extant research, this female effect could arise from any of three broad reasons: female directors have strong innate preference for other-regarding behavior such as making environmental investments that have positive social externalities (Adams and Funk [2012], Cronqvist and Yu [2017]); female directors as new board members shake up groupthink as discussed in Janis [1972]; or, female directors bring new corporate governance skills as suggested in the US evidence from Kim and Starks [2016]. Unfortunately, existing international board data do not yet allow us to differentiate between these explanations.[26]

## 5. Are Board Renewal Mechanisms More Impactful in Certain Settings?

### *5.1. Country-Level Institutions*

When examining traditional governance mechanisms, extant research shows that the effectiveness of traditional governance mechanisms does depend on country-level disclosure and investor protection rules. Hail and Leuz [2006], for instance, find that firms' cost of capital is lower in countries with more extensive disclosure requirements, stronger securities regulation, and stricter enforcement mechanisms. Doidge, Karolyi, and Stulz [2007] find that traditional governance metrics improve firm valuations only in countries with strong institutions. Similarly, Lel and Miller [2019] find that directors face consequences for shareholder-unfriendly actions only when country-level investor protection is strong.

Our paper's focus is on mechanisms of board renewal. To our knowledge, no prior work has investigated whether board renewal has larger or smaller effects on corporate outcomes depending on other country-level parameters. It is plausible that, similar to the effect of traditional governance, board renewal will only be impactful in countries with strong institutions. On the other hand, giving investors effective powers to renew the board and replace directors may result in appointments of directors that embrace investors' views, and thus could be impactful regardless of the strength of country institutions.

[26] For example, outside the US, firms are rarely required to disclose detailed director-specific skill sets similar to those required under Regulation S-K rules since 2009 (see, e.g., Adams, Akyol, and Verwijmeren [2018]).

To test the role of country-level institutions, we follow the literature and use cross-country differences in securities regulation, self-dealing regulation, legal origin, and ESG disclosure rules. The securities regulation measure is taken from Hail and Leuz [2006] and incorporates both disclosure rules and supporting enforcement institutions. The self-dealing regulation measure captures the ability of investors to curb insiders' tunneling of resources out of the firm, and is obtained from Djankov, La Porta, Lopez-de-Silanes, and Shleifer [2008]. The legal origin measure uses the La Porta, Lopez-de-Silanes, Shleifer, and Vishny [1998] result that common law provides investors with higher quality information and stronger legal powers to protect their interests. The ESG disclosure measure captures the extent to which governmental and non-governmental bodies mandate environmental, social, and governance disclosure, and is obtained from Amiraslani, Deller, Ittner, and Keusch [2020]. For each of these four measures, we partition the full sample into two subsamples using the median value of the measure. Table 5, Panels A and B present results using the ASSET4 Environmental z-Scores, first without and then with firm fixed effects. Panels C and D present these results for the ASSET4 Equal-Weighted Environmental Scores.

We generally find larger coefficients for the two board renewal measures in the high institution subsamples compared to the low institution subsamples. In Panel A, we find this to be the case in 7 of 8 comparisons, and in all 8 comparisons in Panel B. Further, the relation between the two board renewal measures and environmental performance is almost always significant in the high institution subsamples, with or without firm fixed effects (for 14 of 16 coefficients). In the low institution subsamples, board renewal is generally significant in Panel A (for 7 of 8 coefficients), but board renewal coefficients are never significant with firm fixed effects in Panel B. Taken together, the lesson to draw from these cross-country comparisons is that board renewal is more impactful in settings with strong institutions.

*5.2. Motivated Investors*

As discussed earlier, survey evidence (and the assumption in our theoretical section) indicates a mismatch between investors' preferences and firms' choices regarding environmental

performance. In this section, we test whether board renewal has a greater impact when investors are more motivated to increase what they view as suboptimal environmental performance.

For these tests, we first build on the Dyck et al. [2019] finding that institutional investors have a greater impact on environmental performance if they have larger ownership stakes and come from countries with high social norms toward the environment. We measure a firm's motivated investors by summing up the product of each institutional investor's ownership percentage and the World Values Survey environmental norm score of the investor's headquarter-country. We define a firm as having environmentally motivated investors if its environmental-norm-weighted institutional ownership places it in the top quartile of all firm-years in our sample.

A second source of variation in motivated investors stems from the fact that several countries adopted a stewardship code during our sample period. In the presence of a stewardship code, all institutional investors from that country commit to exercise governance.[27] Given institutional investors' latent demand for more environmental investment, when a stewardship code is introduced, investors should be more motivated to use governance to change firms' suboptimal policies, one of which is underinvestment in environmental performance. We measure a firm's stewardship-motivated investors by summing up the product of each institutional investor's ownership percentage and a dummy variable equal to one if the investor's headquarter-country has adopted a stewardship code by that year. We obtain stewardship codes from national regulators and code a country as having adopted a stewardship code from the year of its publication onwards (e.g., Katelouzou and Siems [2020], Ilhan et al. [2021]).[28] We define a firm as having stewardship-motivated institutional investors if its stewardship-code-weighted institutional ownership is in the top quartile of all firm-years in our sample.

[27] For example, in the UK stewardship code adopted in 2010, asset owners commit to "monitor and hold to account managers" and "engage with issuers" to help improve long-term returns to shareholders and the efficient exercise of governance responsibilities (see also Ilhan, Krueger, Sautner, and Starks [2021]).

[28] As in other studies, we use this hard rather than soft coding of stewardship, thus ignoring nuances that codes can have built-in transition periods, that codes are not necessarily binding for (all) institutional investors, and that codes may be initiated not only by regulators, but also by other parties (for a discussion, see, e.g., Hill [2018]).

In Table 6 we test whether the relation between board renewal mechanisms and environmental performance is greater in the subsample of firms that have environmentally motivated (models 1 through 4) or stewardship-motivated investors (models 5 through 8). These tests repeat the baseline estimation from models 4 and 5 of Table 2.

In Panel A, models 1 through 4 show a greater estimated impact of board renewal when there are more environmentally-motivated investors. The coefficient on Majority Election is 0.120 in this subsample (model 1), which is almost double the coefficient of 0.068 in the subsample without environmentally motivated investors (model 2). The coefficient on Female Director is 0.224 in model 1, which is double the coefficient of 0.111 in model 2. With firm fixed effects, we find a coefficient of 0.072 for Majority Election and 0.033 for Female Director in the environmentally motivated investor subsample (model 3), whereas each of these coefficients are insignificant in the subsample of firms that do not have an environmentally motivated investor base (model 4).[29]

In models 5 through 8 of Panel A, we measure motivated investors using stewardship codes, and find generally similar patterns. For example, in the firm fixed effect specifications in models 7 and 8, we find positive and significant coefficients of 0.035 for Majority Election and 0.037 for Female Director in the stewardship-motivated investor subsample, while these board renewal coefficients are insignificant in firms without stewardship-motivated investors. Finally, Panel B repeats all the Panel A tests using ASSET4 Equal-Weighted Environmental Scores. We find broadly similar patterns but the board renewal coefficients in the motivated investor subsample using firm fixed effects (model 7) are no longer significant.

In summary, Table 6 provides evidence consistent with board renewal mechanisms being more impactful for environmental performance when they are present in settings where investors are more motivated to use them.

[29] We note that the *p*-values for the differences between coefficients on majority election and female directors between models 1 and 2, are 0.113 and 0.032, respectively, and are 0.025 and 0.447 for models 3 and 4, respectively.

## 6. Board Renewal and Actions that Target Improved Environmental Performance

In this final section of the paper, we analyze whether the path from board renewal to improved environmental performance is associated with one or more actions through which boards directly target firms' environmental performance. We examine four specific actions: having a sustainability committee; producing annual sustainability reports; tying executive pay to sustainability targets; and disclosing how the firm engages with its stakeholders regarding sustainability. We focus on these actions because the board controls them, some of these actions are connected to stronger environmental performance (e.g., Christensen, Hail, and Leuz [2021]), and we can construct indicator variables for each of these actions from ASSET4.[30] If these sustainability-oriented actions accrue once board renewal happens, this can shed light on one or more plausible channels through which firms improve their environmental performance.

For these tests, we estimate linear probability models, with indicators for each of these four actions as dependent variables, and lagged board renewal variables as the independent variables of interest.[31] The right-hand-side variables for these tests mirror model 4 of Table 2. Models 1 through 4 of Table 7, Panel B include industry-by-year and country-by-year fixed effects to capture variation over time in sustainability-oriented actions, while models 5 through 8 include firm fixed effects in addition.

Table 7, Panel A reports summary statistics for the four sustainability-oriented actions. On average 53% of firm-year observations have a sustainability committee, 58% produce a sustainability report, 21% tie their executives' pay to sustainability targets, and 36% disclose on their engagements with outside stakeholders.

Panel B reports the regression results. Models 1 through 4 show that there are positive and statistically significant coefficients on our board renewal measures (except the coefficient on

[30] We note that these data items are not part of ASSET4's environmental performance metrics; rather, they are identified in ASSET4 as ESG-specific governance items.

[31] Results are similar using a logistic or probit regression. To provide economic interpretations consistent with prior tables, we report results from a linear probability model.

Majority Election for Stakeholder Engagement). Models 5 through 8 use firm fixed effects. In these models, the board renewal coefficient estimates pick up the average change in sustainability-oriented action variables within-firm from before to after board renewal. Thus, they test whether there is sequencing, with board renewal followed by adoption of sustainability-oriented actions.

We find that at least one of the board renewal mechanisms has a positive and significant relationship to each of the four sustainability-oriented actions, consistent with sequencing. In terms of economic magnitudes, specifications without firm fixed effects indicate that firms with majority elections are 2% to 6% more likely to have taken one of these sustainability-oriented actions, and firms with a female director are 4% to 7% more likely to have taken one of these actions. With firm fixed effects, board renewal increases the likelihood of taking a sustainability-oriented action by 2% to 3% in most cases.

Taken together, these results suggest that firms that renew the thinking of the board via majority elections or female board representation undertake real policy changes that increase the importance of their sustainability commitments. By documenting that firms commonly take specific actions targeting environmental performance once board renewal happens, we provide evidence of plausible channels through which the improved performance occurs.

## 7. Conclusion

Given the gap between investors' and firm insiders' preferences regarding environmental performance, we hypothesize that to change firm policies investors will need board renewal mechanisms powerful enough to renew the thinking of the board. We identify two corporate governance mechanisms potentially strong enough to accomplish this: the adoption of majority voting and the introduction of a female director. Using a sample of firms from 41 countries, we find evidence consistent with board renewal being a fundamental driver of environmental sustainability around the world.

In terms of economic impact, panel regressions with firm fixed effects show that a majority voting rule or a female director correlates to 3% to 4% higher environmental performance. Using

quasi-exogenous shocks in a nine-country sample, firm fixed effect regressions show that environmental performance is on average 8% higher over the three years after the addition of the first female director relative to the three years prior to adding the director. We also find that the positive association between board renewal and environmental performance is larger in countries with strong institutional environments, and when firms have a base of motivated institutional investors.

Further, we analyze whether the path from board renewal to improved environmental performance is associated with one or more actions through which boards directly target firms' environmental performance. We find that at least one of the board renewal mechanisms has a positive and significant relationship on four sustainability-oriented actions, consistent with sustainability-oriented actions being taken once board renewal happens. With firm fixed effects, our models suggest that board renewal increases the likelihood of taking a sustainability-oriented action by 2% to 3% in most cases.

Our results provide a roadmap for sustainability-minded investors suggesting that they should not focus on aggregate measures of ESG, or even environmental performance as a stand-alone measure. Instead, they should focus on board renewal mechanisms, such as majority voting and adding female directors, that renew the thinking of the board and align it with their own preferences, since doing so contributes to improvements in firms' environmental performance.

One novel result uncovered in our tests is the strong impact of female directors on environmental performance, even when specific director characteristics are accounted for. A possible explanation for this result is that female directors affect environmental performance for reasons related specifically to their gender, consistent with prior behavioral economics research showing that, relative to men, women have higher levels of 'other regarding' preferences which would thus extend to environmental performance. Future research can test whether this explanation holds should regulations change such that, around the world, there is more specificity and comparability in firm's disclosures of the skill sets of their board members.

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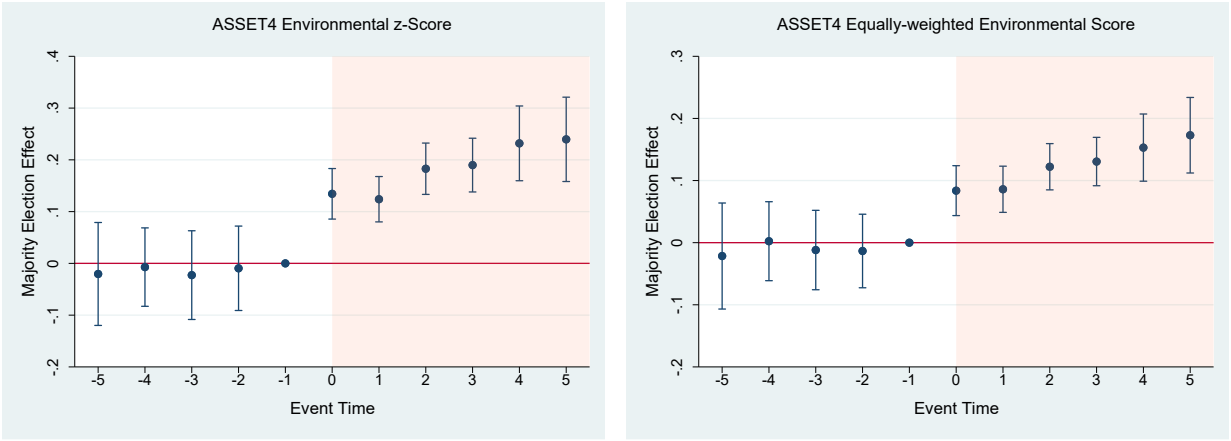
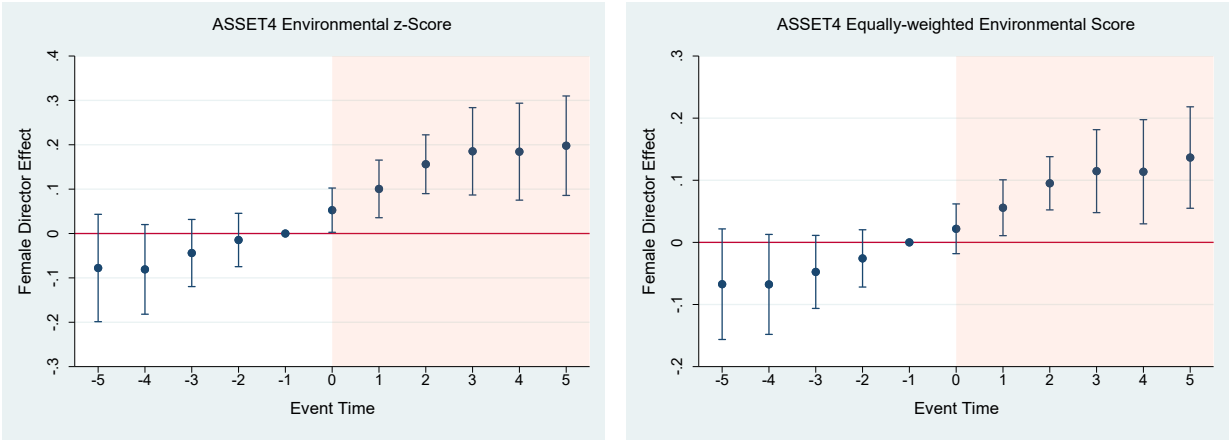
**Figure 1**
**Event Time Indicator Coefficients for Majority Election and Female Director**

This figure plots the event time indicator coefficient estimates for Majority Election (model 6 of Panels A and B of Table 2) and Female Director (model 7 of Panels A and B of Table 2) with a 95% confidence interval around the point estimates. The event time indicator for the year before the board-renewal event is omitted in the regressions of Table 2 and is set to zero in this figure.



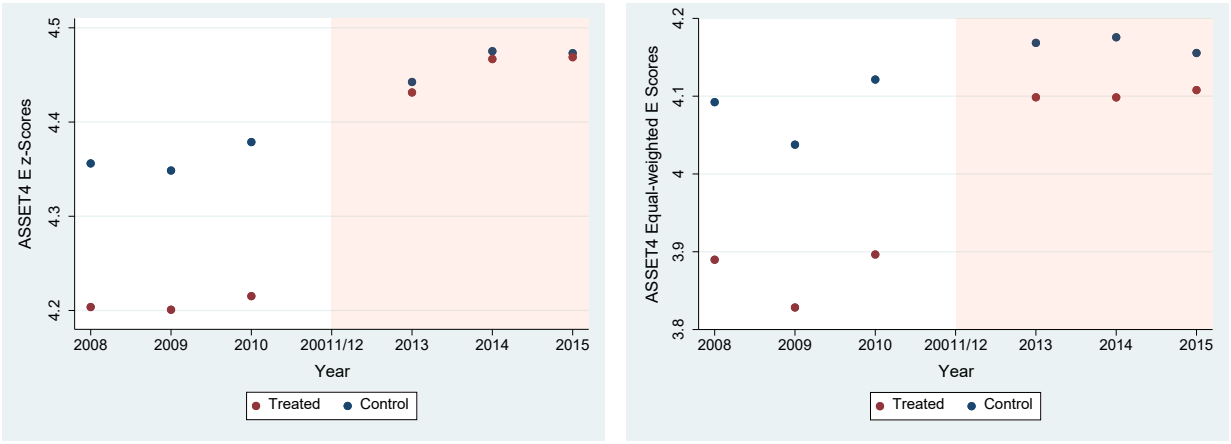

Panel A: Majority Election



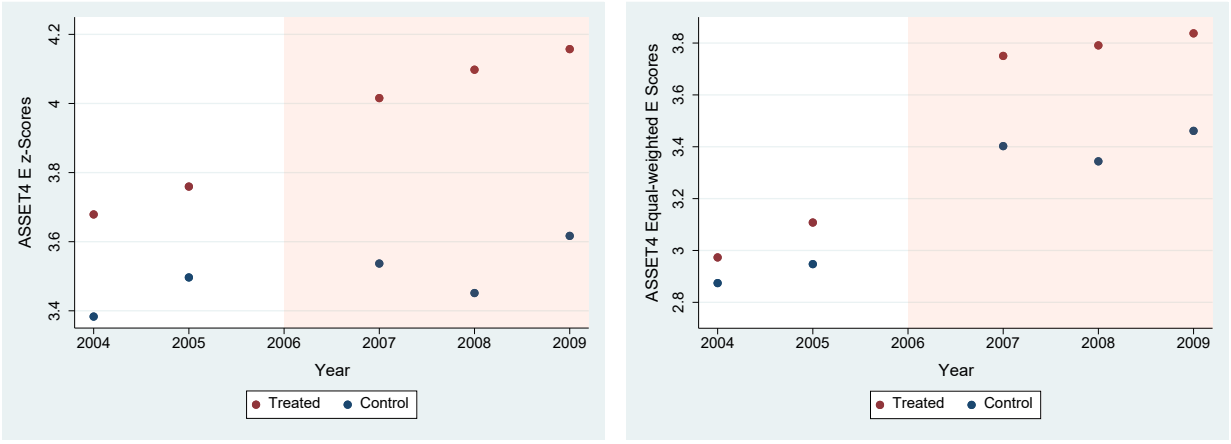

Panel B: Female Director

**Figure 2**
**Shocks and Environmental Performance: Single-Country Plots**

This figure shows the ASSET4 Environmental *z*-Score and the ASSET4 Equal-weighted Environmental Score for years surrounding quotas for female board representation in France and a quasi-exogenous shock to majority director election rules in Canada. The figures plot the natural log of average environmental scores for the treated and control firms for the three years before and three years after the shocks (Panel B shows one pre-year less since our sample starts in 2004). In Panel A, treated firms had no female board members in 2008 to 2010 and at least one female board member in 2013. Control firms already had a female board member (treatment years are 2011 and 2012). In Panel B, treated firms adopted majority voting by 2007. Control firms did not change majority voting policies during the 2004 to 2009 period (treatment year is 2006).




Panel A: Quotas for Female Board Representation in France




Panel B: Majority Director Election in Canada

**Table 1**
**Descriptive Statistics**

This table shows descriptive statistics of environmental scores, measures of corporate governance, and other key variables used in our main tests. Panel A shows summary statistics for the full sample. Panel B shows country averages for the year 2012 and the number of observations for the year 2012 and the full sample. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All variables are described in Appendix A.

Panel A: Summary Statistics

| Variable | Mean | Median | SD | Obs |
|---|---|---|---|---|
| A. Environmental Performance Measures | | | | |
| ASSET4 Environmental *z*-Score | 54.2 | 57.6 | 31.2 | 20,447 |
| ASSET4 Equal-weighted Environmental Score | 39.1 | 36.8 | 21.2 | 20,447 |
| B. Governance Mechanisms | | | | |
| Majority Election | 0.548 | 1.000 | 0.498 | 20,447 |
| Female Director | 0.596 | 1.000 | 0.491 | 20,447 |
| Traditional Governance | 3.650 | 4.000 | 1.431 | 20,447 |
| Board Independence | 0.465 | 0.000 | 0.499 | 20,447 |
| Board Size | 0.840 | 1.000 | 0.367 | 20,447 |
| CEO-Chairman Separation | 0.656 | 1.000 | 0.475 | 20,447 |
| Board Structure | 0.331 | 0.000 | 0.470 | 20,447 |
| Audit Committee Independence | 0.615 | 1.000 | 0.487 | 20,447 |
| Stock Classes | 0.745 | 1.000 | 0.436 | 20,447 |
| C. Firm Financials and Ownership Characteristics | | | | |
| Log (Total Assets) | 8.671 | 8.561 | 1.810 | 20,447 |
| Cash | 0.126 | 0.088 | 0.125 | 20,447 |
| Tangibility | 0.308 | 0.255 | 0.261 | 20,447 |
| Leverage | 0.236 | 0.221 | 0.173 | 20,447 |
| Profitability | 0.056 | 0.051 | 0.086 | 20,447 |
| Family | 0.225 | 0.000 | 0.418 | 20,447 |
| Other Blockholder | 0.067 | 0.000 | 0.249 | 20,447 |
| Institutional Ownership | 0.241 | 0.197 | 0.176 | 20,447 |
| Cross-list | 0.109 | 0.000 | 0.311 | 20,447 |
| D. Director Characteristics | | | | |
| CEO Experience | 0.396 | 0.400 | 0.207 | 15,881 |
| MBA | 0.106 | 0.091 | 0.116 | 15,881 |
| Higher Education | 0.183 | 0.154 | 0.163 | 15,881 |
| Same Name | 0.057 | 0.000 | 0.124 | 15,881 |
| Age | 58.04 | 58.00 | 4.394 | 15,881 |
| Tenure | 6.130 | 5.508 | 3.291 | 15,881 |

Panel B: Summary Statistics by Country

| Country | Environmental Scores | | Governance Variables | | | Obs | |
|---|---|---|---|---|---|---|---|
| | ASSET4 *z*-Score | ASSET4 Equal-weighted Score | Majority Election | Female Director | Traditional Governance | Year 2012 | Full Sample |
| Australia | 33.2 | 28.3 | 0.79 | 0.56 | 4.11 | 272 | 2,099 |
| Austria | 59.4 | 46.3 | 0.80 | 0.87 | 3.40 | 15 | 141 |
| Belgium | 57.2 | 44.3 | 0.71 | 0.83 | 3.13 | 24 | 242 |
| Brazil | 57.5 | 44.6 | 0.56 | 0.54 | 3.84 | 57 | 358 |
| Canada | 40.2 | 32.6 | 0.81 | 0.59 | 5.42 | 229 | 1,998 |
| Chile | 39.5 | 32.0 | 0.41 | 0.29 | 3.00 | 17 | 107 |
| China | 31.7 | 26.8 | 0.68 | 0.53 | 2.57 | 120 | 783 |
| Colombia | 40.4 | 34.2 | 0.60 | 0.50 | 3.90 | 10 | 56 |
| Denmark | 68.3 | 50.7 | 0.96 | 0.88 | 4.00 | 25 | 186 |
| Egypt | 18.3 | 18.1 | 0.09 | 0.55 | 2.18 | 11 | 59 |
| Finland | 80.9 | 62.1 | 0.29 | 1.00 | 5.38 | 24 | 264 |
| France | 81.9 | 63.3 | 0.70 | 0.99 | 2.11 | 89 | 861 |
| Germany | 70.5 | 56.0 | 0.81 | 0.93 | 2.03 | 72 | 541 |
| Greece | 59.0 | 47.0 | 0.38 | 0.81 | 2.56 | 16 | 152 |
| Hong Kong | 36.6 | 30.5 | 0.65 | 0.60 | 2.83 | 106 | 941 |
| India | 50.2 | 42.3 | 0.41 | 0.53 | 3.05 | 80 | 529 |
| Indonesia | 46.3 | 36.6 | 0.29 | 0.46 | 3.25 | 28 | 194 |
| Ireland | 49.2 | 41.6 | 0.73 | 0.87 | 4.67 | 15 | 147 |
| Israel | 42.1 | 33.7 | 0.60 | 1.00 | 4.00 | 15 | 98 |
| Italy | 60.8 | 49.9 | 0.72 | 0.72 | 3.00 | 43 | 422 |
| Japan | 67.1 | 54.3 | 0.38 | 0.12 | 2.21 | 349 | 2,129 |
| Luxembourg | 62.6 | 45.6 | 1.00 | 0.57 | 4.00 | 7 | 64 |
| Malaysia | 41.5 | 33.8 | 0.64 | 0.57 | 3.62 | 42 | 278 |
| Mexico | 45.4 | 35.8 | 0.38 | 0.46 | 3.81 | 26 | 190 |
| Netherlands | 67.9 | 52.2 | 0.85 | 0.73 | 3.91 | 33 | 334 |
| New Zealand | 44.2 | 34.2 | 1.00 | 0.80 | 4.70 | 10 | 129 |
| Norway | 68.1 | 52.0 | 0.53 | 1.00 | 4.53 | 17 | 151 |
| Philippines | 43.9 | 34.9 | 0.26 | 0.37 | 3.32 | 19 | 126 |
| Poland | 35.9 | 30.9 | 0.78 | 0.78 | 2.83 | 23 | 149 |
| Portugal | 73.4 | 57.5 | 0.67 | 0.67 | 2.58 | 12 | 120 |
| Russia | 46.8 | 36.3 | 0.31 | 0.53 | 4.31 | 32 | 239 |
| Singapore | 41.9 | 35.3 | 0.55 | 0.50 | 4.23 | 44 | 426 |
| South Africa | 50.2 | 39.4 | 0.92 | 0.92 | 4.16 | 119 | 580 |
| South Korea | 67.4 | 53.2 | 0.36 | 0.10 | 3.27 | 59 | 305 |
| Spain | 75.4 | 57.3 | 0.79 | 0.88 | 2.26 | 42 | 427 |
| Sweden | 75.6 | 57.5 | 0.30 | 1.00 | 4.73 | 40 | 417 |
| Switzerland | 57.7 | 45.3 | 0.86 | 0.57 | 3.91 | 58 | 508 |
| Taiwan | 54.4 | 43.2 | 0.32 | 0.48 | 2.75 | 75 | 418 |
| Thailand | 53.4 | 42.8 | 0.88 | 0.79 | 3.58 | 24 | 150 |
| Turkey | 57.9 | 44.7 | 0.38 | 0.54 | 3.25 | 24 | 151 |
| UK | 60.7 | 46.0 | 0.91 | 0.76 | 5.27 | 276 | 2,978 |
| Overall | 54.2 | 39.1 | 0.55 | 0.60 | 3.65 | 2,599 | 20,447 |

**Table 2**
**Are Governance Mechanisms Related to Firms' Environmental Performance?**

This table reports regression estimates of environmental scores on governance mechanisms and control variables. The dependent variables are the natural logarithm of environmental scores. The ASSET4 Environmental *z*-Score is a standardized score, calculated by and obtained from ASSET4, and measures firms' environmental performance relative to other companies. The ASSET4 Equal-weighted Environmental Score is the average of three category scores (Emission Reduction, Resource Reduction, and Product Innovation). In both panels, models 1 to 4 use the full sample, model 5 includes firm fixed effects and only uses firms where Majority Election or Female Director are time-varying during the sample period and models 6 and 7 report regressions in event time. For each firm, a set of time indicator variables is created for the five years before and the five years after the board-renewal events majority election and female director. The indicator variable for the year before the board-renewal event is omitted from the regressions because of collinearity. Online Appendix Table OA-1 describes the indicator variables used to calculate the environmental scores. All variables are described in Appendix A. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the country-level and *t*-statistics are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: ASSET4 Environmental *z*-Scores

| | | | | | | Board-renewal Events | |
|---|---|---|---|---|---|---|---|
| | | | | | | Majority Election | Female Director |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Majority Election | 0.089*** | | | 0.080*** | 0.032* | | |
| | (4.06) | | | (3.54) | (1.79) | | |
| Female Director | | 0.142*** | | 0.137*** | 0.035** | | |
| | | (4.64) | | (4.55) | (2.43) | | |
| Traditional Governance | | | 0.030** | 0.024** | 0.010 | | |
| | | | (2.55) | (2.04) | (1.29) | | |
| Log (Total Assets) | 0.219*** | 0.212*** | 0.221*** | 0.208*** | 0.087*** | 0.230*** | 0.236*** |
| | (11.43) | (11.75) | (11.63) | (11.61) | (5.18) | (13.35) | (12.56) |
| Cash | -0.089 | -0.073 | -0.078 | -0.077 | -0.143** | -0.043 | -0.038 |
| | (-1.30) | (-1.05) | (-1.13) | (-1.09) | (-2.55) | (-0.58) | (-0.48) |
| Tangibility | 0.189*** | 0.189*** | 0.186*** | 0.190*** | 0.095 | 0.211*** | 0.203** |
| | (2.87) | (3.08) | (2.79) | (3.10) | (1.00) | (2.72) | (2.64) |
| Leverage | -0.156 | -0.145 | -0.154 | -0.148 | -0.105* | -0.154 | -0.121 |
| | (-1.63) | (-1.54) | (-1.59) | (-1.55) | (-1.72) | (-1.53) | (-1.13) |
| Profitability | 0.300** | 0.275** | 0.300** | 0.275** | -0.049 | 0.263* | 0.262* |
| | (2.20) | (2.07) | (2.19) | (2.04) | (-1.44) | (1.77) | (1.96) |
| Family | -0.106*** | -0.108*** | -0.100*** | -0.098*** | 0.031 | -0.117*** | -0.121*** |
| | (-3.56) | (-3.78) | (-3.32) | (-3.30) | (1.13) | (-3.36) | (-3.60) |
| Other Blockholder | 0.063 | 0.063 | 0.067* | 0.068* | -0.249* | 0.067 | 0.111*** |
| | (1.51) | (1.61) | (1.70) | (1.76) | (-1.95) | (1.60) | (2.78) |
| Institutional Ownership | 0.251** | 0.248** | 0.238** | 0.217** | 0.090 | 0.231** | 0.252** |
| | (2.48) | (2.55) | (2.30) | (2.16) | (1.02) | (2.49) | (2.21) |
| Cross-list | -0.064* | -0.050 | -0.064* | -0.065* | -0.061 | -0.051 | -0.037 |
| | (-1.76) | (-1.41) | (-1.72) | (-1.78) | (-1.51) | (-1.39) | (-0.99) |
| Distance from Board-renewal Event | | | | | | | |
| 5 Years Before | | | | | | -0.020 | -0.078 |
| | | | | | | (-0.42) | (-1.30) |
| 4 Years Before | | | | | | -0.007 | -0.081 |
| | | | | | | (-0.19) | (-1.62) |
| 3 Years Before | | | | | | -0.023 | -0.044 |
| | | | | | | (-0.54) | (-1.17) |
| 2 Years Before | | | | | | -0.010 | -0.015 |
| | | | | | | (-0.24) | (-0.49) |
| Event Year | | | | | | 0.134*** | 0.053** |
| | | | | | | (5.56) | (2.13) |
| 1 Year After | | | | | | 0.124*** | 0.101*** |
| | | | | | | (5.72) | (3.13) |
| 2 Years After | | | | | | 0.183*** | 0.156*** |
| | | | | | | (7.45) | (4.76) |
| 3 Years After | | | | | | 0.190*** | 0.185*** |
| | | | | | | (7.40) | (3.80) |
| 4 Years After | | | | | | 0.232*** | 0.184*** |
| | | | | | | (6.49) | (3.41) |
| 5 Years After | | | | | | 0.240*** | 0.198*** |
| | | | | | | (5.94) | (3.57) |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes | No | No |
| Obs | 20,447 | 20,447 | 20,447 | 20,447 | 13,072 | 18,501 | 17,913 |
| Adjusted $R^2$ | 0.451 | 0.455 | 0.450 | 0.458 | 0.849 | 0.459 | 0.469 |

Panel B: ASSET4 Equal-weighted Environmental Scores

| | | | | | | Board-renewal Events | |
|---|---|---|---|---|---|---|---|
| | | | | | | Majority Election | Female Director |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Majority Election | 0.073*** | | | 0.066*** | 0.024** | | |
| | (4.23) | | | (3.69) | (2.21) | | |
| Female Director | | 0.109*** | | 0.105*** | 0.023*** | | |
| | | (5.03) | | (4.92) | (2.87) | | |
| Traditional Governance | | | 0.021** | 0.017* | 0.008 | | |
| | | | (2.41) | (1.87) | (1.28) | | |
| Log (Total Assets) | 0.188*** | 0.183*** | 0.190*** | 0.180*** | 0.059*** | 0.195*** | 0.201*** |
| | (13.38) | (13.46) | (13.42) | (13.31) | (5.93) | (14.51) | (13.96) |
| Cash | -0.007 | 0.005 | 0.001 | 0.001 | -0.053 | 0.017 | 0.024 |
| | (-0.11) | (0.08) | (0.02) | (0.02) | (-1.58) | (0.25) | (0.33) |
| Tangibility | 0.169*** | 0.169*** | 0.167*** | 0.170*** | 0.079 | 0.184*** | 0.181*** |
| | (3.49) | (3.74) | (3.41) | (3.74) | (1.39) | (3.18) | (3.12) |
| Leverage | -0.142* | -0.134* | -0.140* | -0.136* | -0.072* | -0.138* | -0.127 |
| | (-2.00) | (-1.92) | (-1.95) | (-1.93) | (-1.79) | (-1.88) | (-1.64) |
| Profitability | 0.237** | 0.218* | 0.237** | 0.218* | -0.021 | 0.209* | 0.188 |
| | (2.05) | (1.93) | (2.03) | (1.92) | (-0.99) | (1.69) | (1.68) |
| Family | -0.081*** | -0.083*** | -0.077*** | -0.075*** | 0.025 | -0.090*** | -0.096*** |
| | (-3.38) | (-3.58) | (-3.18) | (-3.15) | (1.54) | (-3.28) | (-3.56) |
| Other Blockholder | 0.026 | 0.026 | 0.029 | 0.029 | -0.122 | 0.028 | 0.057* |
| | (0.80) | (0.84) | (0.93) | (0.97) | (-1.45) | (0.83) | (1.74) |
| Institutional Ownership | 0.149* | 0.147** | 0.141* | 0.124* | 0.077 | 0.133* | 0.148* |
| | (2.02) | (2.08) | (1.89) | (1.72) | (1.18) | (1.88) | (1.72) |
| Cross-list | -0.025 | -0.014 | -0.024 | -0.025 | -0.028 | -0.011 | -0.009 |
| | (-0.96) | (-0.56) | (-0.92) | (-1.01) | (-1.11) | (-0.41) | (-0.33) |
| Distance from Board-renewal Event | | | | | | | |
| 5 Years Before | | | | | | -0.022 | -0.067 |
| | | | | | | (-0.51) | (-1.53) |
| 4 Years Before | | | | | | 0.002 | -0.068* |
| | | | | | | (0.07) | (-1.70) |
| 3 Years Before | | | | | | -0.012 | -0.048 |
| | | | | | | (-0.38) | (-1.63) |
| 2 Years Before | | | | | | -0.013 | -0.026 |
| | | | | | | (-0.46) | (-1.13) |
| Event Year | | | | | | 0.084*** | 0.022 |
| | | | | | | (4.21) | (1.10) |
| 1 Year After | | | | | | 0.086*** | 0.056** |
| | | | | | | (4.67) | (2.51) |
| 2 Years After | | | | | | 0.122*** | 0.095*** |
| | | | | | | (6.64) | (4.49) |
| 3 Years After | | | | | | 0.131*** | 0.115*** |
| | | | | | | (6.78) | (3.47) |
| 4 Years After | | | | | | 0.153*** | 0.114*** |
| | | | | | | (5.72) | (2.74) |
| 5 Years After | | | | | | 0.173*** | 0.137*** |
| | | | | | | (5.75) | (3.38) |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes | No | No |
| Obs | 20,447 | 20,447 | 20,447 | 20,447 | 13,072 | 18,501 | 17,913 |
| Adjusted $R^2$ | 0.528 | 0.531 | 0.526 | 0.534 | 0.902 | 0.524 | 0.538 |

**Table 3**
**Governance Mechanisms and Firms' Environmental Performance: Evidence from Outside Shocks**

This table reports regression estimates of environmental scores for years surrounding quotas for female board representation and a quasi-exogenous shock to majority director election rules. The dependent variables are the natural logarithm of the ASSET4 Environmental *z*-Score and the ASSET4 Equal-weighted Environmental Score. Panel A shows results for single country experiences. Models 1 and 2 focus on female board quotas in France. Treated firms had no female board members in 2008 to 2010 and at least one female board member in 2013. Control firms already had a female board member. The sample period covers the three years before and three years after the treatment years of 2011/12. Models 3 and 4 focus on the quasi-exogenous shocks to majority director elections in Canada. Treated firms adopted majority voting by 2007. Control firms did not change majority voting policies during the 2004 to 2009 period. The sample period covers the two years before and three years after the treatment year of 2006 (one pre-year less since our sample starts in 2004). Panel B shows results for countries with female board quotas or for which there was significant outside pressure for greater female board representation. Models 1 and 2 include all countries with legislated quotas for female board representation. Models 3 and 4 supplement countries with mandated quotas with Germany and the UK which faced substantial outside pressure for more female board representation in 2011. Treated firms had no female board members in the three years leading up to the quota and had a female board member after the quota was adopted. Control firms already had a female board member. Further details for these quotas and outside pressure are in Online Appendix Table OA-8. All specifications include three years before and three years after the event years. Firms that change family control, other-blockholder control, or cross-listing status are excluded. All variables are described in Appendix A. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the 2-digit SIC level and *t*-statistics are reported in parentheses. $^{***}$, $^{**}$, $^{*}$ denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: Single Country Experiences

| | Female Board Quota Introduction in France | | Majority Director Elections in Canada | |
|---|---|---|---|---|
| | ASSET4 E *z*-Scores | ASSET4 Equal-weighted E Scores | ASSET4 E *z*-Scores | ASSET4 Equal-weighted E Scores |
| | (1) | (2) | (3) | (4) |
| Post × Treated | 0.130$^{*}$ | 0.142$^{***}$ | 0.235$^{**}$ | 0.234$^{***}$ |
| | (1.72) | (2.99) | (2.55) | (3.09) |
| Post | 0.075$^{***}$ | 0.057$^{***}$ | -0.045 | 0.323$^{***}$ |
| | (2.96) | (3.32) | (-0.55) | (5.04) |
| Log (Total Assets) | 0.076 | 0.104 | 0.152$^{*}$ | 0.188$^{***}$ |
| | (0.68) | (1.17) | (1.99) | (3.34) |
| Cash | -0.517$^{**}$ | -0.533$^{***}$ | 0.255 | 0.354 |
| | (-2.17) | (-3.49) | (0.52) | (0.93) |
| Tangibility | 1.469$^{**}$ | 0.586 | 0.901 | 0.714 |
| | (2.70) | (1.43) | (1.61) | (1.49) |
| Leverage | -0.358 | -0.403 | -0.394$^{*}$ | -0.328$^{*}$ |
| | (-1.08) | (-1.49) | (-2.00) | (-1.93) |
| Profitability | -0.810 | -0.289 | -0.058 | 0.145 |
| | (-1.60) | (-1.05) | (-0.24) | (0.74) |
| Institutional Ownership | 0.230 | 0.158 | 0.322 | 0.354$^{*}$ |
| | (1.30) | (1.60) | (1.43) | (1.95) |
| Firm FE | Yes | Yes | Yes | Yes |
| Obs | 533 | 533 | 275 | 275 |
| Adjusted $R^2$ | 0.776 | 0.872 | 0.810 | 0.843 |

Panel B: Female Board Quotas for Broad Country Samples

| | Countries with Mandatory Female Board Quotas Through Legislation | | Countries with Mandatory Female Board Quotas Through Legislation or Outside Pressure to Increase Female Board Representation | |
|---|---|---|---|---|
| | ASSET4 E *z*-Scores | ASSET4 Equal-weighted E Scores | ASSET4 E *z*-Scores | ASSET4 Equal-weighted E Scores |
| | (1) | (2) | (3) | (4) |
| Post × Treated | 0.078** | 0.050** | 0.078*** | 0.049*** |
| | (2.41) | (2.55) | (2.97) | (3.06) |
| Log (Total Assets) | 0.077** | 0.050*** | 0.070*** | 0.044*** |
| | (2.64) | (3.24) | (3.54) | (4.20) |
| Cash | -0.179 | -0.035 | -0.125 | -0.025 |
| | (-1.40) | (-0.47) | (-1.09) | (-0.40) |
| Tangibility | 0.000 | 0.066 | 0.043 | 0.080 |
| | (0.00) | (0.86) | (0.50) | (1.30) |
| Leverage | -0.018 | -0.034 | -0.055 | -0.036 |
| | (-0.16) | (-0.45) | (-0.72) | (-0.73) |
| Profitability | -0.087 | -0.020 | -0.139 | -0.044 |
| | (-0.77) | (-0.28) | (-1.38) | (-0.69) |
| Institutional Ownership | -0.145 | 0.015 | -0.081 | -0.006 |
| | (-1.12) | (0.20) | (-0.64) | (-0.07) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Obs | 2,576 | 2,576 | 4,443 | 4,443 |
| Adjusted $R^2$ | 0.902 | 0.940 | 0.888 | 0.933 |

**Table 4**
**Director Characteristics, Board Renewal, and Environmental Performance**

This table reports regression estimates of environmental scores on board characteristics, governance mechanisms, and control variables. The dependent variables are the natural logarithm of the ASSET4 Environmental *z*-Score and the ASSET4 Equal-weighted Environmental Score. The board characteristics (CEO Experience, Higher Education, MBA, Age, Tenure, and Same Name) are the means across all board members in a given firm-year. The below (above) median female characteristics are indicator variables equal to one if there is a female board member in a given year whose characteristics are equal to or less (greater) than the average of all board members in that year, and zero otherwise. All variables are described in Appendix A. Control variables are included but not reported. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the country-level and *t*-statistics are reported in parentheses. $^{***}$, $^{**}$, $^{*}$ denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: ASSET4 Environmental *z*-Scores

| Female Characteristics Grouping Variable | | | | | | CEO Experience | Higher Education |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Majority Election | | 0.073** | 0.039* | 0.072** | 0.039* | 0.073** | 0.074*** |
| | | (2.69) | (1.95) | (2.56) | (1.96) | (2.64) | (2.71) |
| Female Director | | 0.141*** | 0.040*** | 0.147*** | 0.045*** | | |
| | | (5.08) | (3.11) | (5.18) | (3.44) | | |
| CEO Experience | 0.211*** | | | 0.202*** | 0.035 | 0.214*** | 0.206*** |
| | (3.15) | | | (3.34) | (1.10) | (3.39) | (3.48) |
| Higher Education | 0.117* | | | 0.090 | 0.007 | 0.092 | 0.125 |
| | (1.70) | | | (1.27) | (0.22) | (1.31) | (1.66) |
| MBA | -0.014 | | | -0.056 | 0.040 | -0.058 | -0.051 |
| | (-0.11) | | | (-0.46) | (0.50) | (-0.47) | (-0.42) |
| Age | 0.004 | | | 0.005 | 0.006** | 0.005 | 0.005 |
| | (1.14) | | | (1.32) | (2.03) | (1.35) | (1.42) |
| Tenure | -0.002 | | | -0.000 | 0.002 | -0.000 | -0.000 |
| | (-0.44) | | | (-0.02) | (0.61) | (-0.00) | (-0.02) |
| Same Name | -0.065 | | | -0.062 | 0.010 | -0.067 | -0.064 |
| | (-0.53) | | | (-0.50) | (0.11) | (-0.53) | (-0.51) |
| Female Characteristics | | | | | | | |
| Below Median Group | | | | | | 0.136*** | 0.141*** |
| | | | | | | (5.51) | (5.20) |
| Above Median Group | | | | | | 0.072*** | 0.044** |
| | | | | | | (3.82) | (2.29) |
| Traditional Governance | | 0.032** | 0.013* | 0.024** | 0.012 | 0.023** | 0.023** |
| | | (2.70) | (1.71) | (2.18) | (1.52) | (2.16) | (2.13) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | Yes | No | Yes | No | No |
| Obs | 15,881 | 15,881 | 10,819 | 15,881 | 10,819 | 15,881 | 15,881 |
| Adjusted $R^2$ | 0.454 | 0.499 | 0.889 | 0.465 | 0.856 | 0.465 | 0.465 |

Panel B: ASSET4 Equal-weighted Environmental Scores

| Female Characteristics Grouping Variable | | | | | | CEO Experience | Higher Education |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Majority Election | | 0.062*** | 0.029** | 0.061*** | 0.028** | 0.062*** | 0.063*** |
| | | (3.00) | (2.64) | (2.88) | (2.65) | (2.96) | (3.02) |
| Female Director | | 0.111*** | 0.023*** | 0.115*** | 0.027*** | | |
| | | (6.08) | (3.05) | (6.20) | (3.50) | | |
| CEO Experience | 0.174*** | | | 0.170*** | 0.029 | 0.176*** | 0.172*** |
| | (3.75) | | | (4.06) | (1.48) | (4.16) | (4.24) |
| Higher Education | 0.097 | | | 0.077 | 0.002 | 0.078 | 0.099 |
| | (1.56) | | | (1.18) | (0.06) | (1.22) | (1.51) |
| MBA | -0.016 | | | -0.048 | -0.002 | -0.050 | -0.044 |
| | (-0.16) | | | (-0.50) | (-0.04) | (-0.51) | (-0.46) |
| Age | 0.004 | | | 0.004 | 0.005* | 0.005 | 0.005 |
| | (1.18) | | | (1.38) | (1.98) | (1.44) | (1.48) |
| Tenure | -0.000 | | | 0.001 | 0.000 | 0.001 | 0.001 |
| | (-0.16) | | | (0.19) | (0.06) | (0.21) | (0.20) |
| Same Name | -0.068 | | | -0.067 | -0.016 | -0.070 | -0.068 |
| | (-0.77) | | | (-0.72) | (-0.27) | (-0.76) | (-0.74) |
| Female Characteristics | | | | | | | |
| Below Median Group | | | | | | 0.107*** | 0.110*** |
| | | | | | | (7.21) | (6.24) |
| Above Median Group | | | | | | 0.063*** | 0.039*** |
| | | | | | | (4.40) | (2.72) |
| Traditional Governance | | 0.021** | 0.011* | 0.015* | 0.010 | 0.015* | 0.015 |
| | | (2.39) | (1.81) | (1.73) | (1.60) | (1.69) | (1.68) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | Yes | No | Yes | No | No |
| Obs | 15,881 | 15,881 | 10,819 | 15,881 | 10,819 | 15,881 | 15,881 |
| Adjusted $R^2$ | 0.537 | 0.575 | 0.929 | 0.547 | 0.907 | 0.548 | 0.547 |

**Table 5**
**Country-level Institutions and the Relation Between Governance and Firms' Environmental Performance**

This table reports regression estimates of environmental scores on governance mechanisms and control variables for firms grouped by their countries' investor protection laws and regulations. The dependent variables are the natural logarithm of the ASSET4 Environmental *z*-Score and the ASSET4 Equal-weighted Environmental Score. We sort firms into low and high country-level investor protection groups. In models 1 and 2, we split the sample based on below- or above-median cutoffs on a country's strength of securities regulation as in Hail and Leuz [2006]; it is the average of the disclosure index, liability standard index, and a public enforcement index. In models 3 and 4, we employ below- or above-median cutoffs on a country's anti-self-dealing index (ASDI) that measures the average of ex-ante and ex-post private control of self-dealing (Djankov et al. [2008]). In models 5 and 6, we split the sample based on whether a country has a code-based (civil law) or common law legal tradition (La Porta et al. [1998]). In models 7 and 8 we split the sample based on below- or above-median cutoffs on a country's ESG disclosure rules as in Amiraslani et al. [2020]. All variables are described in Appendix A. Control variables are included but not reported. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the country-level and *t*-statistics are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: ASSET4 Environmental *z*-Scores

| Grouped by | Securities Regulation | | ASDI Index | | Legal Tradition | | ADIK Disclosure | |
|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Civil | Common | Low | High |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.063* | 0.099* | 0.084*** | 0.076* | 0.084*** | 0.087* | 0.062** | 0.088** |
| | (1.98) | (2.15) | (3.00) | (1.90) | (2.96) | (1.93) | (2.52) | (2.45) |
| Female Director | 0.092** | 0.152*** | 0.064* | 0.174*** | 0.055 | 0.186*** | 0.100*** | 0.160*** |
| | (2.26) | (3.51) | (1.75) | (4.56) | (1.56) | (4.95) | (2.80) | (4.41) |
| Traditional Governance | 0.004 | 0.043** | 0.008 | 0.034** | 0.001 | 0.043*** | 0.028* | 0.014 |
| | (0.24) | (2.81) | (0.52) | (2.84) | (0.05) | (3.13) | (1.91) | (0.87) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | No | No | No | No | No | No |
| Obs | 9,238 | 9,826 | 9,544 | 10,753 | 10,002 | 10,293 | 8,359 | 11,932 |
| Adjusted $R^2$ | 0.410 | 0.448 | 0.392 | 0.459 | 0.430 | 0.462 | 0.411 | 0.506 |

Panel B: ASSET4 Environmental *z*-Scores (with Firm Fixed Effects)

| Grouped by | Securities Regulation | | ASDI Index | | Legal Tradition | | ADIK Disclosure | |
|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Civil | Common | Low | High |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | -0.000 | 0.054* | 0.018 | 0.044 | 0.008 | 0.048 | 0.005 | 0.049* |
| | (-0.00) | (1.96) | (1.48) | (1.55) | (0.64) | (1.73) | (0.29) | (1.98) |
| Female Director | 0.015 | 0.045* | 0.020 | 0.047** | 0.018 | 0.043* | 0.001 | 0.050*** |
| | (0.93) | (2.07) | (1.36) | (2.47) | (1.34) | (2.01) | (0.03) | (3.84) |
| Traditional Governance | 0.004 | 0.011 | 0.009 | 0.006 | 0.005 | 0.009 | 0.002 | 0.014 |
| | (0.49) | (0.93) | (0.99) | (0.48) | (0.59) | (0.76) | (0.18) | (1.42) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 5,116 | 7,182 | 5,360 | 7,572 | 5,447 | 7,492 | 5,085 | 7,855 |
| Adjusted $R^2$ | 0.901 | 0.863 | 0.900 | 0.867 | 0.908 | 0.864 | 0.894 | 0.883 |

Panel C: ASSET4 Equal-weighted Environmental Scores

| Grouped by | Securities Regulation | | ASDI Index | | Legal Tradition | | ADIK Disclosure | |
|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Civil | Common | Low | High |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.064** | 0.067* | 0.076*** | 0.052 | 0.077*** | 0.059 | 0.058*** | 0.071** |
| | (2.61) | (1.88) | (3.51) | (1.69) | (3.50) | (1.69) | (3.06) | (2.47) |
| Female Director | 0.074** | 0.116*** | 0.053* | 0.135*** | 0.045 | 0.144*** | 0.083*** | 0.118*** |
| | (2.45) | (3.90) | (1.95) | (5.29) | (1.69) | (6.03) | (3.36) | (4.30) |
| Traditional Governance | -0.001 | 0.036*** | 0.002 | 0.029*** | -0.003 | 0.035*** | 0.019 | 0.010 |
| | (-0.09) | (3.30) | (0.14) | (3.27) | (-0.35) | (3.62) | (1.58) | (0.81) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | No | No | No | No | No | No |
| Obs | 9,238 | 9,826 | 9,544 | 10,753 | 10,002 | 10,293 | 8,359 | 11,932 |
| Adjusted $R^2$ | 0.492 | 0.509 | 0.470 | 0.516 | 0.504 | 0.525 | 0.470 | 0.590 |

Panel D: ASSET4 Equal-weighted Environmental Scores (with Firm Fixed Effects)

| Grouped by | Securities Regulation | | ASDI Index | | Legal Tradition | | ADIK Disclosure | |
|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Civil | Common | Low | High |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.005 | 0.036** | 0.017* | 0.030* | 0.010 | 0.032* | 0.008 | 0.034** |
| | (0.50) | (2.40) | (1.89) | (1.93) | (1.13) | (2.16) | (0.76) | (2.33) |
| Female Director | 0.015 | 0.028** | 0.015 | 0.030*** | 0.014 | 0.028** | 0.002 | 0.033*** |
| | (1.14) | (2.67) | (1.23) | (3.61) | (1.22) | (2.86) | (0.14) | (6.03) |
| Traditional Governance | 0.004 | 0.010 | 0.006 | 0.007 | 0.004 | 0.009 | -0.001 | 0.012 |
| | (0.44) | (1.05) | (0.80) | (0.77) | (0.55) | (0.96) | (-0.06) | (1.47) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 5,116 | 7,182 | 5,360 | 7,572 | 5,447 | 7,492 | 5,085 | 7,855 |
| Adjusted $R^2$ | 0.935 | 0.910 | 0.935 | 0.910 | 0.939 | 0.911 | 0.930 | 0.926 |

**Table 6**
**Motivated Institutional Investors**

This table reports regression estimates of environmental scores on governance mechanisms and control variables for firms grouped by the presence of motivated institutional investors. We measure a firm's motivated institutional investors as: a) the sum of the product of each institution's ownership percentage with the institution's headquarter-country World Values Survey score; and b) the sum of the product of each institution's ownership percentage with an indicator variable that is equal to one if the institution's headquarter-country has adopted a Stewardship code, and zero otherwise. The World Values Survey social norm scores are obtained from Dyck et al. [2019] and measure countries' social norms towards environmental and social issues. Stewardship codes are based on national regulators' code publications. We split the sample into high and low motivated investor groups by whether the measure of motivated investors is in the top quartile and bottom three quartiles, respectively. The dependent variables are the natural logarithm of the ASSET4 Environmental *z*-Score and the ASSET4 Equal-weighted Environmental Score. Odd numbered models include firms that are in the top quartile of the measures within our sample. Even numbered models include firms that are in the bottom three quartiles. All variables are described in Appendix A. Control variables are included but not reported. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the country-level and *t*-statistics are reported in parentheses. $^{***}$, $^{**}$, $^{*}$ denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: ASSET4 Environmental *z*-Scores

| Motivated Investors Splits by | World Values Survey Scores | | | | Stewardship Codes | | | |
|---|---|---|---|---|---|---|---|---|
| | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.120*** | 0.068*** | 0.072** | 0.014 | 0.074** | 0.078*** | 0.035* | 0.030 |
| | (3.01) | (3.42) | (2.44) | (0.94) | (2.52) | (2.98) | (1.71) | (1.17) |
| Female Director | 0.224*** | 0.111*** | 0.033*** | 0.018 | 0.178*** | 0.124*** | 0.037* | 0.023 |
| | (4.45) | (3.75) | (3.18) | (1.16) | (7.20) | (3.68) | (1.69) | (1.23) |
| Traditional Governance | 0.005 | 0.026** | 0.012 | 0.004 | 0.009 | 0.029** | -0.003 | 0.003 |
| | (0.27) | (2.21) | (1.33) | (0.51) | (0.75) | (2.28) | (-0.31) | (0.37) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | Yes | Yes | No | No | Yes | Yes |
| Obs | 4,881 | 15,071 | 3,503 | 9,009 | 4,996 | 15,099 | 3,098 | 9,446 |
| Adjusted $R^2$ | 0.482 | 0.461 | 0.905 | 0.896 | 0.477 | 0.454 | 0.939 | 0.890 |

Panel B: ASSET4 Equal-weighted Environmental Scores

| Motivated Investors Splits by | World Values Survey Scores | | | | Stewardship Codes | | | |
|---|---|---|---|---|---|---|---|---|
| | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles | Top Quartile | Bottom 3 Quartiles |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.098*** | 0.058*** | 0.044*** | 0.011 | 0.075*** | 0.063*** | 0.004 | 0.025 |
| | (3.20) | (3.47) | (2.85) | (1.11) | (2.81) | (3.11) | (0.39) | (1.49) |
| Female Director | 0.154*** | 0.089*** | 0.027** | 0.016* | 0.132*** | 0.097*** | 0.014 | 0.020* |
| | (4.36) | (4.12) | (2.25) | (1.72) | (6.40) | (4.23) | (1.47) | (1.72) |
| Traditional Governance | 0.000 | 0.019** | 0.007 | 0.006 | 0.004 | 0.021** | -0.002 | 0.005 |
| | (0.03) | (2.05) | (0.98) | (0.77) | (0.40) | (2.23) | (-0.35) | (0.67) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | Yes | Yes | No | No | Yes | Yes |
| Obs | 4,881 | 15,071 | 3,503 | 9,009 | 4,996 | 15,099 | 3,098 | 9,446 |
| Adjusted $R^2$ | 0.587 | 0.528 | 0.941 | 0.932 | 0.537 | 0.530 | 0.968 | 0.927 |

**Table 7**
**Board Renewal and Actions that Target Improved Environmental Performance**

This table reports summary statistics and regression estimates of specific actions through which boards directly target improved environmental performance mechanisms on governance mechanisms and control variables. The dependent variables are: Sustainability Committee, an indicator variable equal to one if the firm has a sustainability committee, and zero otherwise; Sustainability Report, an indicator variable equal to one if the firm publishes a separate sustainability report or publishes a section in its annual report on sustainability, and zero otherwise; Executive Pay is Tied to Sustainability Targets, an indicator variable equal to one if the executives' compensation of a firm is linked to the firm's sustainability outcomes, and zero otherwise; and Stakeholder Engagement, an indicator variable equal to one if the firm explains how it engages with its stakeholders, and zero otherwise. Panel A shows summary statistics. Panel B reports regression results with models 1 to 4 using the full sample and models 5 to 8 including firm fixed effects and only using firms where Majority Election or Female Director are time-varying during the sample period. All variables are described in Appendix A. The sample period is 2004-2015. All variables are winsorized at the 1st and 99th percentiles. All right-hand side variables are lagged by one year. Standard errors are clustered at the country-level and *t*-statistics are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: Summary Statistics

| Variable | Mean | Median | SD | Obs |
|---|---|---|---|---|
| Sustainability Committee | 0.534 | 1.000 | 0.499 | 20,253 |
| Sustainability Report | 0.579 | 1.000 | 0.494 | 20,253 |
| Executive Pay is Tied to Sustainability Targets | 0.205 | 0.000 | 0.404 | 20,253 |
| Stakeholder Engagement | 0.358 | 0.000 | 0.479 | 20,253 |

Panel B: Regression Results

| | Sustainability Committee | Sustainability Report | Executive Pay is Tied to Sustainability Targets | Stakeholder Engagements | Sustainability Committee | Sustainability Report | Executive Pay is Tied to Sustainability Targets | Stakeholder Engagements |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Majority Election | 0.057*** | 0.038*** | 0.017** | 0.014 | 0.014 | 0.019* | 0.022** | -0.003 |
| | (4.67) | (4.58) | (2.41) | (1.15) | (1.58) | (1.96) | (2.08) | (-0.26) |
| Female Director | 0.072*** | 0.072*** | 0.041*** | 0.056*** | 0.031** | 0.019 | 0.031** | 0.027** |
| | (4.59) | (4.02) | (4.13) | (3.93) | (2.46) | (1.68) | (2.46) | (2.45) |
| Traditional Governance | 0.019*** | 0.011* | 0.018*** | 0.016* | -0.002 | 0.012 | 0.004 | 0.014** |
| | (2.78) | (1.75) | (3.04) | (2.02) | (-0.41) | (1.63) | (0.55) | (2.20) |
| Log (Total Assets) | 0.111*** | 0.115*** | 0.049*** | 0.124*** | 0.057*** | 0.061*** | 0.012 | 0.054*** |
| | (14.63) | (9.15) | (8.77) | (19.50) | (3.76) | (4.73) | (0.90) | (4.94) |
| Cash | -0.018 | -0.047 | 0.005 | 0.108 | -0.056 | -0.181*** | -0.083 | -0.020 |
| | (-0.39) | (-1.21) | (0.10) | (1.49) | (-0.87) | (-3.41) | (-1.44) | (-0.33) |
| Tangibility | 0.079** | 0.138*** | 0.080*** | 0.072** | -0.091** | 0.010 | -0.065*** | 0.072 |
| | (2.46) | (2.85) | (3.09) | (2.42) | (-2.10) | (0.15) | (-2.79) | (1.25) |
| Leverage | -0.025 | -0.158** | -0.077*** | -0.089 | -0.052 | -0.072 | -0.087* | -0.002 |
| | (-0.53) | (-2.55) | (-3.19) | (-1.64) | (-1.16) | (-1.52) | (-1.78) | (-0.03) |
| Profitability | 0.067 | 0.264*** | 0.108*** | 0.201** | 0.004 | 0.022 | 0.022 | 0.032 |
| | (0.95) | (3.51) | (4.01) | (2.17) | (0.09) | (0.57) | (0.30) | (0.72) |
| Family | -0.058*** | -0.042** | -0.031** | -0.015 | 0.002 | -0.002 | -0.032 | 0.046* |
| | (-3.25) | (-2.45) | (-2.23) | (-0.83) | (0.06) | (-0.08) | (-1.46) | (1.80) |
| Other Blockholder | -0.005 | 0.045* | -0.032 | 0.011 | 0.008 | -0.086 | 0.073 | 0.097 |
| | (-0.16) | (1.78) | (-1.51) | (0.42) | (0.11) | (-0.48) | (0.76) | (0.72) |
| Institutional Ownership | 0.063 | 0.214*** | 0.059* | 0.090 | -0.011 | 0.052 | -0.019 | 0.082 |
| | (1.33) | (3.27) | (1.89) | (1.58) | (-0.20) | (0.55) | (-0.34) | (1.38) |
| Cross-list | -0.053** | -0.051* | -0.018 | 0.032 | -0.001 | -0.016 | 0.010 | 0.040 |
| | (-2.49) | (-1.75) | (-1.08) | (0.95) | (-0.02) | (-0.65) | (0.32) | (0.82) |
| Country×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry×Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes | Yes | Yes | Yes |
| Obs | 20,253 | 20,253 | 20,253 | 20,253 | 12,939 | 12,939 | 12,939 | 12,939 |
| Adjusted $R^2$ | 0.339 | 0.406 | 0.309 | 0.320 | 0.754 | 0.757 | 0.555 | 0.765 |

**Appendix A: Variables and Data Descriptions**

| Variable | Description | Source |
|---|---|---|
| A. Environmental Performance Measures | | |
| ASSET4 Environmental *z*-Score | Proprietary-weighted aggregate scores of environmental performance that ASSET4 provides to investors. These rank-based scores range from 0 to 100 and measure the environmental performance relative to all companies in a given year. | ASSET4 |
| ASSET4 Equal-weighted Environmental Score | Aggregate score based on 70 line items of environmental commitments across three categories (emission reduction, resource reduction, and product innovation). Each line item is translated into an indicator variable such that a 'one' corresponds to better environmental performance (e.g., a below-median greenhouse gas emission firm would get a 'one'). Category scores are calculated as the sum of all indicator variables in each category divided by the number of reported items times 100. The ASSET4 Equal-weighted Environmental Score is the average of the category scores. Online Appendix Table OA-1 describes the indicator variables used to calculate the environmental scores. | ASSET4 |
| ASSET4 Material Environmental Score | Follows the approach of the ASSET4 Equal-weighted Environmental Score. The score is based only on those line items from ASSET4 that are 'material' according to the SASB Materiality Map, with materiality depending upon industry. | ASSET4, SASB |
| ASSET4 Environmental Category *z*-Scores | Category scores for emission reduction, resource reduction, and product innovation. These scores are proprietary-weighted aggregate category scores that ASSET4 provides to investors. These rank-based scores range from 0 to 100 and measure the environmental performance relative to all other companies in a given year. | ASSET4 |
| ASSET4 Equal-weighted Environmental Category Scores | Category scores for emission reduction, resource reduction, and product innovation. The scores are based on line items of environmental commitments across the three environmental categories. Each line item is translated into an indicator variable such that a 'one' corresponds to better environmental performance (e.g., a below-median greenhouse gas emission firm would get a 'one'). The category scores are calculated as the sum of all indicator variables in each category divided by the number of reported items times 100. Online Appendix Table OA-1 describes the indicator variables used to calculate the environmental scores. | ASSET4 |
| SAM S&P Environmental Score | SAM S&P Global environmental score. The scores are based on data obtained from an annual corporate assessment using an industry-specific questionnaire focusing on financially relevant criteria. The focus is on sustainability factors that can have an impact on companies' long-term value creation. These data are supplemented with a media and stakeholder analysis that examines more recent findings which have surfaced via the media and other channels. To construct the environmental score, individual data items across various criterion levels are aggregated while applying a proprietary weighting scheme. The scores range between 0 and 100 and are ranked against other companies in the same industry and year. Data are available for our entire sample period. | S&P Global |
| Sustainalytics Environmental Score | Sustainalytics' overall environmental score. The scores are constructed by considering firm-level information available from annual reports, corporate sustainability reports, NGOs, and news sources, applying a proprietary weighting matrix across items. The scores range from 0 to 100 and coverage begins in 2009. | Sustainalytics |
| B. Governance Mechanisms | | |
| Majority Election | Indicator variable that equals one if the board members are generally elected with a majority vote, zero otherwise. | ASSET4 |
| Female Director | Indicator variable that equals one if the firm has at least one female director, zero otherwise. | ASSET4, BoardEx |
| One Female Director | Indicator variable that equals one if the firm has one female director on the board, zero otherwise. | ASSET4, BoardEx |
| Two+ Female Dir. | Indicator variable that equals one if the firm has two or more female directors on the board, zero otherwise. | ASSET4, BoardEx |

| | | |
|---|---|---|
| % Female Directors | Number of female directors divided by the number of directors on the board. | ASSET4, BoardEx |
| Traditional Governance | Sum of the six indicator variables: Board Independence, Board Size, CEO-Chairman Separation, Board Structure, Audit Committee Independence, Stock Class. | BoardEx, ASSET4 |
| Board Independence | Indicator variable that equals one if the board has more than 50% independent directors, zero otherwise. | ASSET4, BoardEx |
| Board Size | Indicator variable that equals one if the board has more than five but less than 16 members, zero otherwise. | ASSET4, BoardEx |
| CEO-Chairman Sep. | Indicator variable that equals one if the CEO is not the chairman of the board of directors, zero otherwise. | ASSET4, BoardEx |
| Board Structure | Indicator variable that equals one if all board members are individually elected (no staggered board), zero otherwise. | ASSET4 |
| Audit Committee Ind. | Indicator variable that quals one if the audit committee is composed only of independent directors, zero otherwise. | ASSET4 |
| Stock Classes | Indicator variable that equals one if all shares of the company provide equal voting rights, zero otherwise. | ASSET4 |

C. Firm Financials and Ownership Characteristics

| | | |
|---|---|---|
| Log(Total Assets) | Natural logarithm of total assets in US$ million. | Worldscope |
| Cash | Cash and cash equivalents divided by total assets. | Worldscope |
| Tangibility | Property, plant, and equipment divided by total assets. | Worldscope |
| Leverage | Total debt divided by total assets. | Worldscope |
| Profitability | Net income plus after-tax interest expenses divide by total assets. | Worldscope |
| Family | Indicator variable that equals one if the firm is controlled by a family, zero otherwise. For each firm-year, we classify a firm as controlled by a family if any of the following conditions are met: 1) Orbis (Bureau van Dijk) identifies a family as the ultimate owner of the firm with a minimum controlling threshold of 25% (following Lins, Volpin, and Wagner, 2013); 2) Orbis identifies the ultimate owner to be a Nominee, Trust, or Trustee, and the firm has dual class shares (obtained from ASSET4); 3) Datastream reports a minimum family stake of 20%, or Datastream reports a minimum family stake of 5% and the firm has dual class shares; 4) the Global Family Business Index (obtained from Center for Family Business at the University of St. Gallen, Switzerland) reports the firm as family controlled. For each firm, we impute intermittent years as family controlled if a firm is classified as family controlled in at least one earlier and one later year. We further extend family control both backwards and forwards in time if ASSET4 indicates that the votes of a firm's largest blockholder are within 5% of the year during which a firm is known to be family controlled and the largest blockholder's stake is at least 20%. | ASSET4, Datastream, Orbis, Global Family Business Index |
| Other Blockholder | Indicator variable that equals one if the firm is not family controlled or widely held, zero otherwise. This category includes controlling blockholders that are non-financial firms (themselves widely held), financial investors, governments, banks, and insurance firms. | ASSET4, Datastream, Orbis |
| Institutional Ownership | Total institutional ownership. | Factset |
| Cross-list | Indicator variable that equals one if the firm is cross-listed on a major US exchange, zero otherwise. | ADR lists, CRSP |
| Motivated Investors, Stewardship | For each firm-year, we multiply each institutional investor's ownership percentage with a dummy variable that is equal to one if the investor's headquarter country has adopted a stewardship code, and zero otherwise, and compute the sum. | Factset, National Regulators |
| Motivated Investors, World Values Survey | For each firm-year, we multiply each institutional investor's ownership percentage with the World Values Survey social norm score from the investor's headquarter-country and compute the sum. | Factset, WVS, Dyck et al. (2019) |

D. Other Firm Characteristics

| | | |
|---|---|---|
| CEO Experience | Fraction of board members who have prior CEO experience. | BoardEx |
| MBA | Fraction of board members who hold an MBA. | BoardEx |
| Higher Education | Fraction of board members with non-MBA graduate degrees. | BoardEx |
| Same Name | Fraction of board members that have the same last name. | BoardEx |
| Age | Average age in years of all board members. | BoardEx |
| Tenure | Average board tenure in years of all board members. | BoardEx |
| Sustainability Committee | Indicator variable that equals one if the firm has a sustainability committee, and zero otherwise. | ASSET4 |
| Sustainability Report | Indicator variable that equals one if the firm publishes a separate sustainability report or publishes a section in its annual report on sustainability, and zero otherwise. | ASSET4 |
| Executive Pay is Tied to Sustainability Targets | Indicator variable that equals one if the senior executives' compensation of a firm is linked to the firm's sustainability targets, and zero otherwise. | ASSET4 |
| Stakeholder Engagement | Indicator variable that equals one if the firm explains how it engages with its stakeholders, and zero otherwise. | ASSET4 |

E. Social Performance Measures

| | | |
|---|---|---|
| ASSET4 Social *z*-Score | Proprietary-weighted aggregate scores of social performance that ASSET4 provides to investors. These rank-based scores range from 0 to 100 and measure the social performance relative to all companies in a given year. | ASSET4 |
| ASSET4 Equal-weighted Social Score | Aggregate score based on 78 line items of social commitments across seven categories (community, diversity & opportunity, employment quality, health & safety, human rights, product responsibility, and training & development). Each line item is translated into an indicator variable such that a 'one' corresponds to better social performance. Category scores are calculated as the sum of all indicator variables in each category divided by the number of reported items times 100. The ASSET4 Equal-weighted Social Score is the average of the category scores. | ASSET4 |
| SAM S&P Social Score | SAM S&P Global social score. The scores are based on data obtained from an annual corporate assessment using an industry-specific questionnaire focusing on financially relevant criteria. The focus is on sustainability factors that can have an impact on companies' long-term value creation. These data are supplemented with a media and stakeholder analysis that examines more recent findings which have surfaced via the media and other channels. To construct the social score, individual data items across various criterion levels are aggregated while applying a proprietary weighting scheme. The scores range between 0 and 100 and are ranked against other companies in the same industry and year. Data are available for our entire sample period. | S&P Global |
| Sustainalytics Social Score | Sustainalytics' overall social score. The scores are constructed by considering firm-level information available from annual reports, corporate sustainability reports, NGOs, and news sources, applying a proprietary weighting matrix across items. The scores range from 0 to 100 and coverage begins in 2009. | Sustainalytics |