Green Stewards: Responsible Institutional Investors Foster Green CapEx*

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Abstract

There are markedly different views on the rise of the sustainable investment movement. While some commentators argue that it is just window dressing, others believe that it is having a real impact on corporate sustainability. This paper seeks to determine how changes in the responsible investor base affects corporate green capital expenditures. I identify responsible investors via the Climate Action 100+ initiative and approximate green capital expenditures with green debt instruments. I exploit the fact that the proportion of institutional investors with sustainable preferences is higher in Europe and Asia than in the United States, and use the cross-listing of European and Asian headquartered firms in the United States as a negative responsible ownership shock. In a staggered difference-in-differences estimation, I find that cross-listing firms have a lower responsible investor share and are less likely to undertake green capital expenditures post cross-listing. I also document that responsible institutional investors engage more with management and are associated with stricter green governance. Together, my findings suggest that responsible institutional investors foster greater green capital expenditures by exerting influence on management.

Keywords: Responsible Institutional Investors, Green Capital Expenditures, Green Debt, Investor Stewardship, Investor Engagement

JEL Codes: G11, G23, G30, D25, D62

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1 Introduction

There has been a phenomenal rise in responsible investing in the first two decades of the 21st century. Multiple responsible investor initiatives with growing numbers of institutional investor signatories have sprung up. The formation of the "Glasgow Financial Alliance for Net Zero" investor coalition in 2021 was a high point. Its signatories' assets under management represent roughly 40% of the total global financial asset base. Such enormous and rapid growth inevitably elicits questions and backlashes. Is responsible investing mostly a fad, an extension of culture wars, or has it resulted in meaningful changes in corporations' sustainability? While the literature has focused on the portfolio impact of responsible investors (e.g. Heath et al., 2021; Gibson Brandon et al., 2022; Atta-Darkua et al., 2022), less is known on the real economic impact of responsible investors.

In this paper, I empirically investigate how the rise in ownership by responsible investors has impacted one key real outcome: green capital expenditures. Green capital expenditures are critical to replace brown operations and scale green technology. To be on target for a Net Zero by 2050 trajectory, the International Energy Association estimates annual required green capital expenditures to be about $4 trillion IEA (2022) compared to realized green capital expenditures of about $1 trillion in 2022.[1] My findings suggest that responsible institutional investors foster and therefore help accelerate firms' green capital expenditures by exerting influence on management. In addressing this question, there are three immediate empirical challenges. First, on the institutional side, who counts as a responsible investor? Second, on the firm side, what qualifies as green capital expenditure? Third, how to separate the causal impact of responsible investment from the endogenous selection of green firms by responsible investors?

My study combines global data on firm-level ownership by responsible institutional investors and green capital expenditure. I define responsible investors as institutional investors who care about global decarbonization as opposed to conventional investors who seek to maximize shareholder returns. To identify responsible investors, I exploit membership of the Climate Action 100+ (CA100+) initiative, the largest collaborative engagement group for climate change, as arguable credible signal of investors' objective. The objective of the CA100+ initiative is to "ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change". In contrast to many other climate change initiatives, the CA100+ initiative includes a verifiable obligation, specifically, investors commit to engage with target companies' management on decarbonization. I use the signatories' joining date and FactSet's institutional ownership

[1] Clean energy capital expenditures represent capital spent on deployment of low-carbon technology in the renewable energy, energy storage, nuclear power, hydrogen, carbon capture and storage, electrified transport and heating as well as sustainable materials sector. (see Catsaros, B. (2023, January 26). "Global Low-Carbon Energy Technology Investment Surges Past $1 Trillion for the First Time". Bloomberg.

database to compute the time-varying share of responsible ownership for each firm (CA100 SHARE), the proportion of CA100+ institutional investors relative to all institutional investors. I conduct robustness exercises to address the possibility that this measure over or under counts responsible investors.

As firms do not typically disclose green capital expenditures, i.e. investments in assets that allow reduced carbon emissions, I need to develop a possible measure. I approximate green capital expenditures with recently developed debt instruments linked to environmental projects. In contrast to standard debt instruments green bonds and loans as well as sustainability bonds and loans have a "use of proceeds" clause to ensure funds are dedicated to environmental projects. Sustainability-linked bonds and loans do not finance specific projects but link financing conditions to key environmental performance indicators. I define the universe of all three debt instruments, i.e. green bonds/ loans, sustainability bonds/ loans and sustainability-linked bonds/loans, as green debt and collect data on both externally verified and self-classified instruments from Bloomberg.

Assuming that green debt issuance relative to green capital expenditures is approximately proportionate, green financing allows me to indirectly measure green capital expenditures over a long time period and across different sectors. Yet, as an approximation, there are immediate concerns regarding green debt instruments' green nature and coverage. Flammer (2021) shows that green bond issuers improve their environmental performance post-issuance. Further, most large investment expenditures are financed at least partially with debt (see DeAngelo (2022) for a list of references), so that the (green) debt financing likely captures a significant fraction of green capital expenditures. The main measure (GREENDEBT-DUMMY) is a dummy equal to one if a firm issued at least one green debt instrument in a given year. To address concerns that this measure does not capture the full range of green capital expenditures, I also gather alternative variables on green investment activities and outcomes. Specifically, I consider tighter definitions focusing on externally verified green debt only, firm-level data on clean investment and revenue ratios based on a green taxonomy from Corporate Knights[2], green patents from Orbis IP as well as greenhouse gas emissions from S&P Global Trucost.

In the last 5 years both responsible investment and green debt have grown in tandem. The average proportion of institutional ownership by CA100+ investors of firms in the MSCI ACWI index grew from 10.3% at the end of 2017 to 35.9% at the end of 2021 compared to 24.6% owned by the four large US asset managers (BlackRock, Vanguard, SSGA and Capital Group) in 2017 and 25.7% in 2021. At the same time the probability of issuing a green debt instrument rose from 1.5% in 2017 to 9.4% in 2021 for the MSCI ACWI subset.

My first empirical result is to document that responsible institutional ownership is associated with

[2]For more information see: https://www.corporateknights.com/sustainable-economy-intelligence/

greater green debt issuance within an industry. In line with Gibson Brandon et al. (2022) and Atta-Darkua et al. (2022), institutional investors with sustainable preferences hold greener stocks within an industry. Next, I show that increases in responsible ownership correlate with increased green capital expenditures *within* firms by adding firm and industry-year fixed effects. A one standard deviation increase in the CA100+ share (22pp) is followed by a 0.9pp higher probability of issuing a green debt instrument three years later on average. Considering that on average only 2.6% of firms issued a green debt instrument per year in the sample period, this effect represents a 35% increase in the probability of issuing green debt. Moreover, adding firm and industry-year fixed effects leaves the coefficient largely unchanged despite a large increase in R2. This pattern is consistent with limited selection on unobservables (Altonji, Elder, and Taber, 2005). I further show that this finding is robust to different specifications, alternative responsible investor measures and alternative green investment proxies, i.e. clean investment ratios, green innovation and greenhouse gas emissions. My results are consistent with the view that responsible owners affect firms' green investment but inconsistent with the alternative view that responsible investing is cheap talk.

This correlation could be partly driven by omitted variables. Certain firm characteristics, e.g. management strategy changes, may jointly increase responsible ownership and green capital expenditures. To isolate the causal impact of responsible investing, I exploit a plausibly exogenous change in the proportion of responsible institutional investors through firms cross-listing in a different region. Institutional investors in Europe and Asia are on average more likely to declare sustainability interests than their American counterparts (GSIA, 2021; Gibson Brandon et al., 2022). The regional difference in investor sustainability is the key source of variation. I propose that cross-listing in the United States should increase the proportion of American investors and therefore decrease the proportion of responsible institutional investors within a firm. While the decision to cross-list is endogenous and affects firms in multiple ways, the key identifying assumption is that a firm's decision to cross-list does not affect or reflect their green investments other than through responsible institutional investors. Researchers have identified a variety of reasons why firms may choose to cross-list in the United States. Popular motivations for firms to list abroad include lower cost of capital, greater investor recognition, improved access to capital, improved liquidity or improved governance mechanisms (see e.g. Karolyi (2006) and Pagano, Röell, and Zechner (2002)), but do not directly involve targeting responsible investors or green investment opportunities. My sample includes 96 European and Asian headquartered firms that cross-list in the United States between 2007 and 2021.

I implement the identification strategy with a staggered difference-in-differences estimation approach following Sun and Abraham (2021). I first identify the control group by choosing the three nearest neighbors based on one-year ex-ante firm characteristics LOGSIZE, INVEST/A, ROE and LEVERAGE after exact matching on the region (Asia or Europe) and the 2-digit SIC industry. I then estimate the interaction-weighted estimator to avoid early-treated firms acting as controls for late-treated firms. Treated firms have on average a roughly 9pp higher American investor share and a 5pp lower responsible investor (CA100+) share relative to the control group three years after cross-listing. Further, the probability of issuing a green debt instrument is about 5pp lower and absolute scope 1 emissions are 41% higher on average over the same period. The cross-listing sample captures a subset of European and Asian firms, where the unconditional likelihood of issuing green debt is higher than in the worldwide sample. While the coefficients are accordingly larger for the difference-in-differences estimation, the results are qualitatively similar to my earlier results. To the extent that we can take this as causal evidence, it suggests lower responsible shares affect companies decisions on green capital expenditures.

This result raises the question of how responsible investors affect companies' green investment decisions. There are two plausible mechanisms. Responsible investing can affect firms' green capital expenditures by lowering the cost of capital for green projects due to the higher demand (e.g. Heinkel, Kraus, and Zechner, 2001; Bolton and Kacperczyk, 2021; Pástor, Stambaugh, and Taylor, 2021) and through corporate engagement, i.e. investors entering a discussion with management to push for green capital expenditures (e.g. Broccardo, Hart, and Zingales, 2022; Biais and Landier, 2022; Chowdhry, Davies, and Waters, 2019; Oehmke and Opp, 2022). Active governance allows shareholders to introduce internal governance mechanisms to direct managements' capital expenditure decisions. In line with the latter channel, one dimension of stewardship and the differentiating characteristics of the CA100+ initiative is investor engagement with management. I show the role of corporate engagement along three dimensions. First, I use the Principles for Responsible Investment survey to document that within the survey subset CA100+ signatories engage more with management than non-CA100+ signatories. Second, I document that responsible ownership is associated with stricter future environmental governance, specifically decarbonization targets as well as executive environmental responsibilities and compensation targets. Third, I find that the relationship between responsible ownership and green debt issuance is strongest for the highest emission firms, the subset investors with a limited amount of time and budget for engagement should target to achieve material emission reduction.

Concrete examples that highlight the impact of responsible ownership and the role of engagement are the success story of the power company "Enel" and the struggle with the conglomerate "Berkshire Hathaway". Both companies are target companies for change of the CA100+ initiative. Asset manager Robecco started to engage with Enel under the CA100+ initiative in 2018. Responsible ownership at Enel was 18% in 2018 compared to an average responsible ownership of 8% (12% for the MSCI ACWI sample). Enel has made significant improvements including a more ambitious verified decarbonization target, three green bond issues between 2018 and 2022 and a decrease in scope 1 emissions by 46% between 2018 and 2021. Moreover, the CA100+ initiative evaluated Enel's capital investments in 2022 for the first time net-zero aligned.[3] In contrast, Berkshire Hathaway, which is a CA100+ target since 2017, has made very little progress and consistently rejects pushes by investors.[4] Berkshire Hathaway has not yet a verified decarbonization target and its capital investments were evaluated to be not net-zero aligned. Responsible ownership at Berkshire Hathaway is below average with 5% in 2018. The company has not issued any green debt between 2018 and 2022 and scope 1 emissions decreased only by 16% between 2018 and 2021. Enel, with a relatively large share of responsible ownership and active long-term engagements, is reshaping its environmental impact suggesting that responsible investors are not just about window-dressing. In contrast, responsible investing had little if any impact on Berkshire Hathaway, where the firm-level responsible ownership was relatively modest. This points towards the role of responsible ownership at the firm-level beyond its impact on general green asset demand.

Lastly, I investigate the relationship between responsible investor pressure and other net-zero transition pressures, such as regulation and consumer boycotts. Responsible investors may be substitutes or complements to other net-zero transition pressures. Stricter environmental regulation and societal pressure make green business models more profitable. This effect may reduce the perceived necessity for responsible investors to act. Alternatively, stronger other pressures may strengthen responsible investors' position, ambition and negotiation with management as incentives for firms to invest in green projects are higher. I find that the correlation between the responsible investor share and green debt is stronger more recently, in Europe, in tight environmental regulation countries, and for firms exposed to more climate change campaigns from NGOs. This points to responsible institutional investors being most effective in conjunction with other net-zero transition pressures and thus complementary to them.

This paper relates to different strands of literature. First, it contributes to the growing literature on the role of institutional investors in the net zero transition. The theoretical literature on socially responsible investing focuses on two main strands: exclusion and impact investing. Both can generate firm investments in green activities. The exclusion literature, pioneered by Heinkel, Kraus, and Zechner (2001), studies the effect of portfolio divestment or tilting away from brown firms. Exclusion typically increases the firm's cost of capital as firms cannot access capital from responsible investors with the remaining investors requiring higher risk premia to absorb the divested shares (e.g. Pástor, Stambaugh, and Taylor, 2021; Pedersen, Fitzgibbons, and Pomorski, 2021; De Angelis, Tankov, and Zerbib, 2022; Broccardo, Hart, and Zingales, 2022; Zerbib, 2022)). Pástor, Stambaugh, and Taylor (2021) show that even without managerial preferences for ESG, a rise in responsible investors creates positive social impact through two sources. Greener firms

[3] Enel (2022, November 9) "Enel recognized as the first company to fully align disclosures". Enel Press Release
[4] Hodgson, C. (2021, March 2021) "Powerful investor group finds net zero pledges distant and hollow". Financial Times

raise more capital and firms invest to become greener. They further hypothesize that social impact should be even greater if management has ESG preferences, which could for instance be induced by shareholder engagement. The second theoretical strand investigates how investors can finance capital and engage with management to change firm behavior (e.g. Biais and Landier, 2022; Gollier and Pouget, 2014; Chowdhry, Davies, and Waters, 2019). Here, large responsible investors subsidize firms to adopt clean technologies by accepting lower rates of return. Oehmke and Opp (2022) identify conditions under which responsible investors can induce firms to reduce externalities and invest in clean technologies. Gupta, Kopytov, and Starmans (2022) highlight that the impact of responsible investing is not unambigious as responsible investors may cause strategic delays in firm reform. I provide novel empirical evidence on the real green impact of responsible investors and highlight the role of engagement and stewardship in how responsible owners drive firms' green capital expenditures.

The empirical literature on socially responsible investing has mostly focused on the portfolio impact. Krueger, Sautner, and Starks (2020), Gibson Brandon et al. (2022) and Cenedese, Han, and Kacperczyk (2023) study how institutional investors, respectively investor initiative signatories, incorporate climate risk in their portfolio holdings. Kim and Yoon (2023) and Heath et al. (2021) study the portfolio allocation, respectively the behaviour impact on firms, of sustainable mutual funds and find mixed evidence on greenwashing concerns. Pastor, Stambaugh, and Taylor (2023) measure ESG-related tilts at the portfolio level. Other papers study how institutional investors affect ESG related firms outcomes. Dyck et al. (2019) and Ceccarelli et al. (2022) look at ESG ratings, specifically environmental and social performance, as outcome. Flammer, Toffel, and Viswanathan (2021) and Ilhan et al. (2023) study how institutional investors can help improve firm-level climate risk disclosure. A few studies also look at emissions as outcome. Azar et al. (2021) assess the role of the Big Three asset managers, while Gantchev, Giannetti, and Li (2022) document differential firm responses to E&S incidents conditional on E&S-conscious institutional ownership. Atta-Darkua et al. (2022) suggest that climate-conscious investors decarbonize their portfolio by re-weighting their portfolio towards lower carbon emitting firms. Several papers also document how institutional investors engage with company boards and executives and influence them on different ESG dimensions (Becht et al., 2023; Dimson, Karakaş, and Li, 2015, 2021; Hoepner et al., 2021). I employ a novel identification strategy based on firms' cross-listing and am the first to document that responsible institutional investors foster green capital expenditure, a key real outcome variable in the net zero energy transition.

Second, I contribute to the literature on how corporations incorporate climate risk and transition towards net zero. A growing literature explores how climate-related commitments affect firms' actions. These include Ioannou, Li, and Serafeim (2016), Ramadorai and Zeni (2021), Comello, Reichelstein, and Reichelstein (2021), and Bolton and Kacperczyk (2023a). Kacperczyk and Peydró (2022), Accetturo et al. (2022) and

De Haas et al. (2023) study the role of credit in shaping firms' environmental and social performance. Other papers study the impact of natural disasters, respectively physical risk, on firm outcomes (e.g. Ginglinger and Moreau, 2019; Pankratz and Schiller, 2021; Custodio et al., 2022). Wang, Wurgler, and Zhang (2023) show that policy uncertainty hampers green investments. In contrast to these studies, I focus on the role of instutitonal investors as moderator. My findings suggest that institutional investors are one driver of firms' green investments and shed light how firm's decarbonize with green capital expenditures.

Third, I contribute to the literature on green bonds. Several papers study green or sustainability-linked bonds' premium (e.g. Zerbib, 2019; Fatica, Panzica, and Rancan, 2021; Baker et al., 2022; Kölbel and Lambillon, 2022; Berrada et al., 2022). Flammer (2021) examines the rational for issuing corporate green bonds and finds that companies signal their commitment toward the environment by issuing green bonds. In the same vein, Lu (2023) suggests that green bonds can be seen as a form of climate commitment. Fatica and Panzica (2021) show that green bond issuance is associated with a reduction in emissions. Barbalau and Zeni (2022) and Allen, Barbalau, and Zeni (2023) study the features of green bonds, respectively sustainability linked bonds, theoretically. To the best of my knowledge, I am the first to interpret green debt instruments as an indirect measure of firms' green capital expenditures and show how responsible institutional investors moderate this. Although responsible institutional investors are under a lot of scrutiny for their real impact, I find that they practice stewardship and are a positive force in driving green capital expenditures.

2 Background and Data

2.1 Identifying responsible institutional investors

Responsible investment captures many different types of investors and styles of investing. For instance, the Global Sustainable Investor Alliance defines sustainable investment as an investment strategy that "considers environmental, social and governance factors in portfolio selection and management". I define responsible investors more narrowly as institutional investors who care about global decarbonization and declare that they want their portfolio companies to be net zero by 2050 as opposed to conventional investors who only care about maximizing shareholder returns. As I am unable to observe investors' minds, I rely on investors' actions and words to determine a credible signal that identifies responsible investors while addressing cheap talk concerns. I exploit the signing up to the CA100+ initiative, a major investor initiative with a decarbonization objective and a costly verifiable obligation, namely corporate engagements, as credible signal.

The literature has largely followed two main approaches, revealed preferences or self-declarations, to identify sustainable oriented investors (see Appendix Section A.1.1 for a detailed discussion). The "revealed preference" stream exploits investors undelrying holdings to classify responsible investors (e.g. Yang and Koci, 2020; Albuquerque et al., 2020; Cao et al., 2019; Hwang, Titman, and Wang, 2022; Döttling and Kim, 2022; Gibson, Krueger, and Mitali, 2020; Kaustia and Yu, 2021; Pástor and Vorsatz, 2020; Gantchev, Giannetti, and Li, 2022), but thereby introduces a circular nature. The "self-declaration" stream generally classifies investors as responsible based on being a member of a responsible investor initiative (e.g. PRI initiative by (Gibson Brandon et al., 2022; Kim and Yoon, 2023; Liang, Sun, and Teo, 2022; Dimson, Karakaş, and Li, 2021), CERES by (Flammer, 2021), CDP/CA100+ (Atta-Darkua et al., 2022)). The latter approach allows to abstract from investors' underlying holdings, but many initiatives have a relatively weak governance structure and merely require members to sign the initiatives' objective and pay annual fees. The lack of formal requirements leaves ample room for greenwashing.

The CA100+ initiative is also an investor initiative, but it is arguably more rigorous. Next to its decarbonization objective, the CA100+ initiative requires investors to engage with target companies' management on decarbonization. This costly verifiable obligation addresses cheap talk concerns. While the CA100+ initiative is not without critics[5], it is credited with the potential to drive change[6] and can claim several successful corporation engagements. Launched in December 2017 with 225 signatories, CA100+ has grown to more than 700 signatories and represents the largest collaborative engagement group on climate change. The signatories engage over the long-term with the world's largest greenhouse gas emitters to "improve governance on climate change, curb emissions and strengthen climate-related financial disclosures".[7] In contrast to many other sustainable initiatives, the narrow emission reduction objective and engagement component are suggestive of a "real impact mandate" Oehmke and Opp (2022). These characteristics indicate that this initiative serves as a good measure of responsible institutional investors in my context.

Having made that choice, there are immediate concerns that the responsible investor measure is over or under-inclusive. Some institutions with a clear decarbonization objective may not be signatories. For instance, the Norges Bank Investment Management is a prominent advocate in tackling climate change, but is not a signatory. On the other hand, the initiative may also be over-inclusive. The two large index providers BlackRock and State Street Global Advisors are members, but their role in active governance is unclear. This noise leads to attenuation bias, which draws the coefficient towards zero and should result in underestimation of the coefficient size. Still, I construct several alternative measures to address measurement concerns.

[5]Critics challenge the lack of transparency and milestones as well as the voting behavior of some signatories (see e.g. Majority Action. (2022, March). "Fulfilling the Promise: How Climate Action 100+ Investor-Signatories Can Mitigate Systemic Climate Risk". Majority Action.)

[6]Mooney, A. (2020, August 8). "Corporate eco-warriors driving change from Shell to Qantas". Financial Times.

[7]Cliamte Action 100+. (2017, December 12). "Global Investors Launch New Initiative To Drive Action On Climate Change By World's Largest Corporate Greenhouse Gas Emitters".

For robustness, I consider only early signatories that have been shown to be more committed in other initiatives (Gibson Brandon et al., 2022), drop/ add key institutions, exploit investors' holdings to identify and drop high churn-rate or high emission, investors, restrict the initiative to the signatory subset that is active in engagements, and build an alternative measure based on the PRI signatories and their survey responses.[8]

[Insert Figure 1 about here]

I collect institutional ownership data from FactSet and follow Ferreira and Matos (2008) to identify the annual level of institutional ownership from 13F and Mutual Fund Holdings data. I calculate the total firm-level institutional ownership as well as firm-level institutional ownership for CA100+ and PRI signatories with the signatory list and sign-up date. Figure 1, Panel A, shows the proportion of AUM of institutional investors who signed the CA100+, respectively PRI, initiative has risen over time and represent 33%, respectively 71%, in my sample in 2022. My main measure is the responsible ownership share, defined as the annual (t) ownership share of responsible institutional investors ownership relative to the total institutional investor ownership at a corporation (f):

$$CA100\,SHARE_{t,f} = \frac{CA100+\ Institutional\ Ownership_{t,f}}{Total\ Institutional\ Ownership_{t,f}} \tag{1}$$

where $CA100$+ $Institutional\ Ownership_{t,f}$ is the percentage ownership of CA100+ signatories and $Total\ Institutional\ Ownership_{t,f}$ is the percentage ownership of all institutional owners. This specification focuses on the responsible institutional share relative to the arguably active governance share in a firm, i.e. total institutional investors. Figure 1 Panel A shows that the proportion of institutional asset under management (AUM) of the CA100+ initiative steadily grew as well as the proportion of PRI signatories and two definitions of IMPACT-PRI investors as robustness measure. In 2022, the average proportion of CA100+ institutional investors at the firm level is 28% (see Table 1).

[Insert Table 1 about here]

2.2 Determining green capital expenditure

Green capital expenditures are a broad concept that the United Nations Environment Programme describes as investments in "infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services".[9] To identify firms' green capital expendiutres, I would ideally like to classify the individual capital expenditures

[8] For more information see: https://www.unpri.org/about-us/about-the-pri

[9] See https://www.unep.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency/green-economy

into green and non-green activities. However, corporations do not typically disclose project level capital expenditures.[10] Accetturo et al. (2022) and Wang, Wurgler, and Zhang (2023) identify green investment components by applying a "green" dictionary to financial statement items for Italian, respectively Chinese firms. De Haas et al. (2023) use survey responses of managers from European firms to identify green capital expenditures. I approximate green capital expenditures for a worldwide sample by using firms' green debt funding: Financial instruments whose proceeds are directly or indirectly linked to green projects through the contract terms.

Recent financial instruments whose proceeds are either directly or indirectly linked to green projects include (i) green bonds and loans, (ii) sustainability linked bonds and loans, and (iii) sustainability bonds and loans. The proceeds of green bonds are earmarked for environmental projects, sustainability-linked bonds have a coupon payment linked to key environmental performance indicators and proceeds of sustainability bonds are committed towards environmental or social projects. I define the universe of these instruments as green debt. The first corporate green bond issuance was in 2013[11] and green debt issues can be found in all major SIC divisions (see Appendix Figure A.II). Using green debt as green capital expenditure measure has the advantage of covering a global cross-industry sample for a long time period.

Although green debt neglects investments funded by means other than debt[12], it serves as good indirect measure as it is an important funding source shown to be followed by emission reductions. Total green debt issuance between 2017 and 2022 was 2.3 trillion USD, which accounts for the majority (56%) of global low carbon capital expenditures in this time period.[13] Moreover, 98.7% of green debt in my sample has some form of third party verification, which mitigates greenwashing concerns. Further, Flammer (2021) and Fatica and Panzica (2021) highlight the green investment nature of green bonds by showing that green bond issuers have a better environmental performance post-issuance. I confirm the negative correlation between green debt issuance and emissions in my sample in Appendix Table A.IV. Finally, it is well established that large investment expenditures are financed at least partially with debt, so that the (green) debt financing captures a significant fraction of the green capex (see DeAngelo (2022) for a list of references). Assuming that green debt issuance is approximately proportionate to green capital expenditures, green debt therefore allows me to indirectly measure green investments well over a long time period and across different sectors.

[Insert Table 2 about here]

[10] The EU now requires large companies to disclose their capital and operating expenditure aligned with the EU taxonomy `https://eu-taxonomy.info/info/eu-taxonomy-for-companies`

[11] See SEB Group press release: `https://sebgroup.com/press/news/2018/vasakronan-pioneered-green-certificates`

[12] There is some suggestive evidence, even though the overall evidence is mixed, of a greenium (e.g. Zerbib, 2019; Baker et al., 2022). To the extent that there is a greenium, firms would have an incentive to issue green debt rather than normal debt to fund green projects. Although outside finance may still be more expensive than internal funds.

[13] BloombergNEF. (2023, January 26). "Global Low-Carbon Energy Technology Investment Surges Past $1 Trillion for the First Time".

I collect corporate bond and loan data on green bonds and loans, sustainability linked bonds and loans and sustainability bonds and loans from Bloomberg.[14] Between 2013 and 2022 the total number of public green debt issuances is 4,607, of which I am able to match 97% to FactSet via the Legal-Entity Identifier or a ticker/fuzzy name match with manual cross-check. My sample contains 88% of all public issues (93% in terms of amount issued), as shown in Figure A.I. 95% of all green debt instruments are green bonds/ loans and sustainability-linked bonds/loans, whose proceeds are committed or linked to finance environmental and climate-friendly projects. Sustainability bonds/ loans whose proceeds may also be assigned to social projects thus represent only a small fraction. With Bloomberg's comprehensive coverage, my sample is a close map of the universe of public green debt that has been issued over the period of my study.

I construct two main variables $GREENDEBT - DUMMY$, which is equal to one if the firm has issued at least one green debt instrument in a given year and $ASINH(GREENDEBT)$, which is the inverse hyperbolic sine transformation of the dollar amount of proceeds raised through green debt. Table 2 Panel B shows that only 0.1% of firms had issued at least one green debt instrument in 2013. Since then, the market has grown multifold, albeit from a very low level. In 2022 2.6% of firms have issued at least one green debt instrument. Asset-weighted, this proportion is an order of magnitude larger and reached 30.7% in 2022. Hence, larger firms are significantly more likely to issue a green debt instrument.

To address the concern that green debt underestimates green capital expenditure, I also look at alternative measures along the value chain. First, I look at the initial research activity of corporations, namely green innovation measured via patent data from Orbis Intellectual Property. Following Bolton, Kacperczyk, and Wiedemann (2022), I use *green patents* which capture technologies that may substitute carbon dioxide emitting technologies for carbon dioxide-free technologies or make carbon-dioxide free technologies more accessible. Given my focus on near-term green outcomes I focus on patent applications. Focusing on applications mitigates the lag between patent grants and citations (Lerner and Seru, 2022), but may also capture applications that are not evaluated as novel. I further drop the most recent year 2022 in which some applications may have not yet been recorded. My main patent variables are based on the European Patent Office. I use as measures both the patent ratio calculated as the number of green patents over total patent applications (GREENRATIOEP) and a citation weighted count (GREENCITCOUNTEP). Patent ratios relate new patent filings to a firm's innovation capacity and allow a more complete picture of the intensive margin of innovation activity (Bolton, Kacperczyk, and Wiedemann, 2022). The average green ratio (GREENRATIOEP) has risen from 9.6% in 2006 to 14.3% in 2021 for the patenting sample. Patent citation counts scale for the significance of the innovation by the the degree by accounting for the number of citations. As robustness

[14] I gather bonds with one of the following indicator variables equal to yes: GREEN_BOND_LOAN_INDICATOR; SUSTNABILTY_LINKD_INDCTR; SUSTNBLE_DEBT_INSTRMNT_INDICATOR; SELF_REPRTD_SUSTAIN_INSTR_INDCTR; SELF_REPRTD_GREEN_INSTR_INDCTR; SELF_REPRT_SUSTAIN_DBT_INSTR_IND; SELF_REPRTD_TRANS_INSTR_INDCTR

measures, I also consider ratios and citation counts based on patent families at any patent office worldwide and the maximum number of citations of all green patents of a firm in a given year (see Table 11).

Second, I collect annual clean revenue and clean investment data from 2019 to 2022 from Corporate Knights. Using their Sustainable Economy Taxonomy (similar to the EU green taxonomy), Corporate Knights calculates the proportion of corporate investment (capital expenditure, R&D and acquisitions) and revenue that is green for about 2,800 companies.[15] While there will be different opinions regarding which activities are green and noise in the classification of activities, this measure captures green investments as well as a measure of the last stage in the value chain, green sales. The average clean investment ratio has increased slightly from 10.1% in 2019 to 14.3% in 2021.

Third, I use S&P Global Trucost to collect data on firm-level scope 1, scope 2 and upstream scope 3 emissions. As a last stage, green capital expenditures should translate into greenhouse gas emission reductions if invested into true green projects. In line with the other green measures, average absolute scope 1 emissions decreased over time (compare Table 1 Panel B). However, the sharp drop in average emissions from 2015 to 2016 is driven by a substantial data coverage expansion to smaller firms.

2.3 Firm financial data

Control variables from firm financial and balance sheet data are from FactSet and include: i) LOGSIZE which stands for the natural logarithm of a listed company's market capitalization (price times shares outstanding); ii) LEVERAGE, which is the ratio of debt to book value of assets; iv) ROE, which is given by the ratio of firm i's net yearly income divided by the value of its equity; v) M/B, which is the end of year market cap divided by the firm's book value; vi) BETA, which is the market beta of individual companies calculated over the preceding 12-month period; vii) VOLAT, which is the standard deviation of returns based on the past 12 monthly returns; viii) momentum, MOM, which is given by the average of the most recent 12 months' returns on stock i, leading up to and including month t-1; ix) short-term reversal, RET, which is the past year's December return on stock i; x) capital expenditure INVEST/A, which we measure as the firm's capital expenditures divided by the book value of its assets. To mitigate the impact of outliers I winsorize M/B, LEVERAGE, INVEST/A, and ROE at the 2.5% level, and MOM and VOLAT at the 0.5% level. Finally, I gather MSCI All Country World Index (ACWI) constituent data from MSCI. I merge the data together using firm ISINs and construct the indicator variable MSCI, which is equal to one if a stock is part of the MSCI ACWI index in year t, and zero otherwise. Table 2 highlights that on average 14% of the sample is part of the MSCI ACWI index. The variable definitions are summarized in Appendix Table 11.

[15] See for more detail: https://www.corporateknights.com/sustainable-economy-intelligence/

3 Results

3.1 Responsible institutional investors & green capital expenditures

3.1.1 CA100+ investors and green debt instruments

If the rise in responsible investment movement is reshaping how corporations take into account their environmental impact then we should expect to see a positive relation between green capital expenditures and the share of responsible investors. If, however, this movement is mostly window dressing then we should not expect to see any significant relation (possibly even a negative relation) between green capital expenditures and the share of responsible investors. I first document a strong positive correlation between the CA100+ share and future green debt issuance, which is consistent with responsible investors affecting firms' green capital expenditure decisions.

I formally examine this relationship by estimating the following linear regression model first with year (t), country (c), and 4-digit SIC code industry (j) fixed effects, and subsequently with firm (f) and industry-year (jt) fixed effects:

$$GREENDEBT_{cfjt} = \alpha + \beta CA100\,SHARE_{cfjt-x} + \gamma Controls_{cfjt-x} + FixedEffects + \epsilon_{cfjt} \tag{2}$$

The dependent variable $GREENDEBT$ is either the dummy $GREENDEBT - DUMMY$ or $ASINH(GREENDEBT)$, the inverse hyperbolic sine of the amount of green debt raised. The independent variable $CA100\,SHARE$ is lagged by $x = 1,3$ years. Time-varying firm-level controls $Controls_{cfjt-x}$ measured with with the same lag include LOGSIZE, LOGPEE, LEVERAGE, ROE, M/B, INVEST/A, BETA, VOLAT, MOM, RET, and MSCI. The sample period is defined by the start of the CA100+ initiative and goes from 2017 to 2022.

Table 3 shows that both the likelihood of issuing at least one green debt instrument and the amount issued is positively correlated with the proportion of responsible institutional investors over the next year and next three years. Columns 1, 2, 5 and 6 document this positive correlation within industries. In line with Gibson Brandon et al. (2022); Atta-Darkua et al. (2022); Heath et al. (2021) responsible investors hold greener firms.

In columns 3, 4, 7, and 8, I find that this correlation also holds *within* firm after controlling for firm and industry-year fixed effects. This suggests that responsible investors may not only sort into greener firms, but may also drive firms to become greener. A one standard deviation increase in the CA100+ proportion (22pp) translates on average to a 0.90pp higher probability of issuing a green debt instrument three years later. Considering that on average only 2.6% of firms issued a green debt instrument per year in the sample period, this change represents a 35% increase and is economically large. Importantly, while the R2 increases by about 40%, the size of the coefficient is largely unchanged after adding firm and industry-year fixed effects. This pattern is consistent with limited selection on unobservables(Altonji, Elder, and Taber, 2005). I formally verify this statement and calculate Oster's delta based on the rule of thumb bound of 1.3 times partial R2 (Oster, 2019). This bound assumes that unobservables explain somewhat less than observables. I find that Oster's delta is above 1 which leaves limited scope for unobservables to explain the results. These findings are consistent with the view that responsible investors are influencing firms' green capital expenditure decisions but inconsistent with the alternative view that responsible investors only practice cheap talk.

[Insert Table 3 about here]

3.1.2 Robustness in the responsible ownership measure

I address over- and under-inclusiveness concerns in identifying responsible investors by considering several alternative responsible share measures, even though classical measurement error in the independent variable biases the coefficients towards zero and therefore against finding a result. I find that the positive relationship between responsible investors and future green capital expenditures is robust to alternative classifications of responsible institutional investors and specifications of the main regression.

Alternatives to address overinclusiveness

To begin with, I focus on the concern that the set of CA100+ signatories is overly inclusive, and limit to a set of plausibly more stringent subsets. Table 4 reports in Panel A to D that the positive relationship is robust to the more narrow responsible investor measures that consider only early signatories, drop questionnable institutions and drop high churn or high emission investors. First, in Panel A, I consider only early signatories, i.e. signatories that joined in the first two years (2017 and 2018) of the initiative. I conjecture that late signatories are more likely to be opportunists and be pressured by reputation concerns to join the initiative rather than by true beliefs. Gibson Brandon et al. (2022) show for the PRI initiative that late joiners have worse total portfolio ESG scores. Second, in Panel B, I adjust the CA100+ signatory base and drop the two large passive investor signatories, BlackRock and State Street Global Advisors. They offer passive index offerings and the degree to which they are active owners is often challenged.

Third, I adjust my "self-declaration"-based responsible investor measure by accounting for portfolio-inferred types and preferences.[16] Specifically, I follow Gaspar, Massa, and Matos (2005) to calculate the

[16]The identification of short-term and high emission investors is at the reporting institution level, which is often below the global

quarterly investor churn rate and group investors in annualized terciles. I define investors in the top tercile, i.e. those with the highest churn rate, to be short-term investors and remove any institutional investor that appeared at least once in the top tercile between 2017 and 2021, the period of interest. This mixes the two primary methods of identifying responsible investors, i.e. self-declaration and revealed preferences, and therefore may allow me to more cleanly identify the truly long-term responsible investors. Panel C documents that the positive relationship if anything is slightly stronger after removing long-term signatories. Fourth, I similarly identify and drop investors with the highest portfolio weighted absolute scope 1 emissions. I calculate total portfolio weighted scope 1 emissions in line with Gibson Brandon et al. (2022). I require at least 50% of an institutional investors portfolio to have emission data and calculate the portfolio weighted score of the most recent 8 quarters. I sort investors into portfolio weighted terciles and define the top tercile with the highest emissions as high emission investors. Investors without an emission score are considered to be part of the highest emission tercile. I again remove any institutional investor that has been identified at least once as high emission investor between 2017 and 2021. Panel D again confirms the positive relationship.

[Insert Table 4 about here]

In Appendix Table A.V, I additionally show that the results are robust to the "participant" signatory subset, which are the institutional investors who are actively involved in firm engagements, and excluding high emission investors identified based on scope 1 emission intensities rather than absolute emissions. Finally in Appendix Table A.VI, I randomly sort signatories into 5 buckets and iteratively calculate the responsible investor share based on 4 out of the 5 buckets and show that the results are not driven by a specific group of signatories. Across the different specifications, the size of the coefficient remains relatively stable and significant. My findings therefore do not seem to be driven by a specific signatory or a set of institutional investors whose sustainable preferences can be challenged.

Alternatives to address underinclusiveness

Alternatively, my responsible investor measure may also miss out on important responsible investors who are not part of the initiatives and actually be under-inclusive. I construct an alternative measures for responsible ownership based on the older and larger PRI initiative instead of the CA100+ initiative. PRI is a leading global network of financial institutions that commit to incorporate environmental, social and governance issues in their investment analysis and ownership practices. While it is one of the largest sustainable investor initiatives with $121.3 trillion AUM in 2021, its size and weaker membership requirements have

parent level. BlackRock for instance has more than 40 reporting institutions. This adjustment thus also allows me to abstract from the stark one-zero classification at the aggregate institutional investors and lower it to the reporting institution level.

also generated doubts about the "true responsibility" of these investors (Gibson Brandon et al., 2022). I therefore use the PRI survey responses from the PRI reporting framework to filter for institutional investors in this subset that similar to CA100+ follow an engagement strategy and are therefore more likely to actively care about global decarbonization. I call these "IMPACT-PRI" investors and describe the steps taken in detail in Appendix Section A.1.3. The variable $IMPACT - PRI\, SHARE$ is calculated as the $CA100\, SHARE$ in equation 1. In Table 4, Panel E, I report results with IMPACT-PRI SHARE as independent variable and again identify a significant positive relationship with future green debt issuance. Because of the earlier start period, this variable is available from the first green bond issuance in 2013 onwards. Given that the PRI-based responsible investor measure is likely much noisier, it is unsurprising that the size of the coefficient is smaller. However, the relationship between responsible ownership and green capital expenditures is still positive and significant. In Appendix Table A.V, Panel C, I show the results are also robust to a broader CA100 SHARE measure, which considers the Norges Bank Investment Management (NBIM) as a signatory from the start of the CA100+ initiative. NBIM is often considered to be an active climate steward, but is not part of the initiative.

Alternative specifications

In my main specification, I scale responsible institutional ownership relative to total institutional ownership to focus on the fraction of investors that are arguably actively involved in firms' governance. This scaling treats firms with little institutional ownership similar to firms with large institutional ownership and raises concerns that the results are driven by firm observations with little institutional ownership. I next show that the results are robust to various alternative regression specifications that account for total institutional ownership.

I first restrict the sample to firm-years with at least 10% institutional ownership and confirm that the results are not driven by firms with very little institutional ownership in Panel A of Appendix Table A.VII. Next, I consider an alternative specification with responsible institutional ownership measured relative to total ownership and an additional control for total institutional ownership to address the concern that institutional investors select into certain firms. This idea follows Hong and Kacperczyk (2009) who control for firms in industries related to sin stocks. Appendix Table A.VII, Panel B, highlights that responsible ownership is again positively related to green debt issuance. The results further suggest that institutional ownership in general is negatively related to green debt issuance. If firms' green investments are relatively lower NPV projects, it makes sense that institutional investors in general would drive managers to shun away from these projects. Finally, in Panel C of Appendix Table A.VII, I replace CA100 SHARE with indicators for different levels of CA100 proportion. The positive relationship is confirmed, as the dummy for

30%+ responsible ownership is statistically significantly positive and larger than the dummy for responsible ownership between 10% and 30%.

3.1.3 Robustness in the green capital expenditure measure

I cannot measure green capital expenditures directly and instead approximate it with green debt. As proxy, green debt is possibly under-inclusive and at worst biased. I document that the positive relationship between responsible investors and green capital expenditures is robust to alternative green debt definitions, taxonomy-based revenue and investment ratios, green innovation and emissions. Across many different green capital expenditure proxies, I find results in line with the view that responsible investors pressure corporations to reduce their environment impact. These results support the conjecture that green debt is a good proxy of green capital expenditures and further alleviate concerns that green debt is uncorrelated to green capital expenditures.

I start by confirming that the positive relationship between responsible investor shares and green debt also holds for subsets of the green debt universe, specifically externally verified green bonds/ loans and externally verified sustainability-linked bonds/ loans. External verification of the bonds remedies the concern that the proceeds do not actually end up in green projects. Further, green bonds/ loans target environmental projects only rather than the mix of environmental and social projects for sustainability bonds/ loans. Sustainability linked bonds/ loans do not earmark proceeds to specific projects, but link the borrower's financing costs to key environmental performance indicators. They thus allow to capture green capital expenditure from firms that are unable to tie proceeds to a specific project. Appendix Table A.VIII shows that the responsible investor share also correlates positively with the future issuance of these debt instruments both within industry and firm.

Flammer (2021) points out that a large fraction of green debt instruments are issued by financial institutions, whose incentives and use-of-proceeds may differ from non-financial institutions. I confirm this pattern in my data in Appendix Figure A.II Panel B. To ensure that my results are not driven by this subset, I repeat the main specifications and drop all financial institutions. Appendix Table A.IX shows that the results are robust to dropping this subset.

Next, I repeat the main specification with the alternative green capital expenditure proxies and confirm that the relationship also holds for the other measures although with a different degree of significance. A first alternative measure of green capital expenditures is to classify firms' total capital expenditures into green and non-green. Corporate Knights' Sustainability Economy Taxonomy aims to do so. I rerun specification 2 with Corporate Knights $CLEANREVENUERATIO$ and $CLEANINVESTMENTRATIO$ as dependent variable. I find a significant positive correlation with country, industry and year fixed effects, as shown in Table 5 in Panel A. The results with firm and industry-year fixed effects are insignificant, but for the $CLEANINVESTMENTRATIO$ align qualitatively with the baseline specification.

A second alternative measure of green capital expenditures is to look at green activities. I therefore measure corporate level green innovation with patent data from Orbis Intellectual Property. Given the count (count-like) data of the patent variables, I estimate specification 2 with a Pseudo Poisson Maximum Likelihood model. Table 5, Panel B, shows that the correlation between the CA100 SHARE and future green innovation measured with the patent ratio ($GREENRATIOEP$) or citation count ($GREENCITCOUNTEP$) is positive and significant in most specifications. In Appendix Table A.X, I consider alternative patent activity measures incorporating patent activity at worldwide patent office, that are less stringent than the European Patent Office, in Panel A as well maximum citations as alternative innovation measure in Panel B. These measures also broadly confirm the positive relationship.

Finally, I consider greenhouse gas emissions as third alternative measure, that looks at the outcome of green capital expenditure. Firms' emissions as ultimate end-goal are of particular interest. Table 5 Panel C and D consider as dependent variables log absolute scope 1 emissions ($LOGS1TOT$) and scope 1 emission intensity based on firm level revenues ($S1INT$), respectively scope 2 absolute ($LOGS2TOT$) and intensity ($S2INT$) metrics. I find a statistically negative coefficient for the one and the three year-lagged CA100 SHARE coefficient across most specifications with firm and industry-year fixed effects. In Appendix Table A.XI, I also consider upstream scope 3 emissions. Here, the results are mostly statistically insignificant suggesting the the responsible investor pressure may not stretch beyond the target firm to the suppliers for the given time period. In general, the results suggest that there are real firm-level changes and strides towards net-zero following responsible investor pressure.

[Insert Table 5 about here]

3.2 Cross-listing in the United States as negative responsible ownership shock

3.2.1 Hypothesis and methodology of the cross-listing "shock"

To isolate the causal impact of responsible investors, I exploit variation in the firm-level share of responsible institutional investors induced from European and Asian firms cross-listing in the United States. The positive correlation between responsible ownership and green capital expenditures may be driven by omitted variables, for instance, certain firm characteristics that may jointly affect ownership and firm behavior. Even though I control for firm and industry-year fixed effects as well as various firm level controls, there may still be bias. Further, there may be reverse causality. Responsible institutional investors may sort into firms with higher planned green capital expenditures rather than driving green capital expenditures. I address these concerns by exploiting variation in responsible ownership driven from firms cross-listing in the United States, i.e. opening a secondary listing in the United States next to their home listing either with or without a capital raise. I estimate the results with a staggered difference-in-differences estimation with matching.

Regional difference in institutional investor sustainability is the key source of variation. The proportion of institutional investors with a sustainable investment orientation in Asia and Europe is on average substantially higher than in the United States (GSIA, 2021; Gibson Brandon et al., 2022). Figure 1 Panel B, documents this for the CA100+ initiative, where the 2017 to 2021 average Asian and European proportion of institutional AUM signed up to the CA100+ initiative is more than 20% above the American proportion. Moreover, Gibson Brandon et al. (2022) suggest that American institutional investors that commit to a sustainable investment initiative, the Principles for Responsible Investment initiative, are on average less likely to follow up on this commitment because of commercial motives, uncertainty about fiduciary duties and a less mature ESG market. Based on these observations, I propose that cross-listing in the United States should increase the proportion of American investors and therefore decrease the proportion of responsible institutional investors within a firm.

While cross-listing may create variation in responsible institutional ownership, the decision to list in the United States is an endogenous decision a firm takes. Cross-listing in the United States may not only change American institutional ownership, but also affect firms on different dimensions. My identifying assumption is that a firm's decision to cross-list does not affect nor reflect relative green investment opportunities other than through the impact on the proportion of responsible institutional investors. I first assess this assumption qualitatively by studying managers' stated motivation for cross-listing and the theoretical literature on why firms cross-list.

Common motivations cited by corporate managers that have successfully executed cross-listing include access to a larger and deeper market for capital, enhanced visibility, diversification of their investor base, and greater liquidity of their stock (Bancel and Mittoo, 2001, 2009; Fanto and Karmel, 1997; Mittoo, 1992). I manually inspect annual reports and press releases for half of my cross-listing sample and find that this echoes the reason stated in these public reports. Appendix Table A.II summarizes my results. In line with the literature survey results, my findings highlight the importance of access to capital and visibility in the cross-listing decision. The main theoretical reasons put forward for firms' cross-listing include the "market segmentation hypothesis", "bonding hypothesis", and "insulation hypothesis" (see Appendix Section A.2 for a detailed discussion on why firms cross-list). The arguments focus on how accessing other markets and improving firms' governance can lower cross-listings firms' cost of capital, but are orthogonal to sustainability reasons. Both, managers' stated motivations and the theoretical literature on cross-listing suggest that the decision to cross-list in the United States is unlikely to be driven by firms' desire to reduce the proportion of responsible investors.

I collect data on cross-listings in the United States using the share codes 12, 30 and 31 from CRSP.[17] I merge this data using ISINs and focus on cross-listings from firms with their headquarter in Asia or Europe. I require the treated firms to have at least 3 years of financial controls and ownership data (one year before to one year after the cross-listing year). My final sample includes 96 firms (31 Asian firms and 65 European firms) that cross-list between 2007 and 2021. Figure 2 shows that the treatment is staggered over multiple years with at least two treated firms per year and up to twelve treated firms in a given year. The staggered adoption and involvement of different industries and countries mitigates concerns that the results are driven by specific time trends affecting particular groups of firms.

[Insert Figure 2 about here]

To choose the control group, I first calculate propensity scores based on the ex ante (1 year before inclusion) characteristics LOGSIZE, INVEST/A, ROE and LEVERAGE and region and 2-digit SIC fixed effects. I then perform exact matching on the region (Asia or Europe) and 2-digit SIC industry and choose the three nearest neighbors based on the propensity score with replacement. Table 6 shows the quality of the matching for the four match variables as well as for American share, responsible investor share and green capital expenditures over the four years prior to cross-listing. While the American share and emissions are at a different level before cross-listing, one-year changes as well as the level of the CA100+ share and green debt issues are not statistically different for the treated group from the control group. The balance table thus suggests that treated and control firms are not on a different trend before cross-listing.

[Insert Table 6 about here]

I follow Sun and Abraham (2021) to estimate the staggered difference-in-differences that restricts the control group to never-treated observations. In the staggered difference-in-differences estimation with only lead and lags already treated units act as controls for newly treated units and weights across treatment cohorts may be non-intuitive or at worst negative (Goodman-Bacon, 2021; Roth et al., 2023). I estimate cohort-specific average treatment effects on the treated ($(CATT(e, \ell))$), ℓ periods from initial treatment for cohort first treated at time e. I subsequently calculate the interaction-weighted estimator by aggregating the cohort-specific coefficients for each relative time period based on the given sample share in that period (Sun and Abraham, 2021). I use the maximum available time span for each variable in the estimation. While I can only measure the proportion of CA100+ investors over a short-time period, I conjecture that American

[17] Share code 12 refers to ordinary common shares from firms incorporated outside the United States and share codes 30 and 31 denote American Depository Receipts (ADRs) covering Level II and III ADRs (see also Chaplinsky and Ramchand (2012)).

investors have been less sustainability oriented on average beforehand already. Cross-listing in the United States should therefore tilt the institutional investor base towards a lower sustainable orientation across the different time periods.

$$y_{ft} = \alpha + \sum_{e \in \{2007,2008,\ldots,2021\}} \sum_{l=-15,\neq -1}^{15} \delta_{e,l} \mathbf{1}\{E_f = e\} RP_{ft}^{\ell} + \gamma Controls_{ft-1} + \theta_f + \tau_t + \epsilon_{ft} \tag{3}$$

The dependent variable is a firm-year measure of American ownership or responsible ownership (CA100 SHARE or IMPACT-PRI SHARE) for the first step of my hypothesis and GREENDEBT-DUMMY or ASINH(GREENDEBT) in the second step. RP_{ft}^{ℓ} are relative period indicators that are equal to one for a firm calendar year observation, where the time relative to the cross-listing year matches the dummy statement and zero otherwise. For instance, the relative time period dummy minus 2, RP_{ft}^{-2}, is equal to one for any firm in calendar year 2018 that listed in the United States in 2020. To avoid multicollinearity I drop the relative time period dummy "minus 1". $\mathbf{1}\{E_f = e\}$ are cohort specific indicators for firms in a given cross-listing year. For instance the cohort dummy "listing year" 2020 ($\mathbf{1}\{E_f = 2020\}$) is equal to one for firms that listed in the United States in 2020. I additionally include firm level controls as before.

I first assess the plausibility of the parallel trend assumption in Figure 3 and Figure 4 and visually inspect the data around the listing period. Firms listed between the years -1 and 0. I do not observe any clear differential pre-trends in both ownership dependent variables and green capital expenditure proxies between the two groups of firms. Yet, Roth (2022) highlights that this visual pretest inspection may fail to detect pre-existing trends that can produce meaningful bias in the treatment effect. I follow Roth (2022) to identify whether my pre-test is likely to be well powered against violations of parallel trends. I plot a linear violation in Appendix Figures A.III and A.IV with a hypothesized slope based on having 50% power, i.e. the probability of passing the pre-test is 50%. The estimated slopes are economically meaningful, e.g. a 1.6pp annual increase in the US share translates into a hypothesized difference of 4.8pp three years later relative to a 30% average share in the US share. Similarly, a negative 0.3pp slope for green debt instruments translates into a 0.9pp difference three years later relative to a 2% average in green debt issuance. The likelihood ratio for this hypothesized trends are displayed in Appendix Table A.XII and are between 0.02 and 1.6, i.e. the chance of seeing the observed pre-test coefficients under the hypothesized trend relative to under parallel trends is at most 60% higher but often less likely. This observation supports the plausibility of the parallel trend assumption and the qualitative evidence that the reason for cross-listing is unrelated to managing firms' responsible ownership.

3.2.2 Impact of cross-listing on ownership and green capital expenditure

I first document the increase in American institutional ownership and decrease in responsible ownership post-cross listing. Following the cross-listing, the share of American institutional investors is on average 8.8pp higher for the treated firms relative to the control group three years post cross-listing. Further, the CA100 SHARE (IMPACT-PRI SHARE) decreases on average by 5.1pp (6.0pp) three years post cross-listing. While the CA100 SHARE for instance is only available for a short period, the IMPACT-PRI SHARE, as an alternative measure of responsible institutional investor ownership with a longer time series, also highlights a pronounced drop in the responsible investor share. This supports the decision to measure the impact on green debt over the maximum time period available, i.e. starting with firms first cross-listing in 2014 to have at least one year of pre-treatment data available.

[Insert Figure 3 about here]

The correlation results suggest that lower responsible ownership may translate into lower green capital expenditures. I next assess whether the plausibly exogenous decrease in responsible ownership post cross-listing also translates into lower green capital expenditures. Figure 4 shows that the probability of firms issuing at least one green debt instrument decreases by 4.6pp three years after the treatment[18]. Panel B and C in Figure 4 highlight that the amount green debt raised decreases post cross-listing and absolute scope 1 emissions increase post cross-listing. I also document an increase in scope 1 emission intensities in Appendix Figure A.VI and a decrease in green innovation in Appendix Figure A.VII. Emission and green innovation as alternative measure mitigate any concern that green debt as a capital source is impacted by the cross-listing for reasons unrelated to responsible investor pressure. Together, the results are in line with the view that lower responsible ownership leads to lower green capital expenditures.

[Insert Figure 4 about here]

Concerns in the identification approach include a general change in investing post cross-listing, governance differences in particular between the United States and Asia and more generally some unobserved variable or shock driving cross-listing and decreases in green debt. Despite matching firms on capital expenditure relative to assets, firms cross-listing in the United States may have different (more) investment opportunities than firms that do not cross-list. Yet, listing in the United States should increase access to capital and is usually expected to increase capital expenditures. If green capital expenditure stays proportionally to general capital expenditure, I would have expected green capital expenditure to increase. I find that green

[18] In Appendix Figure A.V, I show the Bacon decomposition for all possible two-group/ two-period DID estimators of the general two-way fixed estimator (Goodman-Bacon, 2021). This figure shows the "good" Treated vs Never-Treated estimates are all negative and would account for 85% of the general two-way fixed effect estimator.

debt instruments issuance drops. Part of the initial drop in green debt instruments may be explained from a more general decrease in debt funding need following new raised capital from the cross-listing. However, I find a long pronounced drop in green debt issuance that persists four years after listing in the United States. Indeed, when I look at capital expenditures and total outstanding long-term debt in general in Figure 5, I do not find any statistically significant change between firms that cross-list in the United States and those that do not. Furthermore, in Appendix Figure A.VIII I also show that the proportion of foreign sales do not increase significantly post cross-listing. This alleviates concerns that firms' business model changes radically post cross-listing.

[Insert Figure 5 about here]

In Asia, the average institutional ownership and the regulatory environment is more different from the United States relative to the difference between Europe and the United States. Both differences may imply that more factors may convolute the cross-listing of Asian firms. I therefore repeat the analysis with European firms' cross-listings only. Results in Appendix Figures A.IX and A.X show that the reduction in responsible ownership and green capital expenditure also hold for the European only sample.

Lastly, I also consider the flip side of European and Asian firms cross-listing in the United States, namely American firms' cross-listing in Europe. While the firm rationale and its characteristic may differ substantially for different cross-listing destinations (see e.g. Pagano, Röell, and Zechner (2002)), American firms' cross-listing on European exchanges should increase their exposure to European investors, who are on average more sustainable. I therefore expect their share of responsible investors and the green debt issuance to increase. I collect the ticker, exchange, currency of the ticker and date of all public firms cross-listing on a European exchange from SP Capital IQ for the total available time series.[19] This approach includes securities listed on exchanges as well as over the counter listings.[20] More than 90% of the cross-listings I identify are over-the-counter cross-listings, which weakens the expected shareholder structure impact. Yet, after matching the 143 American firms that cross-listed in Europe (see Appendix Figure A.XI) following the same approach to the three nearest neighbors, I still find a small positive increase in the responsible share and (insignificant) increase in green debt issuance.

Together, my findings support that responsible institutional investors drive firms to increase green capital expenditures and contradict the view that responsible investors only engage in cheap talk.

[19] Chen, Ng, and Tsang (2015) highlight that collecting cross-listings through SP Capital IQ provides a more complete picture of foreign firms' cross-listings than relying on data from major stock exchanges that on top of this have varying definitions of foreign firms.

[20] The first cross-listing is an over-the counter listing by Host Hotels & Resorts, Inc. in 1953 on Deutsche Boerse

3.3 Evidence for responsible investor engagement

Responsible investing can affect firms' green capital expenditures through two main channels. First, a larger sustainable investment sector lowers cost of capital for green projects and therefore incentivizes management to invest in green projects (e.g. Heinkel, Kraus, and Zechner, 2001; Bolton and Kacperczyk, 2021; Pástor, Stambaugh, and Taylor, 2021). Second, responsible institutional investors can exert influence over firms' capital expenditure by voicing their preferences, i.e. by engaging with management (e.g. Broccardo, Hart, and Zingales, 2022; Biais and Landier, 2022; Chowdhry, Davies, and Waters, 2019; Oehmke and Opp, 2022). They can push the implementation of internal governance mechanisms that set incentives in line with their preferences and ultimately drive management to act in line with their preferences. Dimson, Karakaş, and Li (2015) show empirically that engagement is an effective tool in influencing corporate decisions. In Appendix Section A.5, I expand the model by Pástor, Stambaugh, and Taylor (2021) and show that inducing shareholder preferences for green technologies on management through social impact linked compensation increases firms' green capital expenditure above any pure green asset demand side effects. Oehmke and Opp (2022) more formally study optimal engagement via a contracting approach. Sustainable investors with a real impact mandate are willing to accept lower rate of returns in return for control over the technology the company adopts. These observations motivate that investor engagement with management is an important channel for investors to accelerate green capital expenditure. In line with this, one of the distinguishing characteristics of the CA100+ initiative is its engagement strategy to drive firms to reduce their greenhouse gas emissions. I therefore hypothesize that responsible investors engage with their portfolio companies to achieve their desired objective of lower carbon emissions. I expect to see higher number of engagements and the implementation of appropriate internal governance mechanisms.

I start by documenting that within the PRI survey subset, CA100+ investors engage more with management on environmental, social and governance topics than non-CA100+ investors. The histogram in Figure 6 shows that the distribution of engagement by non-CA100+ investors is right-skewed with more than 55% of non-CA100+ investor-year observations having less than 100 engagements per year. In contrast, less than 18% of CA100+ investor-year observations have less than 100 engagements per year. In general, the distribution of CA100+ investor-years has substantially more mass shifted towards a higher number of annual engagements.

[Insert Figure 6 about here]

Next, I observe that responsible ownership is associated with tighter future environmental governance that monitors and incentivizes management to invest in green technology. A first commitment device is a decarbonization target. Decarbonization targets may self-discipline management and ensure that the advertised carbon emission reductions are carried out. Bolton and Kacperczyk (2023a) point out that these commitments are associated with future decarbonization and are mostly set by already low greenhouse gas emitting firms or firms willing to reduce greenhouse gas emissions. To push firms to commit to the green transition and track their progress, responsible institutional investors should drive firms to set decarbonization targets. The Science-Based Targets initiative (SBTi) enables organizations to set science-based emissions reduction targets. I construct two indicator variables identifying SBTi signatories (SBTSIGN) and SBTi target setters (SBTTGT). SBTSIGN is one for firms that commit to set a decabronization target or have already set a decarbonization target and zero otherwise. SBTTGT is one for firms that have set and got an approved decarbonization target. I use SBTSIGN and SBTTGT as dependent variable in the main specificatoin 2 with firm and industry-year fixed effects. Table 7, Panel A, highlights that a higher responsible investor share is followed by being more likely to be a signatory and have an approved target. I also repeat this analysis with the cross-listing sample. Figure 7 shows that European and Asian firms probability of becoming a SBTi signatory decreases post cross-listing, i.e. after the responsible ownership drop. This result suggests that responsible institutional investors may be causally related to stricter environmental governance.

[Insert Figure 7 about here]

Environmental responsibilities and incentives at the executive level are another environmental governance tool to direct management strategy. Using Refinitiv ESG data, I construct indicator variables for firms having a chief sustainability officer (CSO), sustainability responsibilities assigned to at least one executive (EXECSUSRESP) and sustainability targets in executive compensation (EXECSUSCOMP).[21] Following Strand (2013), I first screen managers' job titles for the words "sustainable", "sustainability", "responsibility", "ethics", "environment", "climate", "CSO", "CSR" and subsequently manually scrutinize the job title to identify CSOs. I rerun specification 2 with the environmental governance variables as dependent variables and firm and industry-year fixed effects. Table 7, Panel B, shows that there is a positive association between the responsible investor share and future environmental executive responsibilities. A one standard deviation increase in the CA100 proportion (0.22), translates on average in a 1.2pp higher probability of having a CSO, a 2.1pp higher probability of executive responsibility for sustainability issues and a 1.1pp higher probability of sustainability targets in executive compensation three years later. Higher proportions of responsible institutional investors thus correlate with stronger future firm-level environmental governance that creates incentive structures to spur green capital expenditure.

[21] I use the variables CG_BD_CP_DP039: Senior Executive CSR Sustainability Compensation Incentives and CG_BD_CP_DP029: Senior Executive Responsibility for CSR Sustainability to identify if at least one senior executive has sustainability responsibilities respectively compensation incentives

[Insert Table 7 about here]

Finally, given that engagement with firms is costly for institutional investors, institutional investors should concentrate their effort on the most important firm subset for the net zero transition. Indeed, the CA100+ initiative initially only targeted the 100 highest emitters and has subsequently expanded its focus now targeting 171 companies that it believes play a critical role in the net zero transition. I define $CA100\ TARGET$ as a time-varying dummy equal to one if the firm is part of the target companies of the CA100+ initiative. Using Trucost emission data, I also create a dummy ($HIGHEST\ EMITTERS$) equal to one for the 200 companies with the highest scope 1 emissions in 2016, which is the year before the CA100+ initiative was launched. The 200 highest emitters are responsible for more than 70% of total scope 1 emissions in my sample in 2016 and their decarbonization is thus critical for the net zero transition. Already green companies have limited scope to reduce emissions further. Institutional investors whose goal is the net zero transition should therefore focus their attention on the highest emitters subset.

Similar to the main specification 2, I run the pooled regression specification 4 with the interaction term, firm fixed effects and industry-year fixed effects. The coefficient of interest is β_2, which captures interaction between the $CA100\ SHARE$ variable and either $TARGET$ group. While $CA100\ TARGET$ is time-varying, $HIGHEST\ EMITTERS$ is constant and β_3 is therefore not estimtaed with $HIGHEST\ EMITTERS$ as $TARGET$ group.

$$\begin{aligned} GREENDEBT_{fjt} = &\alpha + \beta_1 CA100\ SHARE_{fjt-x} + \beta_2 CA100\ SHARE_{fjt-x} * TARGET_{fjt-x} + \\ &\beta_3 TARGET_{fjt-x} + \gamma Controls_{cfjt-x} + \theta_f + \tau_{jt} + \epsilon_{fjt} \end{aligned} \tag{4}$$

If institutional investors target a certain subset, the correlation between responsible ownership and green capital expenditure should be stronger for this subset. Table 8, Panel A, reports that the correlation with future green capital expenditure is indeed multiple magnitudes stronger for these subsets. A one standard deviation increase in the CA100 SHARE (22pp), translates on average in a 11.44pp higher probability of issuing green debt three years later for the the highest emitters. In contrast, for the rest it only leads on average to a 0.84pp higher probability of issuing green debt three years later. Part of the economically much larger effect is explained by unconditional green debt issuance being substantially higher for the highest emitters (see Appendix Figure A.XIII). On average, 19.00% of the highest emitters issued green debt in the sample period compared to 2.45% for the remaining sample. Yet, the percentage change is still larger for the highest emitters (60% vs 34%) suggesting that some of the effect is driven by stronger responsible investor pressure for this subset. In line with this result, I also find that the effect on absolute and emission intensity scope 1 emissions are stronger for the highest emitter and CA100+ target subset (compare Appendix Table

A.XIII.

[Insert Table 8 about here]

I repeat this exercise with the environmental governance variables, as I also expect that environmental governance is more stringently implemented within the highest emitters. Panels B and C of Table 8 show that the interaction terms are mostly positive and significant for both decarbonization targets and executive environmental responsibilities. The effects are strongest for the largest emitters on which responsible institutional investors are most likely to focus on if they want to achieve impact. Overall, these results suggest that responsible institutional investors engage with firms to change their behavior. While it does not pin down the mechanism to engagement, engagement likely plays an important role in how responsible institutional investors drive firms to increase green capital expenditure.

3.4 Factors moderating responsible investors' pressure

Responsible institutional investors are not operating in isolation, but are one factor of many in the net zero transition. Given the plurality of net zero transition pressures, this section aims to understand for which firms responsible investor pressure bites most and under which circumstance responsible institutional investors are most active. My results suggest that responsible investor pressure is more effective in firms with more resources to respond and in environments where other net-zero transition pressure exists.

My first hypothesis is that larger and more profitable firms have the necessary resources to respond, while smaller and less profitable firms are more constrained and less able to enter into lower net present value projects. To test this hypothesis, I interact the responsible investor share (CA100 SHARE) with LOGSIZE and ROE. Table 9 reports the results and documents that the interaction terms are positive and statistically significant. In line with the hypothesis, responsible investor pressure is more impactful for larger and more profitable firms.

[Insert Table 9 about here]

I next assess how responsible investor pressure interacts with other societal net zero transition pressure. As environmental regulation and other societal pressure to reduce emission tighten, green business models become more profitable. Responsible investors may act as substitute or complement to other societal pressures. If other net zero transition incentives are sufficient or other pressures weaken responsible investors' perceived necessity for action, they may operate as substitute. On the other hand, stronger other net zero transition incentives may strengthen responsible investors' position and ambition. Ex-ante more profitable green business models should ease negotiation with management and other shareholders to push green projects and can thus accelerate responsible investor action.

I collect data on six different measures of net-zero pressures covering dimensions from regulatory to broader consumer pressures. First, I construct a time trend (TIME), as societal awareness and pressure has been increasing over time. Second, I interact the CA100 SHARE with the firm headquarter regions. The political and societal pressure to speed up the energy transition differs across regions and is probably strongest in Europe. Europe for instance introduced the the world's first major carbon market and it remains the biggest one.[22] Third, I include three measures of regulatory pressure. The regulatory measures include country level net environmental taxes (NETENVAXES) and measures of normalized domestic (DOMPOLICY) and international policy (INTPOLICY) tightness follwoing Bolton and Kacperczyk (2023b). I collect country level data on environmental taxes and fossil fuel subsidies from IMF[23] and define net environmental taxes as the difference of environmental taxes relative to GDP and fossil fuel subsidies relative to GDP. Countries with higher net environmental taxes should provide a more feasible business environment for low emission technologies. Germanwatch calculates annual country level domestic and international climate change policy tightness based on domestic regulation and international pan-governmental agreements. Fourth, I use a more consumer pressure related measure (NGO-CAMPAIGN), which captures an increase in NGO campaign pressure faced by a corporation. Sigwatch tracks firm-level NGO campaign events, which can be a new target or country for pressure, a new allegation, a report or significant public protest (Hatte and Koenig, 2017). I count the number of climate change campaigns a company faces in a given year and construct a dummy equal to one if the number of campaigns a firm is exposed to increased relative to the last year. The dummy is equal to zero for firms where the number of campaigns decreased, remained flat or are not covered.

[Insert Table 10 about here]

The results in Table 10 are consistent with the view that responsible investor pressure is complementary to other societal pressures rather than a substitute. The time trend interaction is positive and statistically significant. Further, the responsible investor pressure is strongest in Europe, which has been more active in addressing the energy transition. Similarly, the interaction with the regulatory pressure variables is positive and mostly significant. Lastly, the interaction with the NGO-CAMPAIGN dummy is also positive, which suggests that the investor pressure may have been more effective in years where the number of campaigns a company has faced increased. All interactions point towards a complementarity between responsible investor pressure and net zero transition pressure. The complementarity suggests that responsible

[22] EU Emission Trading Scheme
[23] IMF Government Policy Indicators

institutional investors pressure alone may be insufficient. Rather, it is the combination with other net zero transition pressures that leads to a strong acceleration of green capital expenditure.

3.5 Responsible investors and green capital expenditures' role in decarbonization

My results suggest that responsible ownership has an economically meaningful impact on a firm's green capital expenditure, but does this effect also aggregate to an economically meaningful quantity at the global level? To assess this question, I first quantify the global impact of responsible investors on green capital expenditures. Next, I compare the pressure of responsible investors to the impact of a carbon tax. Lastly, I provide some suggestion of the importance of green capital expenditure in emission reduction relative to the sale of high emission-intensive assets. Although estimating aggregate economic effects using my empirical exercise is challenging in the absence of a general equilibrium model, I provide back of the envelope calculations for aggregate economic implications abstracting from general equilibrium considerations to be able to judge the relative importance of responsible institutional investors. My results suggest that responsible investors' global impact is similar or greater than the effect of a carbon tax. While responsible investors as capital source and governing agent represent an important force, to limit warming to 1.5°C multiple tools may be needed.

I first translate my results into a measure of the aggregate impact on green capital expenditures. I focus on the correlation results, as these cover the global sample and are therefore likely more representative than the smaller cross-listing sample. A one standard deviation increase in the CA100+ share (22pp) is associated with a 0.041pp higher probability of issuing green debt. Between 2017 and 2021, the average proceeds from a green debt issuance were $350 million in my sample. There are currently about 60,000 public firms.[24] Assuming that the responsible investor share increases across all public firms by one standard deviation, this change would translate into about $200 billion additional green debt.[25] This increase represents about 20% of current green capital expenditures (about $1 trillion in 2022). Although the effect is relatively large compared to current levels, it is still insufficient to close the current $3 trillion gap to be on a net zero trajectory.

I next compare the impact of responsible investor pressure to a carbon tax. Green (2021) assesses 37 studies on carbon taxes and finds that the aggregate reductions from carbon pricing on emissions are limited and translate only into 0% to 2% lower emissions per year. I find that a one standard deviation increase in responsible ownership (22pp) translates over three years into a 3.6% reduction in emissions across all firms worldwide (see Table 5), equivalent to 1.2% annually. Considering that the European Union Emission

[24] World Federation of Exchanges. (2022 May). "Number of Listed Companies".

[25] $\$350mn * 60,000 * 0.22 * 0.041 \approx \$189bn$

Trading Scheme and other carbon taxes typically target manufacturing installations and are thus tilted towards high emission firms, a more accurate comparison group may be the impact on the highest emission subset. For the largest 200 firms, I find on average a 13.2% reduction over three years for a one standard deviation increase in responsible ownership (see Table A.XIII), equivalent to 4.4% annually. My calculations therefore suggest that a one standard deviation increase in responsible ownership is associated with a 1.2% to 4.4% decrease in annual emission reductions. This magnitude is similar and possibly even greater than the impact of a carbon tax on emissions (0% to 2% annual emission decrease). However, the required decarbonization rate to limit warming to 1.5° is about 8% per annum until 2030 .[26] Therefore responsible investor pressure seems to be one economically important driver and within a set of multiple tools can contribute to achieve the necessary decarbonization rate to limit warming to 1.5°C.

Lastly, how much of the reduction in emissions may be attributed to green capital expenditures and changes in operations versus the sale of brown assets. To shed some light on this matter, I compare the change in emissions to changes in assets and sales as well as changes in emission intensities. Table 5, Panel C, shows that higher responsible ownership is not only followed by a decrease in absolute scope 1 emissions, but also scope 1 intensities. This result suggests that firms invest to improve the efficiency of their existing operations, respectively in greener operations. Further, I document in Appendix Table A.XIV Panel A that a higher share of responsible ownership is also associated with a statistically significant decrease in assets and sales, but the coefficients are only about half the size of the change in total scope 1 emissions (0.08 vs 0.17 compare Table 5). It is therefore unlikely that all emission reduction is driven by the sale of brown assets. Moreover, for the highest emitter subset, sales may even increase, although this effect is often not significant. These results jointly suggest that while some of the emission reduction may be attributed to the sale of brown operations, green capital expenditures contribute to emission reductions. Responsible institutional investors seem to pressure firms to green their operations and do not allow firms to only sell off brown operation.

4 Conclusions

In this paper, I empirically show that responsible institutional investors practice stewardship and help accelerate green capital expenditure and thus the net zero transition. Firms with a greater share of responsible institutional investors, as measured by being a CA100+ signatory, are positively associated with future green capital expenditure, proxied with green debt in my main specification. Estimations that exploit plausibly

[26]The 2023 IPCC AR6 report calculates that emissions need to decrease by 48% until 2030 from the 2019 emission levels to limit warming to 1.5°C with more than 50% likelihood with no or limited overshoot. Considering that global emissions in 2023 are above 2019 levels, this translates at least into 48%/6 = 8% annual rate (IPCC, 2023).

exogenous variation based on firm's cross-listings confirm this finding. Institutional investors seem to engage with firms, particularly the largest emitters, and implement environmental governance mechanisms to incentivise managers to invest in green activities. Further, responsible institutional investor pressure seems to be complementary to other net zero transition pressures, which highlights the value of multi-faceted net-zero transition pressure. Overall, my results underscore the importance institutional investors can play in accelerating green capital expenditure, which are crucial to transition away from brown technologies and towards a global net-zero world. Responsible investor pressure and green capital expenditure appear to translate into emission reductions, the ultimate end goal. The effect seems to be at least of the size of a carbon tax. While the magnitude is still instufficient on its own, institutional investors as one factor of many can meaningfully contribute to align public firms on a net zero trajectory. To the extent that more institutional investors adopt sustainable preferences, the investment gap to be on a net-zero trajectory may be closed more quickly.

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Tables

Table 1: Responsible investor share & green investment across time

The table reports annual sample averages across time for the available periods between 2006 and 2021 (2022). In Panel A, I report average responsible investment shares across time based on the CA100 SHARE in columns 1 to 4 worldwide and by headquarter region, the PRI SHARE in column 5 and the IMPACT-PRI SHARE in column 6. In Panel B, I report average green capital expenditure proxies based on the green debt instruments in column 1 to 4, the taxonomy based clean investment ratio in column 5, log absolute scope 1 emissions in column 6 and green innovation in column 7. All variables are defined in Table 11.

Panel A: Responsible investor proportion

	(1)	(2)	(3)	(4)	(5)	(6)
	CA100 SHARE				PRI SHARE	IMPACT-PRI SHARE
	worldwide	North America	Europe	Asia	worldwide	worldwide
2006					4.3	3.8
2007					10.4	9.3
2008					13.3	11.4
2009					17.2	12.8
2010					19.4	14.9
2011					21.7	16.7
2012					28.9	22.2
2013					36.4	29.0
2014					38.1	30.4
2015					41.2	29.5
2016					43.4	31.7
2017	1.5	1.1	3.0	1.0	49.1	39.8
2018	7.9	5.7	16.2	5.8	54.7	41.9
2019	10.0	6.2	18.5	8.9	58.3	48.8
2020	20.6	15.9	27.2	20.4	61.0	48.5
2021	24.8	18.8	30.6	25.4	65.2	48.9
Total	15.4	11.2	21.5	15.2	38.3	30.1

Panel B: Green capital expenditure measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GREENDEBT-DUMMY		GREENDEBT-AMOUNT	VERIFIED GREENDEBT	CLEANINVEST-MENTRATIO	LOGS1TOT	GREENRATIOEP
	equally weighted	asset weighted	sum (mil. USD)	asset weighted			
2006	.	.	.	.	.	6.5	9.6
2007	.	.	.	.	.	6.5	9.8
2008	.	.	.	.	.	6.5	10.4
2009	.	.	.	.	.	6.4	11.9
2010	.	.	.	.	.	6.4	13.0
2011	.	.	.	.	.	6.4	13.9
2012	.	.	.	.	.	6.3	13.3
2013	0.1	1.8	2.5	1.6	.	6.2	12.9
2014	0.2	1.5	8.1	1.2	.	6.1	11.5
2015	0.2	4.9	10.2	4.8	.	6.0	12.5
2016	0.2	8.4	38.5	8.2	.	5.0	13.3
2017	0.4	11.7	37.4	10.4	.	4.9	13.2
2018	0.6	15.8	52.0	13.4	.	4.9	14.1
2019	1.0	20.5	85.8	18.2	10.7	4.9	14.7
2020	1.2	21.0	116.6	16.5	13.2	4.7	14.6
2021	2.6	29.0	273.1	21.8	14.5	4.7	14.3
2022	2.6	30.7	233.1	23.8	35.9	3.9	.
Total	0.9	14.7	86.8	12.2	13.4	5.4	12.7

TABLE 2: SUMMARY STATISTICS

The table reports sample first quartiles, median, third quartiles, averages, standard deviations and firm-year observations for institutional ownership variables in Panel A, green debt instruments in Panel B, other green capital expenditure measures in Panel C and control variables in Panel D. The sample period depends on the availability of data and goes at most from 2006 to 2022. All variables are defined in Table 11.

	(1) 1st Quartile	(2) Median	(3) 3rd Quartile	(4) Mean	(5) Std Dev	(6) Firm-year obs.
Panel A: Institutional ownership						
ALL INSTOSHIP	0.014	0.069	0.218	0.188	0.273	332085
CA100 SHARE	0.000	0.032	0.198	0.131	0.197	104532
PRI SHARE	0.012	0.270	0.649	0.358	0.343	329980
IMPACT-PRI SHARE	0.001	0.158	0.485	0.280	0.312	329980
Panel B: Green debt instruments						
GREENDEBT-DUMMY	0.000	0.000	0.000	0.009	0.096	212256
GREENDEBT-AMOUNT (intensive)	104.298	366.364	960.343	802.168	1437.107	1964
GREENDEBT-AMOUNT	0.000	0.000	0.000	7.422	158.112	212256
ASINH GREENDEBT-AMOUNT	0.000	0.000	0.000	0.059	0.631	212256
VERIFIED GREENDEBT-DUMMY	0.000	0.000	0.000	0.006	0.075	212256
ASINH VERIFIED GREENDEBT-AMOUNT	0.000	0.000	0.000	0.034	0.474	212256
SUSLINKDEBT-DUMMY	0.000	0.000	0.000	0.003	0.055	212256
ASINH SUSLINKDEBT-AMOUNT	0.000	0.000	0.000	0.017	0.348	212256
Panel C: Other green measures						
CLEANREVENUERATIO	0.000	0.000	0.050	0.125	0.273	7061
CLEANINVESTMENTRATIO	0.000	0.000	0.033	0.134	0.298	5923
LOGS1TOT	3.353	5.157	7.115	5.326	3.019	108362
LOGS2TOT	3.758	5.301	6.845	5.261	2.365	108438
LOGS3UPTOT	5.614	7.126	8.624	7.077	2.273	108487
S1INT	0.058	0.173	0.529	2.035	5.863	108487
S2INT	0.084	0.190	0.434	0.402	0.579	108487
S3UPINT	0.494	1.119	2.402	1.738	1.702	108487
GREENRATIOEP	0.000	0.000	0.114	0.129	0.264	47141
GREENRATIOWW	0.000	0.000	0.046	0.071	0.180	119662
GREENCITCOUNTEP	0.000	0.000	8.000	111.099	1542.497	47141
GREENCITCOUNTWW	0.000	0.000	3.000	114.310	1506.325	119662
GREENCITMAXEP	0.000	0.000	6.000	48.546	1336.650	47141
GREENCITMAXWW	0.000	0.000	2.000	30.581	860.856	119662
Panel D: Control variables						
LOGSIZE	4.361	5.688	7.096	5.756	2.064	332085
LEVERAGE	3.002	16.309	32.437	20.270	18.902	332085
ROE	−0.833	7.320	14.839	0.150	33.492	332085
INVEST/A	0.848	2.867	6.438	4.833	5.753	332085
M/B	0.822	1.484	2.848	2.425	2.742	332085
BETA	0.705	0.898	1.124	0.905	0.458	332085
VOLAT	0.070	0.104	0.155	0.129	0.104	332085
MOM	−0.022	0.002	0.024	−0.000	0.048	332085
RET	−0.050	0.003	0.065	0.014	0.142	332085
MSCI	0.000	0.000	0.000	0.140	0.347	332085

TABLE 3: CA100+ SHARE & GREEN DEBT

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. $CA100\,SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include industry-year and firm fixed effects. I cluster standard errors at the firm level. For the industry-year and firm fixed effect specifications, I additionally report the partial R2 and Oster (2019)'s delta based on 1.3 x partial R2. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
1YR-LAG CA100 SHARE	0.018***		0.018***		0.106***		0.105***	
	(0.002)		(0.003)		(0.015)		(0.017)	
3YR-LAG CA100 SHARE		0.031***		0.041***		0.206***		0.261***
		(0.006)		(0.007)		(0.036)		(0.045)
L1/L3 LOGSIZE (/100)	0.727***	1.075***	0.112	−0.008	4.885***	7.257***	0.767	0.097
	(0.058)	(0.090)	(0.087)	(0.170)	(0.388)	(0.593)	(0.544)	(1.117)
L1/L3 LOGPPE (/100)	0.199***	0.239***	0.153	0.433*	1.471***	1.820***	0.878	2.042
	(0.049)	(0.075)	(0.130)	(0.255)	(0.320)	(0.485)	(0.765)	(1.579)
L1/L3 LEVERAGE (/100)	0.018***	0.023***	−0.002	0.001	0.084***	0.111***	−0.016	0.026
	(0.003)	(0.005)	(0.005)	(0.010)	(0.020)	(0.032)	(0.029)	(0.061)
L1/L3 ROE (/100)	−0.007***	−0.014***	0.002	−0.002	−0.047***	−0.099***	0.016*	−0.017
	(0.001)	(0.002)	(0.001)	(0.003)	(0.007)	(0.015)	(0.009)	(0.021)
L1/L3 M/B (/100)	−0.154***	−0.229***	0.039*	0.023	−0.960***	−1.486***	0.334**	0.129
	(0.019)	(0.029)	(0.021)	(0.042)	(0.124)	(0.193)	(0.142)	(0.292)
L1/L3 INVEST/A (/100)	0.002	−0.006	0.015	−0.001	−0.023	−0.051	0.069	0.040
	(0.009)	(0.014)	(0.010)	(0.020)	(0.054)	(0.089)	(0.058)	(0.124)
L1/L3 BETA (/100)	0.015	−0.131	0.005	0.115	0.038	−0.742	−0.243	0.438
	(0.078)	(0.135)	(0.068)	(0.135)	(0.542)	(0.946)	(0.476)	(0.821)
L1/L3 VOLAT (/100)	1.722***	2.811***	−0.086	0.212	12.761***	21.264***	0.050	1.829
	(0.326)	(0.620)	(0.337)	(0.833)	(2.125)	(4.108)	(2.130)	(5.332)
L1/L3 MOM (/100)	−3.044***	−3.041*	−1.057	−0.927	−25.568***	−19.523*	−11.318**	−1.226
	(0.848)	(1.637)	(0.907)	(1.791)	(5.457)	(10.583)	(5.727)	(11.245)
L1/L3 RET (/100)	−0.013	0.612	−0.211	0.286	0.091	4.147*	−0.572	1.863
	(0.221)	(0.379)	(0.237)	(0.450)	(1.415)	(2.490)	(1.538)	(2.839)
L1/L3 MSCI	0.021***	0.030***	0.003	0.016*	0.140***	0.194***	0.023	0.074
	(0.002)	(0.004)	(0.006)	(0.009)	(0.015)	(0.023)	(0.036)	(0.061)
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0885	0.115	0.456	0.583
Partial-R2			.392	.514			.402	.528
Oster Delta			2.646	2.769			2.575	2.649

TABLE 4: ALTERNATIVE RESPONSIBLE OWNERSHIP MEASURES & GREEN DEBT

The unit of observation is firm-year. The sample period is 2017-2022 in Panel A to D and 2013 to 2022 in Panel E. The dependent variable is $GREENDEBT-DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. The key independent variables are $CA100-EARLY\ JOINER\ SHARE$ in Panel A, $CA100\ W/O\ BLK\ and\ SSGA\ SHARE$ in Panel B, $CA100\ W/O\ SHORT-TERM\ SHARE$ in Panel C, $CA100\ W/O\ HIGH\ EMISSION\ SHARE$ in Panel D and $IMPACT-PRI\ SHARE$ in Panel E. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
Panel A: CA100+ early joiners only								
1YR-LAG CA100-EARLY JOINERS SHARE	0.018***		0.014***		0.119***		0.089***	
	(0.003)		(0.004)		(0.021)		(0.025)	
3YR-LAG CA100-EARLY JOINERS SHARE		0.032***		0.044***		0.211***		0.289***
		(0.006)		(0.008)		(0.038)		(0.049)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0858	0.111	0.445	0.568	0.0884	0.115	0.455	0.583
Panel B: CA100+ without BlackRock and State Street Global Advisors								
1YR-LAG CA100 W/0 BLK and SSGA SHARE	0.011***		0.010***		0.067***		0.058***	
	(0.002)		(0.003)		(0.015)		(0.017)	
3YR-LAG CA100 W/0 BLK and SSGA SHARE		0.031***		0.041***		0.206***		0.261***
		(0.006)		(0.007)		(0.036)		(0.045)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0856	0.111	0.445	0.568	0.0883	0.115	0.455	0.583
Panel C: CA100+ without short-term investors								
1YR-LAG CA100 W/O SHORT-TERM SHARE	0.020***		0.020***		0.124***		0.117***	
	(0.003)		(0.003)		(0.018)		(0.019)	
3YR-LAG CA100 W/O SHORT-TERM SHARE		0.029***		0.044***		0.205***		0.286***
		(0.007)		(0.008)		(0.042)		(0.049)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0860	0.111	0.445	0.568	0.0886	0.115	0.456	0.583
Panel D: CA100+ without high emission investors								
1YR-LAG CA100 W/O HIGH-EMISSION SHARE	0.018***		0.022***		0.115***		0.131***	
	(0.003)		(0.003)		(0.017)		(0.019)	
3YR-LAG CA100 W/O HIGH-EMISSION SHARE		0.028***		0.042***		0.199***		0.279***
		(0.006)		(0.008)		(0.042)		(0.048)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0885	0.115	0.456	0.583
Panel E: Impact PRI signatories								
1YR-LAG IMPACT-PRI SHARE	0.004***		0.004***		0.032***		0.025***	
	(0.001)		(0.001)		(0.005)		(0.006)	
3YR-LAG IMPACT-PRI SHARE		0.003***		0.002*		0.024***		0.008
		(0.001)		(0.001)		(0.006)		(0.006)
Observations	207105	185526	206928	185286	207105	185526	206928	185286
R2	0.0568	0.0588	0.305	0.308	0.0574	0.0595	0.309	0.313
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE 5: CA100+ SHARE & ALTERNATIVE GREEN INVESTMENT PROXIES

The unit of observation is firm-year. In Panel A, the sample period is 2018-2021 and the dependent variable is a clean taxonomy based revenue and investment measure, specifically $CLEANREVENUERATIO$ in columns 1 to 4 and $CLEANINVESTMENTRATIO$ in columns 5 to 8. In Panel B, the sample period is 2017-2021 and the dependent variable is a green innovation based measure, specifically $GREENRATIOEP$ in columns 1 to 4 and $GREENCITCOUNTEP$ in columns 5 to 8. In Panel C and D, the sample period is 2017-2022 and the dependent variables are emission based. In Panel C, the dependent variable is $LOGS1TOT$ in columns 1 to 4 and $S1INT$ in columns 5 to 8 and in Panel D the dependent variable is $LOGS2TOT$ in columns 1 to 4 and $S2INT$ in columns 5 to 8. $CA100SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model except for Panel B, which is estimated using Poisson pseudo-maximum likelihood. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Clean taxonomy measures	CLEANREVENUERATIO				CLEANINVESTMENTRATIO			
1YR-LAG CA100 SHARE	0.114*		−0.007		0.182***		0.002	
	(0.059)		(0.027)		(0.063)		(0.036)	
3YR-LAG CA100 SHARE		0.125		−0.009		0.233**		0.048
		(0.085)		(0.032)		(0.092)		(0.055)
Observations	5712	3562	5289	3274	5776	3611	5366	3335
R2	0.566	0.574	0.974	0.984	0.499	0.505	0.927	0.942
Panel B: Green innovation	GREENRATIOEP				GREENCITCOUNTEP			
1YR-LAG CA100 SHARE	0.153		0.105		4.277**		5.387**	
	(0.175)		(0.227)		(2.080)		(2.349)	
3YR-LAG CA100 SHARE		0.258		1.033**		5.016***		9.128*
		(0.352)		(0.523)		(1.630)		(5.144)
Observations	11581	4864	5589	1820	11370	4510	4664	1190
Pseudo R2	0.115	0.124	0.231	0.225	0.748	0.579	0.946	0.932
Panel C: Scope 1 emissions	LOGS1TOT				S1INT			
1YR-LAG CA100 SHARE	−0.222***		−0.122***		−0.522***		−0.065	
	(0.082)		(0.044)		(0.187)		(0.103)	
3YR-LAG CA100 SHARE		−0.328*		−0.165*		−0.412		−0.274**
		(0.172)		(0.090)		(0.341)		(0.125)
Observations	50693	24905	49666	23583	50754	24940	49726	23627
R2	0.767	0.753	0.971	0.985	0.578	0.579	0.956	0.978
Panel D: Scope 2 emissions	LOGS2TOT				S2INT			
1YR-LAG CA100 SHARE	0.117*		−0.063*		0.097***		−0.010	
	(0.067)		(0.037)		(0.024)		(0.014)	
3YR-LAG CA100 SHARE		0.233*		−0.249***		0.177***		−0.052*
		(0.140)		(0.086)		(0.043)		(0.029)
Observations	50740	24927	49712	23609	50754	24940	49726	23627
R2	0.739	0.718	0.961	0.979	0.467	0.457	0.909	0.959
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE 6: ASIAN/EUROPEAN FIRMS' CROSS-LISTING BALANCE TABLE

The unit of observation is firm-year. The table presents the balance test post-matching for the four years prior to cross-listing in the United States. Panel A reports the balance test across the treatment and control sample for the variables on which I matched. Panel B reports the balance test across key outcome variables in levels and one-year changes. I report the mean, stand deviation, median and count for each sample as well as the difference and p-value between the two samples.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Treat sample				Control sample				Difference	
	Mean	Std. Dev.	Median	Count	Mean	Std. Dev.	Median	Count	Difference	p-value
Panel A: Match variables										
LOGSIZE	6.524	2.149	6.201	337	6.754	2.349	6.827	1042	−0.230	0.103
ROE	−16.469	49.817	2.203	337	−8.884	45.727	7.641	1042	−7.585	0.015
LEVERAGE	19.337	19.159	15.974	337	18.640	16.935	15.005	1042	0.696	0.559
INVEST/A	4.115	5.424	2.003	337	4.076	4.196	2.965	1042	0.038	0.906
Panel B: Non-match variables										
US SHARE	0.354	0.352	0.245	337	0.216	0.236	0.154	1042	0.138	0.000
CA100 SHARE	0.098	0.149	0.042	85	0.114	0.157	0.048	264	−0.016	0.402
IMPACT-PRI SHARE	0.251	0.240	0.179	329	0.310	0.268	0.282	1018	−0.059	0.000
1YR-CHG US SHARE	0.344	1.219	−0.000	257	0.215	0.916	0.021	743	0.129	0.156
1YR-CHG CA100 SHARE	2.440	4.009	1.700	43	3.952	8.309	1.134	115	−1.511	0.106
1YR-CHG IMPACT-PRI SHARE	0.437	1.238	0.147	268	0.510	1.606	0.099	822	−0.073	0.493
GREENDEBT-DUMMY	0.006	0.074	0.000	181	0.005	0.072	0.000	569	0.000	0.970
LOGS1TOT	4.329	3.524	4.967	159	5.916	2.729	5.961	514	−1.587	0.000
S1INT	0.617	1.510	0.149	159	1.254	3.295	0.153	514	−0.637	0.004
1YR-CHG SCOPE1TOT	0.158	0.619	0.043	147	0.097	0.422	0.022	478	0.061	0.282
1YR-CHG SCOPE1INT	0.001	0.290	−0.013	147	0.016	0.310	−0.018	478	−0.015	0.618

TABLE 7: CA100+ SHARE & ENVIRONMENTAL GOVERNANCE

The unit of observation is firm-year. In Panel A, the sample period is 2017-2022 and the dependent variable is $SBTSIGN$ in columns 1 and 2 and $SBTTGT$ in columns 3 and 4. In Panel B, the sample period is 2017-2021. The dependent variable is CSO in columns 1 and 2, $EXECSUSRESP$ in columns 3 and 4, and $EXECSUSCOMP$ in columns 5 and 6. $CA100\ SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

Panel A: Decarbonization targets

	(1)	(2)	(3)	(4)
	SBTSIGN		SBTTGT	
1YR-LAG CA100 SHARE	0.042***		0.027***	
	(0.003)		(0.002)	
3YR-LAG CA100 SHARE		0.068***		0.043***
		(0.009)		(0.006)
Controls	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes
Observations	104482	55214	104482	55214
R2	0.714	0.817	0.709	0.843

Panel B: Executive environmental responsibilities and incentives

	(1)	(2)	(3)	(4)	(5)	(6)
	CSO		EXECSUSRESP		EXECSUSCOMP	
1YR-LAG CA100 SHARE	0.018		0.098***		0.102***	
	(0.017)		(0.025)		(0.031)	
3YR-LAG CA100 SHARE		0.055**		0.095**		0.050
		(0.024)		(0.040)		(0.050)
Controls	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes
Observations	26173	10441	26173	10441	26173	10441
R2	0.804	0.890	0.662	0.829	0.717	0.836

Table 8: Responsible investor impact on investor target firms

The unit of observation is firm-year. The sample period is 2017-2022, except for 2017 to 2021 in Panel C. In Panel A, the dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. In Panel B, the dependent variable is $SBTSIGN$ in columns 1 to 4 and $SBTTGT$ in columns 5 to 8. In Panel C, the dependent variable is CSO in columns 1 to 4, $EXECSUSRESP$ in columns 5 to 8, and $EXECSUSCOMP$ in columns 9 to 13. The key independent variables are $CA100\ SHARE$ and its interaction with $HIGHESTEMITTERS$, a dummy equal to one for the for firms in the top 200 highest emitters in 2016 by total scope 1 emissions, as well as its interaction with $CA100TARGET$, a dummy equal to one if the firm is part of the target company set of the CA100+ initiative. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Green debt instruments	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
1YR-LAG CA100 SHARE	0.016^{***}	0.016^{***}			0.092^{***}	0.094^{***}		
	(0.003)	(0.003)			(0.016)	(0.017)		
1YR-LAG CA100 SHARE X HIGHEST EMITTERS	0.285^{***}				2.108^{***}			
	(0.092)				(0.615)			
1YR-LAG CA100 SHARE X CA100 Target		0.357^{***}				2.948^{***}		
		(0.094)				(0.725)		
3YR-LAG CA100 SHARE			0.038^{***}	0.039^{***}			0.246^{***}	0.250^{***}
			(0.007)	(0.007)			(0.044)	(0.044)
3YR-LAG CA100 SHARE X HIGHEST EMITTERS			0.472^{***}				3.193^{***}	
			(0.183)				(1.224)	
3YR-LAG CA100 SHARE X CA100 Target				0.322				2.822^{*}
				(0.235)				(1.712)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	104460	104460	55206	55206	104460	104460	55206	55206
R2	0.446	0.446	0.569	0.569	0.456	0.457	0.583	0.583

Panel B: Decarbonization targets as environmental governance	SBTSIGN				SBTTGT			
1YR-LAG CA100 SHARE	0.041^{***}	0.040^{***}			0.026^{***}	0.025^{***}		
	(0.003)	(0.003)			(0.002)	(0.002)		
1YR-LAG CA100 SHARE X HIGHEST EMITTERS	0.151^{**}				0.128^{**}			
	(0.065)				(0.056)			
1YR-LAG CA100 SHARE X CA100 Target		0.326^{***}				0.527^{***}		
		(0.105)				(0.104)		
3YR-LAG CA100 SHARE			0.067^{***}	0.067^{***}			0.042^{***}	0.041^{***}
			(0.009)	(0.009)			(0.006)	(0.006)
3YR-LAG CA100 SHARE X HIGHEST EMITTERS			0.111				0.065	
			(0.110)				(0.078)	
3YR-LAG CA100 SHARE X CA100 Target				0.057				0.383^{**}
				(0.208)				(0.174)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	104482	104482	55214	55214	104482	104482	55214	55214
R2	0.714	0.714	0.817	0.817	0.709	0.711	0.843	0.844

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel C: Executive environmental responsibilities as environmental governance	CSO				EXECSUSRESP				EXECSUSCOMP			
1YR-LAG CA100 SHARE	0.015	0.015			0.091^{***}	0.095^{***}			0.098^{***}	0.102^{***}		
	(0.017)	(0.017)			(0.025)	(0.025)			(0.031)	(0.031)		
1YR-LAG CA100 SHARE X HIGHEST EMITTERS	0.107				0.331^{**}				0.151			
	(0.086)				(0.145)				(0.135)			
1YR-LAG CA100 SHARE X CA100 Target		0.318				0.285				−0.105		
		(0.197)				(0.201)				(0.186)		
3YR-LAG CA100 SHARE			0.048^{**}	0.047^{**}			0.091^{**}	0.094^{**}			0.046	0.053
			(0.024)	(0.024)			(0.040)	(0.040)			(0.049)	(0.050)
3YR-LAG CA100 SHARE X HIGHEST EMITTERS			0.395				0.754				0.904^{**}	
			(0.297)				(0.472)				(0.425)	
3YR-LAG CA100 SHARE X CA100 Target				0.382				−0.038				−0.368
				(0.279)				(0.393)				(0.480)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	26173	26173	10441	10441	26173	26173	10441	10441	26173	26173	10441	10441
R2	0.804	0.805	0.888	0.888	0.662	0.662	0.829	0.829	0.717	0.717	0.837	0.836

TABLE 9: MODERATING FACTORS OF THE CA100+ SHARE & GREEN INVESTMENT RELATIONSHIP

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. The key independent variables are $CA100\ SHARE$ and its interaction with $LOGSIZE$ and ROE. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
1YR-LAG CA100 SHARE	-0.136^{***}		0.018^{***}		-0.910^{***}		0.107^{***}	
	(0.010)		(0.003)		(0.071)		(0.017)	
1YR-LAG CA100 SHARE X LOGSIZE	0.028^{***}				0.184^{***}			
	(0.002)				(0.014)			
1YR-LAG CA100 SHARE X (ROE/100)			0.026^{***}				0.159^{***}	
			(0.004)				(0.026)	
3YR-LAG CA100 SHARE		-0.185^{***}		0.041^{***}		-1.246^{***}		0.264^{***}
		(0.024)		(0.007)		(0.161)		(0.045)
3YR-LAG CA100 SHARE X LOGSIZE		0.043^{***}				0.287^{***}		
		(0.005)				(0.035)		
3YR-LAG CA100 SHARE X (ROE/100)				0.026^{**}				0.163^{**}
				(0.012)				(0.076)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.448	0.570	0.445	0.568	0.459	0.584	0.456	0.583

TABLE 10: SOCIO-POLITICAL ENVIRONMENT MODERATING CA100+ SHARE & GREEN DEBT

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$. The key independent variables are $CA100SHARE$ and its interaction with $TIME$, a time trend variable, region indicators for Europe, Asia and others while omitting North America, $NET - ENVRIONMENTALTAX$, a country level measure of envrionmental tax collections less fossil fuel subsidies relative to GDP, $INTPOLICY$, a measure of international policy tightness, $DOMPOLICY$, a measure of domestic policy tightness, and $NGOCAMPAIGN - DUMMY$, a dummy equal to one if the number of campaigns a firm is exposed to increased relative to the last year. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one year in Panel A or three years in Panel B. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)
	GREENDEBT-DUMMY					
Panel A: One-year lag						
1YR-LAG CA100 SHARE	0.048***	−0.002	0.021***	0.001	0.010*	0.015***
	(0.005)	(0.008)	(0.005)	(0.006)	(0.006)	(0.003)
1YR-LAG CA100 SHARE X TIME	0.016***					
	(0.002)					
1YR-LAG CA100 SHARE X EUROPE		0.050***				
		(0.011)				
1YR-LAG CA100 SHARE X ASIA		0.012				
		(0.009)				
1YR-LAG CA100 SHARE X OTHERS		0.004				
		(0.012)				
1YR-LAG CA100 SHARE X NET-ENVIRONMENTAL TAX			0.210***			
			(0.072)			
1YR-LAG CA100 SHARE X INTPOLICY				0.030***		
				(0.011)		
1YR-LAG CA100 SHARE X DOMPOLICY					0.012	
					(0.010)	
1YR-LAG CA100 SHARE X NGO CAMPAIGN-DUMMY						0.181***
						(0.039)
1YR-LAG NET-ENVIRONMENTAL TAX			−0.055			
			(0.042)			
1YR-LAG INTPOLICY				0.004		
				(0.003)		
1YR-LAG DOMPOLICY					0.007**	
					(0.003)	
1YR-LAG NGO-CAMPAIGN-DUMMY						−0.036***
						(0.008)
Observations	104460	104460	76958	89028	89028	104460
R2	0.445	0.445	0.465	0.453	0.453	0.446
Panel B: Three-year lag						
3YR-LAG CA100 SHARE	0.043***	0.005	0.047***	−0.007	0.023	0.038***
	(0.014)	(0.014)	(0.010)	(0.017)	(0.016)	(0.007)
3YR-LAG CA100 SHARE X TIME	0.002					
	(0.009)					
3YR-LAG CA100 SHARE X EUROPE		0.064***				
		(0.020)				
3YR-LAG CA100 SHARE X ASIA		0.018				
		(0.017)				
3YR-LAG CA100 SHARE X OTHERS		0.018				
		(0.025)				
3YR-LAG CA100 SHARE X NET-ENVIRONMENTAL TAX			0.324*			
			(0.182)			
3YR-LAG CA100 SHARE X INTPOLICY				0.070***		
				(0.026)		
3YR-LAG CA100 SHARE X DOMPOLICY					0.031	
					(0.030)	
3YR-LAG CA100 SHARE X NGO CAMPAIGN-DUMMY						0.182*
						(0.101)
3YR-LAG NET-ENVIRONMENTAL TAX			−0.120*			
			(0.070)			
3YR-LAG INTPOLICY				0.007*		
				(0.004)		
3YR-LAG DOMPOLICY					0.007*	
					(0.004)	
3YR-LAG NGO-CAMPAIGN-DUMMY						−0.027**
						(0.013)
Observations	55206	55206	43629	46873	46873	55206
R2	0.568	0.568	0.578	0.573	0.573	0.569
Controls	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes

TABLE 11: VARIABLES DEFINITION

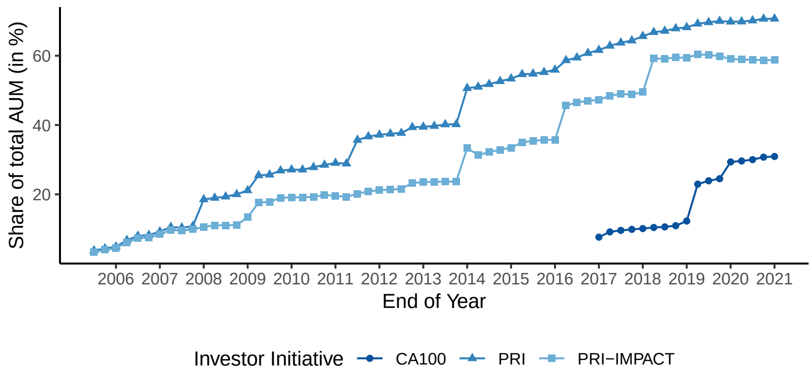
I describe the definitions of institutional ownership variables in Panel A, green investment variables in Panel B, environmental governance variables in Panel C, Control variables in Panel D and Interaction variables in Panel E.

Variable Name	Variable Definition	Data Source
Panel A: Institutional ownership variables		
CA100 SHARE	CA100+ instituional ownership divided by total institutional ownerhsip	CA100+ & FactSet
PRI SHARE	PRI instituional ownership divided by total institutional ownerhsip	PRI & FactSet
IMPACT-PRI SHARE	IMPACT-PRI investors are defined as signtories who report that at least 50% of their engagements are comprehensive or have more than 100 engagements and at least one comprehensive engagement. This is based on the PRI public survey question LEA11.1 and LEA11.2 (LEA9.1 and LEA 9.2 in 2019 and 2020). I fill survey answers forward and backward if a year is missing, assuming that signatories exhibit the same engagement style if they do not disclose or have not yet submitted a survey. IMPACT-PRI PROP is the ownership of IMPACT-PRI investors divided by total institutional ownerhsip	PRI & FactSet
US PROP	US instituional ownership divided by total institutional ownership	FactSet
Panel B: Green investment variables		
GREENDEBT-DUMMY	equals one if a firm issues at least one self-classified or externally verified sustainability bond or loan, green bond or loan or sustainability-linked bond or loan	Bloomberg
ASINH(GREENDEBT)	inverse hyperbolic (IHS) transformation of the dollar amount of proceeds raised through self-classified or externally verified sustainability bond or loan, green bond or loan or sustainability-linked bond or loan	Bloomberg
VERIFIED GREENDEBT-DUMMY	equals one if a firm issues at least one externally verified green bond or loan	Bloomberg
ASINH(GREENBOND)	inverse hyperbolic (IHS) transformation of the dollar amount of proceeds raised through externally verified green bond or loan	Bloomberg
SUSLINKBOND-DUMMY	equals one if a firm issues at least one externally verified sustainability-linked bond or loan	Bloomberg
ASINH(SUSLINKBOND)	inverse hyperbolic (IHS) transformation of the dollar amount of proceeds raised through externally verified sustainability-linked bond or loan	Bloomberg
CLEANREVENUERATIO	clean revenue divided by total revenue	Corporate Knights
CLEANINVESTMENTRATIO	clean investments (including capital expenditures, R&D, and acquisitions) divided by total investments	Corporate Knights
GREENRATIOWW	number of green patent family applications divided by the total number of all patent family applications at any patent office worldwide	Orbis IP
GREENRATIOEP	number of green patent applications divided by the total number of all patent applications at the European Patent Office	Orbis IP
GREENCITMAXWW	maximum patent citations of all green patent family applications at any patent office worldwide	Orbis IP
GREENCITMAXEP	maximum patent citations of all green patent applications at the European Patent Office	Orbis IP
GREENCITCOUNTWW	citation weighted sum of green patent family applications at any patent office worldwide	Orbis IP
GREENCITCOUNTEP	citation weighted sum of green patent applications at the European Patent Office	Orbis IP
Panel C: Environmental governance variables		
SBTSIGN	equals one if a firm is a SBTi signatory, i.e. it has commited to set a target or has an approved target	Science-Based Target initiative
SBTTGT	equals one if a firm has a SBTi approved target	Science-Based Target initiative
CSO	equals one if a firm has at least one chief sustainability officer	Refinitiv
EXECSUSRESP	equals one if a firm has at least one executive with sustainability responsibilities	Refinitiv
EXECSUSCOMP	equals one if a firm has at least one executive with sustainability targets for its compensation	Refinitiv
Panel D: Control variables		
LOGSIZE	natural logarithm of market capitalization (in $ million)	FactSet
LOGPPE	natural logarithm of plant, property & equipment (in $ million)	FactSet
LEVERAGE	book value of leverage defined as the book value of debt divided by the book value of assets	FactSet
ROE	return on equity	FactSet
M/B	market value of equity divided by the book value of equity	FactSet
BETA	firm-level market beta estimated over the one-year period	FactSet
VOLAT	monthly stock return volatility calculated over the one-year period	FactSet
MOM	cumulative stock return over the one-year period	FactSet
RET	last December stock return	FactSet
INVEST/A	capital expenditure divided by book value of assets	FactSet
MSCI	an indicator variable equal to one if a stock is part of MSCI ACWI, and zero otherwise	FactSet
Panel E: Interaction variables		
HIGHEST EMITTERS	equals one if firms are part of the top 100 largest emitters in total scope 1, 2 and upstream 3 in 2006	S&P Global Trucost
CA100 TARGET	equals one if firm is part of the focus group for engagement of the CA100+ iniative	CA100+
ENERGY SECTOR	equals one if firm is in US SIC industry x, y, z	FactSet
TIME	time trend variable	n/a
EUROPE	equals one if a firm's headquarter is located in Europe	FactSet
ASIA	equals one if a firm's headquarter is located in Asia	FactSet
NET ENVIRONMENTAL TAXES	Country level environmental taxes relative to GDP minus fossil fuel subsidies relative to GDP	IMF
INTPOLICY	international policy tightness measure	Germanwatch
DOMPOLICY	domestic policy tightness measure	Germanwatch
NGO-CAMPAIGN DUMMY	equals one if the number of campaigns a firm is exposed to increased relative to the last year and zero if the number of campaings decreased, remained flat or the firm is not covered	Sigwatch-PSE

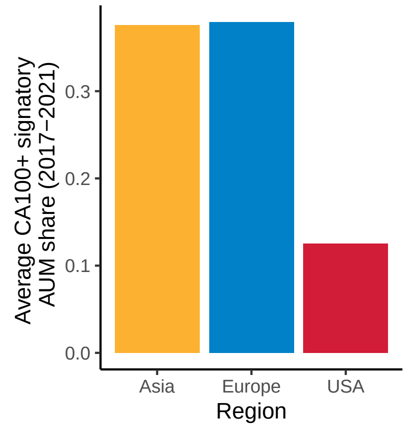
Figures

FIGURE 1: SUSTAINABLE INVESTING ACROSS TIME AND REGION

In Panel A, the sample period is 2006 to 2021. I report the proportion of assets under management by CA100+ signatories in dark blue as well as PRI and IMPACT-PRI signatories in lighter blues relative to total institutional assets under management. In Panel B, the sample period is 2017 to 2021. I report total proportion of institutional assets under management that is owned by CA100+ signatories during this period in Asia, Europe and the United States.



(A) INSTITUTIONAL INVESTOR SIGNATORIES AUM SHARE OVER TIME



(B) CA100+ SIGNATORY SHARE BY REGION

FIGURE 2: EUROPEAN AND ASIAN FIRMS CROSS-LISTING IN THE UNITED STATES

I report the number of Asian and European headquartered firms that cross-listed in the United States per year between 2007 and 2021.

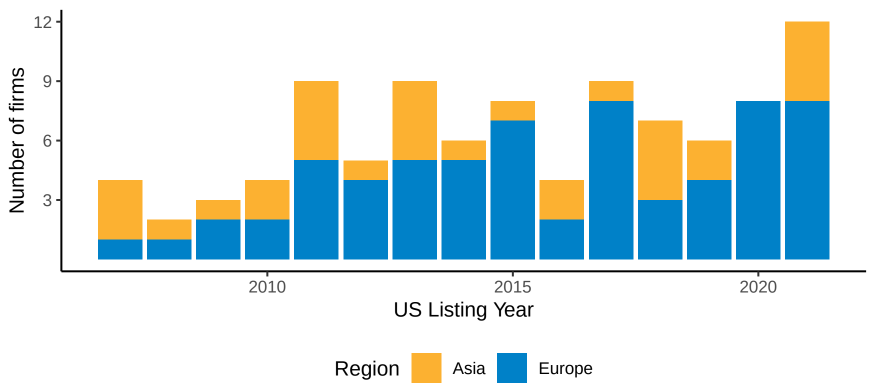
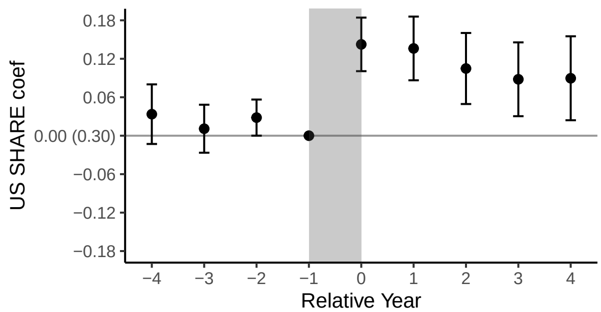
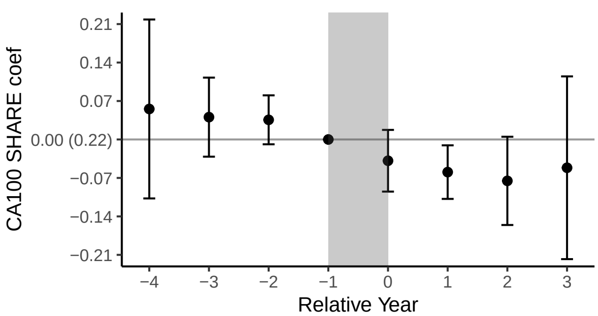


FIGURE 3: CROSS-LISTING IN THE UNITED STATES AND INSTITUTIONAL OWNERSHIP

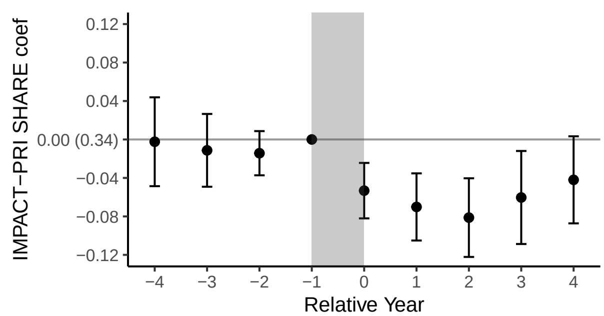
The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2007 to 2021, except for Panel B where it is between 2017 to 2021. The dependent variable is the American share, the share of American institutional ownership relative to total institutional ownership, in Panel A, CA100+ SHARE in Panel B and IMPACT-PRI SHARE in Panel C. Controls include one-year lagged LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) AMERICAN SHARE



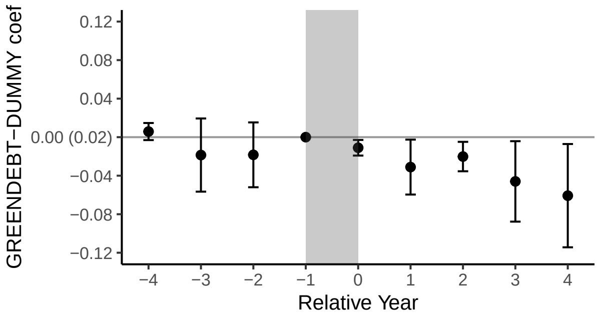
(B) CA100+ SHARE



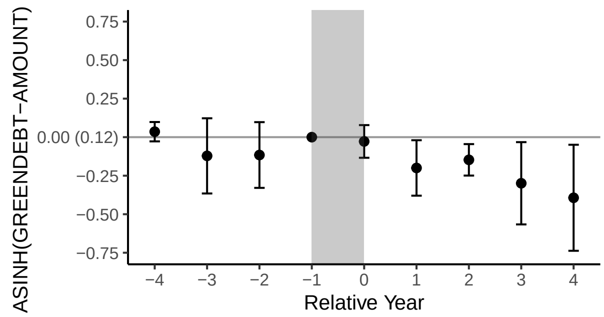
(C) IMPACT-PRI SHARE

FIGURE 4: CROSS-LISTING IN THE UNITED STATES AND GREEN CAPEX

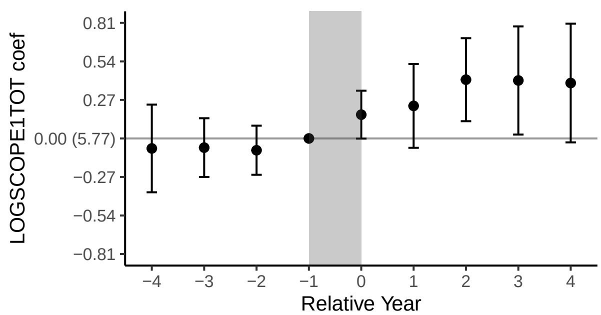
The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2014 to 2021 in Panel A and B, respectively 2007 to 2021 in Panel C. The dependent variable is GREENDEBT-DUMMY in Panel A, ASINH(GREENDEBT) in Panel B and LOGS1TOT in Panel C. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) GREENDEBT-DUMMY



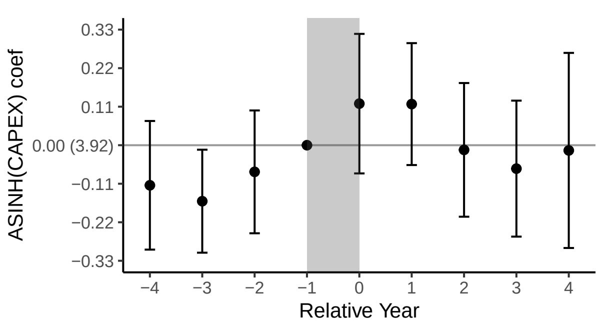
(B) ASINH(GREENDEBT)



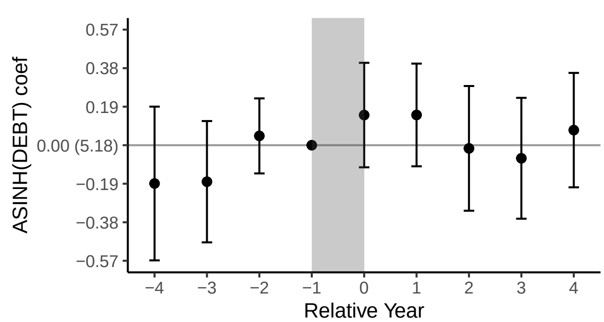
(C) LOGS1TOT

FIGURE 5: CROSS-LISTING IN THE UNITED STATES AND GENERAL INVESTMENT

The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2007 to 2021. The dependent variable is ASINH(CAPEX) in Panel A and ASINH(DEBT) in Panel B. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) ASINH(CAPEX)



(B) ASINH(DEBT)

FIGURE 6: NUMBER OF ENGAGEMENTS BY CA100+ AND NON-CA100+ INVESTORS

The sample is 2013 to 2019. The histogram plots the number of engagements by CA100+ signatories respectively non-CA100+ signatories with a bindwidth of 50 engagements using the PRI survey data. All respondents are also PRI signatories.

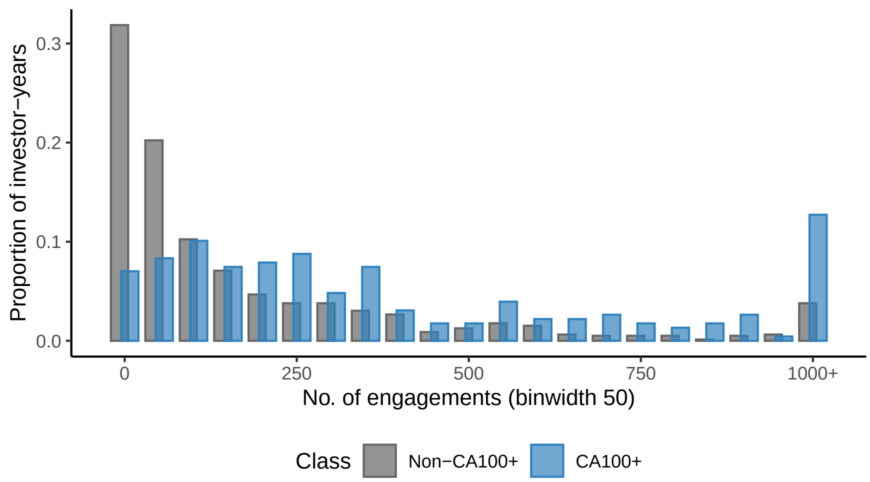
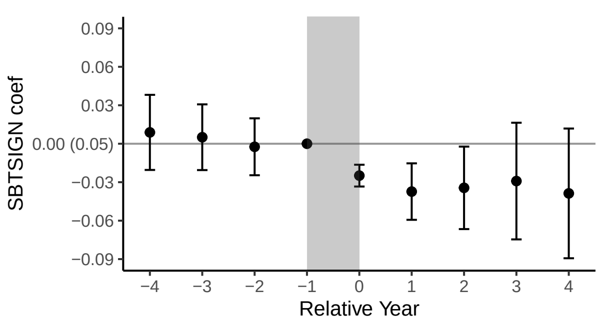
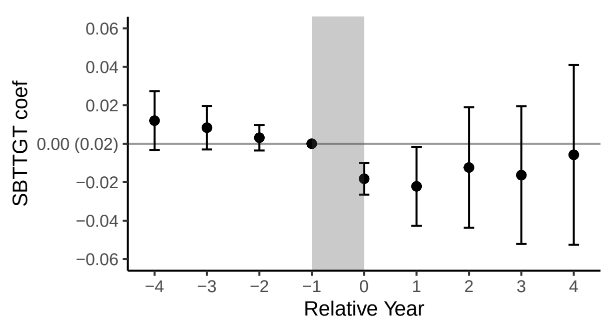


FIGURE 7: CROSS-LISTING IN THE UNITED STATES AND DECARBONIZATION TARGETS

The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2015 and 2021. The dependent variable is SBTSIGN in Panel A and SBTTGT in Panel B. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) SBTSIGN



(B) SBTTGT

Appendix

A Appendix

A.1 Investor initiatives

A.1.1 Literature approaches to identifying responsible investors

The literature has largely followed two main approaches, revealed preferences or self-declarations, to identify sustainable oriented investors. First, several papers infer preferences from investors' underlying holdings (e.g. Yang and Koci, 2020; Albuquerque et al., 2020; Cao et al., 2019; Hwang, Titman, and Wang, 2022; Döttling and Kim, 2022; Gibson, Krueger, and Mitali, 2020; Kaustia and Yu, 2021; Pástor and Vorsatz, 2020; Gantchev, Giannetti, and Li, 2022). Institutional investors whose underlying holdings are more sustainable are subsequently classified as responsible. While revealed preferences avoids picking up merely window-dressing statements of investors, studying investors' portfolio responses and investor impact based on induced preferences has a circular nature. Pastor, Stambaugh, and Taylor (2023) split an institution's total AUM into its ESG and non-ESG share. While this allows to more accurately identify the overall share of ESG-aligned investing, it is not well aligned with my definition of a responsible investor. I assume that an investor has one objective across total AUM and want to study whether this translates into changes in the behavior of their portfolio companies.

Second, other papers use investors' self-declarations to identify responsible investors. Self-declarations are generally based on being a member of a sustainable investor initiative (e.g. PRI initiative by (Gibson Brandon et al., 2022; Kim and Yoon, 2023; Liang, Sun, and Teo, 2022; Dimson, Karakaş, and Li, 2021), CERES by (Flammer, 2021), CDP/CA100+ (Atta-Darkua et al., 2022)) and therefore align investor preferences with the initiatives' objective. There has been a rapid increase in the number and size of institutional investor alliances with sustainable investment goals (see Appendix Table A.I for a list of the largest initiatives). These initiatives allow to abstract from investors' underlying holdings, but many initiatives have a relatively weak governance structure and merely require members to sign the initiatives' objective and pay annual fees. For instance, regional "Sustainable Investment Forums" that later founded the Global Sustainable Investment Alliance (GSIA) act as platform to identify best practices and data hub. The Carbon disclosure project (CDP) gives investors access to environmental data. Other early regional networks, such as Ceres and the Institutional Investors Group on Climate Change, serve as network and launching platform for new initiatives. All of them have few if any formal requirements. The lack of formal requirements leaves ample room for greenwashing.

New initiatives have attempted to raise the bar by introducing formal requirements, but these requirements are criticized for being too loose to affect emissions. A prominent and one of the largest initiatives is the United Nations Principles for Responsible Investors (PRI) initiative. It requires signatories to report on their investment approach and in 2018 also introduced minimum requirements on portfolio and employee responsibilities. In line with greenwashing concerns, Gibson Brandon et al. (2022) show that US PRI signatories do not have better ESG ratings than non-signatories for the sample period 2013 to 2017. The most recent initiatives under the "Glasgow Financial Alliance for Net Zero" umbrella have a net-zero transition objective and formal reporting and investment requirements for signatories, but critics challenge missing requirements for divestment from fossil fuels and weak internally only based verification.[27]

TABLE A.I: INVESTOR INITIATIVES

I report a selected list of the largest investor initiatives and report the funding year in column 2, the assets under management of the initiative members as of October 2023 or latest available year in column 3, member requirements including having fees/ signing a declaration, any reporting requirements, and any requirements beyond reporting such as portfolio or engagement requirements in column 4 to 6. In column 7, I also report whether the initiative is part of a global alliance, specifically Glasgow Financial Alliance for Net Zero (GFANZ) or Global Sustainable Investment Alliance (GSIA).

(1) Initative Name	(2) Founding year	(3) AUM (in trillion USD)	(4) Fee/ declaration	(5) Reporting	(6) Active requirements	(7) Global head
UN Environment Program Finance Initiative (UNEP FI)	1992	170.0	yes	yes	yes	
Carbon disclosure project (CDP)	2000	136.0	yes	no	no	
Principles for Responsible Investment (PRI)	2005	121.3	yes	yes	yes (since 2018)	
Net-Zero Banking Alliance (NZBA)	2021	74.0	yes	yes	yes	GFANZ
Climate Action 100+ (CA100+)	2017	68.0	yes	yes	yes	
Institutional Investors Group on Climate Change (IIGCC)	2012	65.0	yes	no	no	
Ceres	1989	60.0	yes	no	no	
Net Zero Asset Managers initiative (NZAM)	2020	59.0	yes	yes	yes	GFANZ
Transition Pathway Initiative (TPI)	2017	50.0	yes	no	no	
Responsible Investment Association (Canada)	1990	42.0	yes	no	no	GSIA
Asia Investor Group on Climate Change (AIGCC)	2016	32.0	yes	no	no	
Investor Group on Climate Change (IGCC)	2005	30.0	yes	no	no	
Responsible Investment Association Australasia	1999	29.0	yes	no	no	GSIA
Coalition for Climate Resilient Investment (CCRI)	2019	28.0	yes	no	no	
European Sustainable Investment Forum (Euosif)	2002	20.0	yes	no	no	GSIA
UK Sustainable Investment and Finance Association (UKSIF)	1991	19.0	yes	no	no	GSIA
Global Investors for Sustainable Development (GISD)	2019	16.0				
Net Zero Asset Owner's Alliance (NZAOA)	2019	11.0	yes	yes	yes	GFANZ
Net-Zero Insurance Alliance (NZIA)	2021	8.0				GFANZ
US Sustainable Investment Forum	1984	5.0	yes	no	no	GSIA
Paris Aligned Asset Owners (PAAO)	2019	3.3	yes	yes	yes	GFANZ
Net Zero Investment Consultants Initiative (NZICI)	2021	1.3				GFANZ
The Venture Climate Alliance (VCA)	2023	0.1				GFANZ
Net Zero Financial Service Providers Alliance (NZFSPA)	2021	NA				GFANZ
Japan Sustainable Investment Forum	2003	NA	yes	no	no	GSIA

A.1.2 Climate Action 100+ initiative

The Climate Action 100+ initiative was launched in 2017 with 225 investor signatories and $26 trillion in assets under management for a period of five years. This limited period was intended in order to have a deadline for meaningful action. Over the five years, the initiative grew multifold to 700 investors with more than 68$ trillion in assets under management. In 2022 following the consultation of its signatories, the initiative was extended to 2030 to inspire a scale up in active ownership. Phase 2 marks the start of the extension and was kicked of in 2023[28]. The second phase shifted the focus from corporate climate-related

[27] Harvey, F. (2022, June 9) Bank group accused of exploiting loopholes and "greenwashing" in climate pledge'. The Guardian
[28] About Climate Action 100+

disclosure to the implementation of climate transition plans. Several improvements to the transparency of the CA100+ initiative were introduced.

The objective of the initiative is to "engage with the world's largest GHG emitters to improve governance on climate change, curb emissions and strengthen climate- related financial disclosure". The collaborative engagement feature of the CA100+ initiative is one of the defining features. The initiative started out with targeting the 100 largest global emitters with engagement campaigns. It quickly extended the focus companies adding additional companies the signatories identified as critical actors in their regions' transitions or as particularly exposed to climate-related financial risks. There are currently 71 additional companies identified leading to a total of 171 focus companies with whom the initiative engages.

Engagements with a focus company are driven by one or more lead investors who can be assisted by collaborating (contributing) investors. Lead investors drive the conversation while collaborating investors support the lead investors. The investors speak for the CA100+ signatories as one voice. With the start of Phase 2 lead investors are required to set up a year-ahead engagement plan and report an annual engagement progress review. The engagement goals in line with the initiative objective are to ask companies to[29]:

- Implementing a **strong governance framework** which clearly articulates the board's accountability and oversight of climate change risk.
- Taking action to actively **reduce greenhouse gas emissions** across the value chain, including engagement with stakeholders such as policymakers and other actors to address the sectoral barriers to transition.
- Providing **enhanced corporate disclosure on and implementing transition plans** to deliver on robust targets.

There are two types of signatories, investor participants, who pursue the engagements with focus companies, and investor supporters, who are signatories to the initiative and publicly support the initiative's goals, but do not participate directly in engagements with focus companies. To become a participant signatory, the investor must be an asset owner, asset manager or a service provider that is formally representing assets and that typically conducts engagements with companies, be a member of at least one of the five socially responsible investment oriented coordinating partner organizations[30], sign the Climate Action 100+ Sign-on Statement, and purse at least one engagement with a focus company per year. All founding members were investor participants and asset owners can only sign up as investor participants. 64% of current

[29] CA100+ press release: Climate Action 100+ Announces Its Second Phase

[30] Asia Investor Group on Climate Change (AIGCC); Ceres; Investor Group on Climate Change (IGCC); Institutional Investors Group on Climate Change (IIGCC); and Principles for Responsible Investment (PRI).

signatories are investor participants.

A.1.3 Identifying IMPACT-PRI investors

The United Nations Principle for Responsible Investors (PRI) initiative was launched in 2006 with 63 signatories and $6.5 trillion AUM. Since then it has grown to one of the largest initaitves on responsible investing[31]. To become a member, institutions have to sign the declaration to commit to include environmental, social and governance factors in investment decision making and ownership, pay an annual fee and complete the PRI reporting framework. Since 2018, there are also minimum sustainable portfolio and certain employee responsibility requirements. Due to its size and weaker membership requirements, there are doubts of the “true responsibility” of some of its signatories(Gibson Brandon et al., 2022).

I therefore use the PRI survey responses from the PRI reporting framework to filter for institutional investors in this subset that similar to CA100+ follow an engagement strategy and are therefore more likely to actively care about and work on the net-zero transition. The publicly available signatory reporting data starts in 2014 and extends to 2020, translating into reporting years from 2013 to 2019[32]. New signatories have a one year grace period to submit their first report. The PRI survey includes mandatory, mandatory to answer but voluntary to disclose and voluntary questions. To identify the subset of PRI signatories that actively engage with management, I use survey questions in the “Listed Equity Active Ownership” module on the number of engagements and type of engagement[33]. 55% of signatories disclosed this information at least once. Similar to the argument for why the CA100+ is a good proxy of “real impact investors”, investors who sign the declaration agreement and are willing to incur costs for actively engaging and informing their portfolio holdings about their opinion are more likely to be “real impact investors” and less likely to merely turn the portfolio neutral or at worst use the PRI as green-washing instrument.

I define impact signatories as those who engage with more than 50% of their engagement targets comprehensively or signatories that engage with more than 100 companies but at least one comprehensively. I fill survey answers forward and backward if a year is missing, assuming that signatories exhibit the same engagement style if they do not disclose or have not yet submitted a survey. This adjustment allows me to have coverage for the whole time series rather the few survey years. Reassuringly, early signatories, which as mentioned are typically considered to be more serious signatories, represent a significant fraction of the IMPACT-PRI signatories, while later joiners are relatively less likely to be classified as IMPACT-PRI.

[31] For more information see: About PRI

[32] Annual reporting until 2022 takes place between January and March. In line Gibson Brandon et al. (2022) I assume that the responses correspond to the previous calendar year

[33] In 2014 to 2018, the corresponding question is LEA11.1 and LEA11.2. In 2019 and 2020, the corresponding question is LEA9.1 and LEA9.2

A.2 Why do firms cross-list?

Many different reasons for cross-listing in a foreign country have been put forward (see Karolyi (2006, 2012) for a survey of the past literature). The main theoretical reasons for cross-listing include the "market segmentation hypothesis", "bonding hypothesis", and "insulation hypothesis". Corporate managers that have successfully executed cross-listings name access to a larger and deeper market for capital, enhanced visibility, diversification of their investor base, and greater liquidity of their stock (Bancel and Mittoo, 2001, 2009; Fanto and Karmel, 1997; Mittoo, 1992) as motivation. While shareholder base diversification is one of the reasons put forward for cross-listing, neither the theoretical literature on cross-listing nor managers' stated motivation directly identify changing the proportion of sustainable oriented owners as reason.

Several surveys have directly asked managers for their motivation to cross-list. Bancel and Mittoo (2009) identify in the most recent survey of European managers enhanced visibility and the ability to raise capital as most important criteria for the choice of a foreign listing exchange. Older surveys similarly cite increased visibility, access to a deeper market for capital, greater diversification of shareholder base, enhanced stock liquidity as well as the facilitation of the implementation of a global strategy as important cross-listing benefits by managers (Bancel and Mittoo, 2001; Fanto and Karmel, 1997; Mittoo, 1992). Bancel and Mittoo (2001) also ask managers about the major consequences of a foreign listing. Disclosure of more information and the increase in the number of road shows are the most important consequences, while increasing foreign sales of developing a foreign subsidiary are not a major consequence in their sample. I manually inspect annual reports and press releases for half of my cross-listing sample to also elicit the motivation to cross-list for my sample. The results in Appendix Table A.II column 1 echo the reason identified in the literature survey results. Access to capital and visibility are two of the most important in the cross-listing decision.

Theoretical reasons for cross-listing can be broadly framed into the following main hypotheses: "market segmentation hypothesis", "bonding hypothesis", and "insulation hypothesis". Again, neither talk about changes in sustainable ownership. The first theory, the market segmentation hypothesis, inspired by Stapleton and Subrahmanyam (1977); Errunza and Losq (1985); Eun and Janakiramanan (1986); Alexander, Eun, and Janakiramanan (1987) suggests that cross-listing overcomes international investment barriers that segment global investors. Firms benefit from a lower cost of capital as the firm's share become more accessible to foreign investors who would otherwise find it less advantageous to hold the shares. Stulz (1999) points out a number of challenges to the market segmentation hypothesis. First, share-price reactions to cross-listing announcements were economically small. Second, share-price reactions remained constant across time despite investment barriers becoming less significant over time. Third, share-price reactions on average between developed and emerging markets were similar even though the segmentation barriers should be different. Similarly, share-price reactions differed for firms from the same home country, while investment barriers should be similar. Finally, if the economic valuation benefits outsize the costs, all firms that would qualify for cross-listing should cross-list.

Stulz (1999) puts up the "bonding hypothesis" as an alternative rationale for cross-listing. Weak internal governance mechanisms or home country institutions may not adequately prevent managers from extracting private benefits or controlling shareholders from expropriating private returns. Outside investors will be more hesitant to provide capital and thus increase the cost of external financing. Cross-listing is one way for firms to bond themselves to stronger governance requirements and therefore lower cost of capital. Siegel (2005) distinguishes between legal bonding and reputational bonding. Legal bonding is captured more by Coffee Jr (1999, 2002) and refers to governmental enforcement, while reputational bonding is captured more by Stulz (1999) is broader where monitoring takes place through a variety of reputational intermediaries, such as analysts, investment bankers, auditors and other capital market participants. Roosenboom and Van Dijk (2009) find evidence consistent with improved disclosure and the bonding hypothesis for cross-listings on US exchanges, while the evidence is mixed for continental European exchanges.

The most recent hypothesis, proposed by Kastiel and Libson (2019), suggests that cross-listing insulates firms from hostile takeovers as cross-listing increases the costs and barriers for acquirers. Launching a tender offer in both domestic and foreign exchanges can increase large direct fees as well as complexity, uncertainty and possible litigation risk. Tsang, Yang, and Zheng (2022) find empirical evidence for this conjecture.

TABLE A.II: MANAGERS' MOTIVATION FOR CROSS-LISTING

	(1) My sample EU/ Asia	(2) BM2009 EU home listing	(3) BM2001 EU cross-listing	(4) BM2001 CAN cross-listing	(5) FK1997 foreign US listing	(6) FK1997 foreign ADR	(7) **Average**
Visibility	30	57	57	38	23	56	43
Capital access	38	61	38	39	23	23	37
Grow shareholder base	13	-	51	56	11	33	33
Support expansion	45	-	16	8	23	46	28
Liquidity/ stock value	9	19	11	28	-	45	22
External monitoring	-	36	-	-	-	-	36
Acquisition/ merger outcome	15	-	-	-	-	-	15
Other	2	4	-	-	-	8	5
No significant benefit	-	-	12	-	-	-	12

A.3 Appendix Tables

TABLE A.III: SUMMARY STATISTICS - CA100+ SAMPLE PERIOD

The table reports sample first quartiles, median, third quartiles, averages, standard deviations and firm-year observations for institutional ownership variables in Panel A, green debt instruments in Panel B, other green capital expenditure measures in Panel C and control variables in Panel D. The sample period is restricted to the period of the CA100+ initiative and goes from 2017 to 2022. All variables are defined in Table 11.

	(1) 1st Quartile	(2) Median	(3) 3rd Quartile	(4) Mean	(5) Std Dev	(6) Firm-year obs.
Panel A: Institutional ownership						
ALL INSTOSHIP	0.015	0.070	0.215	0.187	0.273	104532
CA100 SHARE	0.000	0.032	0.198	0.131	0.197	104532
PRI SHARE	0.324	0.656	0.872	0.582	0.332	104532
IMPACT-PRI SHARE	0.124	0.482	0.738	0.462	0.336	104532
Panel B: Green debt instruments						
GREENDEBT-DUMMY	0.000	0.000	0.000	0.016	0.127	104532
GREENDEBT-AMOUNT (intensive)	102.723	353.569	918.146	770.366	1387.989	1717
GREENDEBT-AMOUNT	0.000	0.000	0.000	12.654	203.012	104532
ASINH GREENDEBT-AMOUNT	0.000	0.000	0.000	0.104	0.835	104532
VERIFIED GREENDEBT-DUMMY	0.000	0.000	0.000	0.010	0.098	104532
ASINH VERIFIED GREENDEBT-AMOUNT	0.000	0.000	0.000	0.060	0.624	104532
SUSLINKDEBT-DUMMY	0.000	0.000	0.000	0.006	0.075	104532
ASINH SUSLINKDEBT-AMOUNT	0.000	0.000	0.000	0.035	0.494	104532
Panel C: Other green measures						
CLEANREVENUERATIO	0.000	0.000	0.047	0.124	0.272	7036
CLEANINVESTMENTRATIO	0.000	0.000	0.033	0.134	0.297	5902
LOGS1TOT	2.897	4.637	6.489	4.784	2.979	50534
LOGS2TOT	3.337	4.872	6.389	4.837	2.371	50581
LOGS3UPTOT	5.145	6.661	8.115	6.608	2.279	50595
S1INT	0.060	0.163	0.445	1.821	5.544	50595
S2INT	0.085	0.191	0.426	0.402	0.578	50595
S3UPINT	0.486	1.082	2.286	1.681	1.651	50595
GREENRATIOEP	0.000	0.000	0.143	0.144	0.281	11988
GREENRATIOWW	0.000	0.000	0.059	0.079	0.186	36692
GREENCITCOUNTEP	0.000	0.000	1.000	45.358	2253.759	11988
GREENCITCOUNTWW	0.000	0.000	1.000	45.146	1398.498	36692
GREENCITMAXEP	0.000	0.000	1.000	30.385	2232.183	11988
GREENCITMAXWW	0.000	0.000	1.000	17.541	1291.725	36692
Panel D: Control variables						
LOGSIZE	4.793	6.041	7.387	6.137	1.965	104532
LEVERAGE	4.430	17.956	33.784	21.406	18.841	104532
ROE	0.224	7.391	14.295	0.401	32.798	104532
INVEST/A	0.726	2.498	5.519	4.091	4.887	104532
M/B	0.875	1.590	3.139	2.643	2.937	104532
BETA	0.741	0.944	1.138	0.932	0.463	104532
VOLAT	0.066	0.098	0.147	0.123	0.101	104532
MOM	−0.019	0.002	0.024	0.003	0.043	104532
RET	−0.058	0.000	0.056	0.008	0.137	104532
MSCI	0.000	0.000	0.000	0.165	0.371	104532

TABLE A.IV: GREEN DEBT & EMISSIONS

The unit of observation is firm-year. The sample period is 2013-2022. The dependent variable is $LOGS1TOT$, in columns 1 and 2, $S1INT$ in columns 3 and 4, $LOGS123UPTOT$, in columns 5 and 6 and $S123UPINT$ in columns 7 and 8. In Panel A, the sample includes all firms and in Panel B is restricted to non-finance firms. The key independent variable is $GREENDEBT - DUMMY$. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All columns include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LOGS1TOT		S1INT		LOGS123UPTOT		S123UPINT	
Panel A: Full sample								
1YR-LAG GREENDEBT-DUMMY	−0.027		−0.217**		−0.046***		−0.276***	
	(0.032)		(0.086)		(0.017)		(0.102)	
3YR-LAG GREENDEBT-DUMMY		−0.068		−0.144		−0.047**		−0.180
		(0.042)		(0.097)		(0.021)		(0.113)
Observations	80866	65267	80969	65340	80969	65340	80969	65340
R2	0.959	0.961	0.938	0.941	0.975	0.975	0.942	0.945
Panel B: Without finance industry								
1YR-LAG GREENDEBT-DUMMY	−0.034		−0.303**		−0.030		−0.362**	
	(0.034)		(0.130)		(0.019)		(0.155)	
3YR-LAG GREENDEBT-DUMMY		−0.094*		−0.228		−0.044*		−0.286*
		(0.050)		(0.151)		(0.027)		(0.174)
Observations	67208	54427	67260	54463	67260	54463	67260	54463
R2	0.958	0.959	0.938	0.941	0.976	0.976	0.941	0.944
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes

TABLE A.V: ADDITIONAL ALTERNATIVE RESPONSIBLE OWNERSHIP MEASURES & GREEN DEBT

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. The key independent variables are $CA100 - PARTICIPANT\ SHARE$ in Panel A, $CA100\ W/O\ HIGH - EMISSION - INTENSITY\ SHARE$ in Panel B and $CA100\ W.\ NBIM\ SHARE$ in Panel C. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
Panel A: CA100+ Participants only								
1YR-LAG CA100-PARTICIPANT SHARE	0.018***		0.018***		0.108***		0.106***	
	(0.002)		(0.003)		(0.016)		(0.017)	
3YR-LAG CA100-PARTICIPANT SHARE		0.033***		0.043***		0.217***		0.277***
		(0.006)		(0.007)		(0.037)		(0.045)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0885	0.115	0.456	0.583
Panel B: Without high emission intensity investors								
1YR-LAG CA100 W/O HIGH-EMISSION INTENSITY SHARE	0.021***		0.023***		0.137***		0.141***	
	(0.003)		(0.003)		(0.019)		(0.021)	
3YR-LAG CA100 W/O HIGH-EMISSION INTENSITY SHARE		0.026***		0.042***		0.206***		0.287***
		(0.007)		(0.008)		(0.046)		(0.053)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0886	0.115	0.456	0.583
Panel C: CA100+ with Norges Bank Investment Management from start								
1YR-LAG CA100 W. NBIM SHARE	0.016***		0.018***		0.101***		0.106***	
	(0.002)		(0.003)		(0.013)		(0.015)	
3YR-LAG CA100 W. NBIM SHARE		0.024***		0.032***		0.159***		0.209***
		(0.004)		(0.006)		(0.028)		(0.037)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0860	0.111	0.445	0.568	0.0886	0.115	0.456	0.583
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.VI: 4/5 RESPONSIBLE OWNERSHIP MEASURES & GREEN DEBT

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. For the key independent variables are $CA100\ SHARE - 1/5\ DROP$, I randomly allocate all signatories into 5 equally sized buckets and iteratively drop one signatory bucket. The $CA100\ SHARE - 1/5\ DROP$ is thus based on 4/5 of all signatories. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include industry-year and firm fixed effects. Impact signatories are signatories who report in the survey that they engage with more than 50% of their engagement targets comprehensively or signatories that engage with more than 100 companies but at least one comprehensively. The question is mandatory to answer, but voluntary to disclose. I fill survey answers forward and backward if a year is missing. First survey data is from 2013 and last from 2019. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
Panel A: CA100 share without signatory bucket one								
1YR-LAG CA100 SHARE-1/5 DROP	0.016***		0.018***		0.102***		0.111***	
(V1)	(0.003)		(0.003)		(0.016)		(0.017)	
3YR-LAG CA100 SHARE-1/5 DROP		0.026***		0.038***		0.179***		0.243***
(V1)		(0.006)		(0.007)		(0.037)		(0.045)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0858	0.111	0.445	0.568	0.0885	0.115	0.456	0.583
Panel B: CA100 share without signatory bucket two								
1YR-LAG CA100 SHARE-1/5 DROP	0.009***		0.007**		0.058***		0.038**	
(V2)	(0.003)		(0.003)		(0.017)		(0.018)	
3YR-LAG CA100 SHARE-1/5 DROP		0.036***		0.047***		0.233***		0.301***
(V2)		(0.007)		(0.008)		(0.042)		(0.052)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0856	0.111	0.445	0.568	0.0882	0.115	0.455	0.583
Panel C: CA100 share without signatory bucket three								
1YR-LAG CA100 SHARE-1/5 DROP	0.020***		0.018***		0.121***		0.108***	
(V3)	(0.003)		(0.003)		(0.016)		(0.019)	
3YR-LAG CA100 SHARE-1/5 DROP		0.038***		0.041***		0.246***		0.262***
(V3)		(0.007)		(0.008)		(0.041)		(0.051)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0860	0.111	0.445	0.568	0.0886	0.115	0.456	0.583
Panel D: CA100 share without signatory bucket four								
1YR-LAG CA100 SHARE-1/5 DROP	0.020***		0.021***		0.116***		0.125***	
(V4)	(0.003)		(0.003)		(0.016)		(0.019)	
3YR-LAG CA100 SHARE-1/5 DROP		0.029***		0.039***		0.188***		0.258***
(V4)		(0.007)		(0.008)		(0.041)		(0.050)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0885	0.115	0.456	0.583
Panel E: CA100 share without signatory bucket five								
1YR-LAG CA100 SHARE-1/5 DROP	0.020***		0.021***		0.123***		0.130***	
(V5)	(0.003)		(0.003)		(0.018)		(0.019)	
3YR-LAG CA100 SHARE-1/5 DROP		0.029***		0.042***		0.187***		0.267***
(V5)		(0.006)		(0.008)		(0.039)		(0.048)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0859	0.111	0.445	0.568	0.0886	0.115	0.456	0.583
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.VII: CA100+ SHARE & GREEN DEBT WITH ALTERNATIVE SPECIFICATION

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. In Panel A, the key independent variable is $CA100\ SHARE$, but the sample is restricted to firms with at least 10% institutional ownership. In Panel B the key independent variable is $CA100\ INSTOSHIP$, which is the CA100+ share relative to all owners. I also include $ALL\ INSTOSHIP$, which is the total proportion of all institutional investors as additional control. In Panel C, the key independent variables are dummies for different proportions of $CA100\ SHARE$. The omitted group is firms with responsible ownership below 10%. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
Panel A: Restricting the sample to firms with at least 10% institutional ownership								
1YR-LAG CA100 SHARE	0.038***		0.039***		0.212***		0.213***	
	(0.008)		(0.011)		(0.049)		(0.068)	
3YR-LAG CA100 SHARE		0.051***		0.106***		0.323***		0.688***
		(0.015)		(0.023)		(0.096)		(0.144)
Observations	42115	22221	40587	20713	42115	22221	40587	20713
R2	0.119	0.153	0.480	0.598	0.121	0.156	0.483	0.606
Panel B: CA100+ ownership relative to all owners								
1YR-LAG CA100 INSTOSHIP	0.129***		0.105***		0.933***		0.780***	
	(0.015)		(0.015)		(0.102)		(0.105)	
1YR-LAG ALL INSTOSHIP	−0.038***		−0.023***		−0.264***		−0.157***	
	(0.003)		(0.007)		(0.022)		(0.046)	
3YR-LAG CA100 INSTOSHIP		0.286***		0.265***		2.095***		1.890***
		(0.043)		(0.054)		(0.295)		(0.364)
3YR-LAG ALL INSTOSHIP		−0.043***		−0.024		−0.292***		−0.099
		(0.005)		(0.018)		(0.034)		(0.111)
Observations	104532	55276	104460	55206	104532	55276	104460	55206
R2	0.0874	0.113	0.445	0.569	0.0904	0.117	0.456	0.583
Panel C: CA100+ proportion indicators								
1YR-LAG DCA100SHARE 10%-30%	0.001		0.002*		−0.003		0.012	
	(0.001)		(0.001)		(0.008)		(0.008)	
1YR-LAG DCA100SHARE 30%+	0.017***		0.015***		0.107***		0.096***	
	(0.002)		(0.002)		(0.011)		(0.012)	
3YR-LAG DCA100SHARE 10%-30%		0.019***		0.016***		0.122***		0.101***
		(0.003)		(0.003)		(0.018)		(0.018)
3YR-LAG DCA100SHARE 30%+		0.017***		0.019***		0.111***		0.115***
		(0.004)		(0.005)		(0.026)		(0.029)
Observations	104460	55206	104460	55206	104460	55206	104460	55206
R2	0.0871	0.112	0.445	0.569	0.0898	0.116	0.456	0.583
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.VIII: CA100+ SHARE & OTHER GREEN BOND MEASURES

The unit of observation is firm-year. The sample period is 2017-2022. In Panel A, the dependent variable is $VERIFIED\ GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(VERIFIED\ GREENDEBT)$ in columns 5 to 8. In Panel B, the dependent variable is $SUSLINKBOND - DUMMY$ in columns 1 to 4 and $ASINH(SUSLINKBOND)$ in columns 5 to 8.$CA100\ SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

Panel A: Green bonds	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	VERIFIED GREENDEBT-DUMMY				ASINH(VERIFIED GREENDEBT)			
1YR-LAG CA100 SHARE	0.010***		0.008***		0.057***		0.044***	
	(0.002)		(0.002)		(0.012)		(0.013)	
3YR-LAG CA100 SHARE		0.019***		0.026***		0.119***		0.153***
		(0.005)		(0.006)		(0.029)		(0.034)
Observations	104532	55276	104460	55206	104532	55276	104460	55206
R2	0.0652	0.0848	0.437	0.553	0.0670	0.0875	0.461	0.583
Panel B: Sustainability-linked bonds								
	SUSLINKDEBT-DUMMY				ASINH(SUSLINKBOND)			
1YR-LAG CA100 SHARE	0.007***		0.008***		0.049***		0.064***	
	(0.001)		(0.002)		(0.009)		(0.010)	
3YR-LAG CA100 SHARE		0.012***		0.017***		0.089***		0.130***
		(0.003)		(0.005)		(0.022)		(0.031)
Observations	104532	55276	104460	55206	104532	55276	104460	55206
R2	0.0403	0.0537	0.344	0.474	0.0395	0.0557	0.332	0.478
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.IX: CA100+ SHARE & GREEN DEBT W/O FINANCIAL INSTITUTIONS

The unit of observation is firm-year. The sample period is 2017-2022 and the sample is restricted to non-financial institutions. The dependent variable is $GREENDEBT - DUMMY$ in columns 1 to 4 and $ASINH(GREENDEBT)$ in columns 5 to 8. The key independent variable is $CA100\ SHARE$. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GREENDEBT-DUMMY				ASINH(GREENDEBT)			
1YR-LAG CA100 SHARE	0.015***		0.018***		0.091***		0.106***	
	(0.002)		(0.003)		(0.014)		(0.016)	
3YR-LAG CA100 SHARE		0.022***		0.025***		0.140***		0.171***
		(0.005)		(0.007)		(0.032)		(0.042)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes
Observations	87571	46319	87499	46251	87571	46319	87499	46251
R2	0.0767	0.0994	0.418	0.541	0.0781	0.102	0.426	0.556

TABLE A.X: CA100+ SHARE & ALTERNATIVE GREEN INNOVATION MEASURES

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $GREENCITMAXWW$ in columns 1 to 4 and $GREENCITMAXEP$ in columns 5 to 8 in Panel A, respectively $GREENCITCOUNTWW$ in columns 1 to 4 and $GREENCITCOUNTEP$ in columns 5 to 8 in Panel B. $CA100\,SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using Poisson pseudo-maximum likelihood. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Worldwide green innovation	GREENRATIOWW				GREENCITCOUNTWW			
1YR-LAG CA100 SHARE	0.169		0.244**		−0.860		−0.196	
	(0.104)		(0.110)		(1.092)		(0.884)	
3YR-LAG CA100 SHARE		−0.015		0.291		3.116***		0.185
		(0.221)		(0.311)		(1.198)		(2.072)
Observations	36522	16800	20437	7808	35848	16012	15284	4728
Pseudo R2	0.115	0.113	0.249	0.236	0.651	0.641	0.921	0.937
Panel B: Maximum citations of green patents	GREENCITMAXEP				GREENCITMAXWW			
1YR-LAG CA100 SHARE	5.078**		7.168***		−0.663		0.026	
	(2.204)		(2.530)		(1.659)		(1.299)	
3YR-LAG CA100 SHARE		5.747***		10.030**		3.530***		−0.859
		(1.520)		(4.743)		(1.018)		(2.247)
Observations	11370	4510	4664	1190	35848	16012	15284	4728
Pseudo R2	0.827	0.605	0.969	0.938	0.671	0.648	0.943	0.933
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.XI: CA100+ SHARE & SCOPE 3 EMISSIONS

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $LOGS3UPTOT$ in columns 1 to 4 and $S3UPINT$ in columns 5 to 8. $CA100\,SHARE$ is the key independent variables. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. Columns 1, 2, 5 and 6 include year, country, and SIC-4 industry fixed effects. Columns 3,4, 7 and 8 include year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LOGS3UPTOT				S3UPINT			
1YR-LAG CA100 SHARE	0.038		−0.018		−0.005		−0.000	
	(0.057)		(0.025)		(0.047)		(0.018)	
3YR-LAG CA100 SHARE		0.164		0.038		0.116		0.022
		(0.127)		(0.057)		(0.094)		(0.021)
Observations	50754	24940	49726	23627	50754	24940	49726	23627
R2	0.817	0.799	0.982	0.991	0.730	0.733	0.983	0.995
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes

TABLE A.XII: ROTH (2022) PRE-TEST

I follow Roth (2022) to identify whether my pre-test is likely to be well powered against violations of parallel trends. For the dependent variables $AMERICAN\ SHARE$, $CA100\ SHARE$, $IMPACT - PRI\ SHARE$, $GREENDEBT - DUMMY$, $ASINH(GREENDEBT)$ and $LOSG1TOT$, I back out the slope to have an estimated power of 0.5. I report the slope, power (probability that no significant pre-period coefficient would be detected under the hypothesized trend), the Bayes Factor (relative probability that no significant pre-period coefficient would be detected under the hypothesized trend relative to under parallel trends) and the likelihood ratio (the relative likelihood of the estimated coefficients under the hypothesized trend relative to under parallel trends)

	(1) Slope	(2) Power	(3) Bayes Factor	(4) Likelihood Ratio
US SHARE	0.016	0.500	0.571	0.024
CA100 SHARE	-0.039	0.501	0.558	1.079
IMPACT-PRI SHARE	-0.016	0.500	0.561	0.139
GREENDEBT-DUMMY	-0.003	0.499	0.572	1.564
ASINH(GREENDEBT-AMOUNT)	-0.024	0.500	0.571	1.183
LOGSCOPE1TOT	0.091	0.500	0.575	0.591

TABLE A.XIII: RESPONSIBLE INVESTOR IMPACT ON SCOPE 1 EMISSIONS OF INVESTOR TARGET FIRMS

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $LOGS1TOT$ in columns 1 to 4 and $S1INT$ in columns 5 to 8. The key independent variables are $CA100\ SHARE$ and its interaction with $HIGHESTEMITTERS$, a dummy equal to one for the for firms in the top 200 highest emitters in 2016 by total scope 1 emissions, as well as its interaction with $CA100TARGET$, a dummy equal to one if the firm is part of the target company set of the CA100+ initiative. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LOGS1TOT				S1INT			
1YR-LAG CA100 SHARE	-0.116^{***}	-0.118^{***}			-0.021	-0.043		
	(0.044)	(0.044)			(0.102)	(0.103)		
1YR-LAG CA100 SHARE X HIGHEST EMITTERS	-0.533^{*}				-3.898^{**}			
	(0.293)				(1.564)			
1YR-LAG CA100 SHARE X CA100 TARGET		-0.591^{***}				-3.113^{***}		
		(0.183)				(1.027)		
3YR-LAG CA100 SHARE			-0.161^{*}	-0.160^{*}			-0.207^{*}	-0.240^{*}
			(0.090)	(0.090)			(0.122)	(0.124)
3YR-LAG CA100 SHARE X HIGHEST EMITTERS			-0.485				-7.771^{***}	
			(0.382)				(2.274)	
3YR-LAG CA100 SHARE X CA100 TARGET				-0.730^{**}				-3.432^{**}
				(0.340)				(1.490)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	49666	49666	23583	23583	49726	49726	23627	23627
R2	0.971	0.971	0.985	0.985	0.956	0.956	0.978	0.978

TABLE A.XIV: RESPONSIBLE INVESTOR IMPACT ON FIRM SIZE

The unit of observation is firm-year. The sample period is 2017-2022. The dependent variable is $LOGASSETS$ in columns 1 to 4 and $LOGSALES$ in columns 5 to 8. The key independent variables are $CA100\ SHARE$. In Panel B, I additional interact the $CA100\ SHARE$ with $HIGHESTEMITTERS$, a dummy equal to one for the for firms in the top 200 highest emitters in 2016 by total scope 1 emissions, and $CA100TARGET$, a dummy equal to one if the firm is part of the target company set of the CA100+ initiative. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. All variables are defined in Table 11. All independent variables are lagged by one or three years. The model is estimated using pooled regression model. All regressions include industry-year and firm fixed effects. I cluster standard errors at the firm level. *** 1% significance, ** 5% significance * 10% significance.

Panel A: Full sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LOGASSETS				LOGSALES			
1YR-LAG CA100 SHARE	0.005		-0.035^{***}		0.010		-0.059^{***}	
	(0.016)		(0.009)		(0.028)		(0.013)	
3YR-LAG CA100 SHARE		-0.033		-0.078^{***}		0.013		-0.088^{***}
		(0.036)		(0.015)		(0.056)		(0.024)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Country F.E.	yes	yes	no	no	yes	yes	no	no
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	no	no	yes	yes	no	no	yes	yes
Firm F.E.	no	no	yes	yes	no	no	yes	yes
Observations	104532	55276	104460	55206	104531	55276	104459	55206
R2	0.931	0.913	0.991	0.996	0.845	0.829	0.983	0.992

Panel B: Investor target firms interaction								
	LOGASSETS				LOGSALES			
1YR-LAG CA100 SHARE	-0.035^{***}	-0.035^{***}			-0.060^{***}	-0.060^{***}		
	(0.009)	(0.009)			(0.014)	(0.014)		
1YR-LAG CA100 SHARE X HIGHEST EMITTERS	0.030				0.128			
	(0.059)				(0.089)			
1YR-LAG CA100 SHARE X CA100 TARGET		0.039				0.082		
		(0.072)				(0.103)		
3YR-LAG CA100 SHARE			-0.078^{***}	-0.078^{***}			-0.089^{***}	-0.089^{***}
			(0.015)	(0.015)			(0.024)	(0.024)
3YR-LAG CA100 SHARE X HIGHEST EMITTERS			-0.075				0.254^{**}	
			(0.115)				(0.127)	
3YR-LAG CA100 SHARE X CA100 TARGET				-0.046				0.251
				(0.150)				(0.165)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Ind-Year F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Firm F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	104460	104460	55206	55206	104459	104459	55206	55206
R2	0.991	0.991	0.996	0.996	0.983	0.983	0.992	0.992

A.4 Appendix Figures

FIGURE A.I: GREEN DEBT MATCHING

The sample is 2013 to 2022. I report the total number of green debt issuances by public firms in Bloomberg by non-matched (grey), matched - not in sample (light blue) and matched - in sample (blue) per year.

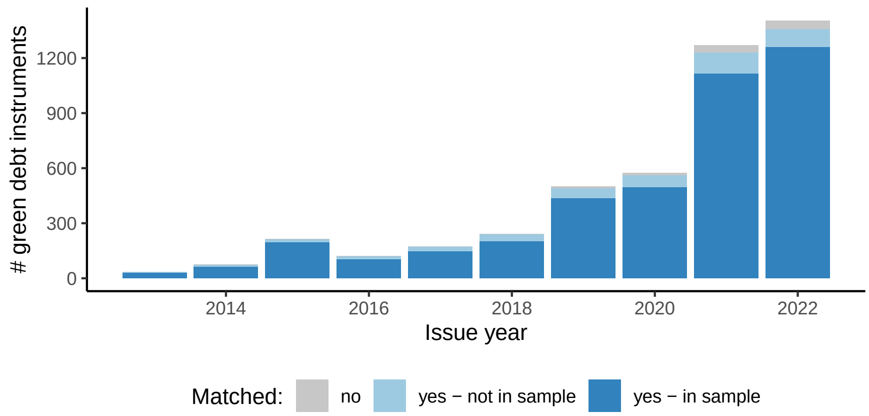
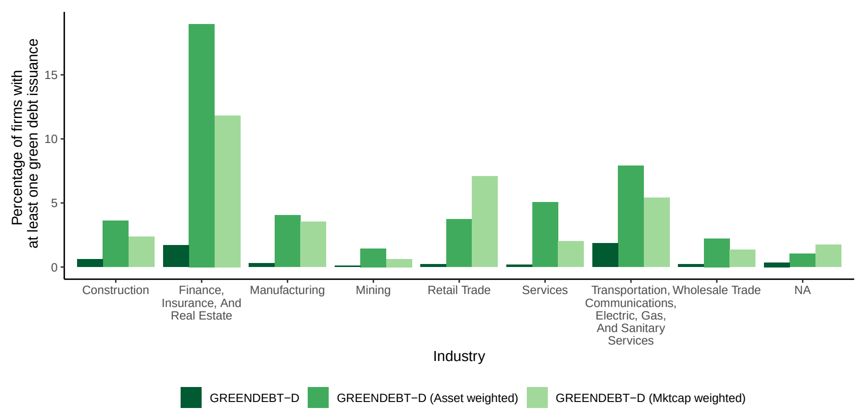
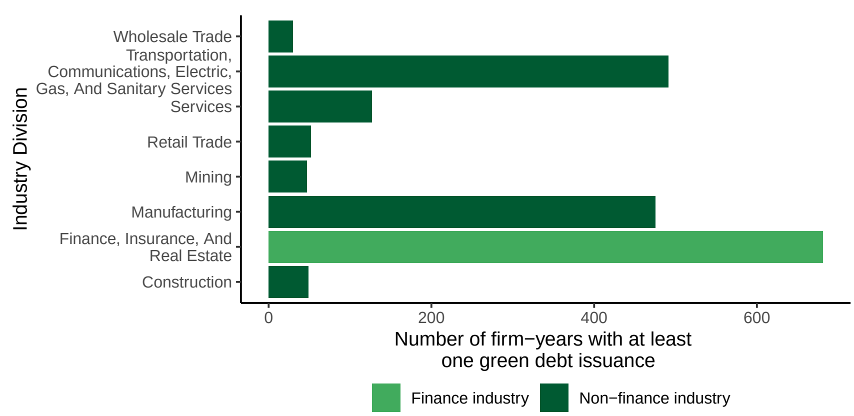


FIGURE A.II: GREEN DEBT ISSUANCE BY INDUSTRY

The sample is 2013 to 2022. I report the proportion of firm-years with at least one green debt issuance by SIC major division in Panel A and the number of firm-year observations with at least one green debt issuance by SIC major division in Panel B.



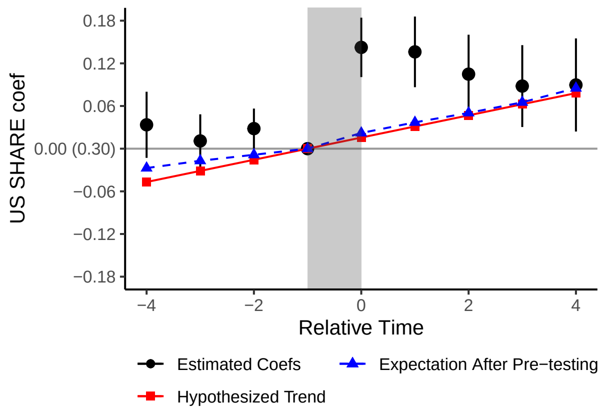
(A) GREEN DEBT ISSUANCE PROPORTION BY INDUSTRY DIVISION



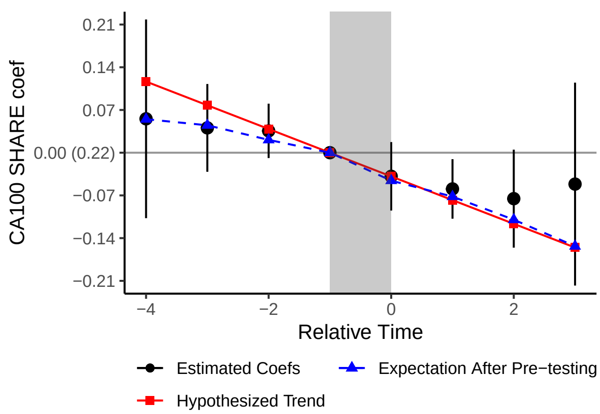
(B) FIRM-YEAR OBSERVATIONS WITH GREEN DEBT ISSUANCE BY INDUSTRY DIVISION

FIGURE A.III: CROSS-LISTING IN THE UNITED STATES AND INSTITUTIONAL OWNERSHIP - ROTH PRETRENDS

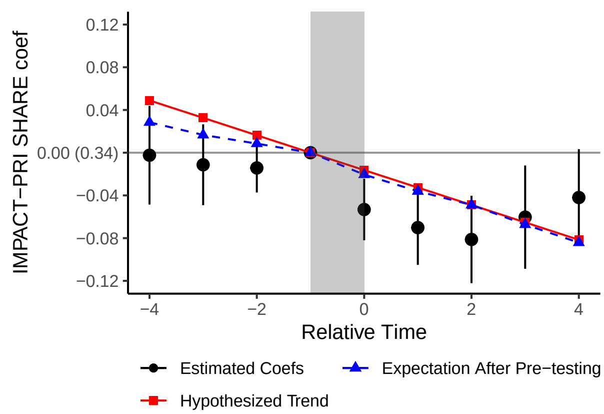
The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2014 to 2021. The dependent variable is the AMERICAN SHARE in Panel A, CA100 SHARE in Panel B and IMPACT-PRI SHARE in Panel C. I follow Roth (2022) and plot a linear violation of the pre trend based on a 50% power in red. Black are coefficients we find in our regression and blue are the expected coefficient we would find based on the hypothesized trend in red.



(A) AMERICAN SHARE



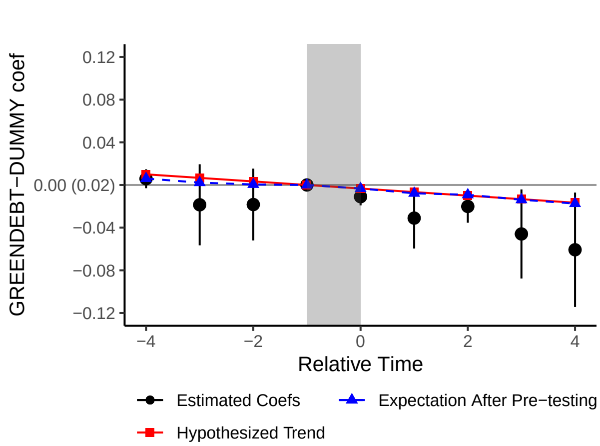
(B) CA100 SHARE



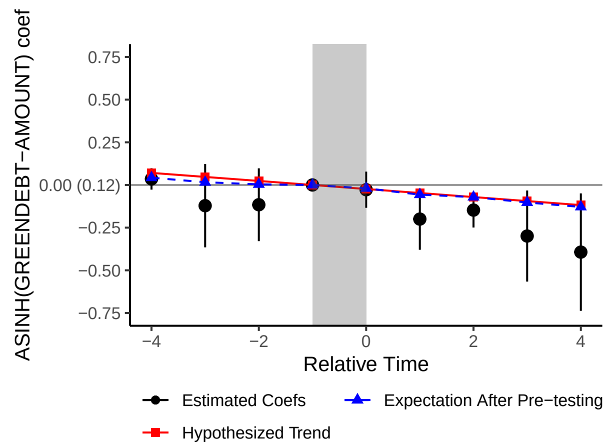
(C) IMPACT-PRI SHARE

FIGURE A.IV: CROSS-LISTING IN THE UNITED STATES AND GREEN CAPEX - ROTH PRETRENDS

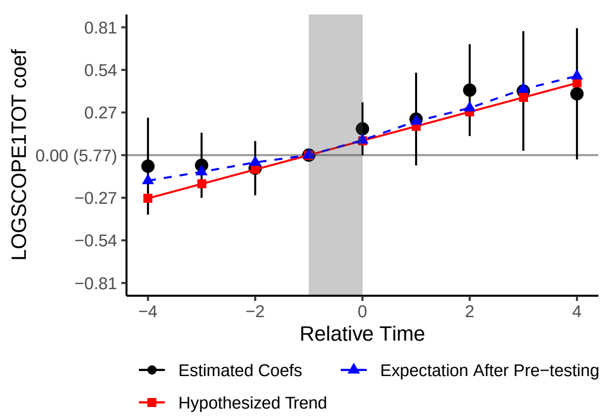
The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2014 to 2021 in Panel A and B, respectively 2007 to 2021 in Panel C. The dependent variable is GREENDEBT-DUMMY in Panel A, ASINH(GREENDEBT) in Panel B, and LOGS1TOT in Panel C. I follow Roth (2022) and plot a linear violation of the pre trend based on a 50% power in red. Black are coefficients we find in our regression and blue are the expected coefficient we would find based on the hypothesized trend in red.



(A) GREENDEBT-DUMMY



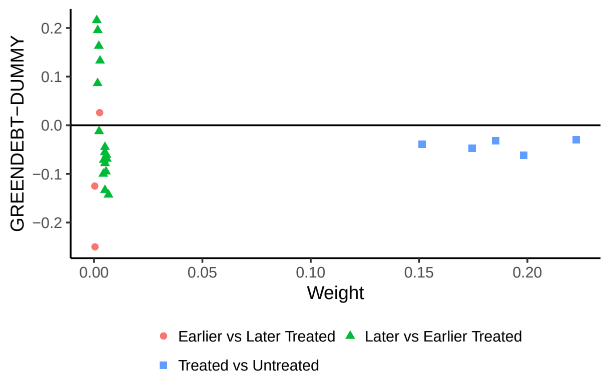
(B) ASINH(GREENDEBT)



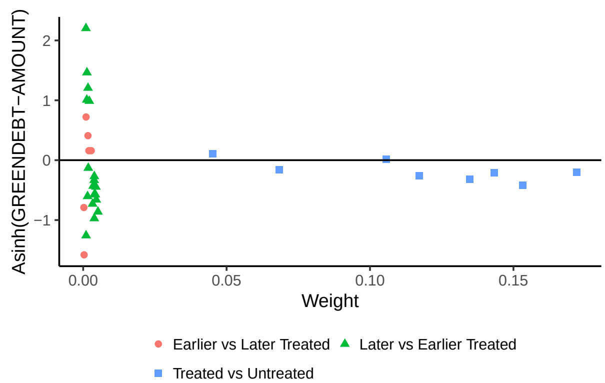
(C) LOGS1TOT

Figure A.V: Cross-Listing in the United States and Green Debt - Bacon decomposition w/o controls

The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2014 to 2021. The dependent variable is GREENDEBT-DUMMY in Panel A and ASINH(GREENDEBT) in Panel B. I show the Goodman-Bacon (2021) decompositions for the TWFE regression without any controls.



(A) GREENDEBT-DUMMY



(B) ASINH(GREENDEBT)

Figure A.VI: Cross-Listing in the United States and scope 1 emission intensity

The unit of observation is firm-year. The sample is the matched US cross-listing sample between 2007 to 2021. The dependent variable is S1INT. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.

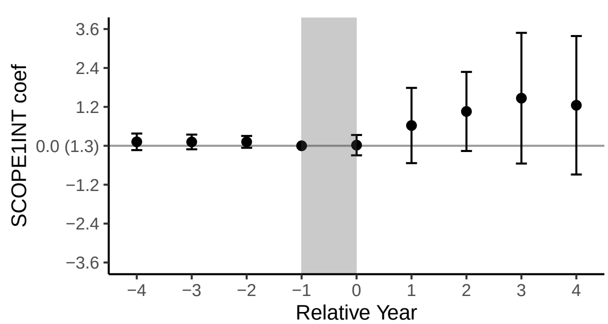
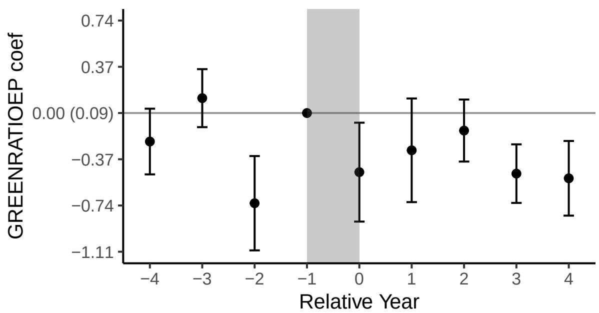
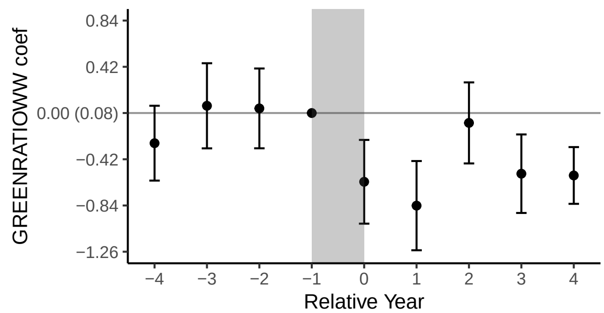


FIGURE A.VII: CROSS-LISTING IN THE UNITED STATES AND GREEN INNOVATION

The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2007 to 2021. The dependent variable is GREENRATIOEP in Panel A and GREENRATIOWW in Panel B. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. The model is estimated using Poisson pseudo-maximum likelihood and I calculate interaction weighted total coefficients with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) GREENRATIOEP



(B) GREENRATIOWW

FIGURE A.VIII: CROSS-LISTING IN THE UNITED STATES AND FOREIGN SALES PERCENTAGE

The unit of observation is firm-year. The sample is the matched US cross-listing sample between 2007 to 2021. The dependent variable is PERCTFORSALES. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.

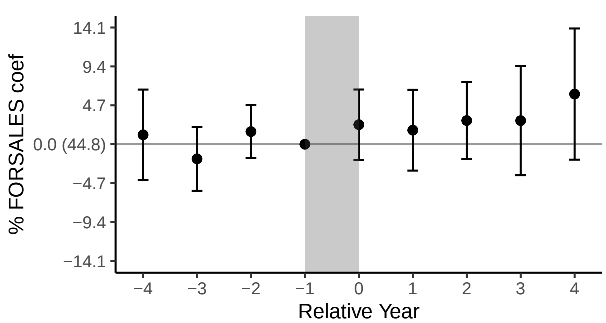
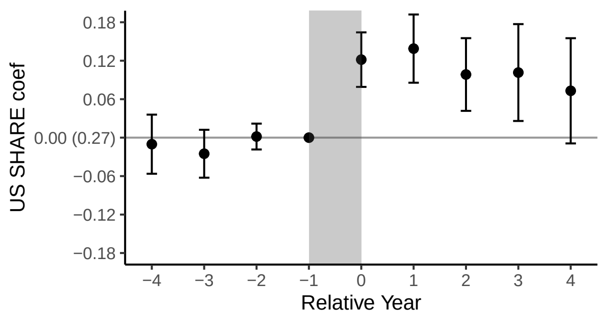
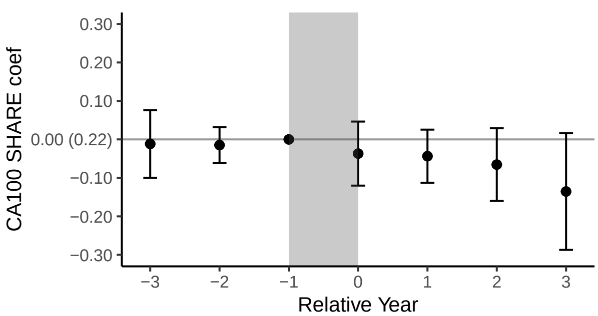


FIGURE A.IX: EUROPEAN FIRMS' CROSS-LISTING IN THE UNITED STATES AND SUSTAINABLE OWNERSHIP

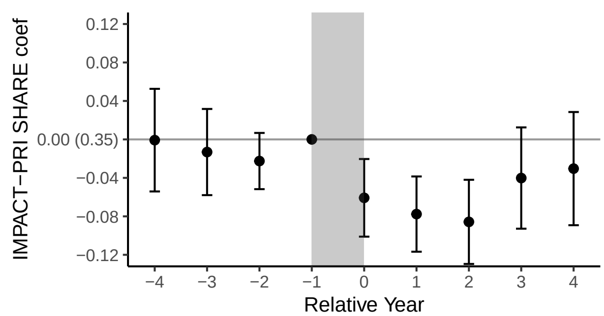
The unit of observation is firm-year. The sample is the matched sample of European headquartered firms that cross-listed in the United States between 2007 to 2021, except for Panel B where it is between 2017 to 2021. The dependent variable is the American SHARE, the share of American institutional ownership relative to total institutional ownership, in Panel A, CA100 SHARE in Panel B and IMPACT PRI SHARE in Panel C. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) AMERICAN SHARE



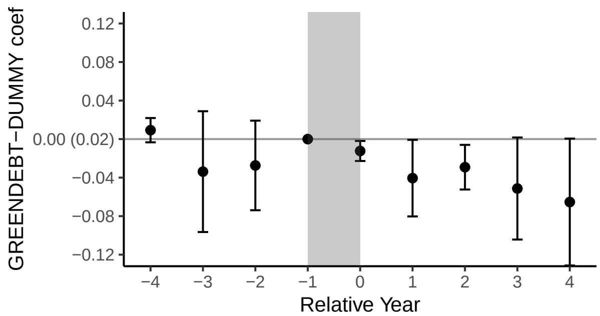
(B) CA100+ SHARE



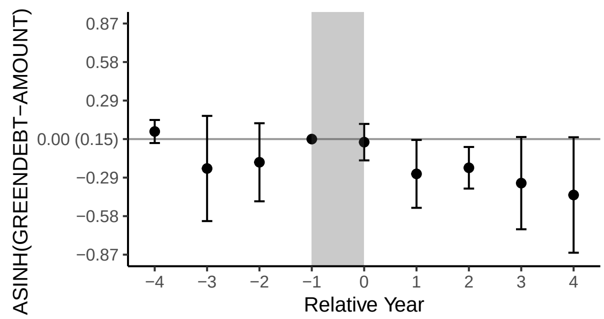
(C) IMPACT-PRI SHARE

Figure A.X: European Firms' Cross-Listing in the United States and Green CapEx

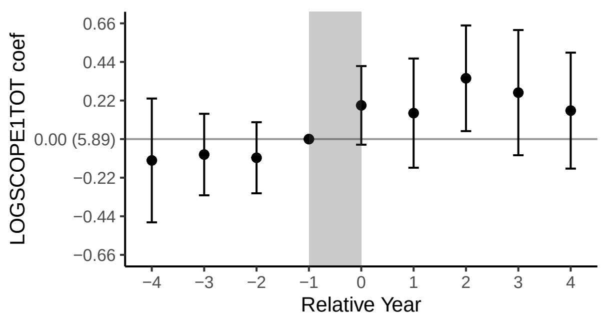
The unit of observation is firm-year. The sample is the matched sample of Asian and European headquartered firms that cross-listed in the United States between 2014 to 2021 in Panel A and B, respectively 2007 to 2021 in Panel C. The dependent variable is GREENDEBT-DUMMY in Panel A, ASINH(GREENDEBT) in Panel B, and LOGS1TOT in Panel C. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



(A) GREENDEBT-DUMMY



(B) ASINH(GREENDEBT)



(C) LOGS1TOT

Figure A.XI: American Firms Cross-Listing in Europe

The sample is 2007 to 2021. I report the number of American firms that cross-listed in a given year and are part of the final difference-in-difference sample.

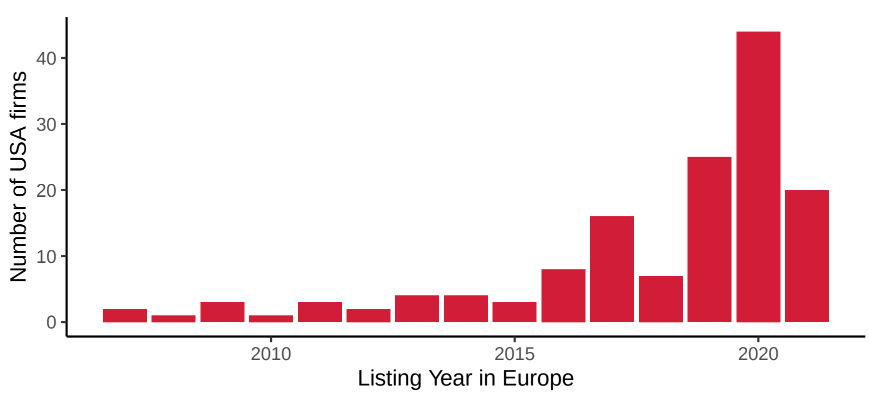
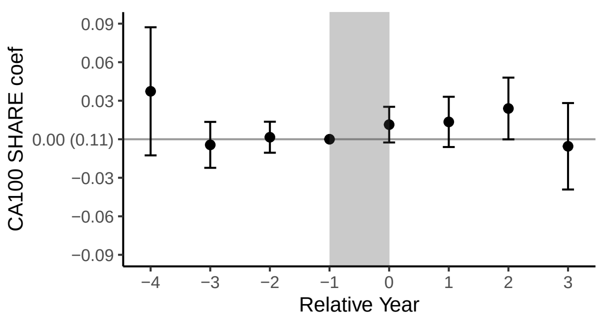
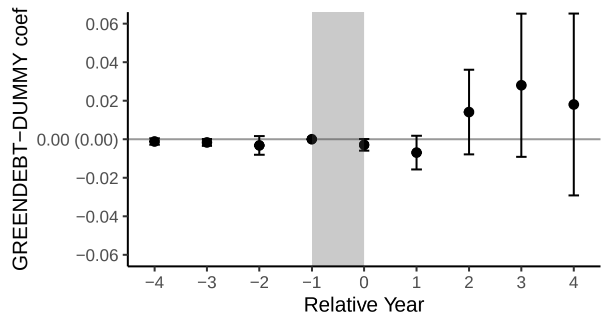


Figure A.XII: Impact on American Firms Cross-Listing in Europe

The unit of observation is firm-year. The sample is the US-firm matched European cross-listing sample between 2014 to 2021. The dependent variable is CA100 SHARE in Panel A and GREENDEBT-D in Panel B. Controls include LOGSIZE, LOGPPE, LEVERAGE, ROE, M/B, BETA, VOLAT, MOM, RET, INVEST/A, MSCI. I plot the interaction weighted total coefficient with a 90% confidence interval for each relative time period following Sun and Abraham (2021). I cluster standard errors at the firm level.



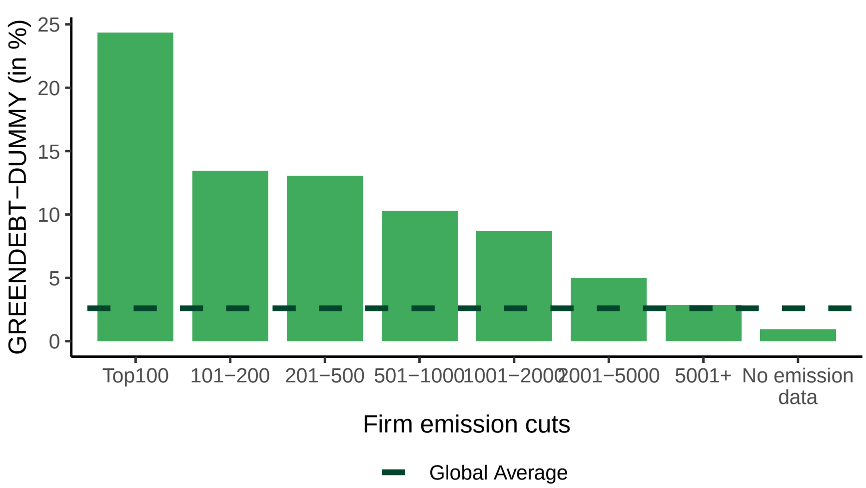
(a) CA100 SHARE



(b) GREENDEBT-DUMMY

Figure A.XIII: Proportion of firms with green debt by emitter subsets

The sample is 2020 to 2021. I report the average proportion of firm-years with at least one green debt issuance for the highest 100 emitters in 2016 and firm emission cuts thereafter.



A.5 Extension of Pástor, Stambaugh, and Taylor (2021) with investor engagement

Pástor, Stambaugh, and Taylor (2021) analyze amongst others how changes in agents' preferences for sustainability can have real social impact on society. They study how firms respond to asset pricing effects with investor preferences for ESG characteristics. They assume that managers maximize the firm's market value and show that sustainable investing produces positive social impact by making firms greener and by shifting real investment toward green firms. I extend the model by altering the assumption of firm market value maximization. Instead, I assume that management compensation is linked to both firm value and social impact. The larger the share of institutional investors, the larger the fraction of compensation linked to social impact. This models one possible channel of engagement with management and the implementation of one internal governance mechanism. This adjustment implies firms becoming even greener, as management has extra incentives for shifting towards green technology. Furthermore, it also leads to even greater shifts of real investment towards green firms, as social impact is also linked to the size of the company.

Formally, I start out with the same set up as Pástor, Stambaugh, and Taylor (2021). The model has one period from time 0 to time 1. There are N firms, $n = 1, ..., N$ with ESG characteristics g_n, which is an (Nx1) vector. $g_n > 0$ implies a green firm with positive ESG characteristics, respectively low emissions, and $g_n < 0$ implies a brown firm with negative ESG characteristics, respectively high emissions. $\tilde{r} = \mu + \tilde{v}$ defines firms' return in excess of the riskless rate r_f with $\tilde{\epsilon} \sim N(0, \Sigma)$. The social impact of a firms (S_n) is defined by the product of its ESG characteristics (g_n) and capital (K_n), formally $S_n \equiv g_n K_n$. A firm is endowed with capital $K_{0,n}$ and ESG characteristics $g_{0,n}$, but managers can change either subject to adjustment costs. A manager can choose how much capital (ΔK_n) to raise/ sell subject to capital adjustment costs $\frac{\kappa_n}{2}(\Delta K_n)^2$ and how much to change its ESG characteristic (Δg_n) subject to ESG adjustment costs $\frac{\chi_n}{2}(\Delta g_n)^2$. Pástor, Stambaugh, and Taylor (2021) assume that manager's maximize firm value by choosing ΔK_n and Δg_n. Instead I assume that a manager is compensated with a proportion of firm value (ρv) and social impact ($\zeta \bar{d} S_n$) and maximizes its compensation by choosing ΔK_n and Δg_n.

The investor side remains as in their model. There is a continuum of agents i with CARA utility $-e^{-A_i \tilde{W}_{1i} - b_i' X_i}$. A_i is the absolute risk aversion of agent i. $\tilde{W}_{1i} = W_{01}(1 + r_f + X_i' \tilde{r})$ is the wealth of agent i at time 1. X_i are portfolio weights of agent i (Nx1). $b_{i,n} = d_i g_n$ is a nonpecuniary benefit agent i derives from holding stock n. Without loss of generalization, one can assume that there are two types of investors. Investors with $d_i = 1$ care about ESG, while investors with $d_i = 0$ do not care about ESG.

The first step as in their model is to solve for optimal portfolio weights X by taking prices as given and to solve for prices by making markets clear. This lays the foundation. I skip reporting this step, as it is equivalent to their model. Instead I focus on the final step with my adjustment, i.e. the managers' optimal choice of ΔK_n and Δg_n. The firm's value at time 0 is given by the expected gross cash flow in time 1 less ESG adjustment costs and discounted by the cost of capital less time 0 capital adjustments. The cost of capital is given by 1+ the risk-free rate, the market risk and CAPM alpha which depends on the ESG characteristics:

$$\nu_n = -\Delta K_n - \frac{\kappa_n}{2}(\Delta K_n)^2 + \frac{\Pi(K_{0,n} + \Delta K_n)(1 - \frac{\chi_n}{2}(\Delta g_n)^2)}{1 + r_f + \mu_m \beta_n - \frac{\bar{d}}{a}(g_{0,n} + \Delta g_n)} \tag{5}$$

I assume that managers do not just maximize firm value ν_n by choosing ΔK_n and Δg_n, but rather that their compensation Ξ_n by choosing ΔK_n and Δg_n, which is also linked to social impact ($S_n \equiv (K_{0,n} + \Delta K_n)(g_{0,n} + \Delta g_n)$):

$$\Xi_n = \rho \nu_n + \zeta \bar{d} S_n \tag{6}$$

The first order condition with respect to ΔK_n yields:

$$\begin{aligned}
&\max_{\Delta K_n} \rho[-\Delta K_n - \frac{\kappa_n}{2}(\Delta K_n)^2 + \frac{\Pi(K_{0,n} + \Delta K_n)(1 - \frac{\chi_n}{2}(\Delta g_n)^2)}{1 + r_f + \mu_m \beta_n - \frac{\bar{d}}{a}(g_{0,n} + \Delta g_n)}] + \zeta \bar{d}[(K_{0,n} + \Delta K_n)(g_{0,n} + \Delta g_n)] \\
&0 = -1 - \kappa_n \Delta K_n + \frac{\Pi_n(1 - \frac{\chi_n}{2}(\Delta g_n)^2)}{1 + r_f + \mu_m \beta_n - \frac{\bar{d}}{a}(g_{0,n} + \Delta g_n)} + \zeta \bar{d}(g_n + \Delta g_n) \\
&\Delta K_n(\bar{d}) = \frac{1}{\kappa_n}[\frac{\Pi_n(1 - \frac{\chi_n}{2}(\Delta g_n)^2)}{1 + r_f + \mu_m \beta_n - \frac{\bar{d}}{a}(g_{0,n} + \Delta g_n)}] + \frac{\zeta}{\rho}\bar{d}(g_n + \Delta g_n) - 1]
\end{aligned} \tag{7}$$

The first part is equivalent to Pástor, Stambaugh, and Taylor (2021) and highlights again that an increase in $\bar{d}$ reduces cost of capital for green firms increasing the net present value of projects and thus investments. The second part $\frac{\zeta}{\rho}\bar{d}(g_n + \Delta g_n)$ is new and highlights that the manager of a green firm is induced to raise even more capital with a higher $\bar{d}$, as this increases the payoff for social impact. Greater capital boosts total social impact and therefore increases manager's compensation and operates as additional payoff. This is moderated by how green $(g_n + \Delta g_n)$ the firm is and the relative fraction of compensation for social impact to firm value ($\frac{\zeta}{\rho}$).

Next I solve the first order condition with respect to Δg_n:

$$\max_{\Delta g_n} \rho[-\Delta K_n - \frac{\kappa_n}{2}(\Delta K_n)^2 + \frac{\Pi(K_{0,n} + \Delta K_n)(1 - \frac{\chi_n}{2}(\Delta g_n)^2)}{1 + r_f + \mu_m \beta_n - \frac{\bar{d}}{a}(g_{0,n} + \Delta g_n)}] + \zeta \bar{d}[(K_{0,n} + \Delta K_n)(g_{0,n} + \Delta g_n)] \tag{8}$$

I first drop terms without Δg_n and let $b = \rho \Pi(K_{0,n} + \Delta K_n)$ as well as $c = r_f + \mu_m \beta_n - \frac{\bar{d}}{a} g_{0,n}$ to simplify to

$$\begin{aligned}
&\max_{\Delta g_n} [\frac{b(1-\frac{\chi_n}{2}(\Delta g_n)^2)}{1+c-\frac{\bar{d}}{a}\Delta g_n}] + \zeta\bar{d}(K_{0,n}+\Delta K_n)\Delta g_n \\
&\max_{\Delta g_n} b[1-\frac{\chi_n}{2}(\Delta g_n)^2]\frac{1}{1+c-\frac{\bar{d}}{a}\Delta g_n} + \zeta\bar{d}(K_{0,n}+\Delta K_n)\Delta g_n \\
&\max_{\Delta g_n} b[1-\frac{\chi_n}{2}(\Delta g_n)^2]\frac{1}{1+c}\frac{1}{1-\frac{\bar{d}}{a(1+c)}\Delta g_n} + \zeta\bar{d}(K_{0,n}+\Delta K_n)\Delta g_n
\end{aligned} \tag{9}$$

Using the approximation $\frac{1}{1-y} \approx 1+y$, this further simplifies to:

$$\begin{aligned}
&\max_{\Delta g_n} b[1-\frac{\chi_n}{2}(\Delta g_n)^2]\frac{1}{1+c}(1+\frac{\bar{d}}{a(1+c)}\Delta g_n) + \zeta\bar{d}(K_{0,n}+\Delta K_n)\Delta g_n \\
&\max_{\Delta g_n} \frac{b}{1+c}(1-\frac{\chi_n}{2}(\Delta g_n)^2 + \frac{\bar{d}}{a(1+c)}\Delta g_n) + \zeta\bar{d}(K_{0,n}+\Delta K_n)\Delta g_n
\end{aligned} \tag{10}$$

The first-order condition delivers:

$$\Delta g_n(\bar{d}) = \frac{\bar{d}}{a\chi_n} + \frac{(1+r_f+\mu_m\beta_n-\frac{\bar{d}}{a}g_{0,n})\zeta\bar{d}}{\rho\Pi\chi_n} \tag{11}$$

The first part ($\frac{\bar{d}}{a\chi_n}$) is again identical to Pástor, Stambaugh, and Taylor (2021) and highlights that managers maximizing market value of their firms make their firms greener when $\bar{d} > 0$, as the expected returns decrease in g_n and market value increases in g_n. With a low risk aversion a this effect is especially strong as ESG characteristics then have large effects on market values. The second term $\frac{(1+r_f+\mu_m\beta_n-\frac{\bar{d}}{a}g_{0,n})\zeta\bar{d}}{\rho\Pi\chi_n}$ is new. First, note from equation (9) in Pástor, Stambaugh, and Taylor (2021) that $-\frac{\bar{d}}{a}g_{0,n}$ is the CAPM alpha and the term in brackets is therefore generally positive. This implies that larger $\bar{d}$ creates extra incentives for making the firm greener scaled by the relative payoff for social impact and firm value. Specifically, it is increasing in the social impact payoff proportion (ζ), but decreasing in the firm value payoff proportion (ρ) and profitability (Π), which is equivalent to one plus the firm's gross profitability. This highlights the trade-off between social impact and firm value, i.e. accepting negative net present value projects that have large positive green characteristics. Interestingly, firms with more negative ESG endowments (small $g_{0,n}$) have a greater incentive to make their firms greener. $g_{0,n}$ and Δg_n have an equivalent weight on social capital, but adjustment costs in Δg_n are exponential. Thus, Δg_n has a bigger impact when starting at a small $g_{0,n}$. Higher adjustment costs (χ_n) reduces both components.

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