The Carbon Cost of Competitive Pressure*

Vesa Pursiainen† , Hanwen Sun‡, and Yue Xiang§

February 2025

Abstract

Higher exposure to competition – measured by product fluidity – is associated with higher carbon emission intensity. This result is robust to using instrumental variables to obtain exogenous variation in fluidity. The positive relationship between competition and carbon emissions is stronger for firms in areas less concerned about climate change. It is also stronger in areas with weaker social norms. Our results suggest that short-termism is not the primary driver, as the emissions-competition link is at least as strong for firms with longer-term-oriented shareholders. Our findings suggest that policies promoting competition may be at odds with climate change abatement.

JEL classification: D40, G30, M14, Q50

Keywords: competition, carbon emissions, carbon intensity

*We appreciate the helpful comments from Julian Kölbel, Felix von Meyerinck, Deniz Okat, Mikael Paaso, Stefano Ramelli, Markus Schmid, Chi-Yang Tsou, and Zoey Yiyuan Zhou. All errors are ours. Vesa Pursiainen gratefully acknowledges financial support by the Swiss National Science Foundation, grant no. 10001196.

†University of St.Gallen and Swiss Finance Institute, E-mail: vesa.pursiainen@unisg.ch

‡University of Bath, E-mail: h.sun@bath.ac.uk

§Durham University, E-mail: yue.xiang@durham.ac.uk

1 Introduction

Climate change presents a profound challenge to society, making carbon emissions reduction a critical global priority. Policymakers and regulators seek to align financial incentives with environmental objectives through carbon pricing, green financing, disclosure mandates, and many other policies.[1] At the same time, financial markets attempt to assess and price the risks related to climate change and carbon emissions. Most finance scholars, professionals, and policymakers argue that markets are more likely to underestimate than overestimate climate risks.[2] Carbon reductions must also be globally coordinated, yet climate change effects vary significantly across regions, complicating mitigation efforts.[3]

At the same time, fostering competition is another supposed cornerstone of economic policy, driving efficiency, innovation, and consumer welfare. The public discourse about the importance of competition has become increasingly urgent as industries have grown more concentrated and profitable in recent decades, both in the U.S. (Covarrubias et al. (2019), Grullon et al. (2019)) and globally (De Loecker and Eeckhout (2018), Bae et al. (2021), Frésard (2010)), prompting calls for regulatory action to ensure competitive markets. However, the policy goals of carbon reduction and increasing competition may sometimes be in conflict.

In this paper, we study the role of competitive pressure in corporate carbon emissions, using data from Trucost. Our main measure of carbon intensity is the scope 1 GHG intensity, converted into CO_2 equivalent. To measure domestic competitive pressure, we use the product fluidity index of Hoberg et al. (2014). This index is based on textual analysis of the mandatory product descriptions in 10-K filings, capturing the similarity between a firm's products and the overall changes in the rivals' products. A greater product fluidity index means more overlap with competitors in product space, implying higher levels of competitive

[1] For discussions of carbon reduction policies, see, e.g., Gillingham and Stock (2018).
[2] See Stroebel and Wurgler (2021).
[3] See, e.g., Cruz and Rossi-Hansberg (2024).

pressure.[4] We construct a comprehensive sample of U.S. listed firms for the years 2002-2023.

We find that higher competitive pressure is associated with higher carbon emissions per unit of revenue. This finding is both statistically and economically significant and robust to controlling for a large number of firm characteristics as well as firm, industry-time and state-time fixed effects. A one-standard-deviation increase in product fluidity is associated with a 4-5% increase in carbon intensity, depending on the model specification.

To better establish causality between competition and carbon emissions, we use two instrumental variables to capture exogenous variation in product fluidity: changes in state-level trade-weighted foreign exchange rates (Li and Zhan (2019), Loncan (2023), Loncan and Valta (2024)) and the staggered introduction of Paid Sick Leave (PSL) laws (Loncan and Valta (2024), Maclean et al. (2024)). An appreciation in the state-level FX rate reduces the relative costs of imports, thus increasing local competition from foreign products. The passage of a PSL increases firm costs, presumably with a stronger effect for firms with less market power, and hence reduces competitive pressure. Similar to Loncan and Valta (2024), we confirm that both of these instruments strongly predict firm-level fluidity. Using either one of them or both simultaneously as instruments for fluidity, we confirm that increases in fluidity are associated with significant increases in carbon emissions. The economic magnitude of the IV estimates is substantially larger than our baseline OLS estimates.

Next, we explore the role of local climate attitudes and political views in moderating the effect of competitive pressure on carbon emissions.[5] We use county-level data on climate opinions from the Yale Climate Maps and find that the effect of fluidity on carbon emissions is significantly larger for firms headquartered in areas that consider climate action by corporations less important. The estimated relationship between fluidity and carbon emissions is also somewhat stronger for firms in Republican-voting areas, but the difference along political

[4] *Fluidity* is used by a number of recent studies to measure competitive threats in the product market (e.g., Li and Zhan (2019), Mattei and Platikanova (2017), Hoberg et al. (2014)).

[5] For example, Ramadorai and Zeni (2024) find that firms' beliefs about climate regulation strongly affect abatement. Several studies suggest that political views are correlated with preferences on sustainability, also in investments (Hong and Kostovetsky (2012), Gormley et al. (2024), Kempf and Tsoutsoura (2024)).

lines is economically small and not statistically significant. We also use corporate lobbying data from Leippold et al. (2024) and find that firms that spend more lobbying Democrats (Republicans) exhibit a weaker (stronger) link between fluidity and carbon emissions.

Investing in carbon abatement may be partly driven by considerations of stakeholders other than shareholders. Hence, we might expect such investment to depend on the strength of social norms in the communities where the firms operate. To test this, we use three proxies for the strength of social norms. First, we use the *Social capital index* of Lin and Pursiainen (2022), to measure the strength of local social norms. Second, we use the local volunteering rate (Chetty et al. (2022a), Chetty et al. (2022b)), defined as the percentage of Facebook users who are members of a group which is predicted to be about "volunteering" or "activism" based on group title and other group characteristics in the county. Third, we classify the firms in our data into *Sin industry* and other industries, following Hong and Kacperczyk (2009). With all of these proxies for social norms, we find that the positive relationship between product fluidity and carbon emissions is stronger when social norms are weaker.

Many commentators (see, e.g. Paulson (2015), van Lierop (2024)) and some academic studies (e.g., Maeckle (2024), Wiersema et al. (2025)) have suggested that short-termism is a key obstacle to tackling carbon emissions. To explore whether short-termism plays a role in our findings, we use three proxies for investor short-termism: the churn ratio of Gaspar et al. (2005), the adjusted churn ratio of Yan and Zhang (2009), and the share of transient ownership by Bushee (1998).[6] Across all these measures, we find that the estimated positive relationship between product fluidity and carbon emissions is actually stronger for firms with longer-horizon shareholders, although this difference is not statistically significant. This contrasts the results of Starks et al. (2023), who find that long-term institutional investors tilt their portfolios towards firms with better ESG profiles.

[6] Churn ratio is an indicator of investor turnover for the firm, measured by a weighted average of the total portfolio churn rate of all institutional shareholders over the four quarters of the year. The transient investor definition by Bushee (1998) is based on factor analysis and cluster analysis of past investment behavior. Transient institutions have high portfolio turnover and engage in momentum trading strategies.

On the other hand, the estimated relationship between fluidity and carbon emissions is stronger for firms with lower institutional ownership in general. although this difference is also not statistically significant. This seems consistent with Azar et al. (2021), who find a negative association between Big Three ownership and subsequent carbon emissions among MSCI index constituents. Taken together, our results on ownership suggest that institutional ownership matters, but that the sensitivity of carbon emissions to competitive pressure is not driven by short-term owners.

To assess the importance of out findings for the aggregate carbon emissions in the economy, we perform further subsample analyses dividing our sample by firm size, age, and total carbon emissions.[7] We find that the results are broadly similar for firms regardless of their size, age, or total carbon footprint. This suggests that the relationship between competitive pressure and carbon emissions that we document may be important for the total carbon emissions, as it also applies to the large emitters.

We make several contributions. First, we contribute to the rapidly growing literature on corporate carbon emissions and the role of markets in moderating them. Several studies focus on the pricing of climate risk and carbon and other emissions risk in equity (Choi et al. (2020), Bolton and Kacperczyk (2021), Bolton and Kacperczyk (2023), Aswani et al. (2024), Zhang (2025), Hsu et al. (2023)), debt (Duan et al. (2023b), Ginglinger and Moreau (2023), Ivanov et al. (2024)), and other financial markets (e.g., Ilhan et al. (2021), Giglio et al. (2021)). Some recent studies use earnings call transcripts to quantify firms' climate risk exposures (e.g., Li et al. (2024), citeSautner2023). A related literature focuses on the effects of carbon abatement policies. Hong et al. (2023) model the welfare consequences of mandates that restrict investors to hold firms with net-zero carbon emissions. Martinsson et al. (2024) and Andersson (2019) estimate that the Swedish carbon tax substantially reduced the carbon emissions. A large literature discusses the social cost of carbon (e.g., Barnett et al. (2020), van den Bremer and van der Ploeg (2021)). Akey and Appel (2021) find that limitations in

[7]For example, Fang et al. (2024) argue that under financial constraints, smaller and younger firms invest more in capital and engage less in pollution abatement.

parent company environmental liability result in lower investment in abatement technologies. Shapiro and Walker (2018) show that between 1990 and 2008, air pollution emissions from U.S. manufacturing fell by 60 percent despite a substantial increase in manufacturing output, primarily driven by within-product changes in emissions intensity.

Our study is also related to the literature documenting unintended consequences of carbon reduction policies. Several studies focus on emissions leakage amid local restrictions (e.g., Fowlie (2009), Fowlie et al. (2016), Bartram et al. (2022)). Shapiro (2016) finds that the benefits of international trade exceed trade's environmental costs due to CO_2 emissions. In a study closely related to ours, Cenci et al. (2023) argue that competition induces firms to increase their sustainability efforts and invest in a broader spectrum of sustainability issues. This appears to somewhat contradict our empirical findings – although it is obviously possible that in the very long term competition would have the opposite effect to what we find in the contemporaneous setting.

We add to the large literature on the effects of competition. There are many studies suggesting that more competition is associated with lower prices (Dafny et al. (2012), Borenstein and Rose (1994), Brown and Goolsbee (2002)), better product quality (Matsa, 2011), and reduced governance problems (Lie and Yang (2023), Giroud and Mueller (2010, 2011)), as well as other broadly positive outcomes. von Meyerinck et al. (2024) show that competition is important for consumers' ability to discipline firms. Our findings suggest that competition may also have possibly negative societal impacts in reducing firms' commitment to sustainability. Other studies finding negative societal as well as firm-level effects from competition include Autor et al. (2013), Autor et al. (2020), Pierce and Schott (2016), Frésard and Valta (2016), Valta (2012). Hombert and Matray (2018) find that innovative firms are less exposed to import competition. Frésard (2010), on the other hand, finds that financial strength can lead to market share gains. The discussion about the effects of competition is increasingly important as industries have grown more concentrated and profitable in recent decades, both in the U.S. (Covarrubias et al. (2019), Grullon et al. (2019)) and globally (De Loecker and

Eeckhout (2018), Bae et al. (2021), Frésard (2010)).

There is some prior work on the relationship between competition and different measures of sustainability. Flammer (2015) finds that tariff reductions are associated with increases in CSR, while Ding et al. (2022) provide international evidence that intensifying competition laws are associated with an increase in CSR. Duanmu et al. (2018) find that a reduction in protective tariffs at WTO entry is associated with worsening of environmental performance of Chinese manufacturing firms. Some related recent studies look at consumer responses to negative ESG incidents (Houston et al. (2023), Duan et al. (2023a).)

We also contribute to the literature on the role of ownership in corporate emissions (e.g. Shive and Forster (2020)). Our finding that firms with longer-term owners exhibit a stronger relationship between competitive pressure and carbon emissions is in contrast to Starks et al. (2023), who find that short-term owners are associated with poorer ESG profiles, and to Pursiainen et al. (2024), who show find the relationship between competition and ESG performance is more negative for firms with shorter-term shareholders. On the other hand, our result that institutional ownership is associated with weaker link between competition and emissions appears consistent with prior studies suggesting that institutional ownership is associated with more investment in sustainability and more climate risk disclosures (Azar et al. (2021), Ilhan et al. (2023), Cohen et al. (2023)).

Finally, our study is related to the literature on the interaction between morals and markets. Falk and Szech (2013) present experimental evidence that market interaction erodes moral values. Similarly, Bartling et al. (2015) find that consumers in markets exhibit less social concern than subjects in a comparable individual choice context. In a more recent paper, Bartling et al. (2023) argue that it may not be markets per se, but rather playing repeatedly that leads to the erosion of moral values. Dewatripont and Tirole (2024) show that intense market competition does not crowd out consequentialist ethics. Our findings provide nuance to this discussion, as the carbon emissions of firms that might be expected to be more "moral" indeed seem to be less sensitive to competitive pressure – but react nevertheless.

2 Data and methodology

2.1 Sample construction

To construct our sample, we start with all public U.S. firms over the period of 2002 to 2023. Our sample starts from 2002 as it is the beginning of carbon intensity data coverage in S&P Global Trucost. Product fluidity data are from the Hoberg and Phillips Data Library. Corporate financial and accounting data are from Compustat.

Other data sources include state-level exchange rate data are from Federal Reserve at Dallas. Climate opinion data are from Yale Climate Opinion Maps. Presidential election voting data are from MIT Election Lab. Lobbying data are from Leippold et al. (2024). Social capital data are from Lin and Pursiainen (2022) and Meta, and institutional ownership data are from Thomson Reuters Institutional (13f) Holdings. After dropping firms from the financial sector (SIC codes between 6000 and 6999) and deleting observations with missing data, we obtain a sample with 28,721 firm-year observations for 3,725 U.S. firms.

2.2 Measuring carbon intensity

We measure corporate carbon intensity using data provided by S&P Global Trucost, a database prevalent in recent studies (e.g.,Azar et al. (2021),Bolton and Kacperczyk (2023), Cohen et al. (2023)). Trucost compiles emission data from publicly available sources, such as financial reports, CSR reports, CDP filings, and EPA filings. It categorizes carbon emissions related to corporate activities into different scopes. For each scope, Trucost quantifies carbon emissions in absolute tonnes of CO2 equivalent, as well as calculates emission intensity as the ratio of absolute tonnes to a firm's revenue in millions of U.S. dollars. Among them, emission intensity, i.e., carbon efficiency, reflects corporate operational scale and indicates its dependency on carbon emissions in generating revenue.

In this paper, we focus on Scope 1 carbon emissions – emissions that come from direct emitting sources a firm owns or controls – because they are more directly controlled by firms, and they are more accurately quantified. We logarithmically transform the Scope 1 carbon intensity. Specifically, we define *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. Higher values indicate greater levels of carbon emissions.

2.3 Measuring competitive pressure

As the main measure for competitive pressure, we use the product fluidity index of Hoberg et al. (2014). This index (*Fluidity*) is based on textual analysis of the mandatory product descriptions in 10-K filings, capturing the similarity between a focal firm's products and the overall changes in the rivals' products. A greater product fluidity index means more overlap with opponents in product space, implying that the firm suffers more severe competitive threats induced by rivals – i.e., higher levels of competitive pressure. *Fluidity* is used by a number of recent studies to measure competitive threats in the product market (e.g., Li and Zhan (2019), Mattei and Platikanova (2017), Hoberg et al. (2014)).

The product fluidity index has four benefits. First, company-level product fluidity data contain firm-specific information that is not available in other competition dimensions, such as national competition laws. The index reflects the actual competitive pressure that each company faces in the product market from both public companies and potential private firms. Second, the product fluidity represents the instability caused by the action of rivals rather than the diversification in self-products of the focal company. The launch of comparable products from opponents could intensify product market competition for firms with stationary product structures. Third, a potential endogeneity problem in investigating the association between product market competition and corporate carbon intensity is that the CEO who formulates emission policies also set the competition strategies. Since product fluidity captures moves by rival firms competing in a focal company's product field, this measurement is more likely to be exogenous from a single firm's perspective (Hoberg et al. (2014)). Last, the fluidity data has comprehensive coverage for U.S. public companies across various industries, providing the same scope as the Compustat database and the Center for Research in Security Prices (CRSP) database.

2.4 Control variables

Following previous literature, we control for a wide range of firm characteristics that might influence corporate carbon intensity. The control variables include *ln(Total assets)*, measured by the natural logarithm of total assets; *Leverage*, measured by the ratio of book value of debt to total assets; *Cash*, measured by the ratio of cash and short-term investments to total assets; *Tangibility*, measured by the ratio of net property, plant and equipment to total assets; *Capital expenditure*, measured by the ratio of capital expenditures to total assets; *ln(1+N analysts)*, measured by the natural logarithm of one plus the number of analysts following a firm; *Sales growth*, measured by the one-year net sales growth rate; *R&D expenditure*, measured by the ratio of research and development expenditures to total sales, where missing R&D is set to zero; *Tobin's Q*, measured by the ratio of the market value of a firm plus total liability to total assets; *EBIT margin*, measured by the ratio of earnings before interest and taxes to total sales; *EBIT to total assets*, measured by the ratio of earnings before interest and taxes to total assets;and *Foreign sales*, measured by a dummy variable that equals one if a firm reports foreign income.

Detailed definitions of variables can be found in Appendix A. To avoid the effects of outliers, we winsorize all continuous variables at the 1% level.

2.5 Description of the data

Table 1 provides summary statistics for the key variables used in the analysis. The average Scope 1 carbon emission intensity(*Scope 1 intensity*) is 240.916, with a high standard deviation of 979.402, indicating significant variation among firms. When log-transformed, the mean carbon intensity(*ln(Scope 1 intensity*) is 3.288, suggesting a skewed distribution with some firms exhibiting substantially higher emissions. Product fluidity(*Fluidity*), the primary measure of competition, has an average value of 6.221 with a standard deviation of 3.661, reflecting differing levels of competitive pressure across firms.

Firm size, measured by the logarithm of total assets, has a mean of 7.702, indicating the presence of both mid-sized and large firms in the sample. On average, firms finance 28.2% of their assets with debt, while cash holdings constitute approximately 19.7% of total assets. Capital expenditures account for 4.5% of total assets, and firms experience an average annual sales growth of 12%. Tobin's Q, with a mean of 2.347, suggests that firms are valued at more than twice their book value. Additionally, R&D expenditures represent around 12% of total sales, and 65% of firms report foreign income.

3 Main results

3.1 Product fluidity and carbon emissions

To examine the relationship between competitive pressure and corporate carbon emissions we perform a regression analysis of the following form:

$$\textit{ln(Scope 1 intensity)}_{i,t} = \alpha + \beta Fluidity_{i,t-1} + \gamma X_{i,t-1} + \epsilon_{i,t-1}, \tag{1}$$

where i and t denote the firm and year, respectively. The dependent variable, *ln(Scope 1 intensity)*, is the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). X is a vector of controls. We include firm and year fixed effects throughout the paper but also include alternative sets of fixed effects for robustness. All right-hand-side variables are lagged by one year. Standard errors are clustered by firm.

Table 2 presents the results. Across all model specifications, the coefficients of *Fluidity* are all positive and statistically significant at the 1% level, confirming a positive relationship between product fluidity and carbon emissions. This relationship is also economically meaningful. Taking the results with firm and year fixed effects for example, on average, firms operating in more competitive product markets tend to increase their carbon emissions per unit of revenue by around 4.06% for each standard deviation increase in competition. This positive relationship remains robust even after controlling for firm characteristics, including size, leverage, cash holdings, and capital expenditure, as well as incorporating fixed effects at the industry, state, and firm levels.

3.2 Lagged fluidity and carbon emissions

We also examine the dynamic relationship between product fluidity and carbon intensity by incorporating lagged measures of fluidity as right-hand-side variables. Incorporating lagged measures of product fluidity allows us to establish a stronger causal link, accounting for delayed firm responses, and assessing the persistence of competition-induced changes in emissions.

In this model specification, the primary dependent variable is *ln(Scope 1 intensity)*. The key explanatory variables are contemporaneous and lagged measures of product fluidity, allowing for an assessment of how past competitive pressure influences current carbon emissions. The results in Table 3 confirm a positive and persistent relationship between product fluidity and carbon intensity, even when fluidity is lagged by multiple years. The results indicate that increased competition leads to higher carbon emissions in both the short and medium term, with the strongest impact occurring one to two years after the initial increase in competition. This suggests that firms take time to adjust to competitive pressures, potentially implementing cost-cutting measures that result in higher emissions. However, the effect gradually weakens over time, becoming insignificant after three to four years, implying that firms may eventually adapt or find ways to offset the initial increase in emissions.

3.3 Instrumenting product fluidity

To shed more light on the causal relationship between competitive pressure and carbon emissions, we use two instrumental variables to obtain exogenous variation in product fluidity: changes in state-level trade-weighted foreign exchange rates (Li and Zhan (2019), Loncan (2023), Loncan and Valta (2024)) and the staggered introduction of Paid Sick Leave (PSL) laws (Loncan and Valta (2024), Maclean et al. (2024)).

The first instrument is Δ *ln(FX)*, measured by the growth rate of real trade-weighted state-level exchange rates. An increase in the state-level value of the U.S. dollar is plausibly associated with increased localized competition since a higher dollar value reduces the relative cost of imports, which in turn spurs local competition. However, exchange rates are determined by decentralized and aggregated market-based transactions (at the state-level in our case). The actions of individual firms are unlikely to determine the outcome of such aggregate transactions, hence it is plausible that the residual of the structural IV equation is uncorrelated with the exchange rate.

The second instrument is *PSL*, a dummy variable that equals one if a state adopts Paid Sick Leave mandates. [8]The exogenous PSL mandates make the compensation of sick absences mandatory increase in affected states, implying an increase in labor costs, and thus decreasing profit margins. Firms that have market power ex-ante have more financial slack to absorb such higher costs, whereas firms with lower market power should take a stronger hit from increased labor costs. If powerful firms can weather surges in labor costs better, then this labor policy shock could have anti-competitive effects, erode the competitive position of weaker firms, and reduce competition. On the other hand, PSL mandates are constitutional choices regarding labor conditions made by states and are set at the policy

[8]Following Maclean et al. (2024), firms' exposure to PSL mandates is determined based on the headquarter locations. The following states/jurisdictions implemented PSL mandates during the sample period: Arizona (2017), California (2015), Colorado (2021), Connecticut (2012), District of Columbia (2008), Massachusetts (2015), Maryland (2018), Minnesota (2024), New Jersey (2018), New Mexico (2022), New York (2021), Oregon (2016), Rhode Island (2016), Vermont (2017), and Washington (2018). Firms headquartered in these states are classified as being subject to PSL mandates from the respective effective year onward.

level. The passage of PSL laws is unlikely to be endogenous to the competitive actions of individual firms. Therefore, the residual of the structural equation is plausibly uncorrelated with the policy shock, suggesting that the exclusion condition is likely to be satisfied.

By using the two instrumental variables, we assume that Δ *ln(FX)* and *PSL* are strongly correlated with product market fluidity but have no direct effect on carbon emissions except through their impact on competition. The instrumental variables approach mitigates endogeneity concerns, allowing for a causal interpretation of the relationship between competition and carbon emissions.

Table 4 presents the results of the instrumental variables (IV) estimation, where state-level exchange rate fluctuations (Δ *ln(FX)*) and Paid Sick Leave mandates (*PSL*) are used as instruments for product fluidity. This table is divided into three panels: Panel A reports the ordinary least squares (OLS) estimates of the relationship between IVs and carbon intensity, Panel B presents the first-stage regression results, and Panel C provides the second-stage regression results estimating the causal effect of product fluidity on carbon emissions.

The results in Panel A show that a stronger U.S. dollar (Δ *ln(FX)*) is associated with higher carbon emissions, suggesting that increased competition from cheaper imports may push firms to raise emissions. In contrast, PSL mandates(*PSL*) are negatively related to carbon intensity, implying that stricter labor regulations may reduce emissions. While these findings show that the instruments are linked to carbon emissions, they do not yet establish whether this effect operates through product fluidity, which is tested in the subsequent panels using a two-stage least squares (2SLS) approach.

The results in Panel B confirm that both instruments are strongly associated with product fluidity, which is similar to Loncan and Valta (2024): a stronger U.S. dollar (Δ *ln(FX)*) significantly increases fluidity, indicating that higher exchange rates intensify competition by making imports cheaper and raising market pressure on domestic firms. Conversely, PSL mandates (*PSL*) significantly reduce product fluidity, suggesting that higher labor costs from mandated paid sick leave discourage competition, likely by disproportionately affecting firms with weaker market power. The high F-statistics indicate that the instruments are sufficiently strong, addressing concerns about weak instruments and confirming their relevance in explaining variation in product fluidity.

The results in Panel C show that the instrumented product fluidity remains positively and significantly associated with carbon intensity, reinforcing the conclusion that increased competition leads to higher carbon emissions. Compared to the OLS estimates, the effect size is larger, suggesting that the uninstrumented regression in earlier tables may have underestimated the true impact of competition on emissions. By addressing endogeneity concerns, Panel C provides strong causal evidence that heightened product market competition results in greater carbon emissions.

3.4 Climate opinions, political views, and lobbying

Firms operate within broader societal and political contexts that shape their environmental decisions. Research suggests that corporate expectations about climate regulation influence emissions strategies (Ramadorai and Zeni (2024)), while political ideology correlates with sustainability preferences, including in investment decisions (Hong and Kostovetsky (2012), Gormley et al. (2024), Kempf and Tsoutsoura (2024)).

Public climate opinions reflect societal expectations for corporate environmental responsibility, potentially constraining firms from increasing emissions when facing competition. Strong climate concern may lead to greater pressure from consumers, investors, and regulators, while weaker concern may allow firms to prioritize cost-cutting over sustainability. Similarly, political ideology shapes regulatory environments, with conservative-leaning regions typically having less stringent environmental policies, giving firms more flexibility to raise emissions under competition, whereas progressive-leaning areas impose stricter oversight and reputational risks.

Panel A of Table 5 examines how public climate opinions and political views moderate the relationship between product fluidity and carbon intensity. We first partition the sample based on the county-level climate concern where the firm is headquartered, measured by the ratio of population who think corporations and industry should be doing more or much more to address global warming from Yale Climate Opinion Maps. Counties with higher climate concern(above the sample median each year) have a larger proportion of residents who believe that climate change is a serious issue and support stronger environmental policies, while counties with lower climate concern exhibit less public support for climate action. The results show that the effect of product fluidity on carbon intensity is significantly weaker in regions with higher climate concern. In these regions, firms appear more constrained in their ability to increase emissions in response to competitive pressures.

We then partition the sample based on the county-level political views, measured by the ratio of residents in a county that vote for the Republican party in the Presidential election from MIT Election Lab. The results show that firms in politically conservative states (measured by higher Republican vote shares) exhibit a stronger positive relationship between competition and carbon emissions. In these regions, firms appear to face fewer social or regulatory constraints on emissions, allowing them to prioritize cost-cutting over environmental concerns when faced with competitive pressure. However, the economic difference along political lines is small.

Panel B of Table 5 examines how firm-level lobbying expenditures moderate the relationship between product fluidity and carbon intensity. *Democratic* is measured by the Democratic-leaning lobbying expenses of Leippold et al. (2024). *Republican* is measured by the Republican-leaning lobbying expenses of Leippold et al. (2024). Firms with *Democratic* or *Republican* above sample medians each year are classified as *High*, otherwise as *Low*.

The results show that firms that lobby Democrats more heavily exhibit a weaker relationship between competition and carbon intensity. Although it is not statistically significant, the results suggest that engagement with Democratic policymakers, who generally support stronger environmental regulations, may constrain firms from increasing emissions even under competitive pressure. In contrast, firms that lobby Republicans more heavily exhibit a stronger positive relationship between competition and carbon intensity, implying that lobbying efforts directed toward Republican policymakers, who typically advocate for deregulation, allow firms greater flexibility to increase emissions in response to competitive pressures. This suggests to some extent the effectiveness of corporate lobbying in shaping environmental outcomes depends on the political orientation of the recipients.

3.5 Social norms

Firms' carbon abatement decisions are shaped not only by financial incentives but also by social norms, which reflect community expectations regarding corporate responsibility. In regions with strong pro-environmental norms, firms may face greater public pressure to maintain sustainability efforts, limiting their ability to increase emissions under competition. In contrast, firms in areas with weaker social norms may feel less constrained by stakeholder expectations, allowing them to prioritize cost-cutting over sustainability when facing competitive pressure.

Table 6 presents the results about how social norms moderate the relationship between product fluidity and carbon intensity. The analysis partitions firms based on three proxies of social norms. First, we use the *Social capital* of Lin and Pursiainen (2022). Social capital refers to communities and networks of relationships that affect individuals' and firms' behavior by imposing norms, creating reciprocity, and hence facilitating trust. A higher level of social capital implies stronger social norms. Second, we use *Volunteering*, measured by the ratio of Facebook users who are members of a group which is predicted to be about volunteering or activism based on group title and other group characteristics(Chetty et al. (2022a), Chetty et al. (2022b)). Third, we classify firms into *Sin industry* and other industries, following Hong and Kacperczyk (2009). Sin industries include alcohol, tobacco, gambling, and weapons and are often considered less ethical. Sin industries are defined as SIC codes: 2100-2199, 2080-2085; NAICS codes: 7132, 71312, 713210, 71329, 713290, 72112, and 721120. Firms with *Social capital* or *Volunteering* above sample medians each year are classified as *High*, otherwise as *Low*. Firms in the *Sin industry* are classified as *Yes*, otherwise as *No*.

The results of Table 6 confirm that firms in high social capital and high volunteering regions exhibit a weaker relationship between competition and carbon intensity, suggesting that stronger community values and civic engagement serve as informal regulatory mechanisms that constrain emissions increases. In contrast, firms in low social capital and low volunteering areas face fewer social constraints, allowing them to respond to competition with higher emissions intensity. Additionally, firms in sin industries show a stronger competition-emissions link, implying that these firms, already under ethical scrutiny, may increase emissions when facing heightened competition, although it is not statistically significant.

3.6 Ownership and investor horizion

Many commentators (see, e.g., Paulson (2015), van Lierop (2024)) and academic studies (e.g., Maeckle (2024), Wiersema et al. (2025)) have suggested that short-termism is a major barrier to corporate carbon reduction efforts. Short-term-oriented investors, who frequently trade stocks and prioritize immediate financial returns, may pressure firms to focus on cost-cutting and short-term profitability at the expense of long-term sustainability goals. In contrast, long-term investors, such as pension funds and large institutional shareholders, often advocate for corporate policies that enhance long-term value, including environmental responsibility.

Table 7 examines how investor horizon influences the relationship between product fluidity and carbon intensity. We conduct subsample analyses using several proxies for investor short-termism, including the Churn ratio (Gaspar et al. (2005)), the Adjusted churn ratio (Yan and Zhang (2009)), and Transient ownership (Bushee (1998)). The Churn ratio measures investor turnover, calculated as the weighted average portfolio churn rate of institutional shareholders over four quarters. The Adjusted churn ratio, introduced by Yan and Zhang (2009), refines this measure. Transient ownership captures the proportion of shares held by momentum traders with high turnover and frequent trading activity (Bushee (1998)). Firms with higher Churn ratio, Adjusted churn ratio, or Transient ownership are considered to have shorter investment horizons.

Firms are categorized into high and low groups based on the sample median for each measure each year. The results show that, across all measures, the positive relationship between product fluidity and carbon emissions is to some extent stronger for firms with longer-horizon shareholders. This contrasts with the findings of Starks et al. (2023), who report that long-term institutional investors tend to allocate capital toward firms with stronger ESG profiles.

Conversely, the relationship between fluidity and carbon emissions is stronger for firms with lower institutional ownership. Institutional ownership, defined as the proportion of shares held by institutional investors, appears to moderate firms' emissions responses to competition. This result aligns with Azar et al. (2021), who find that Big Three ownership is negatively associated with subsequent carbon emissions among MSCI index constituents.

Overall, these findings suggest that institutional ownership plays a role in firms' environmental responses to competition. However, the results do not indicate that short-term investors drive the sensitivity of carbon emissions to competitive pressure, challenging the prevailing view that short-termism is the primary barrier to reduce carbon emissions.

3.7 Firm size, age, and total carbon emissions

We also examine how firm characteristics, in particular size, age, and total carbon emissions, influence the relationship between product fluidity and carbon intensity. Prior research suggests that smaller and younger firms, particularly those facing financial constraints, prioritize capital investment over pollution abatement (Fang et al. (2024)). By analyzing firms of varying sizes and ages, we can determine whether competition-induced emissions increases are driven by specific firm characteristics or whether they represent a broader trend across the corporate sector. Additionally, examining firms based on total carbon emissions helps assess whether competitive pressures primarily affect high-emission firms, which contribute most to aggregate carbon output, or whether they influence firms across the emissions spectrum.

Table 8 presents subsample regression results. The table categorizes firms into high and low groups based on the sample median each year for: *Total assets*, as a proxy for firm size;*Firm age*, measuring the number of years since a firm first appeared in the CRSP monthly stock return files;*Total Scope 1 emissions*, are firm-level yearly emissions, capturing absolute carbon output rather than intensity. By splitting firms into these groups, the table assesses whether larger, older, or high-emitting firms respond differently to competitive pressures in terms of carbon intensity.

The results indicate that fluidity is significantly associated with carbon intensity across all subsamples, meaning competition consistently correlates with higher emissions. However, the differences between high and low groups are not statistically significant. This suggests that firm size, age, and total emissions do not systematically alter the competition-emissions relationship, implying that firms across different characteristics tend to react similarly to competitive pressures in terms of carbon intensity.

4 Conclusion

We find that higher exposure to competition is associated with higher carbon emission intensity, using product fluidity as our measure of competition. This result is robust to using instrumental variables to obtain exogenous variation in fluidity.

The positive relationship between competition and carbon emissions is stronger for firms in areas less concerned about climate change, as well as for Republican-lobbying firms. This suggests that climate opinions and political views that are correlated with views on the importance of carbon abatement are reflected in the decisions that firms make. We also find that the sensitivity of carbon emissions to competition is stronger in areas with weaker social norms and for firms in "sin-industries", further suggesting that social norms matter in guiding firm actions. Our results do not appear to be driven by short-termism, as the relationship between emissions and competition is at least as strong for firms with longer-term-oriented shareholder bases.

Importantly, our results hold across firms of all sizes and emission levels. This suggests that our findings may be important for the aggregate dynamics of carbon emissions. Overall, our findings highlight a potential conflict between pro-competition policies and climate change mitigation efforts.

References

Akey, Pat, and Ian Appel, 2021, The limits of limited liability: Evidence from industrial pollution, *Journal of Finance* 76, 5–55.

Andersson, Julius J., 2019, Carbon taxes and CO2 emissions: Sweden as a case study, *American Economic Journal: Economic Policy* 11, 1–30.

Aswani, Jitendra, Aneesh Raghunandan, and Shiva Rajgopal, 2024, Are carbon emissions associated with stock returns?, *Review of Finance* 28, 75–106.

Autor, David, David Dorn, Gordon H. Hanson, Gary Pisano, and Pian Shu, 2020, Foreign competition and domestic innovation: Evidence from US patents, *American Economic Review: Insights* 2, 357–74.

Autor, David H., David Dorn, and Gordon H. Hanson, 2013, The China syndrome: Local labor market effects of import competition in the United States, *American Economic Review* 103, 2121–68.

Azar, José, Miguel Duro, Igor Kadach, and Gaizka Ormazabal, 2021, The big three and corporate carbon emissions around the world, *Journal of Financial Economics* 142, 674–696.

Bae, Kee-Hong, Warren Bailey, and Jisok Kang, 2021, Why is stock market concentration bad for the economy?, *Journal of Financial Economics* 140, 436–459.

Barnett, Michael, William Brock, and Lars Peter Hansen, 2020, Pricing uncertainty induced by climate change, *Review of Financial Studies* 33, 1024–1066.

Bartling, Björn, Ernst Fehr, and Yagiz Özdemir, 2023, Does market interaction erode moral values?, *Review of Economics and Statistics* 105, 226–235.

Bartling, Björn, Roberto A. Weber, and Lan Yao, 2015, Do markets erode social responsibility?, *Quarterly Journal of Economics* 130, 219–266.

Bartram, Söhnke M., Kewei Hou, and Sehoon Kim, 2022, Real effects of climate policy: Financial constraints and spillovers, *Journal of Financial Economics* 143, 668–696.

Bolton, Patrick, and Marcin Kacperczyk, 2021, Do investors care about carbon risk?, *Journal of Financial Economics* 142, 517–549.

Bolton, Patrick, and Marcin Kacperczyk, 2023, Global pricing of carbon-transition risk, *Journal of Finance* 78, 3677–3754.

Borenstein, Severin, and Nancy L. Rose, 1994, Competition and price dispersion in the U.S. airline industry, *Journal of Political Economy* 102, 653–683.

Brown, Jeffrey R., and Austan Goolsbee, 2002, Does the internet make markets more competitive? Evidence from the life insurance industry, *Journal of Political Economy* 110, 481–507.

Bushee, Brian J, 1998, The influence of institutional investors on myopic R&D investment behavior, *Accounting Review* 73, 305–333.

Cenci, Simone, Hossein Asgharian, Lu Liu, Marek Rei, and Maurizio Zollo, 2023, Competitive pressure and emission reduction: Unravelling the link, Working paper.

Chetty, Raj, Matthew O. Jackson, Theresa Kuchler, Johannes Stroebel, Nathaniel Hendren, Robert Fluegge, Sara Gong, Federico Gonzalez, Armelle Grondin, Matthew Jacob, Drew Johnston, Martin Koenen, Eduardo Laguna-Muggenberg, Florian Mudekereza, Tom Rutter, Nicolaj Thor, Wilbur Townsend, Ruby Zhang, Mike Bailey, Pablo Barberá, Monica Bhole, and Nils Wernerfelt, 2022a, Social capital I: measurement and associations with economic mobility, *Nature* 608, 108–121.

Chetty, Raj, Matthew O. Jackson, Theresa Kuchler, Johannes Stroebel, Nathaniel Hendren, Robert Fluegge, Sara Gong, Federico Gonzalez, Armelle Grondin, Matthew Jacob, Drew

Johnston, Martin Koenen, Eduardo Laguna-Muggenberg, Florian Mudekereza, Tom Rutter, Nicolaj Thor, Wilbur Townsend, Ruby Zhang, Mike Bailey, Pablo Barberá, Monica Bhole, and Nils Wernerfelt, 2022b, Social capital II: Determinants of economic connectedness, *Nature* 608, 122–134.

Choi, Darwin, Zhenyu Gao, and Wenxi Jiang, 2020, Attention to global warming, *Review of Financial Studies* 33, 1112–1145.

Cohen, Shira, Igor Kadach, and Gaizka Ormazabal, 2023, Institutional investors, climate disclosure, and carbon emissions, *Journal of Accounting and Economics* 76.

Covarrubias, Matias, Germán Gutiérrez, and Thomas Philippon, 2019, From good to bad concentration? U.S. industries over the past 30 years, *NBER Macroeconomics Annual* 34.

Cruz, José-Luis, and Esteban Rossi-Hansberg, 2024, The economic geography of global warming, *Review of Economic Studies* 91, 899–939.

Dafny, Leemore, Mark Duggan, and Subramaniam Ramanarayanan, 2012, Paying a premium on your premium? Consolidation in the U.S. health insurance industry, *American Economic Review* 102, 1161–85.

De Loecker, Jan, and Jan Eeckhout, 2018, Global market power, Working paper.

Dewatripont, Mathias, and Jean Tirole, 2024, The morality of markets, *Journal of Political Economy* 132, 2655–2694.

Ding, Wenzhi, Ross Levine, Chen Lin, and Wensi Xie, 2022, Competition laws, ownership, and corporate social responsibility, *Journal of International Business Studies* 53, 1576–1602.

Duan, Tinghua, Frank Weikai Li, and Roni Michaely, 2023a, Consumers' reaction to corporate ESG performance: Evidence from store visits, Working paper.

Duan, Tinghua, Frank Weikai Li, and Quan Wen, 2023b, Is carbon risk priced in the cross section of corporate bond returns?, *Journal of Financial and Quantitative Analysis* Forthcoming.

Duanmu, Jing-Lin, Maoliang Bu, and Russell Pittman, 2018, Does market competition dampen environmental performance? Evidence from China, *Strategic Management Journal* 39, 3006–3030.

Falk, Armin, and Nora Szech, 2013, Morals and markets, *Science* 340, 707–711.

Fang, Min, Po-Hsuan Hsu, and Chi-Yang Tsou, 2024, Financial frictions and pollution abatement over the life cycle of firms, Working paper.

Flammer, Caroline, 2015, Does product market competition foster corporate social responsibility? Evidence from trade liberalization, *Strategic Management Journal* 36, 1469–1485.

Fowlie, Meredith, Mar Reguant, and Stephen P. Ryan, 2016, Market-based emissions regulation and industry dynamics, *Journal of Political Economy* 124.

Fowlie, Meredith L., 2009, Incomplete environmental regulation, imperfect competition, and emissions leakage, *American Economic Journal: Economic Policy* 1, 72–112.

Frésard, Laurent, 2010, Financial strength and product market behavior: The real effects of corporate cash holdings, *Journal of Finance* 65, 1097–1122.

Frésard, Laurent, and Philip Valta, 2016, How does corporate investment respond to increased entry threat?, *Review of Corporate Finance Studies* 5, 1–35.

Gaspar, José-Miguel, Massimo Massa, and Pedro Matos, 2005, Shareholder investment horizons and the market for corporate control, *Journal of Financial Economics* 76, 135–165.

Giglio, Stefano, Matteo Maggiori, Krishna Rao, Johannes Stroebel, and Andreas Weber, 2021, Climate change and long-run discount rates: Evidence from real estate, *Review of Financial Studies* 34, 3527–3571.

Gillingham, Kenneth, and James H. Stock, 2018, The cost of reducing greenhouse gas emissions, *Journal of Economic Perspectives* 32, 53–72.

Ginglinger, Edith, and Quentin Moreau, 2023, Climate risk and capital structure, *Management Science* 69, 7151–7882.

Giroud, Xavier, and Holger M. Mueller, 2010, Does corporate governance matter in competitive industries?, *Journal of Financial Economics* 95, 312–331.

Giroud, Xavier, and Holger M. Mueller, 2011, Corporate governance, product market competition, and equity prices, *Journal of Finance* 66, 563–600.

Gormley, Todd A, Manish Jha, and Meng Wang, 2024, The politicization of social responsibility, NBER Working Paper.

Grullon, Gustavo, Yelena Larkin, and Roni Michaely, 2019, Are US industries becoming more concentrated?, *Review of Finance* 23, 697–743.

Hoberg, Gerard, Gordon Phillips, and Nagpurnanand Prabhala, 2014, Product market threats, payouts, and financial flexibility, *Journal of Finance* 69, 293–324.

Hombert, Johan, and Adrien Matray, 2018, Can innovation help U.S. manufacturing firms escape import competition from China?, *Journal of Finance* 73, 2003–2039.

Hong, Harrison, and Marcin Kacperczyk, 2009, The price of sin: The effects of social norms on markets, *Journal of Financial Economics* 93, 15–36.

Hong, Harrison, and Leonard Kostovetsky, 2012, Red and blue investing: Values and finance, *Journal of Financial Economics* 103, 1–19.

Hong, Harrison, Neng Wang, and Jinqiang Yang, 2023, Welfare consequences of sustainable finance, *Review of Financial Studies* 36, 4864–4918.

Houston, Joel F., Chen Lin, Hongyu Shan, and Mo Shen, 2023, How does ESG shape consumption?, Working paper.

Hsu, Po-Hsuan, Kai Li, and Chi-Yang Tsou, 2023, The pollution premium, *Journal of Finance* 78, 1343–1392.

Ilhan, Emirhan, Philipp Krueger, Zacharias Sautner, and Laura T Starks, 2023, Climate risk disclosure and institutional investors, *Review of Financial Studies* 36, 2617–2650.

Ilhan, Emirhan, Zacharias Sautner, and Grigory Vilkov, 2021, Carbon tail risk, *Review of Financial Studies* 34, 1540–1571.

Ivanov, Ivan T, Mathias S Kruttli, and Sumudu W Watugala, 2024, Banking on carbon: Corporate lending and cap-and-trade policy, *Review of Financial Studies* 37, 1640–1684.

Kempf, Elisabeth, and Margarita Tsoutsoura, 2024, Political polarization and finance, *Annual Review of Financial Economics* 16, 413–34.

Leippold, Markus, Zacharias Sautner, and Tingyu Yu, 2024, Corporate climate lobbying, Working paper.

Li, Qing, Hongyu Shan, Yuehua Tang, and Vincent Yao, 2024, Corporate climate risk: Measurements and responses, *Review of Financial Studies* 37, 1778–1830.

Li, Si, and Xintong Zhan, 2019, Product market threats and stock crash risk, *Management Science* 65, 3949–4450.

Lie, Erik, and Keyang (Daniel) Yang, 2023, Import penetration and executive compensation, *Review of Financial Studies* 36, 281–316.

Lin, Tse-Chun, and Vesa Pursiainen, 2022, Regional social capital and moral hazard in crowdfunding, *Journal of Business Venturing* 37, 106224.

Loncan, Tiago, 2023, Product market competition and FDI decisions, *Journal of Financial and Quantitative Analysis* 58, 2617–2656.

Loncan, Tiago, and Philip Valta, 2024, Competition and the boundaries of the firm: Evidence from offshoring, Working paper.

Maclean, Johanna Catherine, Stefan Pichler, and Nicolas R. Ziebarth, 2024, Mandated sick pay: Coverage, utilization, and crowding-in, NBER Working Paper.

Maeckle, Kai, 2024, Short-termist carbon emissions, Working paper.

Martinsson, Gustav, László Sajtos, Per Strömberg, and Christian Thomann, 2024, The effect of carbon pricing on firm emissions: Evidence from the Swedish CO2 tax, *Review of Financial Studies* 37, 1848–1886.

Matsa, David A., 2011, Competition and product quality in the supermarket industry, *Quarterly Journal of Economics* 126, 1539–1591.

Mattei, Marco Maria, and Petya Platikanova, 2017, Do product market threats affect analyst forecast precision?, *Review of Accounting Studies* 22, 1628–1665.

Paulson, Henry M. Jr., 2015, Short-termism and the threat from climate change, McKinsey Commentary.

Pierce, Justin R., and Peter K. Schott, 2016, The surprisingly swift decline of US manufacturing employment, *American Economic Review* 106, 1632–62.

Pursiainen, Vesa, Hanwen Sun, and Yue Xiang, 2024, Competitive pressure and ESG, Working paper.

Ramadorai, Tarun, and Federica Zeni, 2024, Climate regulation and emissions abatement: Theory and evidence from firms' disclosures, *Management Science* 70, 8217–9119.

Shapiro, Joseph S., 2016, Trade costs, CO2, and the environment, *American Economic Journal: Economic Policy* 8, 220–54.

Shapiro, Joseph S., and Reed Walker, 2018, Why is pollution from US manufacturing declining? the roles of environmental regulation, productivity, and trade, *American Economic Review* 108, 3814–54.

Shive, Sophie A, and Margaret M Forster, 2020, Corporate governance and pollution externalities of public and private firms, *Review of Financial Studies* 33, 1296–1330.

Starks, Laura, Parth Venkat, and Qifei Zhu, 2023, Corporate ESG profiles and investor horizons, Working paper.

Stroebel, Johannes, and Jeffrey Wurgler, 2021, What do you think about climate finance?, *Journal of Financial Economics* 142, 487–498.

Valta, Philip, 2012, Competition and the cost of debt, *Journal of Financial Economics* 105, 661–682.

van den Bremer, Ton S., and Frederick van der Ploeg, 2021, The risk-adjusted carbon price, *American Economic Review* 111, 2782–2810.

van Lierop, Wal, 2024, Short-termism is the top threat to net zero, *Forbes* Aug 5, 2024.

von Meyerinck, Felix, Vesa Pursiainen, and Markus Schmid, 2024, Competition and the reputational costs of litigation, *Journal of Financial and Quantitative Analysis* Forthcoming.

Wiersema, Margarethe, Haeyoung Koo, Weiru Chen, and Yu Zhang, 2025, Corporate short-termism: A review and research agenda, *Journal of Management* Forthcoming.

Yan, Xuemin, and Zhe Zhang, 2009, Institutional investors and equity returns: Are short-term institutions better informed?, *Review of Financial Studies* 22, 893–924.

Zhang, Shaojun, 2025, Carbon returns across the globe, *Journal of Finance* 80, 615–645.

Appendix A: Definitions of variables

Variable	Definition
Scope 1 intensity	The ratio of Scope 1 carbon emissions to revenue in millions of dollars.
ln(Scope 1 intensity)	The natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars.
Fluidity	The product fluidity index of Hoberg et al. (2014).
ln(Total assets)	The natural logarithm of total assets.
Leverage	The ratio of book value of debt to total assets.
Cash	The ratio of cash and short-term investments to total assets.
Tangibility	The ratio of net property, plant and equipment to total assets.
Capital expenditure	The ratio of capital expenditures to total assets.
ln(1+N analysts)	The natural logarithm of one plus the number of analysts following a firm.
Sales growth	The one-year net sales growth rate.
R&D expenditure	The ratio of research and development expenditures to total sales, where missing R&D is set to zero.
Tobin's Q	The ratio of the market value of a firm plus total liability to total assets.
EBIT margin	The ratio of earnings before interest and taxes to total sales.
EBIT to total assets	The ratio of earnings before interest and taxes to total assets.
Foreign sales	A dummy variable that equals one if a firm reports foreign income.
Δ ln(FX)	The growth rate of real trade-weighted state-level exchange rates.
PSL	A dummy variable that equals one if a state adopts Paid Sick Leave mandates.
Climate concern	The ratio of population who think corporations and industry should be doing more or much more to address global warming.
Republican vote	The ratio of residents in a county that vote for the Republican party in the Presidential election.
Democratic	The Democratic-leaning lobbying expenses of Leippold et al. (2024).
Republican	The Republican-leaning lobbying expenses of Leippold et al. (2024).
Social capital	The social capital index of Lin and Pursiainen (2022).
Volunteering	The ratio of Facebook users who are members of a group which is predicted to be about volunteering or activism based on group title and other group characteristics.
Sin industry	A dummy variable that equals one if a firm is sin industries (SIC codes: 2100-2199, 2080-2085; NAICS codes: 7132, 71312, 713210, 71329, 713290, 72112, and 721120).
Inst. ownership	The ratio of shareholdings by all institutional investors to total shares outstanding.
Churn ratio	The weighted average churn ratio of Gaspar et al. (2005).
Adj. churn ratio	The adjusted weighted average churn ratio of Yan and Zhang (2009).
Transient ownership	The ratio of shareholdings of transient institutional investors to the total institutional ownership.
Total assets	The number of total assets.

Firm age	The number of years since a firm first appeared in the CRSP monthly stock return files.
Total scope 1 emissions	Firm-level yearly emissions capturing absolute carbon output.

Table 1
Summary statistics

This table presents the descriptive statistics for the main variables used in our analyses. *Scope 1 intensity* is the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level.

	Mean	Std	p25	p50	p75	N
Carbon emissions						
Scope 1 intensity	240.916	979.402	8.464	17.501	46.906	28,721
ln(Scope 1 intensity)	3.288	1.740	2.248	2.918	3.869	28,721
Competition						
Fluidity	6.221	3.661	3.482	5.303	8.028	28,721
Controls						
ln(Total assets)	7.702	1.801	6.492	7.771	8.934	28,694
Leverage	0.282	0.222	0.109	0.261	0.402	28,582
Cash	0.197	0.229	0.036	0.105	0.265	28,692
Tangibility	0.271	0.244	0.081	0.181	0.408	28,680
Capital expenditure	0.045	0.049	0.014	0.030	0.057	28,662
ln(1+N analysts)	2.291	0.815	1.792	2.398	2.890	28,721
Sales growth	0.120	0.243	-0.014	0.075	0.203	28,147
R&D expenditure	0.119	0.285	0.000	0.004	0.082	28,478
Tobin's Q	2.347	1.862	1.253	1.719	2.698	28,661
EBIT margin	-0.064	0.573	0.020	0.091	0.165	28,478
EBIT to total assets	0.029	0.201	0.016	0.069	0.120	28,692
Foreign sales	0.652	0.476	0.000	1.000	1.000	28,721
N	28,721					

Table 2
Carbon intensity and product fluidity

This table presents regression results of the relationship between product fluidity and carbon intensity. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Fluidity	0.0612***	0.0587***	0.0111***	0.0108***	0.0123***
	(0.0081)	(0.0072)	(0.0032)	(0.0034)	(0.0038)
ln(Total assets)		0.1126***	-0.0995***	-0.0675***	-0.0749***
		(0.0243)	(0.0182)	(0.0187)	(0.0218)
Leverage		-0.6092***	-0.0039	-0.0113	0.0128
		(0.0932)	(0.0464)	(0.0477)	(0.0535)
Cash		-0.4871***	0.1297**	0.0731	0.0534
		(0.1236)	(0.0616)	(0.0627)	(0.0701)
Tangibility		4.5108***	0.2423*	0.1952	0.0622
		(0.1803)	(0.1260)	(0.1271)	(0.1688)
Capital expenditure		-3.3139***	-0.4428**	0.1541	0.3647
		(0.5863)	(0.2045)	(0.2090)	(0.2722)
ln(1+N analysts)		-0.2647***	0.0273	0.0436**	0.0125
		(0.0391)	(0.0186)	(0.0196)	(0.0209)
Sales growth		0.1037***	0.0165	-0.0019	0.0019
		(0.0397)	(0.0181)	(0.0192)	(0.0214)
R&D expenditure		-0.1234	-0.1153*	-0.0529	-0.0523
		(0.1154)	(0.0640)	(0.0634)	(0.0718)
Tobin's Q		-0.0470***	-0.0093*	-0.0047	-0.0121**
		(0.0084)	(0.0052)	(0.0051)	(0.0056)
EBIT margin		-0.0493	-0.0624**	-0.0279	-0.0232
		(0.0679)	(0.0246)	(0.0242)	(0.0272)
EBIT to total assets		-0.1578	-0.0696	-0.0278	-0.0338
		(0.1393)	(0.0626)	(0.0619)	(0.0706)
Foreign sales		-0.1207**	0.0437	0.0324	0.0801*
		(0.0601)	(0.0390)	(0.0357)	(0.0456)
Year FE	No	No	Yes	No	No
Industry-Year FE	No	No	No	Yes	No
State-Year FE	No	No	No	Yes	No
State-Industry-Year FE	No	No	No	No	Yes
Firm FE	No	No	Yes	Yes	Yes
N	28,721	27,926	27,537	26,291	19,944
R^2	0.017	0.431	0.931	0.942	0.955

Table 3
Carbon intensity and lagged product fluidity

This table presents regression results of the relationship between product fluidity in different periods and carbon intensity. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Fluidity(t)	0.0061*					0.0023
	(0.0031)					(0.0028)
Fluidity		0.0111***				0.0090***
		(0.0032)				(0.0022)
Fluidity(t-2)			0.0094***			0.0041*
			(0.0032)			(0.0022)
Fluidity(t-3)				0.0069**		0.0026
				(0.0035)		(0.0023)
Fluidity(t-4)					0.0049	0.0020
					(0.0038)	(0.0032)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	26,905	27,537	26,347	25,268	24,272	23,581
R^2	0.931	0.931	0.931	0.932	0.932	0.932

Table 4
Instrumenting product fluidity with FX and PSL

This table presents regression results of the relationship between product fluidity and carbon intensity. *ln(Scope 1 intensity)* is the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. Δ *ln(FX)* is the growth rate of real trade-weighted state-level exchange rates. *PSL* is a dummy variable that equals one if a state adopts Paid Sick Leave mandates. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). Panel A is the regressions estimated with OLS. Panel B and Panel C are estimated with 2SLS and we instrument for *Fluidity* with Δ *ln(FX)* and *PSL*. All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: FX and PSL – OLS regression

	Scope 1 intensity		
	(1)	(2)	(3)
Δ ln(FX) (t-2)	0.1391**		0.1329**
	(0.0670)		(0.0667)
PSL (t-2)		-0.1099***	-0.1032***
		(0.0358)	(0.0358)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	26,246	26,590	26,246
R^2	0.931	0.932	0.932

Panel B: First stage – FX and PSL

	Fluidity		
	(1)	(2)	(3)
Δ ln(FX) (t-2)	1.6980***		1.6745***
	(0.2567)		(0.2559)
PSL (t-2)		-0.3729***	-0.3966***
		(0.0902)	(0.0901)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	26,246	26,590	26,246
R^2	0.819	0.819	0.820

Panel C: Second stage – instrumented fluidity

	Scope 1 intensity		
	(1)	(2)	(3)
Fluidity	0.0819**	0.2947**	0.1993***
	(0.0411)	(0.1195)	(0.0692)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	26,246	26,590	26,246
R^2	-0.040	-0.839	-0.362
F-stat	43.762	17.102	29.651

Table 5
Climate opinions, political views, and lobbying

This table presents subsample regression results by local climate opinions and political views, as well as firm political lobbying. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). Panel A reports the regression results of the effect of product fluidity on carbon intensity by local climate opinions and political views. *Climate concern* is measured by the ratio of population who think corporations and industry should be doing more or much more to address global warming. *Republican vote* is measured by the ratio of residents in a county that vote for the Republican party in the Presidential election. Firms in counties with *Climate concern* or *Republican vote* above sample medians each year are classified as *High*, otherwise as *Low.* Panel B reports the regression results of the effect of product fluidity on carbon intensity by firm political lobbying.*Democratic* is measured by the Democratic-leaning lobbying expenses of Leippold et al. (2024). *Republican* is measured by the Republican-leaning lobbying expenses of Leippold et al. (2024). Firms with *Democratic* or *Republican* above sample medians each year are classified as *High*, otherwise as *Low.* All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Local climate opinions and political views

	Climate concern		Republican vote	
	(1) High	(2) Low	(3) High	(4) Low
Fluidity	0.0011	0.0163***	0.0097**	0.0092*
	(0.0050)	(0.0045)	(0.0045)	(0.0051)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	12,436	12,764	12,545	12,599
R^2	0.923	0.934	0.929	0.933
Diff. high-low	-0.0177	.	0.0006	.
p-value	0.0000	.	0.3960	.

Panel B: Firm political lobbying

	Democratic		Republican	
	(1) High	(2) Low	(3) High	(4) Low
Fluidity	0.0092	0.0160**	0.0162*	0.0061
	(0.0079)	(0.0076)	(0.0083)	(0.0073)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	3,074	3,920	3,452	3,562
R^2	0.959	0.953	0.956	0.959
Diff. high-low	-0.0068	.	0.0101	.
p-value	0.2380	.	0.1720	.

Table 6
Social norms

This table presents subsample regression results by social norms. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). *Social capital* is measured by the social capital index of Lin and Pursiainen (2022). *Volunteering* is measured by the ratio of Facebook users who are members of a group which is predicted to be about volunteering or activism based on group title and other group characteristics. *Sin industry* is measured by a dummy variable that equals one if a firm is sin industries (SIC codes: 2100-2199, 2080-2085; NAICS codes: 7132, 71312, 713210, 71329, 713290, 72112, and 721120). Firms with *Social capital* or *Volunteering* above sample medians each year are classified as *High*, otherwise as *Low*. Firms in the *Sin industry* are classified as *Yes*, otherwise as *No*. All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Social capital		Volunteering		Sin industry	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
Fluidity	0.0071	0.0159***	0.0066	0.0165***	0.0161***	0.0091**
	(0.0048)	(0.0046)	(0.0050)	(0.0046)	(0.0062)	(0.0039)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,944	12,047	12,589	12,689	4,704	22,833
R^2	0.932	0.932	0.931	0.929	0.937	0.930
Diff. high-low	-0.0088	.	-0.0098	.	0.0070	.
p-value	0.0400	.	0.0340	.	0.1240	.

Table 7
Ownership and investor horizon

This table presents subsample regression results by ownership and investor horizon. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). *Inst. ownership* is measured by the ratio of shareholdings by all institutional investors to total shares outstanding. *Churn ratio* is measured by the weighted average churn ratio of Gaspar et al. (2005). *Adj. churn ratio* is measured by the adjusted weighted average churn ratio of Yan and Zhang (2009). *Transient ownership* is measured by the ratio of shareholdings of transient institutional investors to the total institutional ownership. Firms with *Inst. ownership*, *Churn ratio*, *Adj. churn ratio* or *Transient ownership* above sample medians each year are classified as *High*, otherwise as *Low*. All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Inst. ownership		Churn ratio		Adj. churn ratio		Transient ownership	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High	Low	High	Low	High	Low	High	Low
Fluidity	0.0094*	0.0121***	0.0093**	0.0125***	0.0083*	0.0127***	0.0058	0.0123***
	(0.0048)	(0.0040)	(0.0044)	(0.0047)	(0.0045)	(0.0047)	(0.0045)	(0.0047)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	13,667	13,030	11,353	11,520	11,374	11,501	11,462	11,459
R^2	0.918	0.954	0.939	0.939	0.935	0.942	0.935	0.944
Diff. high-low	-0.0027	.	-0.0031	.	-0.0043	.	-0.0065	.
p-value	0.3320	.	0.2600	.	0.1920	.	0.1000	.

Table 8
Firm size, age, and total carbon emissions

This table presents subsample regression results by firm size, age, and total scope 1 emissions. The dependent variable is *ln(Scope 1 intensity)*, measured by the natural logarithm of one plus the ratio of Scope 1 carbon emissions to revenue in millions of dollars. *Fluidity* is the text-based product fluidity index of Hoberg et al. (2014). *Total assets* are the number of total assets. *Firm age* is the number of years since a firm first appeared in the CRSP monthly stock return files. *Total scope 1 emissions* are firm-level yearly emissions capturing absolute carbon output. All variables are defined in Appendix A. All continuous variables are winsorized at the 1% level. Standard errors shown in parentheses are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Total assets		Firm age		Total scope 1 emissions	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
Fluidity	0.0082*	0.0073**	0.0099**	0.0080*	0.0111**	0.0103***
	(0.0049)	(0.0031)	(0.0046)	(0.0043)	(0.0053)	(0.0037)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	14,013	13,248	13,490	13,466	12,379	11,887
R^2	0.946	0.931	0.941	0.932	0.938	0.858
Diff. high-low	0.0008	.	0.0019	.	0.0008	.
p-value	0.3940	.	0.3300	.	0.3940	.