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Firms' Transition to Green: Innovation versus Lobbying

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Abstract

Innovation in green technologies is viewed as a crucial driver of the transition to greener modes of production and consumption. However, there is considerable uncertainty regarding the speed of this transition. Motivated by the fact that regulatory developments represent one key source of uncertainty, we examine how firms complement their innovation activities with efforts to influence the regulatory agenda through lobbying. On average, firms engaging in green innovation do not lobby to increase demand for these products and services. Rather, many green innovators represent firms whose current business operations are mostly brown, and these firms employ lobbying to maintain the status quo, i.e., to protect their brown cash flows into the future. Relative to other green innovators, firms that engage in more brown lobbying have higher rates of future adverse environmental incidents. Evidence suggests that environmental rating agencies do not completely recognize these effects.

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1. Introduction

Over the last few decades, increasing attention to climate change has led companies to invest in green innovation, developing new technologies that enable a transition to cleaner modes of production and consumption. Green innovation offers new growth opportunities and competitive advantages, which firms protect through patents. However, these new opportunities are accompanied by new challenges: there is considerable uncertainty about the speed of transition to greener modes of operation. One key source of uncertainty relates to future regulation. In the face of such uncertainty, we examine how firms complement their innovation with efforts to influence the regulatory agenda through lobbying.

Lobbying decisions can be related to firms' innovation activities in different ways. On the one hand, firms' efforts to shape the competitive landscape and hedge uncertainty may take the form of lobbying for the new technologies they are developing. That is, firms engaging in green innovation may lobby to increase demand for their products and services. Such dynamics suggest that lobbying would expedite progress toward a greener future. However, lobbying may also have distortionary effects. Suppose green technologies are protected by patents held by firms that derive most of their current cash flows from brown activities. Such firms might employ lobbying to maintain the status quo, i.e., to protect their brown cash flows into the future. As stated by Zingales (2017): "Most firms are actively engaged in protecting their source of competitive advantage through a mixture of innovation, lobbying, or both. As long as most of the effort is along the first dimension, there is little to worry about. (…) What is more problematic is when a lot of effort is put into lobbying."

To examine the interaction between innovation and lobbying, we construct a dataset that combines information on both the patenting and lobbying activities of public firms over the period

1999-2020. First, we obtain all patents granted to U.S. firms, and we determine whether each patent relates to green technologies and whether it relates to clean or dirty technologies, using the classifications of OECD and Dechezlepretre, Muckley, and Neelakantan (2020), respectively. Second, from the Senate Office of Public Records (SOPR), we parse and extract information on the timing, amount, and subject of lobbying. Using a combination of textual analysis and machine learning techniques, we identify the subset of lobbying transactions that relate to environmental issues. Finally, we obtain the political contributions of each lobbyist, and we use this information to infer whether each lobbying transaction is pro-environmental (which we refer to as green) or anti-environmental (which we refer to as brown). This is one of the first papers to map such a large and detailed amount of lobbying information to the universe of U.S. firms, including the details of the lobbying transaction and the individual lobbyist.[1]

We start by examining firms' propensity to engage in environment-related innovation. Descriptive evidence is striking. Patents related to green technologies and dirty technologies are concentrated within the same set of industries. The fraction of firms with at least one green patent is highest within chemical and allied products, consumer durables, and manufacturing. These same three industries also rank highest in the likelihood of having at least one dirty patent. While Cohen, Gurun, and Nguyen (2022) show that oil and gas firms engage in green innovation, we find that the propensity for firms in brown industries to hold many green patents is much more widespread.

Industries with the highest level of innovation in environment-related issues also tend to spend the most money lobbying on these issues, and the vast majority of these firms focus their

[1] Huneeus and Kim (2020) also assemble a dataset of lobbying transactions, which they make publicly available on the lobbyview.org website. However, these data do not include the identity of the individual lobbyist, which represents a key component of our empirical analyses. Huneeus and Kim study the impact of lobbying on resource misallocation through its impact on firm size. Other studies on lobbying focus on specific subsets of lobbying activities. For example, Bertrand, Bombardini and Trebbi (2014) studies lobbyists' connections, while Kang (2016) examines how lobbying affects federal legislation in the energy sector.

lobbying almost entirely in either green or brown directions. However, green innovation does not predict green lobbying. While many firms both invest in green innovation and strive to shape the regulatory agenda, in many cases firms' investments along these two channels are in direct contradiction with each other. We pose two non-mutually exclusive hypotheses to explain this puzzling pattern.

First, the *Current Cash Flow Hypothesis* posits that firms' innovation and lobbying activities reflect an effort to balance current cash flows against an uncertain future. Bloom and Van Reenen (2002) show that patenting generates valuable real options because patents provide exclusive rights to develop new innovations, enabling firms to delay investments. While a growing number of firms are applying for and being granted patents for green-related technologies, it is possible that only a portion of these firms use these technologies in their current business operations. This hypothesis predicts that firms whose current business relies less on green technologies will be more likely to lobby brown, irrespective of the firms' intensity of green patenting. Lobbying brown would enable them to protect their current (brown) sources of cash flows, and thereby slow the transition to greener modes of operation. Only firms whose current business relies more on green technologies would tend to lobby green.

Our second hypothesis is the *Market Power Hypothesis*. On average, firms with substantial market power have fewer incentives to invest in new technologies (Arrow, 1962). They do not want to make their existing products obsolete, and the lower competitive pressure lessens their incentive to incur the necessary switching costs (Holmes, Levine, and Schmitz, 2012). To the extent that incumbents have more market power than new entrants, this idea is also consistent with the theoretical and empirical results of Akcigit and Kerr (2018), who argue that incumbents have an incentive to invest in existing rather than new technologies, and to improve their existing

products. Moreover, as argued by Zingales (2017), firms with market power are more effective at exerting political influence through lobbying. Given that existing technologies are more likely to reflect a brown orientation, we predict that market leaders will be more likely to lobby brown. These effects should be particularly strong within more concentrated industries.

To test the *Current Cash Flow Hypothesis*, we require a measure of firms' current reliance on green technologies. To this end, we use textual analysis to quantify the cosine similarity between each firm's business description and green technologies, as represented in firms' 10-Ks and the technology descriptions of green patents, respectively. Consistent with this hypothesis, we find that firms whose current business is more green-oriented are significantly less likely to lobby brown, compared to firms whose current business is more brown-oriented. In economic terms, firms in the top quartile of operational greenness allocate 8.6 percentage points less to brown lobbying, which is equivalent to 15% of the unconditional average allocation to brown lobbying (57.4%). These findings highlight the extent to which green innovation is an incomplete measure of firms' true focus on transitioning to greener modes of operation.

To test the *Market Power Hypothesis*, we define a firm as a dominant player within the industry if it is one of the top three firms in terms of market share. On average, across Fama-French 48 industries, the top three players hold an aggregate 34.9% market share. Results provide evidence in support of this hypothesis as well. We find that the dominant players within each industry spend significantly more on brown lobbying, in particular within concentrated industries where dominant players can accrue more of the gain from suppressing competitors (Cowgill, Prat, and Valletti, 2022). Moreover, we find that market leaders' green innovation efforts have no predictive power for the direction of their environmental lobbying: irrespective of the stock of green patents, market leaders are more likely to lobby brown, compared to other firms within the

industry.

In terms of transition toward a greener future, our findings highlight a dark side of lobbying. On average, 44.2% of green patents are held by market leaders within each industry, but these market leaders are more likely to strive to protect the status quo through brown lobbying efforts.[2]

In the next portion of the paper, we examine whether firms' innovation or lobbying has more influence in predicting future adverse environmental incidents. We rely on RepRisk data, which scans media outlets around the world to quantify incidents. Findings indicate that while green innovators have significantly fewer incidents over the subsequent one to three years, this relation is substantially (sometimes entirely) reversed among firms that expend more dollars in brown lobbying activities. For example, when firms become green innovators (defined as having at least 25% of their patent stock within green patents), they experience 18.3% fewer incidents in the following year. However, when these firms lobby primarily in the brown direction, the effect on e-related incidents is more than reversed: these firms see an increase in incidents by 9.6% in the following year. These findings provide added evidence regarding the extent to which firms' innovation efforts represent an incomplete, and in some cases biased, representation of firms' true environmental stance.

In the final portion of the paper, we ask whether firms' lobbying efforts are recognized by markets. We focus on the environmental ratings index of MSCI, the ESG rating provider with the most comprehensive coverage.[3] Perhaps reassuringly, we find that green innovators have

[2] The statistic (44.2%) represents the mean of the fraction of green patents owned by market leaders in each Fama-French 48 industry-year. If we calculate the same statistic in the pooled the sample, 61% of green patents are owned by marker leaders.

[3] These ratings are widely employed by asset managers to inform their ESG decisions. For example, in 2007 over two thirds of institutional money managers around the world were using KLD (the predecessor to MSCI) to incorporate ESG factors into their investment decisions (Eccles and Stroehle, 2018). Moreover, ESG ratings influence flows into

significantly higher ratings. However, our results indicate that firms' lobbying efforts are not recognized by ratings agencies. MSCI ratings do not recognize two critical points. First, green innovators (which on average receive higher ratings) are equally likely to lobby in green or brown directions. Second, those that lobby brown are no better environmental stewards than non-green innovators, as measured by subsequent environmental incidents.

Our paper contributes to several strands of literature. First, we contribute to the literature on lobbying. Previous work on lobbying focuses mostly on potential misallocations of resources (Huneeus and Kim, 2020), the implications for firm value and risk premia (Borisov, Goldman, and Gupta, 2016; Grotteria, 2022), and the role of political connections (Blanes i Vidal, Draca, and Fons-Rosen, 2012; Bertrand, Bombardini, and Trebbi, 2014).[4] There is also a related literature on political contributions, and among this work the most closely related paper is Fich and Xu (2023), who examine whether firms' contributions relate to their E-scores. Relative to this body of work, our findings focus on the distortionary effects of lobbying that can arise when firms patent new technologies but then lobby to impede progress in these directions. Such behavior can negatively impact the development of new technologies and economic growth, particularly given the influence of lobbying on legislative outcomes (Kang, 2016). In our setting, our results suggest that lobbying may slow the transition to cleaner modes of consumption and production.

Our second contribution to the lobbying literature is the introduction of a new approach to determine the direction of a firm's lobbying activity. While previous papers use information contained in lobbying reports to categorize lobbying expenditures by subject (Huneeus and Kim,

stocks; Pastor, Stambaugh and Taylor (2022) conclude that ESG-related flows have affected stock returns over the 2012 – 2018 period.

[4] Related to lobbying, but distinct from it, is the literature on political connections (for example, Fisman (2001), Faccio (2006), Cohen, Diether and Malloy (2013)) and on political donations. In particular, donations through political action committees (PACs) are payments to individual politicians aimed at obtaining political influence, but not at affecting a specific issues or legislative outcome. A recent paper by Fich and Xu (2023) relates these political donations to firms' environmental scores.

2020), they cannot identify the direction of firms' lobbying initiatives. To infer the direction of firm-specific lobbying, we construct a new dataset containing the identity of individual lobbyists and their political contributions.

Finally, our paper contributes to the growing literature on green innovation. Recent studies focus on the technical changes and the optimal policies that can enable the transition from dirty technologies to clean technologies (Acemoglu et al., 2016; Aghion et al., 2016), but Bolton et al. (2023) find that firms' green innovation efforts do not translate into lower future emissions. We contribute to this body of work by studying how firms that are involved in this transition choose to engage in lobbying activities to shape the regulatory agenda on environment-related issues. Our finding that green innovators are more likely to lobby brown if their current business is related to brown technologies builds upon Cohen et al. (2022), who show that green innovators are concentrated in traditionally brown industries such as oil and energy. It also relates to the findings of Bloom and Van Reenen (2002), who show that patents have real option value in times of uncertainty and can be used by firms to delay their investments.

2. Data

We construct a dataset that relies on firm-level information from CRSP-Compustat, lobbying data from the Senate Office of Public Records (SOPR), lobbyists' individual contributions from OpenSecrets.org, and patent data from the USPTO PatentsView and Kogan, Papanikolaou, Seru, and Stoffman (KPSS) data repository. We define each of these data sources

within the following subsections.

2.1. Sample of firms

Our initial sample consists of all publicly traded firms with CRSP and Compustat data from 1999 to 2020, where the starting year of 1999 is dictated by publicly available machine-readable lobbying reports. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. In regressions, we winsorize assets, size, age, and financial ratios (leverage, R&D/Assets, ROA, Cash/Assets) at the 1% and 99% annually.

2.2. Patent data

We identify patents granted to public firms using the extended KPSS data, which covers patents granted between 1926 to 2020. We use PatentsView to obtain the IPC (International Patent Classification) code, which is used to classify patents as green, clean, or dirty (as explained in detail below).[5]

We employ two approaches to classify whether patents have an environmental focus. First, to identify the subset of patents that pertain to green technology (i.e., *green* patents), we rely on the OECD classifications.[6] Technologies related to green patents focus on issues such as environmental management, water-related adaptation technologies, and climate change mitigation technologies. Second, we identify *clean* patents and *dirty* patents, following Dechezlepretre, Muckley, and Neelakantan (2020). Examples of clean patents include energy generation from renewable and non-fossil sources, combustion technologies with mitigation potential, and other technologies with potential contribution to emissions mitigation. Examples of dirty patents include

[5] PatentsView is a patent data visualization and analysis platform supported by the Office of the Chief Economists in the USPTO.

[6] https://www.oecd.org/environment/consumption-innovation/ENV-tech%20search%20strategies,%20version%20for%20OECDstat%20(2016).pdf

steam engine plants, gas turbine plants, and combustion engines. When a patent is classified as both clean and dirty (this may occur when multiple technology classes are associated with a patent), we define such a patent as neither clean nor dirty.

Panel A of Figure 1 shows the total number of patents granted each year, 1999-2020, as well as the number of green, clean, and dirty patents. The key takeaway is that the numbers of green and clean patents have grown much faster than either dirty patents or even total patents. This pattern is even more evident in Panel B, which shows the stock of patents within each of these categories. We define the stock as the cumulative number of patents granted over the prior 20 years, within each category. The stock of dirty patents has remained relatively constant throughout the sample period (compound annual growth rate of 0.8%), indicating that a newly granted patent on average replaces an obsolete patent (defined here as a patent granted over 20 years ago). In contrast, the stock of green and clean patents has grown by an average of 4.93% and 6.87% per year, respectively, over this period.

2.3. Lobbying transactions

We identify firms' lobbying activities from the lobbying reports filed with the Senate Office of Public Records (SOPR). In accordance with the mandated Lobbying Disclosure Act of 1995, every lobbyist and every corporation with in-house lobbying is required to disclose their lobbying activity. These disclosures are reported in LD-1 and LD-2 forms. First, lobbyists file an LD-1 form for each of their clients, which contains the names and addresses of the client, as well as the starting date of the lobbying-client relationship. Second, an LD-2 form is filed for each lobbying transaction, containing the following details: the date, the amount lobbied, the issue on which a corporation is lobbying and where applicable the bill number to which the transaction relates, the lobbyist name, and whether a lobbying transaction concerns the Senate, the House of

Representatives or any other US government branch. Information on these LD-1 and LD-2 forms are available through the SOPR in compressed XML format, starting in 1999.[7] Using Python script, we parse and extract information from these forms.[8] An example of an LD-2 form (which shows one lobbying transaction) is shown in Appendix B.

The universe of LD-1 and LD-2 forms comprises all firms that comply with the Lobbying Disclosure Act and as such are covered by the SOPR. According to the Government Accountability Office, since 2010 approximately 90% of lobbyists have been in compliance with these disclosure requirements, and as discussed by Huneeus and Kim (2020) lobbyists who fail to comply with these requirements face potential monetary fines and imprisonment.[9]

We match client names in lobbying reports with firm names in CRSP-Compustat. First, we create a Cartesian product between client names and firm names, and for each unique client name we keep the best 5 matches with the smallest textual distance. Second, we use a search engine-based matching algorithm proposed by Autor, Dorn, Hanson, Pisano, and Shu (2020) to verify whether these pairs indeed share the same URLs. Finally, we manually verify the matching quality. As noted by Huneeus and Kim (2020), filers sometimes submit amendments or duplicate lobbying reports. We remove duplicate filings and keep the latest report when there are multiple amendments to the same filing. Finally, we winsorize scaled lobbying expenditures (by assets or sales) at the 99% level annually.

[7] https://www.senate.gov/legislative/Public_Disclosure/database_download.htm

[8] Some of this information can be extracted from Lobbyview. However, Lobbyview does not provide information on lobbyists, which as we describe in the next subsection is necessary for our classification of green versus brown lobbying.

[9] See https://www.gao.gov/products/GAO-20-449. In 2014 the Carmen Group paid $125,000 in fines to the federal government for not disclosing its political contributions (https://www.washingtonpost.com/local/crime/carmen-group-to-pay-125000-to-resolve-lobbying-disclosure-violations/2015/08/28/2d46c1b2-4d9d-11e5-84df-923b3ef1a64b_story.html).

Figure 2 shows the time series of lobbying transactions. The solid white bars show the number of lobbying transactions each year, and the solid lines show lobbying dollars spent each year. Lobbying increased through approximately 2008, and it has leveled off and even decreased since then.[10] The number of LD-2s exhibits a similar pattern, but also has a discrete jump between 2007 and 2008. The approximate doubling in the number of LD2s in 2008 is driven by the Honest Leadership and Open Government Act, which switched the filing requirement of LD-2s from semi-annually to quarterly.

2.4. Lobbyist individual contributions

Our proxy for each lobbyist's position on environmental issues is based on his or her political contributions. House and Senate committees report contributions received from individuals to the Federal Election Commission (FEC), and the individual contributions are itemized on Schedule A of FEC Form 3 when the amount exceeds $200.[11] OpenSecrets processes individual contribution data (originally reported to the FEC) and provides information on the name of the contributor, the reported date of the contribution, the amount contributed, and details regarding the recipient.[12] Using a matching technique similar to that described in the previous section, we name-match lobbyist names in lobbying reports with the contributor names in the individual contribution dataset.

Among 290,886 individual contributions made by 29,128 unique lobbyists between 1990-2020, we restrict our focus to 128,766 individual contributions associated with 11,264 lobbyists who lobbied for public firms. For these lobbyists, we calculate the sum of lifetime individual

[10] OpenSecrets shows a similar time-series pattern: https://www.opensecrets.org/federal-lobbying.
[11] https://www.fec.gov/help-candidates-and-committees/filing-reports/individual-contributions/
[12] These data are provided for each two-year federal election cycle. We thank OpenSecrets (https://www.opensecrets.org/) for providing research access.

contributions to the Democratic party (D), Republican party (R), and other (O). Panel A of Figure 3 shows the distribution of lobbyist-level lifetime political contributions. The largest mass lies at the extreme cases of 0 or 100% of a person's donations to a given political party. Approximately 78% percent of lobbyists make over 75% of their contributions to a single party. The concentration of an individual's donations to a single party provides support for the use of this measure as a proxy for political leanings.

We define a lobbyist to be Democratic (Republican) party-leaning if more than 75% of the lobbyist's lifetime individual contribution to these parties is allocated to the Democratic (Republican) party.[13] As shown in Panel B of Figure 3, under this scheme, 41.6% (36.4%) of lobbyists are defined to be Democratic (Republican) party-leaning. The remaining 22.04% of lobbyists are classified as neutral. We find that lobbyists' political orientation is very sticky: as shown in Appendix Table A1, when we classify lobbyists' political orientation annually, the probability of being classified as a Democratic (Republican) party-leaning in year t+1 conditional on being classified as a Democratic (Republican) party-leaning in year t is 96.8% (96.7%). We use lobbyists' political orientations to classify the direction of environmental lobbying, as described in the next section.

2.5. Environmental lobbying

Our empirical tests focus on the subset of lobbying transactions that relate to issues that are linked to the environment (which we refer to as e-lobbying). To identify this set of transactions,

[13] Our classification is similar in spirit to Di Giuli and Kostovetsky (2014), who use campaign contributions to define the political affiliations of CEOs, directors, and founders of the firms.

we rely on information found on lines 15 and 16 of each LD-2. We define a transaction to be e-related if one or more of the following criteria is satisfied.

Our first criteria for defining e-lobbying relies on the standardized codes in LD-2 line 15, which reflect the general category(ies) to which the lobbying transaction belongs. There are a total of 79 unique codes. From this set, we define the lobbying transaction to be e-related if one or more of the following five categories is listed: *Energy/Nuclear, Environment/Superfund, Fuel/Gas/Oil, Clean air and water, and Waste (hazardous/solid/interstate/nuclear).*

Our second criteria for defining e-lobbying relies on Congressional bill numbers that are frequently included in LD-2 line 16. On line 16, filers are required to list the precise lobbying issues, including specific bills before Congress or specific executive branch actions. Where relevant, filers must provide information on the bill number, bill title, and description of the section(s) of interest. Within our sample, 30.5% of LD-2s contain specific bill numbers on line 16. We define the lobbying transaction to be e-related if at least one of the listed bills are categorized by Congress.Gov (the online database of the United Congress) as belonging to one of the four categories of environment-related issues: *Energy, Environmental protection, Public lands and natural resources, and Water resources development*.

Our third criteria for e-lobbying strives to capture transactions that are missed by the prior two filters, for example because a specific bill was not mentioned or because the line 15 category is more tangentially related to the environment (e.g., Chemicals/Chemical Industry or Natural Resources). Following Engle, Giglio, Lee, Kelly, and Stroebel (2020), we develop an environment-related vocabulary. In our setting, this vocabulary comes from the prior two steps. Specifically, it comes from the textual description of the lobbying transaction provided in line 16, across those LD-2s identified in steps one and two as representing e-lobbying. Figure 4 depicts

this vocabulary in the form of a word cloud.[14] For each LD-2 not identified in steps 1 or 2 as being environment-related, we calculate the cosine similarity between the Line 16 text and this environment-related vocabulary. We define the LD-2 as e-related if the cosine similarity is greater than a benchmark. Our main results are based on a benchmark equal to the average cosine similarity of e-related LD-2s identified using the prior two criteria.[15]

Appendix Figure A3 shows the overlap among our classification methods. Figure 2 shows that the trends in e-lobbying generally mirror those in total lobbying: expenditures increased through 2008, and they have leveled off and decreased slightly since then.

Our final step is to classify each e-related LD-2 as green or brown. As noted above, we argue that Democratic-leaning lobbyists are more likely to lobby in support of green-related legislation, whereas Republican-leaning lobbyists are more likely to lobby against such actions. We classify an LD-2 as green if at least one of the following conditions hold: (1) more than 75% of lobbyists listed on the LD-2 are Democratic-leaning; (2) more than 50% of lobbyists listed on the LD-2 can be classified as having a political orientation (either Democratic- or Republican) AND more than 75% of classified lobbyists are Democratic-leaning. An analogous procedure is employed to identify LD-2s as brown. Panel A of Figure 5 shows that among the 37,840 e-related LD-2s in our sample, 17.6% are Green, 23.5% are Brown, and 58.9% are unclassified.[16]

Within our empirical tests, we aggregate these LD-2 level statistics up to the firm-year level. While we use multiple measures within regressions, for descriptive purposes Panel B of

[14] Panels A and B of Appendix A1 illustrate the separate word clouds from criteria 1 and 2, respectively.
[15] The mean cosine similarity between the Line 16 text and the environmental vocabulary is 0.148837 for LD-2s that are classified as being environmental-related in steps 1 and 2. See Appendix Figure A2 for the distribution of cosine similarities.
[16] The majority of unclassified LD2s reflect instances in which the lobbyist's political contribution information is not available. There could be two explanations: 1) the lobbyists have not made political contributions; and/or 2) we are not able to perfectly match names between lobbyists and contributors due to variations/typos in names.

Figure 5 shows brown and green lobbying as a percent of all e-lobbying. Within our sample, 83.4% of firm-years have over 95% of their e-lobbying dollars allocated nearly entirely to brown (47.4% of firm-years) or nearly entirely to green (33.3% of firm-years). In sum, similar to statistics at the lobbyist level, firm-years tend to focus their environmental lobbying efforts in one direction or the other.

3. Distribution of Innovation and Lobbying

Climate change is increasingly accepted as a major source of risk, and firms must choose how to handle this risk. In this section, we provide descriptive statistics regarding two key channels: innovation and efforts to influence the regulatory agenda through lobbying. We start by providing industry-level statistics, and we then examine within-industry patterns.

3.1 Innovation across industries

As described in the prior section, we measure innovation in terms of patents, and we categorize the environmental aspects of patents along two dimensions. Our first classification is based on whether a patent is green or not. Column 2 of Table 1 shows the percent of firm-years with at least one green patent, within each Fama-French 12 industry grouping. The takeaway from this simple exercise is that the industries with the greatest frequency of green patenting represent industries that are typically considered as not environmentally friendly: chemicals and allied products (25% of firm-years), consumer durables (19% of firm years), and manufacturing (17% of firm-years).

Conclusions are similar if we focus on the percent of firm-years with clean versus dirty patents, as shown in columns 3 and 4. For example, within the chemicals and allied product

industry, 13% of firm-years have a clean patent compared to only 5% with a dirty patent. Similarly, 10% of firm-years within manufacturing have a clean patent, compared to only 6% with a dirty patent.

These statistics are influenced by the frequency of innovation and associated patenting within each industry, and also by the portion of innovative firms that focus on green issues. To separate these two factors, column 5 reports the percent of firm-years within each industry with at least one patent, and columns 7 – 9 present statistics on green, clean, and dirty patenting based on the subsample of firm-years with at least one patent. Magnitudes are even more remarkable within this subsample. For example, among patenting firms in the chemicals and allied products industry, 52% have a green patent and 27% have a clean patent, whereas only 10% have a dirty patent.

Focusing on the subset of firm-years that choose to engage in innovation, two of the industries in which clean patenting is most common also represent industries in which dirty patenting is most common: oil and gas, and utilities. Moreover, the top 5 industries in clean patenting also represent the top 5 in dirty patenting. In sum, at the industry level, a substantial portion of green or clean innovation is held within industries where there also continues to be much dirty innovation.[17]

The growth in Environmental, social, and corporate governance (ESG) investing has contributed to the labeling of industries as 'green' or 'brown'. The univariate statistics in Table 1 highlight the extent to which this simple classification can be misleading. While Cohen, Gurun, and Nguyen (2022) show that oil and gas firms are key innovators in the green space, we extend their finding and show that the incidence of green patenting within brown industries is quite

[17] Conclusions are similar regardless of whether we measure innovation with patent applications or patent grants.

prevalent.

3.2 Lobbying across industries

Table 2 provides statistics regarding the frequency of different types of lobbying, across these same Fama French 12 industries. As described in section 2, we classify all firm-years with one or more lobbying transactions as green, brown, or other. Many of the patterns in Table 2 mirror those in Table 1. We find that the frequency of green lobbying is highest among industries that are frequently characterized as brown. The top 3 industries in terms of green lobbying are utilities, chemicals and allied products, and oil and gas, with 15%, 5%, and 5% of firm-years, respectively. To provide one example, in 2018, eight firms in the oil/gas/coal industries spent a total of $1,093,200 on green lobbying, with Conocophillips being the top spender ($240,000). However, other firms within the same industry concentrate their efforts much more heavily on brown lobbying.[18]

Similar to Table 1, these statistics reflect both the choice to lobby and the decision of lobbying focus. The right-hand columns of Table 2 separate these two factors, in a format similar to Table 1. Among firm-years with lobbying, the percent of firm-years with green lobbying equals 25% within the utilities industry, 14% within the chemicals industry, and 21% within the oil and gas industry. Similar to patterns in innovation, these industries also rank highest in brown lobbying: 30% within the utilities industry, 19% within the chemicals industry, and 38% within the oil and gas industry.

3.3 Do green innovators focus their lobbying efforts in green directions?

[18] In 2008, 20 firms in the oil/gas/coal industries spent a total of $8,235,000 (i.e., $8.2 mil) on brown lobbying, with Anadarko Petroleum being the top spender ($2,040,000).

Tables 1 and 2 show that green and brown innovation are clustered within the same industries, and pro-environmental and anti-environmental lobbying are also clustered within the same industries. To examine more directly the overlap between lobbying and innovation, in Table 3 we partition the sample according to whether the firm-year has at least one green patent grant (columns 1 and 2) and whether the firm has at least one clean patent or at least one dirty patent (columns 3 and 4). We provide evidence across all firm-years (top portion of table), across firm-years with lobbying (middle portion of table), and across firm-years with green or brown lobbying (bottom portion of table).

The first conclusion from Table 3 is that firms engaging in green innovation, on average, are no more likely to engage in green lobbying than brown lobbying. Even more surprising, along several metrics they are *more* likely to engage in brown lobbying. Focusing on firm-years with one or more green patents (column 1), we see that 9.4% engage in green lobbying compared to 11.6% in brown lobbying. Among the subset of firm-years with lobbying, average expenditures on green lobbying equal $72,088, compared to $108,690 on brown lobbying. Conclusions are similar if we focus on firm-years with one or more clean patents (column 3).

The second conclusion from Table 3 is that firm-years with dirty patents have a higher rate of brown lobbying than firm-years with clean patents, which is consistent with what one might expect; perhaps surprisingly however, they also have a higher rate of green lobbying. Approximately 15% of firm-years with dirty patents engage in green lobbying, compared to 11% of firm-years with clean patents. Conclusions are similar if we restrict the sample to firm-years with lobbying: firm-years with dirty patents spend an average $90,019 on green lobbying, which represents 4.5% of their lobbying dollars and 0.0004% of their sales. In contrast, firm-years with clean patents (conditional on lobbying) spend an average $83,489 on green lobbying, which

represents 5.1% of their lobbying dollars and 0.0005% of their sales.

In Tables 4 and 5, we examine more directly the relation between innovation and different types of lobbying. On the one hand, firms may employ lobbying to increase demand for their newly developed technologies, suggesting that firms' innovation and lobbying would be focused in the same direction. Alternatively, it may be the case that firms employ lobbying to maintain the status quo. Given that much green innovation is held by firms also engaging in dirty innovation (as shown in Table 1), firms' innovation and lobbying efforts may focus on contradictory objectives.

In Table 4, we estimate firm-year panel regressions in which the dependent variable is a measure of lobbying, and the independent variable of interest is a measure of environmental innovation. We control for firm characteristics such as size, profitability and other firm financials, which might plausibly affect both innovation and lobbying. We also include industry fixed effects, meaning we are examining within-industry variation.

In Panel A, we measure innovation based on the stock of patents, specifically as the log of one plus the number of patents granted over the past 5 years. This captures the quantity of environment-related innovation. In Panel B, we measure innovation as the composition of patents, specifically the number of green patents (or clean or dirty patents) granted over the past five years as a fraction of all patents granted over this period. Thus, in panel B, the sample is restricted to firm-years with at least one patent in the past five years (years t-4 through t). These variables capture the relative importance of environment-related innovation within each firm.[19]

We begin in column 1 by examining the choice to engage in lobbying, as measured by an indicator variable equal to one if the firm engaged in lobbying in year t+1. We find that firms with

[19] To control for the overall innovation intensity of firms, we include the number of patents granted in the last five years as a control variable.

greater investment in innovation, as proxied by their stock of patents, are also more likely to strive to influence the government agenda through lobbying. A one standard deviation increase in the stock of patents accumulated over the past five years is associated with a 5.5% increase in the probability of lobbying.[20] Both innovation and efforts to influence the regulatory environment represent competitive strategies, and our results indicate that firms tend to use these tools jointly, even after controlling for characteristics such as size and profitability.

We next turn to more direct tests of the relation between types of innovation and types of lobbying. Columns 2 and 4 focus on the incidence of green lobbying, and columns 3 and 5 focus on the incidence of brown lobbying. Similar to column 1, our independent variable of interest is the stock of patents granted over the past five years, but we focus on green patents (columns 2 and 3) or on clean and dirty patents (columns 4 and 5). To ensure that our measures of patent type do not capture overall innovation intensity, in columns 2 and 3 we also control for the number of non-green patents, and in columns 4 and 5 we control for the number of gray patents (defined as patents that are not classified as either clean or dirty).

Looking at columns 2 and 3, results show that firms engaging in more green innovation, on average, are more likely to engage in both green lobbying and brown lobbying. Moreover, the economic significance of both effects is similar – a one standard deviation increase in the stock of green patents accumulated over the past five years is associated with a 1.8% (2.2%) increase in the probability of green (brown) lobbying.[21]

Findings in columns 4 and 5 build upon the results in columns 2 and 3; we find that brown

[20] The standard deviation of *All patents* (i.e., ln(granted patents in the last five years + 1)) is 1.72, and 0.032*1.72 = 0.055. Compared to the unconditional probability of lobbying (0.247), this is equivalent to 22.3% (=0.055/0.247) in terms of the magnitude.

[21] Compared to the unconditional probability of green and brown lobbying (2.33% and 2.95%, respectively), these are equivalent to 75.2% and 74.2%, respectively, in terms of the magnitude.

innovation is also significantly positively related to both green and brown lobbying. A one standard deviation increase in dirty patents is associated with a 32% increase in the probability of green lobbying and a 41% increase in brown lobbying.[22] A one standard deviation increase in clean patents is associated with a 47% (32%) increase in the incidence of green (brown) lobbying.

Regressions shown in Panel B yield similar conclusions. Columns 1 and 2 show that green patents as a fraction of all patents are significantly positively related to the incidence of both green lobbying and brown lobbying. In a similar vein, columns 3 and 4 show that clean patents / all patents is significantly related to both green and brown lobbying.[23] In sum, on average across all firms, green innovation contains no information regarding whether firms are striving to influence the regulatory agenda in more green directions or in more brown directions.

In Table 5, we focus on dollars spent on green and brown lobbying, rather than just the incidence of lobbying. Ex ante, one might expect that firms with a greater stock of green patents would spend more money on pro-environmental lobbying and less on anti-environmental lobbying. However, results indicate that this is not the case. Similar to analyses in Table 4, we measure the extent of green innovation in two alternative ways: by the number of green patents granted to the firm over the past five years (in natural log form), and by the fraction of green patents within a firm's patent portfolio.

In columns 1 and 2, the dependent variable is dollars spent in year t+1 on green lobbying and brown lobbying, respectively, deflated by firm assets at the end of year t. We find that the

[22] The economic magnitude for green lobbying is calculated by multiplying the coefficient on dirty patents (0.024) by its standard deviation (0.307) and dividing by the mean of the green lobbying indicator (0.023). Analogously, the economic magnitude for brown lobbying is calculated as 0.040x0.307/0.03.

[23] Results in Panel B are similar if we limit the sample to the 14,493 firm-years with at least ten patents in the past five years.

stock of green patents is positively related to dollars spent on both these forms of lobbying. A one standard deviation increase in the stock of green patents is associated with a 54% (58%) increase in the relative amount spent on green (brown) lobbying.[24] Conclusions are similar if we deflate lobbying dollars by sales (not tabulated).

In columns 3 - 6, we restrict the sample to firm-years with positive expenditures on some form of environmental lobbying, either green or brown. This enables us to more precisely capture the direction in which the firm is striving to influence environmental-related regulation, abstracting from the decision to engage in this type of lobbying activity. The dependent variable equals the fraction of environmental lobbying dollars (green plus brown) spent on brown lobbying. Contrary to expectations but consistent with other results reported to this point, we find no evidence that firms with a larger stock of green patents strive to influence the government toward adopting a more pro-environmental stance. Looking at column 3, the coefficient on the stock of green patents is negative rather than positive (though not significant at conventional levels). As shown in column 4, this conclusion is robust to restricting the sample to firm-years with at least one patent in the past five years and defining the key independent variable as the fraction of green patents as a portion of the firm's entire patent portfolio.

In columns 5 and 6, we replace green patents with clean and dirty patents, using both the stock and fraction measures. Echoing other results reported to this point, neither of the measures of clean or dirty patents is significantly related to the fraction of a firm's lobbying devoted to brown issues. In sum, results indicate that neither the stock of green innovation nor the relative

[24] The mean of green lobbying (multiplied by 1,000) as a percent of assets is 0.042. Multiplying the coefficient estimate by the standard deviation of the stock of green patents and dividing by this mean (0.031*0.732 / 0.042) equals 54%. Analogously, the analogous economic effect of the green patent stock on brown lobbying equals 0.045*0.732 / 0.057 = 58%.

weight of green innovation in a firm's patent portfolio is informative regarding the direction in which a firm is lobbying the government.

4. Why do green innovators lobby both green and brown?

We posit two non-mutually exclusive hypotheses to explain the finding that green innovators do not, on average, direct their lobbying efforts in green directions. Section 4.1 focuses on the *Current cash flow* hypothesis, and section 4.2 focuses on the *Market power* hypothesis.

4.1 Current Cash Flow hypothesis

The *Current cash flow* hypothesis posits that firms' sources of current cash flows drive their lobbying efforts. Firms' green innovation may contribute to current cash flows, or it may primarily represent a potential source of future cash flows, in an option-like sense. Given that patents provide firms with exclusive rights to their technologies, Bloom and Van Reenen (2002) argue that they also provide firms with the option to delay their investments; this option is particularly valuable in times of high uncertainty. Importantly, environmental-related innovation and the value of associated investments are characterized by high uncertainty. Firms face great uncertainty related to the speed of transition to greener modes of operation, where this uncertainty stems from both technological uncertainty and regulatory uncertainty. Firms whose current cash flows derive mostly from brown activities can protect current sources of profits by lobbying brown. In contrast, a firm whose current cash flows already stem from green operations will be more likely to lobby green. We test this hypothesis in Table 6.

To measure the nature of a firm's current operations, we rely on the textual description of the firm's business reported in the annual report (i.e., 10-K). Prior literature shows that text

contained in 10-Ks provides useful information on characterizing firms' product markets (see, e.g., Hoberg and Phillips (2010, 2016)). Building on this idea, we extract information from the *Business* section of the 10-K (Item 1) using web crawling and text parsing algorithms.[25] We then calculate the cosine similarity between this text (measured in year *t*) and the patent summary text for all green patents granted to public firms in our sample in the last 5 years (from year *t*-4 to *t*). Our underlying assumption is that the summary text of recently granted green patents captures the extent of the latest green technologies in the industry. Therefore, a higher cosine similarity between the business description and the patent summary text implies that the firm's business is more closely related to the latest green technologies. We use both a continuous measure of this variable, *Current green operations*, and a dummy variable, *High current green operations*, which equals one if the continuous measure is in the top quartile, zero otherwise.

We estimate regressions in which the dependent variable is brown lobbying as a fraction of green plus brown lobbying dollars (i.e., *B/(G+B)*). Control variables similar to those in Tables 4 and 5 are included, as well as year and industry fixed effects. Standard errors are clustered at the firm level.

We begin by examining the overall tendency of firms to focus their lobbying expenditures in directions that correlate with their current sources of cash flows. As shown in column 1, consistent with expectations the coefficient on current green operations is negative and statistically significant at the 5% level. In economic terms, a one standard deviation increase in *Current green operations* is associated with a 4.5 percentage point lower allocation to brown lobbying as a fraction of green and brown dollars. When compared to the mean of *B/(G+B)*, this is equivalent to

[25] See https://cran.r-project.org/web/packages/edgar/index.html for details.

a decrease of 7.8%.

Lobbying is driven by both firms' current priorities and firms' expected future (potentially near-term future) strategy. The significance of current operational greenness in column 1 captures current priorities. If firms' green innovation truly captures their future strategy, then this should also be related to lobbying. To allow for the influence of each as well as the potential interaction between the two, in column 2, we include the firm's current green operations, the stock of green patents granted over the past five years, and the interaction between the two.

Findings cast doubt on the common assertion that firms' green innovation represents an informative signal regarding their future strategy. First, firms engaging in more green innovation are equally likely to engage in brown lobbying, as indicated by the insignificant coefficient on *green patents*. Second, the interaction between *green patents* and *green operations* is also insignificant. Even among firms with higher green operations, green innovation does not lessen the tendency to lobby in brown directions. Analogously, firms that are less operationally green direct significantly more of their lobbying dollars in brown directions, irrespective of the extent of their green innovation efforts. In sum, while brown firms engage in green innovation to help prepare for the future, they simultaneously strive to delay that future state of the world through lobbying.

Column 3 shows that inferences are similar if we use clean and dirty patents instead of green patents, and columns 4 – 6 show that conclusions are also robust to using the indicator measure of firm operational greenness, *High current green operations*.

While green patents are often used as a way to measure firms' commitment to environment-related issues, our findings indicate that this measure ignores key information on firms' true focus.

If firms' current cash flows derive more from brown-type operations, then they engage in lobbying to protect those cash flows. As such, our findings provide strong support for the Current cash flow hypothesis.

4.2 Market Power Hypothesis

The Market Power hypothesis builds upon the ideas of Arrow (1962) and Holmes, Levine, and Schmitz (2012), who postulate that monopolists do not have incentives to incur the switching costs associated with adopting new technologies. Incumbents have a greater incentive to invest in existing technologies to improve their existing products (Akcigit and Kerr, 2018). In contrast, new entrants tend to invest in new technologies to acquire new product lines. Thus, the main prediction of this hypothesis is that firms with more market power will have greater incentives and greater ability to protect the status quo.

In our setting, the status quo represents a more brown-oriented business model, and firms strive to protect this state of the world through brown lobbying. Our proxy for market power is represented by *Market leader*, which we define as a dummy variable equal to one for the three firms with the largest market share (measured in terms of sales) within each Fama-French 48 industry. Descriptive statistics are consistent with the premise that market leaders are more focused on the status quo. Among firms that engage in environmental-related lobbying, only 35% of market leaders' current operations are green (based on *High current green operations* from the prior subsection), compared to 40% of non-market leaders. To allow for the fact that market leaders have more power within more concentrated industries, we interact this variable with the HHI of the industry.

Our main tests are shown in Table 7. Similar to prior analyses, we estimate regressions in which the dependent variable equals the fraction of environmental lobbying dollars (green plus

brown) spent on brown lobbying. All specifications include both year and industry fixed effects. Looking first at column 1, results are consistent with predictions. We find that market leaders within more concentrated industries are significantly more likely to engage in brown lobbying. Given that firms with more market power generally have the loudest voices, this is obviously troubling.

In column 2, we additionally include the three-way interaction term *market leader* × *HHI* × *green patents*. If green innovation decreases market leaders' tendency to lobby brown, then this 3-way interaction term will be significantly negative. Alternatively, if market leaders' incentives to protect the status quo are sufficiently strong, then innovation will not play a significant role. Firms may view green innovation as a real option, which is only exercised when necessary, for example when regulation requires it or when the competitive landscape changes. In this case, the 3-way interaction term would be insignificant. Findings support this latter scenario. The 3-way interaction term is not only insignificant, but it is positive rather than negative. Market leaders are significantly more likely to lobby brown, irrespective of the extent of their green innovation.

In column 3, we take advantage of the clean and dirty patent definitions to conduct a more nuanced analysis of the relation between innovation and lobbying behavior. Our independent variables of interest are now the 3-way interaction terms *market leader* × *HHI* × *clean patents* and *market leader* × *HHI* × *dirty patents.* Findings are consistent with prior specifications. We continue to find no evidence that firms' choices on clean and dirty innovation affect market leaders' tendency to brown lobby.

Overall, results are consistent with a scenario in which market leaders view green innovation as an option to exercise when necessary, rather than a planned strategy for the near future. Market leaders are characterized by browner modes of operations, and consistent with this

focus they have incentives to protect the status quo, that is, a brown operational structure. Our results suggest that market leaders employ lobbying as a means to achieve this goal.

5. Does lobbying signal future firm actions?

Under the premise that lobbying is motivated by firms' current and future (potentially near future) strategy, lobbying activities should relate to firm behavior. We test this in Table 8, by examining the relation between firm lobbying and subsequent adverse environmental incidents. We predict that firms that devote a higher fraction of their lobbying dollars in brown directions represent firms whose current and near-term future operating strategy are browner. Accordingly, these firms should experience more adverse environmental incidents over subsequent years.

The dependent variable equals the number of environmental incidents per firm-year, as provided in RepRisk. In columns 1 – 3, we measure the number of incidents over years t+1, t+2, and t+3, respectively. We relate these incidents to lobbying and innovation activities. Consistent with earlier specifications, we define innovation based on patents granted over the past five years. To allow for the possibility that lobbying also has somewhat of a cumulative effect, we define the lobbying dollars over both year t-1 and year t.

In column 1, we regress the number of environmental incidents in year t+1 on: the green patent ratio (measured as green patents / all patents), the fraction of brown lobbying (B/(G+B) lobbying dollars), and the interaction between the two. Control variables are measured in year t. We include firm and year fixed effects, meaning we are capturing the extent to which increases in innovation or lobbying for a given firm are informative regarding the risk of subsequent incidents.

We find that when a firm engages in more green innovation, on average it experiences

significantly fewer negative incidents in the following year. However, brown lobbying mitigates, and in some cases even reverses, this relation. Conclusions are similar at the t+2 and t+3 horizons.

In columns 4 – 6, to facilitate interpretation of economic magnitudes, we define our key variables of interest, innovation and lobbying, using indicator variables. A firm is defined as a green innovator if 25% or more of its total patents (granted within the past five years) relate to green technologies. A firm is defined as a brown lobbyer if the percent of all environmental lobbying dollars (i.e., green plus brown) is greater than 75%. Results are similar using this specification, and statistically significant over all three horizons. Looking at the one-year horizon, green innovators experience 18.3% fewer incidents. However, among firms that focus their lobbying in brown directions, this relation completely reverses; these firms experience 9.6% *more* incidents in the following year. Conclusions are similar at the two- and three-year horizons.

In sum, results in this section indicate that lobbying is informative regarding firm behavior, and, in particular, regarding the risk of future adverse environmental incidents. While green innovation signals a lower risk of such incidents, our results indicate that this is only true for the subset of green innovators that are not lobbying brown. This conclusion has important implications, given prior results that green innovators are equally likely to lobby green or brown.

6. Does the market recognize firms' lobbying activities?

Findings to this point indicate that green innovation is frequently an incomplete measure of firms' efforts to transition to greener modes of operation. When firms' current cash flows stem from brown-type operations, firms rationally expend resources to protect those brown cash flows, for example through lobbying. Moreover, lobbying behavior contains significant information

regarding firm behavior, as evidenced by the relation with subsequent adverse environmental incidents.

The growing inflows into ESG funds suggest that investors increasingly care about factors other than just maximizing firm value. In addition to cash flows, investors also care about environmental impact. Baker, Egan, and Sarkar (2023) conclude that over their 2019-2022 sample period investors are willing to pay 20 basis points in higher fees per annum for pro-ESG funds, compared to otherwise similar funds without an ESG mandate. If investors are willing to pay a premium to invest in firms with pro-environmental policies, then this raises the question: are they getting what they are paying for? Investors who value pro-environmental policies arguably would not want to pay a premium for firms that direct lobbying dollars in brown directions.

To examine this question, we analyze the ratings of the largest ESG ratings provider, MSCI. MSCI ESG ratings are widely followed by asset managers around the world, and they influence a large amount of investment dollars. MSCI ESG KLD Stats Database contains annual ratings on categories such as environmental, employee relations, community, human rights, etc. For each of these categories, MSCI provides ratings on strengths and concerns. Following Lins, Servaes, and Tamayo (2017), among others, we construct *environmental* ratings (i.e., *E-rating*) of firms in our sample by calculating the difference between the relative strengths (i.e., # strengths / maximum possible # strengths) and the relative concerns (i.e., # concerns / maximum possible # concerns).[26] By construction, our E-rating ranges from -1 to 1, with higher value corresponding to a better rating.

Results are shown in Table 9. We regress the E-rating of each firm-year on measures of

[26] This standardization is required because the available number of strengths and concerns vary over time.

firm innovation, firm lobbying, and control variables used in prior tables, all of which are defined in year t. We also include industry and year fixed effects. The dependent variable is the E-rating in year t+1, t+2, and t+3, respectively. In columns 1 – 3 we measure green and brown lobbying in year t, whereas in columns 4 – 6 we define lobbying over years t-1 to t.

The first takeaway is that firms with more green innovation, as measured by the green patent ratio (green patents / all patents), have significantly higher E-ratings. This is consistent with a general perception that green innovation is a way to transition to a greener economy.

Importantly, results in earlier sections showed that firms innovating green are equally likely to lobby green as to lobby brown. Moreover, results in Table 8 indicate that among green innovators, brown lobbyers have significantly higher rates of adverse environmental incidents. However, across all columns, we find no evidence that firms' lobbying behavior is incorporated into MSCI ratings. The coefficients on both *B / (G+B) lobbying* and *Green patent ratio × B / (G+B) lobbying* are insignificant at conventional levels. We have also estimated similar regressions including firm fixed effects (not tabulated), but continue to find no evidence that firms engaging in more brown lobbying have lower ESG ratings.

In sum, our results indicate that green innovation represents an incomplete measure of firms' true environmental stance, and that lobbying expenditures contain significant incremental information. However, MSCI appears to only incorporate innovation activities and not lobbying behavior into their widely-followed ratings.

7. Conclusion

How do innovative firms manage the technological and regulatory risks associated with

the transition to a greener economy? Do green innovators try to shape the regulatory agenda to speed this transition? We study how firms that invest in green innovation make decisions about their lobbying activities.

We introduce a novel method to define the direction of lobbying – green or brown – by analyzing the political contributions of each individual lobbyist. Perhaps surprisingly, we find that green innovators are equally likely to lobby in favor of green or brown legislative agendas.

When we examine the drivers of such lobbying choices, we find evidence that green innovators whose current business is mostly linked to brown activities tend to lobby brown. This result suggests that firms view patents as options to delay their investments while maintaining their competitive advantage in a framework of high uncertainty (Bloom and Van Reenen (2002)). Furthermore, we find that firms with market power in highly concentrated industries tend to lobby brown, consistent with the idea that market leaders have less of an incentive to innovate and a greater tendency to protect the status quo (Holmes, Levine, and Schmitz, 2012; Akcigit and Kerr, 2018; Cowgill, Prat, and Valletti, 2022).

Our results show that, while a higher green innovation intensity predicts a lower risk of environmental incidents, this effect is entirely reversed for the subset of green innovators that are lobbying brown. Moreover, we find that MSCI ESG ratings are positively affected by firms' green innovation activities, whereas they don't take into consideration firms' lobbying behavior.

Overall, our findings indicate that a firm's current innovation activities often do not accurately reflect its current environmental stance. It is reasonable to assume that dollars spent on brown lobbying are more likely to slow than expedite the transition to a greener economy. A significant portion of green innovators engaging in brown lobbying are actively contributing to

this slower transition.

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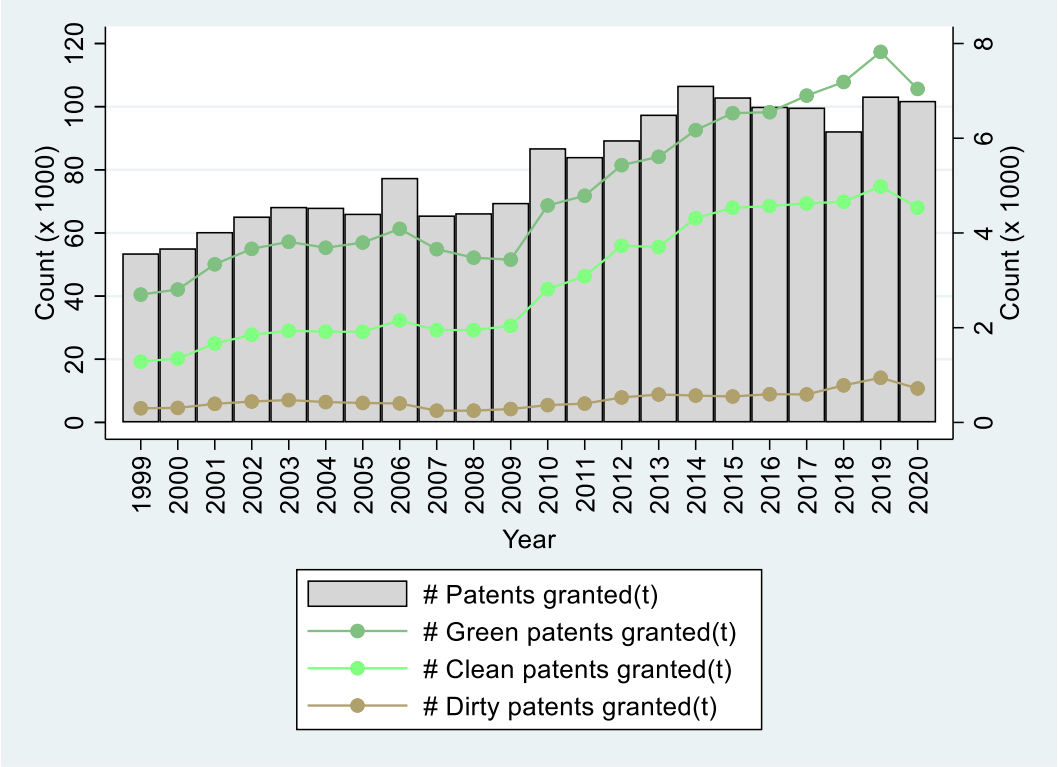
Figure 1
Patenting trend
Panel A shows the number of utility patents granted to US public firms between 1999 and 2020 each year. Similarly, Panel B shows the cumulative number of utility patents granted to US public firms between 1999 and 2020 in the last 20 years (ex: for the year 2020, we count patents granted between 2001 and 2020). Across panels, the primary axis (left-hand side) represents the number of all utility patents and the secondary axis (right-hand side) represents the number of green, clean, and dirty patents. Patent data are obtained from the extended KPSS (Kogan, Papanikolaou, Seru, and Stoffman) patent database. We classify patents as relating to green technologies based on the OECD classification. Clean and dirty patent classifications are from Dechezlepretre, Muckley, and Neelakantan (2020).

Panel A: Patent grants



Panel B: Stock of patents

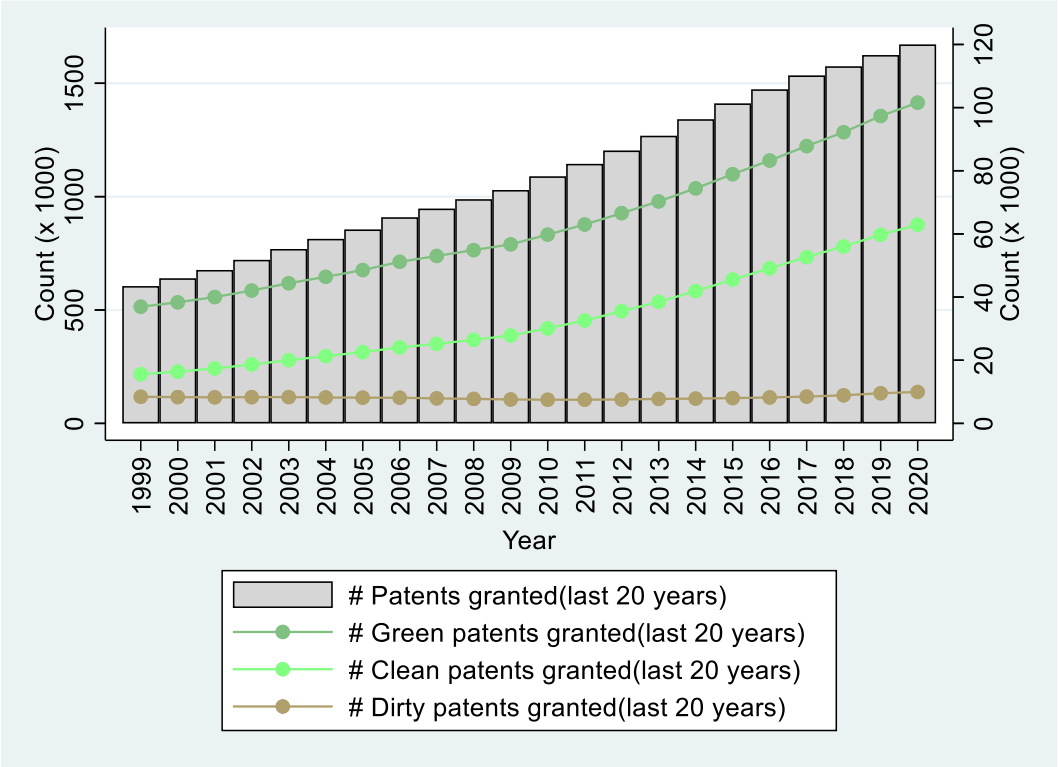


Figure 2
Time-series of lobbying
This figure shows the number of lobbying transactions and the amount of lobbying expenditures. The sample consists of 194,329 (39,840) LD-2s (e-related LD-2s) filed by 3,505 (1,351) public firms in the US between 1999-2020. We limit the sample to firms with positive assets and sales. Lobbying data are obtained from the SOPR (Senate Office of Public Records) and OpenSecrets (https://www.opensecrets.org/). We remove duplicate filings and keep the latest amendments to LD-2s using similar strategies as described in Huneeus and Kim (2020). The left axis shows the total number of LD-2s filed by these firms each year, and the right axis shows the total lobbying spending by these firms each year. An LD-2 is defined to be e-related if 1) the LD-2 contains issue codes (in Line 15) in ENG, ENV, FUE, CAW, or WAS, or 2) the description of the issue (in Line 16) in the LD-2 contains at least one of the bills associated with Environmental protection, Energy, Public lands and natural resources, or Water resources development, as defined by https://www.congress.gov/, or 3) the cosine similarity between the e-related vocabulary (as shown in Figure 4) and the description of the issue (in Line 16) is above 0.148837. Lobbying data are obtained from the SOPR (Senate Office of Public Records) and OpenSecrets (https://www.opensecrets.org/).

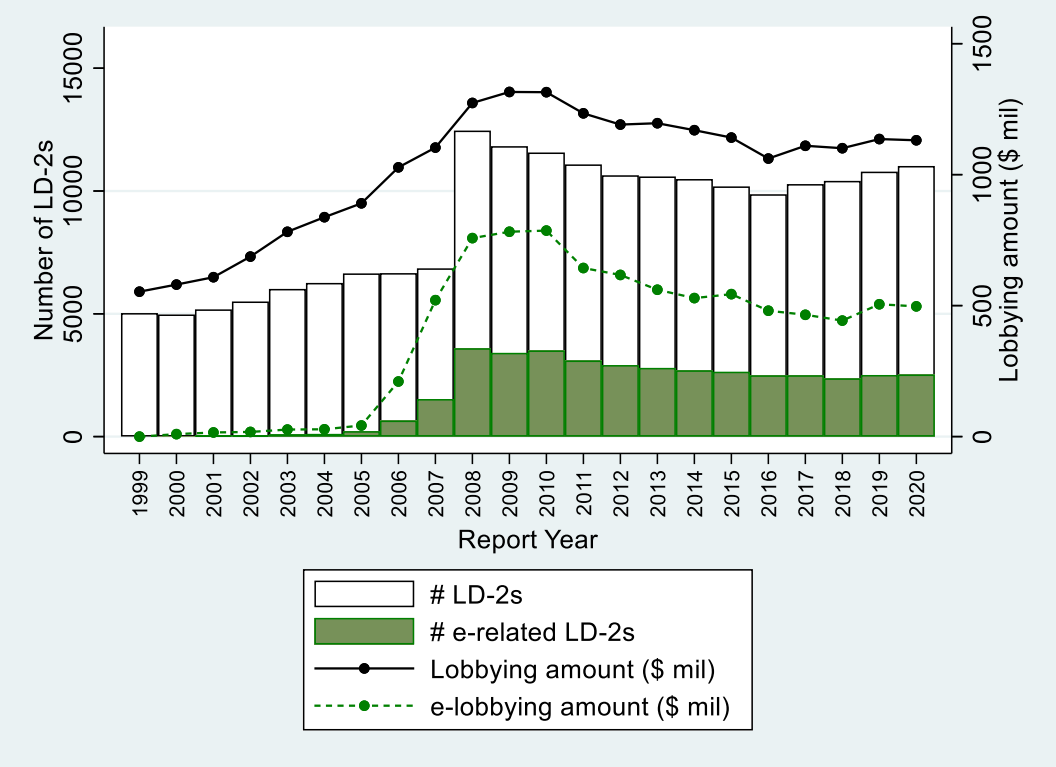
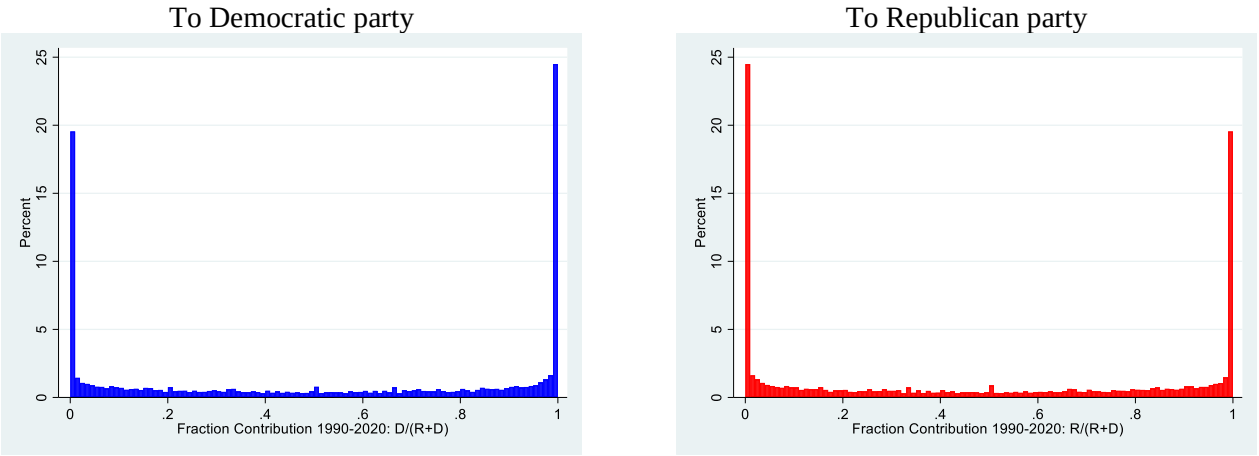


Figure 3
Lobbyists' political contributions
Panel A shows the distribution of political contributions by individual lobbyists. The sample is based on 128,766 individual contributions made between 1990 and 2020 associated with 11,264 lobbyists who lobbied for public firms in our sample. For these 11,264 lobbyists, we calculate the sum of lifetime individual contributions to the Democratic party (D), the Republican party (R), and the rest (O). To be included in the sample, we require the sum of contributions to the Democratic party and the Republican party to be positive, and the sum of contributions to each category to be nonnegative (i.e., $D \geq 0$; $R \geq 0$). Panel B shows the classification of lobbyists' political orientations in our sample. We define a lobbyist to be Democratic (Republican) party-leaning if more than 75% of the lobbyist's lifetime individual contribution to these parties are allocated to the Democratic (Republican) party.

Panel A: Lobbyist-level political contributions



Panel B: Classification of lobbyists' political orientation

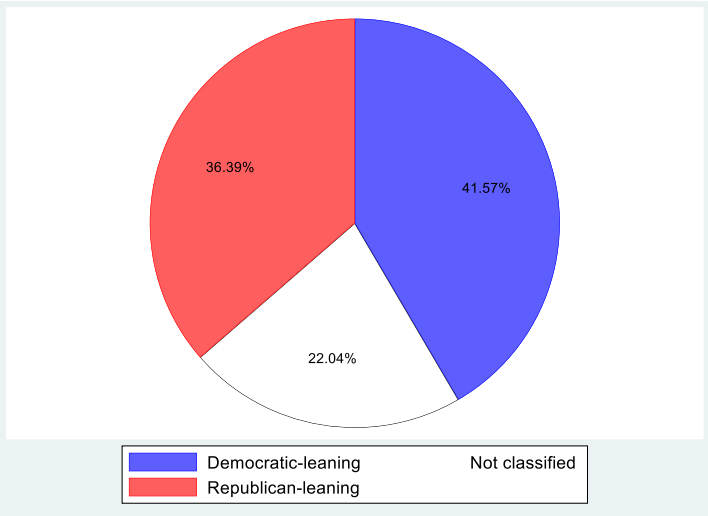


Figure 4

Word cloud for environment-related lobbying

This word cloud represents the vocabulary that we identify as pertaining to lobbying issues that are related to the environment. Specifically, an LD-2 is defined to be e-related if 1) the LD-2 contains issue codes (in Line 15) in ENG, ENV, FUE, CAW, or WAS, or 2) the description of the issue (in Line 16) in the LD-2 contains at least one of the bills associated with Environmental protection, Energy, Public lands and natural resources, or Water resources development, as defined by https://www.congress.gov/. We focus on the LD-2s filed between 1999-2020 by publicly traded US firms with positive assets and sales. We then form a word vector base on the Line 16 descriptions across all of these LD-2s. LD-2s are obtained from the Senate Office of Public Records. Bill numbers are obtained from OpenSecrets (https://www.opensecrets.org/).

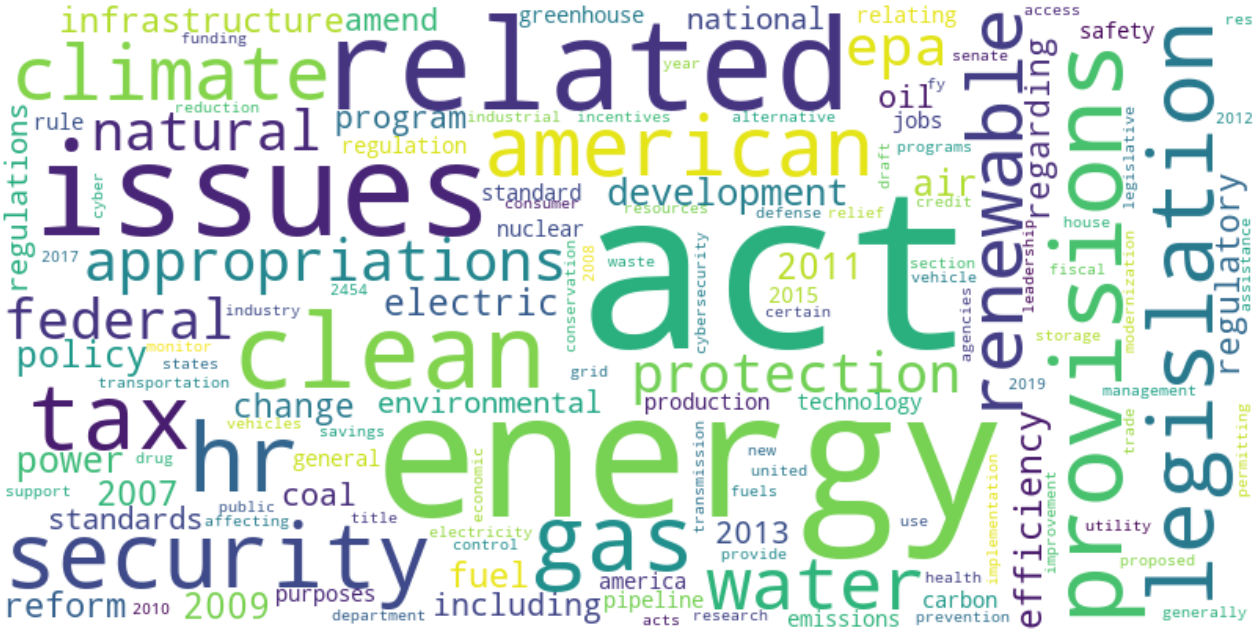
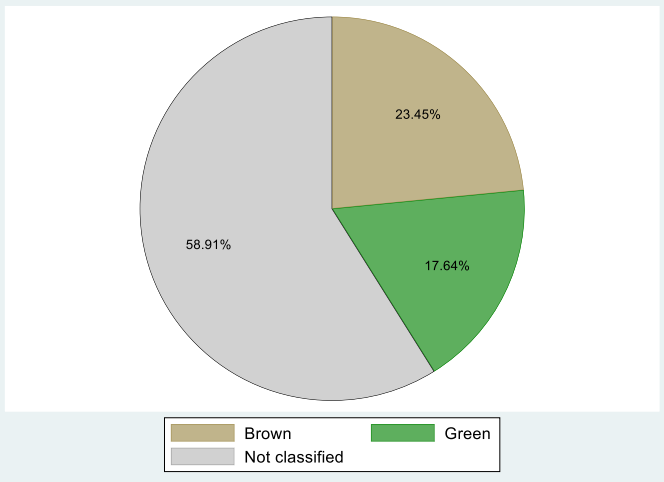


Figure 5
Classification of environmental lobbying
Panel A shows the classification of environment-related (e-related) LD-2s. An e-related LD-2 is classified as Green (Brown) if 1) more than 75% of lobbyists in the LD-2 are Democratic (Republican) party-leaning lobbyists unconditionally or 2) the fraction of lobbyists in the LD-2 whose political orientation can be identified is greater than 50% AND more than 75% of lobbyists in the LD-2—excluding lobbyists whose political orientation cannot be identified—are Democratic (Republican) party-leaning lobbyists. Panel B shows the direction of e-lobbying at the firm-year level. The figure shows the amount of Brown lobbying expenditures divided by the sum of Green and Brown lobbying expenditures. By definition, this measure is available only for firm-years with non-missing Green or Brown lobbying. The amount of Green (Brown) lobbying expenditures at the firm-year level is defined by the sum of lobbying amount reported in Green (Brown) LD-2s.

Panel A: Classification of e-related LD-2s



Panel B: Direction of e-lobbying at the firm-year level

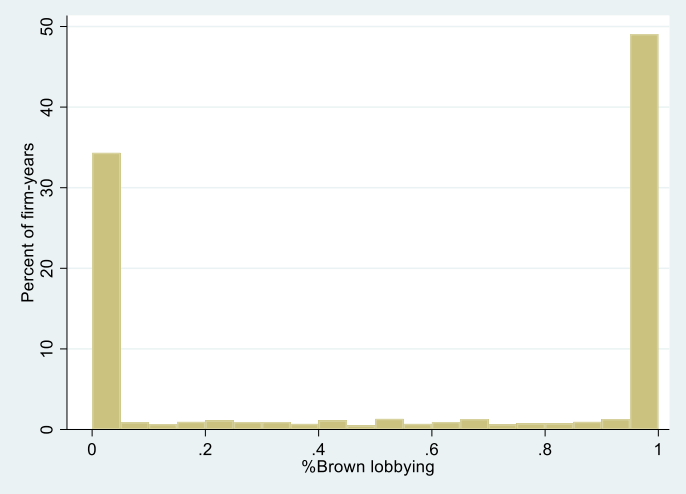


Table 1

Innovation in green, clean, and dirty technologies

Panel A shows the fraction of firms with at least one green patent (columns 2 and 7), at least one clean patent (columns 3 and 8), at least one dirty patent (columns 4 and 9), and at least one patent (column 5) across Fama-French 12 industries. In all cases, these reflect patents that are granted. The sample is based on firm-years between 1999 and 2020. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. We classify patents as relating to green technologies based on the OECD classification. Clean and dirty patent definitions are from Dechezlepretre, Muckley, and Neelakantan (2020). When a patent is classified as both clean and dirty (this may occur when there is more than one technology class for a patent), we define such a patent as neither clean nor dirty. Columns 1-5 are based on all firm-years and columns 6-9 are restricted to firm-years with at least one granted patent.

	All firm-years					Firm-years with at least 1 granted patent			
	N	At least 1 Green patent	At least 1 Clean patent	At least 1 Dirty patent	At least 1 patent	N	At least 1 Green patent	At least 1 Clean patent	At least 1 Dirty patent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Chemicals and Allied Products	1,931	25.3%	13.1%	5.1%	48.6%	939	52.1%	26.9%	10.4%
Consumer Durables	2,073	19.2%	15.8%	6.8%	51.9%	1,075	37.0%	30.4%	13.2%
Manufacturing	8,493	17.0%	10.3%	6.1%	45.4%	3,860	37.3%	22.7%	13.4%
Business Equipment	16,991	9.8%	7.3%	0.8%	48.5%	8,244	20.3%	15.1%	1.7%
Oil, Gas, and Coal Extraction and Products	3,225	5.9%	3.7%	2.1%	11.1%	359	53.2%	33.1%	18.9%
Healthcare, Medical Equipment, and Drugs	10,127	5.0%	1.5%	0.2%	51.4%	5,202	9.7%	3.0%	0.5%
Utilities	2,184	4.9%	3.0%	1.4%	10.3%	224	48.2%	29.0%	13.8%
Telephone and Television Transmission	2,356	2.9%	2.5%	0.3%	18.4%	433	15.7%	13.6%	1.4%
Consumer NonDurables	4,194	2.8%	1.2%	0.5%	20.1%	845	14.0%	6.0%	2.6%
Other	10,237	2.2%	1.1%	0.6%	10.8%	1,109	20.5%	10.2%	5.2%
Wholesale, Retail, and Some Services	8,646	0.8%	0.3%	0.1%	6.7%	578	12.3%	5.2%	1.2%
Finance	18,364	0.4%	0.3%	0.1%	4.1%	759	10.4%	7.0%	1.6%
All	88,821	6.0%	3.8%	1.3%	26.6%	23,627	22.7%	14.2%	4.8%

Table 2

Lobbying in green and brown

This table shows the fraction of firm-years with at least one green lobbying transaction (columns 2 and 6), at least one brown lobbying transaction (columns 3 and 7), and at least one lobbying transaction (column 4) across Fama-French 12 industries. The sample is based on firm-years between 1999 and 2020. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. We define green (brown) lobbying at the LD-2 level. An LD-2 is defined as green (brown) if 1) more than 75% of lobbyists in e-related LD-2s are Democratic (Republican) party-leaning lobbyists, or 2) more than 75% of lobbyists—excluding lobbyists whose political orientation cannot be identified—in e-related LD-2s are Democratic(Republican) party-leaning lobbyists AND the fraction of lobbyists whose political orientation can be identified is greater than 50%. A lobbyist is defined as a Democratic (Republican) party-leaning lobbyist if more than 75% of his/her lifetime political contribution (denominator = contributions to the Democratic party + contributions to the Republican party) between 1990-2020 are allocated to the Democratic (Republican) party. Columns 1-4 are based on all firm-years and columns 5-7 are restricted to firm-years with at least one lobbying transaction.

	All firm years				Firm years with lobbying transactions		
	N	Green lobbying	Brown lobbying	Lobbying	N	Green lobbying	Brown lobbying
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Utilities	2,184	15.34%	18.04%	60.39%	1,319	25.40%	29.87%
Chemicals and Allied Products	1,931	5.49%	7.61%	39.82%	769	13.78%	19.12%
Oil, Gas, and Coal Extraction and Products	3,225	5.12%	9.36%	24.87%	802	20.57%	37.66%
Manufacturing	8,493	2.76%	3.49%	26.88%	2,283	10.25%	12.97%
Consumer Durables	2,073	2.32%	2.85%	23.15%	480	10.00%	12.29%
Other	10,237	2.25%	3.03%	28.62%	2,930	7.85%	10.58%
Consumer NonDurables	4,194	2.05%	2.65%	26.85%	1,126	7.64%	9.86%
Telephone and Television Transmission	2,356	1.95%	1.44%	37.73%	889	5.17%	3.82%
Business Equipment	16,991	1.34%	1.06%	19.87%	3,376	6.75%	5.33%
Healthcare, Medical Equipment, and Drugs	10,127	1.26%	1.58%	28.37%	2,873	4.46%	5.57%
Finance	18,364	0.98%	1.37%	14.83%	2,724	6.61%	9.21%
Wholesale, Retail, and Some Services	8,646	0.86%	1.34%	15.23%	1,317	5.62%	8.81%
All	88,821	2.09%	2.66%	23.52%	20,888	8.90%	11.30%

Table 3

Are the same firms playing both sides?

This table provides summary statistics on lobbying activities. The sample is divided into firm-years with at least one green patent (column 2), no green patent (column 3), at least one clean patent (column 4), and at least one dirty patent (column 5). The sample is based on firm-years between 1999 and 2020. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. We classify patents as relating to green technologies based on the OECD classification. Clean and dirty patent definitions are from Dechezlepretre, Muckley, and Neelakantan (2020). When a patent is classified as both clean and dirty (this may occur when there is more than one technology class for a patent), we define such a patent as neither clean nor dirty. There are 969 unique firms with green patents, 616 unique firms with clean patents, 261 unique firms with dirty patents, and 137 unique firms with both clean and dirty patents.

	Firm-years with			
	Green patents	No green patents	Clean patents	Dirty patents
All firms: # Firm-years	5,362	83,459	3,345	1,124
% Firms-yrs with Any lobbying	58.1%	21.3%	62.0%	75.0%
% Firms-yrs with Green lobbying	9.4%	1.6%	11.3%	14.9%
% Firms-yrs with Brown lobbying	11.6%	2.1%	13.5%	19.4%
Firms that lobby: # Firm-years	3,114	17,774	2,074	843
$ Any lobbying	$2,460,277	$ 698,617	$2,887,683	$3,685,390
Green lobbying	$72,088	$25,282	$83,489	$90,019
Brown lobbying	$108,690	$37,983	$114,032	$170,921
Green/All lobbying	4.6%	2.8%	5.1%	4.5%
Brown/All lobbying	5.3%	3.7%	5.4%	5.9%
$ Any lobbying / sales (%)	0.0375	0.0587	0.0375	0.0245
Green lobbying / sales (%)	0.0004	0.0003	0.0005	0.0004
Brown lobbying / sales (%)	0.0005	0.0004	0.0005	0.0006
Firms that lobby G or B: # Firm-yrs	1,553	4,653	1,148	488
% Brown (=B/(B+G)): $	57.2%	57.0%	56.6%	60.7%

Table 4

Innovation and lobbying

This table shows the relation between innovation and lobbying activities. The sample is based on firm-years between 1999 and 2020. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. Across panels, *I(Lobbying)* is a dummy variable that equals one if a firm lobbied in year *t*+1, and zero otherwise. *I(G Lobbying)* and *I(B Lobbying)* represent dummy variables for green lobbying and brown lobbying, respectively, and are defined in a similar manner. In Panel A, we measure innovation based on the natural log of one plus the number of patents granted to the firm in the last five years from *t* – 4 to *t*. In Panel B, we focus on the composition of a firm's patent portfolio. By construction, the sample is based on firms that have at least one granted patent in the last five years from *t* – 4 to *t.* For example, *Green patents/All patents* equals the ratio of green patents over all patents granted to the firm in the last five years between *t* – 4 and *t*. *Clean patents/All patents* and *Dirty patents/All patents* are defined in a similar manner. Patent classification (green, clean, and dirty) is based on the definition as described in Table 1. *Non-green patents* represent all patents that are not green. *Gray patents* represent patents that are neither clean nor dirty. Green lobbying and brown lobbying are based on the definition as described in Table 2. Industry fixed effects are defined at the Fama-French 48 industry classification. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

Panel A: Stock of patents

VARIABLES	(1) I(Lobbying)	(2) I(G Lobbying)	(3) I(B Lobbying)	(4) I(G Lobbying)	(5) I(B Lobbying)
All patents	0.032***				
	(0.003)				
Green patents		0.024***	0.030***		
		(0.004)	(0.005)		
Non-green patents		0.000	0.000		
		(0.001)	(0.001)		
Clean patents				0.019***	0.017***
				(0.005)	(0.005)
Dirty patents				0.024**	0.040***
				(0.010)	(0.011)
Gray patents				0.002	0.003**
				(0.001)	(0.001)
Size	0.099***	0.013***	0.018***	0.013***	0.018***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Leverage	0.014	-0.009*	-0.019***	-0.009*	-0.019***
	(0.018)	(0.005)	(0.006)	(0.005)	(0.006)
ROA	-0.056***	-0.017***	-0.021***	-0.016***	-0.021***
	(0.011)	(0.003)	(0.003)	(0.003)	(0.003)
Cash/Assets	0.059***	0.007	0.004	0.006	0.003
	(0.019)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	78,123	78,123	78,123	78,123	78,123
R-squared	0.290	0.097	0.129	0.098	0.130
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
S.E.	Firm	Firm	Firm	Firm	Firm

Panel B: Composition of patent portfolio

VARIABLES	(1) I(G Lobbying)	(2) I(B Lobbying)	(3) I(G Lobbying)	(4) I(B Lobbying)
Green patents / All patents	0.048***	0.067***		
	(0.017)	(0.019)		
Clean patents / All patents			0.067**	0.073***
			(0.027)	(0.027)
Dirty patents / All patents			0.056	0.067
			(0.040)	(0.044)
All patents	0.007***	0.006***	0.007***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Size	0.017***	0.024***	0.018***	0.024***
	(0.002)	(0.002)	(0.002)	(0.002)
Leverage	-0.019**	-0.021*	-0.020**	-0.021*
	(0.010)	(0.011)	(0.010)	(0.011)
ROA	-0.026***	-0.032***	-0.025***	-0.032***
	(0.005)	(0.005)	(0.005)	(0.005)
Cash/Assets	-0.004	-0.003	-0.005	-0.004
	(0.008)	(0.008)	(0.008)	(0.008)
Observations	28,372	28,372	28,372	28,372
R-squared	0.123	0.166	0.124	0.165
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
S.E.	Firm	Firm	Firm	Firm

Table 5

Dollars spent on green and brown lobbying

This table shows the relation between innovation and the amount spent on lobbying activities. The sample is based on firm-years between 1999 and 2020. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. In column 1(2), the dependent variable is the amount spent on green(brown) lobbying in year $t + 1$ deflated by total assets in year t. In columns 3 – 6, the dependent variable equals the fraction of environmental lobbying dollars (green plus brown) spent on brown lobbying. In columns 1, 2, 3, and 5, we measure innovation based on the natural log of one plus the number of patents granted to the firm in the last five years from t-4 to t. In columns 4 and 6, we measure innovation based on the composition of a firm's patent portfolio in the last five years from t-4 to t. Patent classification (green, clean, and dirty) is based on the definition as described in Table 1. *Non-green patents* represent all patents that are not green. *Gray patents* represent patents that are neither clean nor dirty. Green lobbying and brown lobbying are based on the definition as described in Table 2. Industry fixed effects are defined at the Fama-French 48 industry classification. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

	Dependent variable =					
	G lobbying/ Assets	B lobbying/ Assets	B/(G+B) Lobbying Dollars			
	(1)	(2)	(3)	(4)	(5)	(6)
Green patents	0.031***	0.045***	0.016			
	(0.010)	(0.012)	(0.016)			
Non-green patents	-0.002	-0.007**	-0.006			
	(0.003)	(0.003)	(0.011)			
Green patents/All patents				0.074		
				(0.086)		
Clean patents					0.001	
					(0.022)	
Dirty patents					0.002	
					(0.028)	
Gray patents					0.002	
					(0.010)	
Clean patents/All patents						-0.025
						(0.123)
Dirty patents/All patents						0.088
						(0.244)
All patents				-0.009		-0.010
				(0.013)		(0.013)
Size(t)	0.012***	0.024***	0.006	0.011	0.006	0.010
	(0.002)	(0.003)	(0.013)	(0.018)	(0.013)	(0.018)
Leverage(t)	0.003	-0.019	-0.102	0.002	-0.100	0.005
	(0.012)	(0.017)	(0.084)	(0.109)	(0.084)	(0.109)
ROA(t)	-0.017*	-0.020**	0.065	0.116	0.060	0.107
	(0.009)	(0.010)	(0.096)	(0.129)	(0.096)	(0.130)
Cash/Assets(t)	0.018	0.022	-0.199*	-0.101	-0.201*	-0.091
	(0.012)	(0.016)	(0.117)	(0.153)	(0.118)	(0.153)
Observations	78,123	78,123	3,455	1,958	3,455	1,958
R-squared	0.037	0.052	0.093	0.138	0.093	0.137
Remark	N/A	N/A	N/A	At least 1 patent	N/A	At least 1 patent
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	Firm	Firm	Firm	Firm	Firm	Firm

Table 6

Source of current cash flows and the direction of environmental lobbying

In this table, we test the *Current Cash Flow Hypothesis*. The sample is restricted to firm-years with non-missing values for green or brown lobbying and *Current green operations*. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. Across columns, the dependent variable equals the fraction of environmental lobbying dollars (green plus brown) spent on brown lobbying. In columns 1-3, we use the continuous measure of *Current green operations*. In columns 4-6, we use a dummy variable, *High current green operations*, which equals one if the continuous measure is in the top quartile (quartiles are defined each year) and zero otherwise. Across columns, we measure innovation based on the natural log of one plus the number of patents granted to the firm in the last five years from *t*-4 to *t*. Patent classification (green, clean, and dirty) is based on the definition as described in Table 1. *Non-green patents* represent all patents that are not green. *Gray patents* represent patents that are neither clean nor dirty. Green lobbying and brown lobbying are based on the definition as described in Table 2. Industry fixed effects are defined at the Fama-French 48 industry classification. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

	Dept Variable = B/(G+B) Lobbying Dollars					
Current green operations measure	Continuous			Indicator Variable		
	(1)	(2)	(3)	(4)	(5)	(6)
Current green operations	-1.403**	-2.024**	-2.034***	-0.086**	-0.127***	-0.124***
	(0.663)	(0.810)	(0.779)	(0.039)	(0.045)	(0.043)
Current green ops x Green Patents		0.402			0.035	
		(0.285)			(0.021)	
Current green ops x Clean Patents			0.732			0.053
			(0.446)			(0.034)
Current green ops x Dirty Patents			-0.275			0.003
			(0.649)			(0.054)
Green Patents		-0.013			-0.001	
		(0.034)			(0.025)	
Clean Patents			-0.053			-0.023
			(0.045)			(0.030)
Dirty Patents			0.017			-0.014
			(0.063)			(0.045)
Non-green patents		-0.008			-0.009	
		(0.012)			(0.012)	
Gray patents			0.001			0.000
			(0.011)			(0.011)
Size	0.018	0.017	0.017	0.018	0.018	0.018
	(0.012)	(0.015)	(0.015)	(0.012)	(0.014)	(0.015)
Leverage	-0.072	-0.071	-0.069	-0.075	-0.076	-0.074
	(0.091)	(0.091)	(0.091)	(0.091)	(0.092)	(0.092)
ROA	-0.051	-0.057	-0.065	-0.039	-0.043	-0.053
	(0.106)	(0.105)	(0.104)	(0.104)	(0.103)	(0.103)
Cash/Assets	-0.179	-0.192	-0.213*	-0.190	-0.197	-0.215*
	(0.122)	(0.123)	(0.125)	(0.123)	(0.122)	(0.124)
Observations	3,041	3,041	3,041	3,041	3,041	3,041
R-squared	0.111	0.115	0.115	0.111	0.116	0.116
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	Firm	Firm	Firm	Firm	Firm	Firm

Table 7

Market power and the direction of environmental lobbying

In this table, we test the *Market Power Hypothesis*. The sample is restricted to firm-years with non-missing values for green or brown lobbying. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. Across columns, the dependent variable equals the fraction of environmental lobbying dollars (green plus brown) spent on brown lobbying. *Market leader* is a dummy variable that equals one if a firm is within one of the top three firms in terms of market share (measured in sales) in each Fama-French 48 industry-year, and zero otherwise. *HHI* represents Herfindahl–Hirschman index, measured within Fama-French 48 industry each year. In columns 2 and 3, we measure innovation based on the natural log of one plus the number of patents granted to the firm in the last five years from *t*-4 to *t*. Patent classification (green, clean, and dirty) is based on the definition as described in Table 1. *Non-green patents* represent all patents that are not green. *Gray patents* represent patents that are neither clean nor dirty. Green lobbying and brown lobbying are based on the definition as described in Table 2. Industry fixed effects are defined at the Fama-French 48 industry classification. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

	Dep't Variable = *Brown / (Green + Brown) Lobbying $*		
VARIABLES	(1)	(2)	(3)
Market leader x HHI	0.911***	0.816**	0.838**
	(0.266)	(0.319)	(0.330)
Market leader x HHI x Green patents		0.055	
		(0.256)	
Market leader x HHI x Clean patents			-0.222
			(0.352)
Market leader x HHI x Dirty patents			0.349
			(0.614)
Market leader x Green patents		0.001	
		(0.033)	
Market leader x Clean patents			-0.011
			(0.053)
Market leader x Dirty patents			0.090
			(0.084)
HHI x Green patents		-0.049	
		(0.244)	
HHI x Clean patents			0.159
			(0.313)
HHI x Dirty patents			-0.341
			(0.547)
HHI	-0.828*	-0.820*	-0.830*
	(0.477)	(0.491)	(0.481)
Market leader	-0.153***	-0.165**	-0.177***
	(0.058)	(0.066)	(0.064)
Green patents		0.017	
		(0.028)	
Clean patents			-0.001
			(0.036)
Dirty patents			-0.039
			(0.057)
Non-green patents		-0.003	
		(0.011)	
Gray patents			0.007

			(0.010)
Size(t)	0.015	0.011	0.011
	(0.012)	(0.014)	(0.014)
Leverage(t)	-0.106	-0.108	-0.119
	(0.084)	(0.083)	(0.083)
ROA(t)	0.052	0.054	0.056
	(0.095)	(0.095)	(0.095)
Cash/Assets(t)	-0.162	-0.174	-0.188
	(0.114)	(0.115)	(0.116)
Observations	3,455	3,455	3,455
R-squared	0.099	0.100	0.104
Remark	N/A	N/A	N/A
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
S.E.	Firm	Firm	Firm

Table 8

Environmental lobbying and real outcomes

This table shows the relation between environmental lobbying and firms' environment-related incidents. The sample is based on firm-years with available data on environment-related incidents data. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. The dependent variable is the natural logarithm of one plus the number of negative incidents related to the environment category. In columns 1–3, we measure innovation and lobbying with continuous variables. We measure green innovation with the number of green patents divided by the number of all patents granted in the last five years from $t-4$ to t (i.e., *Green patent ratio*). In addition, we measure anti-environmental lobbying with the fraction of brown lobbying dollars spent in years $t-1$ and t over the sum of lobbying expenditures spent on green and brown lobbying in years $t-1$ and t ($B/(G+B)\ Lobbying_{[t-1,\ t]}$). In columns 4–6, we measure innovation and lobbying with dummy variables. We measure green innovator with a dummy variable that equals one if *Green patent ratio* is greater than 0.25, and zero otherwise. In addition, we measure Brown lobbyer with a dummy variable that equals one if $B/(G+B)\ Lobbying_{[t-1,\ t]}$ is greater than 0.75, and zero otherwise. Environment-related incident data are obtained from RepRisk. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

	Dep't Variable = ln(# E-incidents) at:					
	t+1	t+2	t+3	t+1	t+2	t+3
	(1)	(2)	(3)	(4)	(5)	(6)
Green patent ratio x B/(G+B) Lobbying$_{[t-1,\ t]}$	0.699**	0.773***	0.646**			
	(0.355)	(0.276)	(0.307)			
B/(G+B) Lobbying$_{[t-1,\ t]}$	-0.113*	-0.072	-0.061			
	(0.062)	(0.051)	(0.062)			
Green patent ratio	-0.635**	-0.887***	-0.913***			
	(0.297)	(0.206)	(0.191)			
Green innovator (1/0) x Brown Lobbyer$_{[t-1,\ t]}$ (1/0)				0.279**	0.255**	0.171
				(0.110)	(0.120)	(0.114)
Brown Lobbyer$_{[t-1,\ t]}$ (1/0)				-0.085	-0.013	0.010
				(0.052)	(0.043)	(0.051)
Green innovator (1/0)				-0.183**	-0.272**	-0.184*
				(0.089)	(0.106)	(0.108)
ln(# Patents)	-0.014	-0.002	-0.001	-0.020	-0.006	-0.006
	(0.035)	(0.036)	(0.038)	(0.036)	(0.036)	(0.040)
ln($ lobbying amount)$_{[t-1,\ t]}$	0.089*	0.125**	0.131**	0.082*	0.117**	0.124**
	(0.051)	(0.051)	(0.054)	(0.050)	(0.053)	(0.054)
Size(t)	0.264***	0.191**	0.257***	0.274***	0.208**	0.270***
	(0.091)	(0.094)	(0.091)	(0.095)	(0.102)	(0.097)
Leverage(t)	-0.309	-0.269	0.085	-0.279	-0.233	0.130
	(0.292)	(0.267)	(0.301)	(0.283)	(0.266)	(0.303)
ROA(t)	-0.254	-0.421	0.005	-0.201	-0.343	0.073
	(0.338)	(0.316)	(0.329)	(0.331)	(0.316)	(0.331)
Cash/Assets(t)	0.184	0.299	0.807**	0.142	0.257	0.788**
	(0.335)	(0.327)	(0.370)	(0.339)	(0.327)	(0.364)
Observations	1,481	1,425	1,327	1,481	1,425	1,327
R-squared	0.825	0.836	0.834	0.824	0.834	0.832
Green innovation cutoff	N/A	N/A	N/A	25%	25%	25%
Brown lobbying cutoff	N/A	N/A	N/A	75%	75%	75%
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No
Industry x Year FE	No	No	No	No	No	No
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	Firm	Firm	Firm	Firm	Firm	Firm

Table 9

Environmental lobbying and environmental rating

This table shows the relation between environmental lobbying and firms' environmental ratings. The sample is based on firm-years between 1999 and 2019 with available environmental ratings. We exclude firms with less than $10 million in assets and negative R&D expenditures, and we require firms to have positive sales. The dependent variable is the firm's net environmental rating, defined by the difference between the scaled number of environmental strengths and the scaled number of concerns in year *t* + 1. E-rating ranges between -1 and 1, with a higher value corresponding to a better rating. Environmental rating data are obtained from MSCI ESG KLD Stats database. We measure green innovation with the number of green patents divided by the number of all patents granted from *t* – 4 to *t*. We classify patents as relating to green technologies (i.e., *Green patents*) based on the OECD classification. In columns 1–3 (4–6), we measure environmental lobbying with the amount of brown lobbying expenditures divided by the sum of lobbying expenditures spent on green and brown lobbying in year *t* (*t* - 1 through t). Industry fixed effects are defined at the Fama-French 48 industry classification. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively. Variable definitions are in Appendix A.

	Dep't Variable = E-rating at:					
	t+1	t+2	t+3	t+1	t+2	t+3
	(1)	(2)	(3)	(4)	(5)	(6)
Green patent ratio x B/(G+B) Lobbying$_t$	-0.005	0.060	-0.010			
	(0.085)	(0.076)	(0.087)			
B/(G+B) Lobbying $_t$	-0.019	-0.024	-0.008			
	(0.024)	(0.024)	(0.024)			
Green patent ratio x B/(G+B) Lobbying $_{t-1,t}$				0.038	0.065	-0.027
				(0.082)	(0.079)	(0.086)
B/(G+B) Lobbying$_{t-1,t}$				-0.030	-0.025	-0.009
				(0.024)	(0.024)	(0.024)
Green patent ratio	0.115*	0.101	0.140**	0.074	0.079	0.129*
	(0.067)	(0.062)	(0.071)	(0.062)	(0.060)	(0.067)
ln(# Patents)	0.038***	0.037***	0.032***	0.036***	0.034***	0.029***
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
ln($ lobbying amount)$_t$	-0.047**	-0.045***	-0.041**			
	(0.018)	(0.017)	(0.017)			
ln($ lobbying amount)$_{t-1,t}$				-0.032**	-0.030**	-0.024*
				(0.014)	(0.014)	(0.014)
Size	0.032***	0.040***	0.045***	0.036***	0.041***	0.047***
	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)
Leverage	0.109*	0.107	0.096	0.094	0.098	0.095
	(0.063)	(0.069)	(0.071)	(0.061)	(0.065)	(0.069)
ROA	-0.030	0.003	0.012	-0.044	0.022	0.049
	(0.098)	(0.101)	(0.095)	(0.103)	(0.102)	(0.097)
Cash/Assets	-0.035	-0.048	-0.033	-0.054	-0.049	-0.025
	(0.084)	(0.084)	(0.090)	(0.082)	(0.084)	(0.090)
Observations	1,543	1,405	1,276	1,895	1,731	1,567
R-squared	0.415	0.424	0.415	0.404	0.418	0.413
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	No
S.E.	Firm	Firm	Firm	Firm	Firm	Firm

Appendix A
Variable definitions

Variable	Definition
Innovation measures	
All patents	Number of patents granted to the firm in the last five years. Source: extended KPSS patent data
Green patents	Number of green patents granted to the firm in the last five years. We classify patents as relating to green technologies based on the OECD classification. Source: extended KPSS patent data, USPTO, and OECD.
Clean patents	Number of clean patents granted to the firm in the last five years. Clean patent definitions are from Dechezlepretre, Muckley, and Neelakantan (2020). Source: extended KPSS patent data, USPTO, and Dechezlepretre, Muckley, and Neelakantan (2020)
Dirty patents	Number of dirty patents granted to the firm in the last five years. Dirty patent definitions are from Dechezlepretre, Muckley, and Neelakantan (2020). Source: extended KPSS patent data, USPTO, and Dechezlepretre, Muckley, and Neelakantan (2020)
Green patents/All patents	The ratio of green patents over all patents granted to the firm in the last five years (i.e., # green patents granted in the last five years / # patents granted in the last five years).Source: extended KPSS patent data, USPTO, and OECD.
Clean patents/All patents	The ratio of clean patents over all patents granted to the firm in the last five years (i.e., # clean patents granted in the last five years / # patents granted in the last five years). Source: extended KPSS patent data, USPTO, and Dechezlepretre, Muckley, and Neelakantan (2020).
Dirty patents/All patents	The ratio of dirty patents over all patents granted to the firm in the last five years (i.e., # dirty patents granted in the last five years / # patents granted in the last five years). Source: extended KPSS patent data, USPTO, and Dechezlepretre, Muckley, and Neelakantan (2020).
Lobbying measures	
I(Lobbying)	Equals one if a firm lobbied, zero otherwise. Source: SOPR
I(G Lobbying)	Equals one if a firm lobbied green, zero otherwise. An LD-2 is defined as green if 1) more than 75% of lobbyists in e-related LD-2s are Democratic party-leaning lobbyists, or 2) more than 75% of lobbyists—excluding lobbyists whose political orientation cannot be identified—in e-related LD-2s are Democratic party-leaning lobbyists AND the fraction of lobbyists whose political orientation can be identified is greater than 50%. A lobbyist is defined as a Democratic party-leaning lobbyist if more than 75% of his/her lifetime political contribution (denominator = contributions to the Democratic party + contributions to the Republican party) between 1990-2020 are allocated to the Democratic party. Source: SOPR, OpenSecrets.
I (B Lobbying)	Equals one if a firm lobbied brown, zero otherwise. An LD-2 is defined as brown if 1) more than 75% of lobbyists in e-related LD-2s are Republican party-leaning lobbyists, or 2) more than 75% of lobbyists—excluding lobbyists whose political orientation cannot be identified—in e-related LD-2s are Republican party-leaning lobbyists AND the fraction of lobbyists whose political orientation can be identified is greater than 50%. A lobbyist is defined as a Republican party-leaning lobbyist if more than 75% of his/her lifetime political contribution (denominator = contributions to the Democratic party + contributions to the Republican party) between 1990-2020 are allocated to the Republican party. Source: SOPR, OpenSecrets.

G Lobbying/Assets	The amount spent on Green lobbying in year *t*+1 deflated by the asset in year *t*. Source: SOPR, OpenSecrets.
B Lobbying/Assets	The amount spent on Brown lobbying in year *t*+1 deflated by the asset in year *t*. Source: SOPR, OpenSecrets.
Green lobbying/lobbying	The amount spent on Green lobbying in year *t* deflated by the total lobbying expenditures in year *t*. Source: SOPR, OpenSecrets.
Brown lobbying/lobbying	The amount spent on Brown lobbying in year *t* deflated by the total lobbying expenditures in year *t*. Source: SOPR, OpenSecrets.
G/(G+B): Lobbying Dollars	The fraction of environmental lobbying dollars (green plus brown) spent on Green lobbying. Source: SOPR, OpenSecrets.
B/(G+B): Lobbying Dollars	The fraction of environmental lobbying dollars (green plus brown) spent on Brown lobbying. Source: SOPR, OpenSecrets.
Other variables	
Current green operations (continuous)	The cosine similarity between 1) year *t*'s business description for a firm and 2) patent summary text for the entire universe of green patents granted in the last five years (i.e., *t*-4 to *t*). Source: extended KPSS data, USPTO, and OECD.
High current green operations (indicator variable)	Equals one if the cosine similarity between 1) year *t*'s business description for a firm and 2) patent summary text for the entire universe of green patents granted in the last five years (i.e., *t*-4 to *t*) is in the top quartile (quartiles are defined each year), and zero otherwise. Source: extended KPSS data, USPTO, and OECD.
E-rating	The difference between the relative strengths (i.e., number of strengths / maximum number of possible strengths) and the relative concerns (i.e., number of concerns / maximum number of possible concerns) for the 'Environment' category. See Lins, Servaes, and Tamayo (2017) for details. Source: MSCI ESG KLD Stats database.
Market leader	Equals on if a firm is within one of the top three firms in terms of market share (measured in sales) in each Fama-French 48 industry-year, and zero otherwise. Source: CRSP/Compustat.
HHI	Herfindahl–Hirschman index, measured within Fama-French 48 industry each year. Source: CRSP/Compustat.
Size	ln(AT + 1). Source: Compustat.
Leverage	(DLTT + DLC) / AT. Source: Compustat.
ROA	NI/AT. Source: Compustat.
Cash/Assets	CHE/AT. Source: Compustat.

Appendix B
LD-2 form example
This appendix shows selected pages from an LD-2 filed by Exxon Mobil in 2014.

Clerk of the House of Representatives Legislative Resource Center 135 Cannon Building Washington, DC 20515 http://lobbyingdisclosure.house.gov	Secretary of the Senate Office of Public Records 232 Hart Building Washington, DC 20510 http://www.senate.gov/lobby

LOBBYING REPORT

Lobbying Disclosure Act of 1995 (Section 5) - **All Filers Are Required to Complete This Page**

1. Registrant Name ☑ Organization/Lobbying Firm ☐ Self Employed Individual
EXXON MOBIL CORP

2. Address
Address1 5959 LAS COLINAS BLVD. Address2
City IRVING State TX Zip Code 75039 Country USA

3. Principal place of business (if different than line 2)
City State Zip Code Country

4a. Contact Name b. Telephone Number c. E-mail

5. Senate ID# 14017-12

7. Client Name ☑ *Self* ☐ *Check if client is a state or local government or instrumentality*
EXXON MOBIL CORP

6. House ID# 302300000

TYPE OF REPORT

8. Year 2014 Q1 (1/1 - 3/31) ☐ Q2 (4/1 - 6/30) ☐ Q3 (7/1 - 9/30) ☑ Q4 (10/1 - 12/31) ☐

9. Check if this filing amends a previously filed version of this report ☐

10. Check if this is a Termination Report ☐ Termination Date ____ 11. No Lobbying Issue Activity ☐

INCOME OR EXPENSES - YOU MUST complete either Line 12 or Line 13

12. Lobbying

INCOME relating to lobbying activities for this reporting period was:

Less than $5,000 ☐

$5,000 or more ☐ $ ____

Provide a good faith estimate, rounded to the nearest $10,000, of all lobbying related income for the client (including all payments to the registrant by any other entity for lobbying activities on behalf of the client).

13. Organizations

EXPENSE relating to lobbying activities for this reporting period were:

Less than $5,000 ☐

$5,000 or more ☑ $ 3,160,000.00

14. REPORTING Check box to indicate expense accounting method. See instructions for description of options.

☑ **Method A.** Reporting amounts using LDA definitions only

☐ **Method B.** Reporting amounts under section 6033(b)(8) of the Internal Revenue Code

☐ **Method C.** Reporting amounts under section 162(e) of the Internal Revenue Code

Signature Digitally Signed By: Courtney S. Walker, Corporate Issues Advisor **Date** 10/20/2014

LOBBYING ACTIVITY. Select as many codes as necessary to reflect the general issue areas in which the registrant engaged in lobbying on behalf of the client during the reporting period. Using a separate page for each code, provide information as requested. Add additional page(s) as needed.

15. General issue area code ENG

16. Specific lobbying issues

HR 6: Domestic Prosperity and Global Freedom Act; provisions related to energy
HR 1461: Renewable Fuel Standard Elimination Act; provisions related to energy
HR 1462: RFS Reform Act of 2013; provisions related to energy
HR 3301: North American Energy Infrastructure Act; provisions related to energy
HR 4007: The Chemical Facility Anti-Terrorism Standards Program Authorization and Accountability Act of 2014; provisions related to energy
HR 4526: 21st Century Energy Workforce Development Jobs Initiative Act of 2014; provisions related to qualified workforce for the energy sector
HR 4923: Energy and Water Development and Related Agencies Appropriations Act, 2015; provisions related to energy
HR 4957: Commonsense Legislative Exceptional Events Reforms (CLEER) Act of 2014; provisions related to energy
S. 2088: American Natural Gas Security and Consumer Protection Act; provisions related to energy
S. 2170: American Energy Renaissance Act of 2014; provisions related to energy
S. 2262: Energy Savings and Industrial Competitiveness Act of 2014; provisions related to energy
Discussions related to LNG exports and Alaska LNG project
Discussions related to the Toxic Substances Control Act
Discussions related to Ozone National Ambient Air Quality Standards
Discussions related to the Keystone XL Pipeline

17. House(s) of Congress and Federal agencies ☐ Check if None

U.S. HOUSE OF REPRESENTATIVES, U.S. SENATE, White House Office, Energy - Dept of, Commerce - Dept of (DOC)

18. Name of each individual who acted as a lobbyist in this issue area

First Name	Last Name	Suffix	Covered Official Position (if applicable)	New
Susan	Carter			☐
Theresa	Fariello			☐
Karen	Matusic			☐
Keith	McCoy			☐
Jeanne	Mitchell			☐
Michael	Roman			☐

19. Interest of each foreign entity in the specific issues listed on line 16 above ☑ Check if None

Information Update Page - Complete ONLY where registration information has changed.

20. Client new address

Address _____

City _____ State _____ Zip Code _____ Country _____

21. Client new principal place of business (if different than line 20)

City _____ State _____ Zip Code _____ Country _____

22. New General description of client's business or activities

LOBBYIST UPDATE

23. Name of each previously reported individual who is no longer expected to act as a lobbyist for the client

	First Name	Last Name	Suffix		First Name	Last Name	Suffix
1				3			
2				4			

ISSUE UPDATE

24. General lobbying issue that no longer pertains

AFFILIATED ORGANIZATIONS

25. Add the following affiliated organization(s)

Internet Address:

Name	Address Street Address City State/Province Zip Country	Principal Place of Business (city and state or country) City State Country

26. Name of each previously reported organization that is no longer affiliated with the registrant or client

1 2 3

FOREIGN ENTITIES

27. Add the following foreign entities:

Name	Address Street Address City State/Province Country	Principal place of business (city and state or country) City State Country	Amount of contribution for lobbying activities	Ownership percentage in client
				%

28. Name of each previously reported foreign entity that no longer owns, or controls, or is affiliated with the registrant, client or affiliated organization

1 3 5

2 4 6

Appendix C
Classification of Green and Brown lobbying

Step 1: At the lobbyist level, classify lobbyists into Democratic-leaning vs. Republican-leaning

- Sum lifetime individual contributions to the Democratic party (D), Republican party (R), and others (O) at the lobbyist level
- A lobbyist is defined as a Democratic(Republican) party-leaning lobbyist if more than 75% of his/her individual contribution (denominator = contributions to the Democratic party + contributions to the Republican party) between 1990-2020 are allocated to the Democratic(Republican) party
- Some lobbyists will be classified as neither Rep-leaning nor Dem-leaning

Example:

Lobbyist	R/(R+D+O)	D/(R+D+O)	O/(R+D+O)	R/(R+D)	D/(R+D)	Rep-leaning	Dem-leaning
WELCH, MIKE	68%	30%	2%	69%	31%	0	0
ANDREWS, BRUCE H	0%	87%	13%	0%	100%	0	1
HULL, KATE	100%	0%	0%	100%	0%	1	0

Step 2: At the LD-2 level, classify lobbying into BLUE vs. RED lobbying (GREEN vs. BROWN for e-related LD-2s)

- We define Blue/Red at the LD-2 level
- An LD-2 is defined as BLUE(RED) if
    - More than 75% of lobbyists in LD-2s are Democratic(Republican) party-leaning lobbyists, or
    - More than 75% of lobbyists—excluding lobbyists whose political orientation cannot be identified—in LD-2s are Democratic(Republican) party-leaning lobbyists AND the fraction of lobbyists whose political orientation can be identified is greater than 50%
- Note that
    - Blue lobbying x e-related LD-2 = Green lobbying
    - Red lobbying x e-related LD-2 = Brown lobbying

Example:

LD2 #	Lobbyist	Year	Rep-leaning	Dem-leaning	%Non-missing info	%Rep-leaning	%Dem-leaning	%Rep-leaning | non-missing	%Dem-leaning | non-missing	Classification
451E5320-9F88-448B-B9C3-37FD76F1AF34	BLALOCK, KIRK	2007	1	0	78%	78%	0%	100%	0%	RED LOBBYING
451E5320-9F88-448B-B9C3-37FD76F1AF34	CHADWICK, KIRSTEN	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	CHAPPELL, MIKE	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	COOK, SAMANTHA	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	FIERCE, DONALD L	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	HUFFARD, KATIE BRADEN	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	HULL, KATE	2007	1	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	ISAKOWITZ, MARK W	2007	0	0	78%	78%	0%	100%	0%	
451E5320-9F88-448B-B9C3-37FD76F1AF34	JARVIS, ALEIX	2007	0	0	78%	78%	0%	100%	0%	
6DED2096-3490-44AE-8040-4A56E12B07FE	ANDREWS, BRUCE H	2007	0	1	63%	38%	25%	60%	40%	N/A
6DED2096-3490-44AE-8040-4A56E12B07FE	ARAPIS, PETER	2007	0	1	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	JONES, ALISON	2007	0	0	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	MORGAN, JAY	2007	1	0	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	OJAKI, ZIAD	2007	0	0	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	OJAKLI, ZIAD	2007	1	0	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	ROUSSEL, JERRY	2007	0	0	63%	38%	25%	60%	40%	
6DED2096-3490-44AE-8040-4A56E12B07FE	YOUNG, JAMES THOMAS	2007	1	0	63%	38%	25%	60%	40%	
78E954B9-6241-49D5-821E-F0FB2E6F4714	FINNEGAN, DAVID B	2007	0	1	100%	0%	100%	0%	100%	BLUE LOBBYING

Step 3: At the firm-year level, define GREEN and BROWN lobbying

- Blue lobbying x e-related LD-2 = Green lobbying
- Red lobbying x e-related LD-2 = Brown lobbying

Example:

YEAR	CONM	LD-2 ID	AMOUNT	E-LOBBYING	BLUE LOBBYING	RED LOBBYING	GREEN	BROWN
2007	FORD MOTOR CO	F9E6362A-E8B7-4A69-A1DA-D3078B97C4DC	$ 100,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	C19D69B7-D301-430D-B4F6-B8EFED806A6D	$ 40,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	B7CA9CCF-0DCC-4433-B9A7-3AB336D40444	$ 3,562,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	E7664EBD-7E5D-47EA-9F14-44BEC840FA1C	$ 40,000	1	1	0	$ 40,000	$ -
2007	FORD MOTOR CO	E0F35BC6-03B2-4266-9E38-2084E19E44B9	$ 140,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	EB705E22-75FE-4266-9333-0ADD48B8BFD0	$ 160,000	1	1	0	$ 160,000	$ -
2007	FORD MOTOR CO	7E39C001-A58A-4953-9EDF-9974F1F78799	$ 160,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	451E5320-9F88-448B-B9C3-37FD76F1AF34	$ 100,000	1	0	1	$ -	$ 100,000
2007	FORD MOTOR CO	6DED2096-3490-44AE-8040-4A56E12B07FE	$ 3,562,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	78E954B9-6241-49D5-821E-F0FB2E6F4714	$ 60,000	1	1	0	$ 60,000	$ -
2007	FORD MOTOR CO	7488B43C-E305-47D3-81A8-56E54BB9A377	$ 60,000	1	1	0	$ 60,000	$ -
2007	FORD MOTOR CO	275A11A4-4C62-48C1-8756-6B6303C70443	$ 160,000	1	0	0	$ -	$ -
2007	FORD MOTOR CO	42BF580C-7C87-4320-8701-05AD4453C2FF	$ 100,000	1	0	1	$ -	$ 100,000
2007	FORD MOTOR CO	2B1D9E8D-0B61-4783-8184-7615E34A7534	$ 100,000	1	1	0	$ 100,000	$ -
2007	FORD MOTOR CO	2B6BD7AD-13CD-4537-B466-3DC43565EEC6	$ 80,000	1	0	0	$ -	$ -

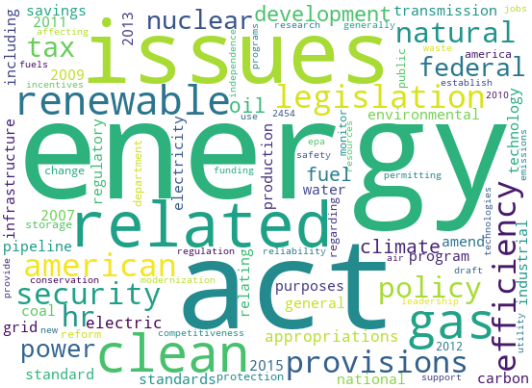
Appendix Figure A1

Lobbying transaction word clouds, for environment-related transactions

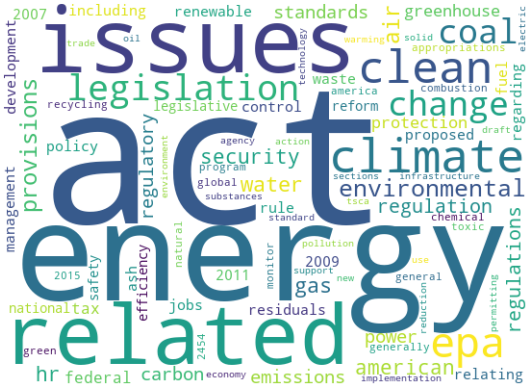
Panel A shows word clouds of the Line16 text for the subset of LD2s for which Line15 belongs to one of the following categories: ENG [*Energy/Nuclear*], ENV [*Environment/superfund*], FUE [*Fuel/gas/oil*], CAW [*Clean air and water (quality)*], and WAS [*Waste (hazardous/solid/interstate/nuclear)*]. Panel B shows word clouds of the bill title text for the subset of LD-2s that have a bill number listed in line16 and for which the bill number belongs to one of the following categories designated by Congress.gov: *environmental protection*, *energy*, *Public lands and natural resources*, or *Water resources development*, as defined by https://www.congress.gov/. We focus on the LD-2s filed between 1999-2020 by publicly traded US firms with positive assets and sales. LD-2s are obtained from the Senate Office of Public Records. Bill numbers are obtained from OpenSecrets (https://www.opensecrets.org/).

Panel A: Line 16 texts

ENERGY/NUCLEAR



ENVIRONMENT/SUPERFUND



FUEL/GAS/OIL

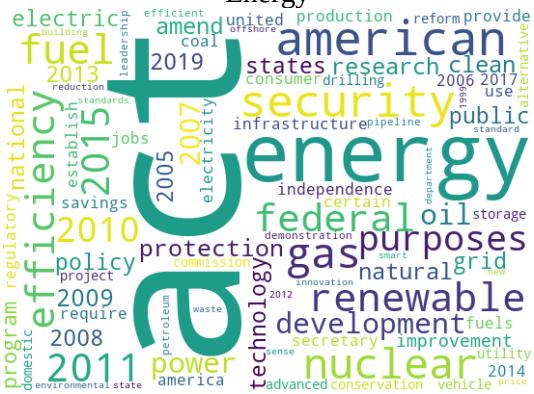
CLEAN AIR AND WATER (QUALITY)

WASTE (HAZARDOUS/SOLID/INTERSTATE/NUCLEAR)

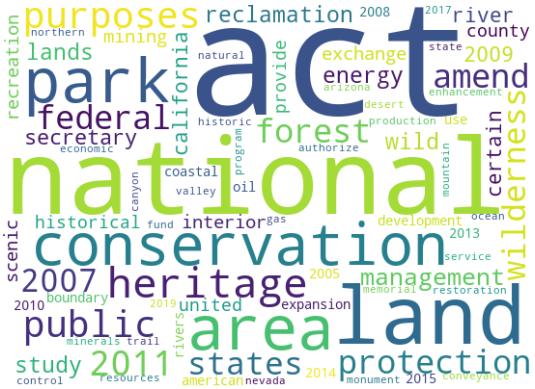
Panel B: Bill texts

Environmental protection

Energy



Public lands and natural resources

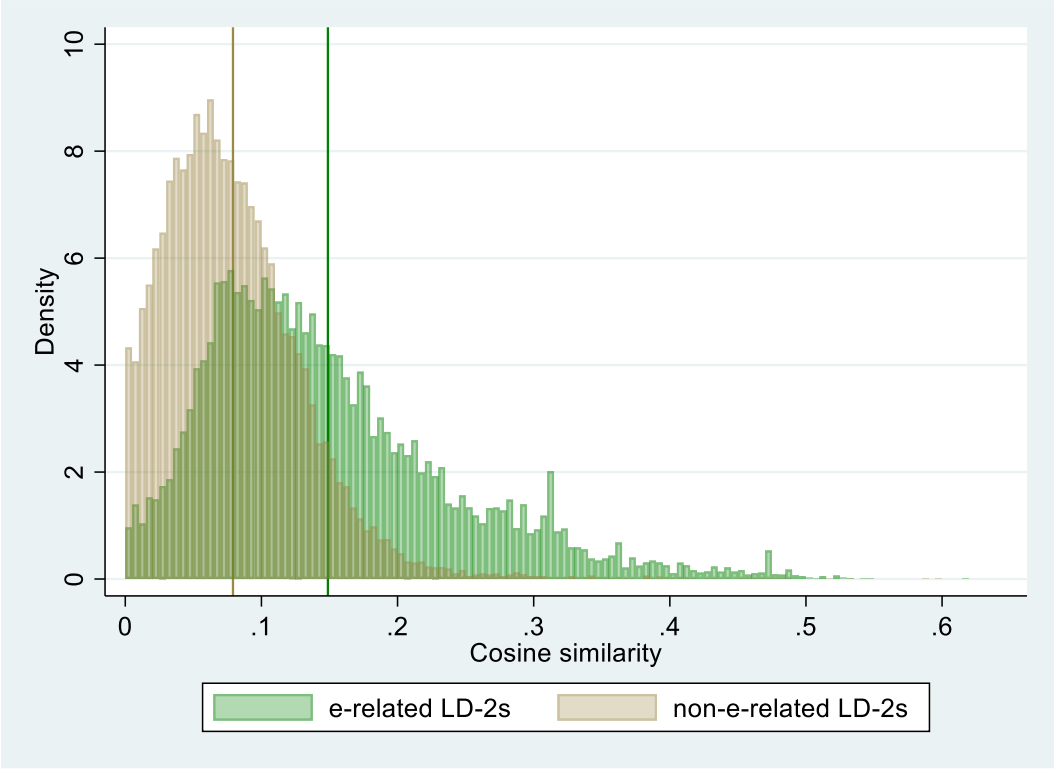


Water resources development

Appendix Figure A2

Cosine similarity between environment-related vocabulary and alternative sets of LD-2s

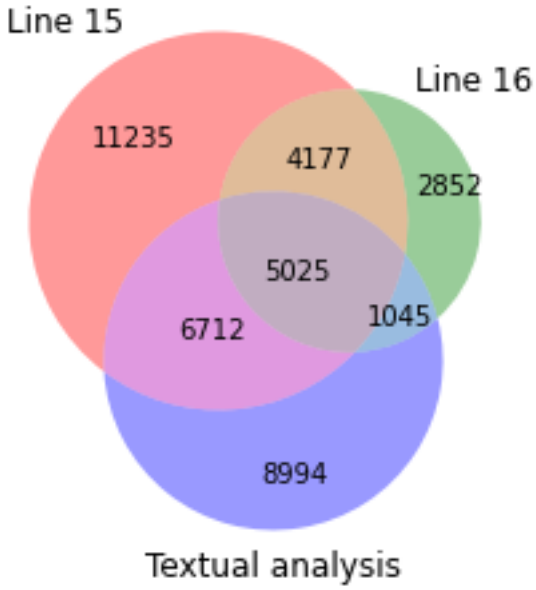
This figure shows the distribution of cosine similarity between our environment-related vocabulary (as depicted in Figure 4) and Line 16 of Form LD-2. Cosine similarity scores for e-related LD-2s are colored green, and cosine similarity scores for non-e-related LD-2s are colored brown. Vertical lines represent the means of cosine similarity scores for each category.



Appendix Figure A3

Classification of LD-2s

This figure shows the universe of LD-2s that are classified and environment-related. Each observation represents an LD-2 form. An LD-2 is defined to be e-related if 1) the LD-2 contains issue codes (in Line 15) in ENG, ENV, FUE, CAW, or WAS, or 2) the description of the issue (in Line 16) in the LD-2 contains at least one of the bills associated with Environmental protection, Energy, Public lands and natural resources, or Water resources development, as defined by https://www.congress.gov/, or 3) the cosine similarity between the e-related vocabulary (as shown in Figure 4) and the description of the issue (in Line 16) is above 0.148837. Lobbying data are obtained from the SOPR (Senate Office of Public Records) and OpenSecrets (https://www.opensecrets.org/).



Appendix Table A1

Classification of lobbyists' political orientation

This table shows the transition matrix of lobbyists' political orientation. A lobbyist is defined as a Democratic (Republican) party-leaning lobbyist if more than 75% of his/her lifetime political contribution (denominator = contributions to the Democratic party + contributions to the Republican party) between 1990-2020 are allocated to the Democratic (Republican) party.

Panel A: All lobbyists

	Democratic(t+1)	Republican(t+1)	Unclassified(t+1)
Democratic(t)	97.07%	0.22%	2.71%
Republican(t)	0.25%	96.11%	3.64%
Unclassified(t)	3.57%	2.94%	93.50%

Panel B: Lobbyists who lobbied for public firms

	Democratic(t+1)	Republican(t+1)	Unclassified(t+1)
Democratic(t)	96.82%	0.22%	2.96%
Republican(t)	0.21%	96.71%	3.09%
Unclassified(t)	3.51%	3.16%	93.33%