Supply Chain Linkages and the Extended Carbon Coalition

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Abstract

Which firms oppose action to fight climate change? Networks of input-sourcing and sales to downstream customers ought to propagate and reinforce opposition to carbon pricing beyond direct emitters of CO_2. To test this claim, we build the largest-ever dataset of public coalitions for and against climate action in the US, revealing that over 70% of producers' opposition to climate change comes from outside fossil fuel mining and utilities. We construct new measures of the carbon-intensity of firms and industries and show that intensity – whether direct, via carbon-intensive inputs, or through exposure to emitting customers – leads to increased public opposition to climate action. 60% of US lobbying on climate policy has been conducted by this extended coalition of firms, associations, and other groups that have publicly opposed reducing carbon emissions. Public opposition to climate action from carbon-connected industries is therefore broad-based, highly organized, and matched with extensive lobbying.

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Introduction

Anthropogenic emissions of carbon dioxide are the primary cause of global warming, and producers – firms and industries – account for most of these emissions. Current efforts to arrest climate change through the regulation and pricing of CO_2 and other greenhouse gases are insufficient to avoid dramatic negative consequences from global warming (UN Environment, 2018). Political compromise, resistance from key emitters, and policy setbacks continue to harm efforts to combat climate change. Global CO_2 emissions grew from 6.6 gigatons per year during the 1980s to 11.3 in 2017 (Le Quéré et al., 2018). Around 40-45% of CO_2 emissions in the industrial era have occurred since 1990, when the threat of climate change first became widely known.

A large literature explores the political activity of producers around climate policy. One strand of this work considers the fossil fuel industry's role in thwarting climate action in the US; a larger set examines the myriad reasons driving support for climate action among firms. Despite this volume of work, we identify and address three related gaps. First, the literature lacks a systematic theoretical account for how the costs of climate policy travel up and down the supply chain, spreading opposition to climate action beyond fossil fuel emitters. Second, accurate measures of carbon-intensity have rarely been matched to firms' supply networks or to data on attitudes towards climate policy. Third, the literature lacks a comprehensive account of the full scope of producers' public attitudes and collective political action around climate policy in the US.

We develop a theory of the distributive consequences of climate action focused on carbon-intensity: carbon dioxide emissions per dollar of output produced. Firms that intensively emit CO_2 are likely to suffer from efforts to price carbon. However, their customers may also bear some of the incidence of carbon taxation. Producers may therefore be exposed to carbon taxation via their input purchases. From the opposite direction, we expect that the suppliers of carbon-intensive industries face negative demand shocks from efforts to restrict carbon emissions, as their customers confront heightened costs and reduced profitability. In these ways, carbon intensity travels both forward and backward through the industrial supply chain, implicating a much larger set of interests in climate policy than just direct emitters.

We therefore expect that firms exposed to carbon taxation – whether through their own emissions or the emissions of their input suppliers or their downstream customers – will be more likely to oppose action on climate change. We test this hypothesis by examining two public forms of political behavior: the formation of climate policy-related *ad hoc* coalitions and lobbying. Because these modes of political engagement are costly, we expect that carbon-intensity will be particularly associated with public action opposed to carbon taxation among the largest firms, though we extend our analysis to industry associations, too.

We develop an original dataset of memberships in US *ad hoc* coalitions interested in climate policy. Our data describe 83 such coalitions operating from 1990 to the present with 13783 unique members.[1] These data are the most comprehensive of their kind, and respond to Brulle (2018)'s call for data on producers' preferences to complement extant sources of data on lobbying. We match these data to a key source on industrial CO_2 emissions as well as input-output tables, and find support for each of our main claims. We confirm our main findings using an instrumental variables approach to account for the endogenous component of emissions.

Using our data on emissions and preferences, we are also able to develop original findings on the role of climate opponents in lobbying which complement the extant literature. We show that carbon in the supply chain leads to individual lobbying on climate issues by firms just as much as it leads to collective organization. Consequently, nearly 60% of lobby expenditures on climate change in the United States over the past 20 years have been spent by firms above the 90th percentile in either direct, input, or downstream carbon-intensity. Even more striking, around 60% of lobbying on climate change has been done by firms or associations that have publicly opposed climate action.

Our findings therefore paint a rich picture of the breadth and depth of opposition to climate action among US producers. Motivated by the negative costs associated with decisive action to reduce carbon emissions, an expanded carbon coalition of firms and associations emerged in the 1990s and has continued to thrive. These firms directly emit carbon, purchase critical inputs from industries that emit carbon, and sell their products to industries that heavily emit. As such, their

[1] 10048 of them are firms and another 1316 are industry or peak associations.

reach extends well beyond the fossil fuel and electricity generation industries that are the focus of current scholarship. Most importantly, these firms and associations are politically active and organized. As individuals, they extensively lobby. They have also created a dense network of connections through collectively organized coalitions that have adapted and endured, despite fierce criticism of public opposition to climate action. Collectively, this carbon coalition accounts for a majority of lobby expenditures on climate change and a substantial minority of public advocacy.

Firms' responses to climate action

Firms and industries take positions on climate policy according in response to social factors, political pressures, and anticipated distributive consequences (Meckling, 2015). We review the scholarship on corporate positions on climate policy, and identify gaps in the extant literature.

Beginning with social context, support for climate policy has been traced to firms' workforce, structure, and history.[2] Corporate leaders may support climate policy out of a desire to demonstrate "corporate citizenship" (Nyberg, Spicer and Wright, 2013; Jones and Levy, 2007). Public spiritedness is stronger when firms have a decentralized organizational structure and when firms employ internal scientists (Kolk and Levy, 2001). Firms may promote climate policy when they have a history of success with climate-compatible alternative technologies and close relationships with government regulators (Levy and Rothenberg, 2002). The effect of a firm's physical location, and consequent exposure to climate hazards, is still a matter of debate, with findings both in support (Kennard, N.d.; Jones and Levy, 2007) and against (Paul, Lang and Baumgartner, 2017) the claim that where a firm places its operations affects climate policy positions.

Social forces outside of the firm also affect how firms approach climate policy. Public backlash from environmental interest groups may pose a threat to brand integrity or political and cultural capital (Cheon and Urpelainen, 2013; Markussen and Svendsen, 2005). Firms are also likely to consider the positions of other firms in their industry, since their own reputation is tied to how

[2] See Delmas, Lim and Nairn-Birch (2016), Hillman, Keim and Schuler (2004), Barnett (2006), and Hansen, Mitchell and Drope (2005).

the industry as a whole is viewed (Barnett and Hoffman, 2008). It also seems likely that firms take different positions on climate policy if they sell their products primarily to other firms or to individual consumers, since accusations of socially irresponsible policy positions are likely to be more threatening for consumer-facing firms.

A second class of determinants relates to the political and institutional context in which a firm operates. If corporate leaders see certain climate policy developments as inevitable, they are likely to be proactive in shaping the policy in their favor.[3] This is especially the case when firms have the resources, expertise, and access to be successful in their lobbying efforts.[4] In contrast, firms are likely to withhold their support for climate change mitigation if they believe it will not effectively reduce emissions or their operations do not stand to be affected one way or the other (Meckling, 2015). Multinational firms face an additional institutional consideration, that of regulatory harmonization. These firms may seek consistent regulations across the jurisdictions in which they operate to minimize compliance costs and maintain their global reputation (Levy and Kolk, 2002; Levy and Rothenberg, 2002).

A third set of determinants center on the distributional consequences of climate policy. Firms are likely to oppose climate policies when they are in industries that emit large quantities of greenhouse gases, since they anticipate bearing greater mitigation costs.[5] But not all high-emitting firms or industries will react in the same manner to climate regulation (Downie, 2017). A firm may prefer a policy that imposes moderate costs to forestall costlier alternatives (Delmas, Lim and Nairn-Birch, 2016). Firms may also believe that they are better or worse positioned than their rivals to make their business practices climate-compatible (Okereke and Russel, 2010; Paul, Lang and Baumgartner, 2017; Meng and Rode, 2019). Firms that compete on the global market are more likely to oppose climate action (Martin and Rice, 2010).

[3] See Bumpus (2015), Okereke and Russel (2010), Kolk and Levy (2001), Hale (2011).

[4] See Pinkse and Kolk (2007),Layzer (2007), and Hillman, Keim and Schuler (2004).

[5] See also: Markussen and Svendsen (2005), Cho, Patten and Roberts (2006), Martin and Rice (2010), Cheon and Urpelainen (2013), and Kim, Urpelainen and Yang (2016). The employees of firms in high-emission sectors are also more likely to oppose climate policies Bechtel, Genovese and Scheve (2019).

Surveying this literature suggests distinct gaps in the study of corporate positions on climate mitigation policy. We address a first gap by providing a systematic theoretical account of how policy actions to slow climate change create costs that travel up and down the supply chain, which in turn motivate firms to both adopt a policy position and engage with the political process. While supply chains have been linked to corporate political behavior in other domains,[6] we know of only two other papers that assess the influence of supply chains on firm behavior with respect to climate policy. These both use the emissions intensity of electricity as an input to explain the likelihood of a subset of firms to lobby on climate policy (Kim, Urpelainen and Yang, 2016) and to oppose or support the 2010 Waxman-Markey bill (Kennard, N.d.).

We address a second gap in the literature by exploiting available data on carbon intensity at the industry level matched to comprehensive data on the input mixes and downstream customers of industries. Existing work has described the relationship between direct carbon intensity and lobbying, but rarely includes the positions that firms take.[7] The few analyses that do include positions rely on incomplete estimates of carbon intensity.

We address a third gap by compiling a comprehensive dataset of firms' and trade associations' policy engagement on and positions toward climate mitigation policy proposals in the US from 1990 to the present. Some work assumes firms and industries held particular positions (e.g., Cheon and Urpelainen, 2013); some data on preferences are anecdotal (Kolk, 2008) or cover a subset of industries (Meckling, 2015), a specific policy proposal (Kennard, N.d.), or a short period of time (Kang, 2015). Our broader data collection effort allows us not only to observe the balance of firms in support or opposition to climate policy over the long run, but also to see the nexus between lobbying and public political advocacy.

[6] In trade politics, see Meckling and Hughes (2017); Osgood (2018); Kim et al. (2018); Zeng, Sebold and Lu (2018).

[7] See Böhringer and Alexeeva-Talebi (2013); Jenkins (2014); Paul, Lang and Baumgartner (2017); Delmas, Lim and Nairn-Birch (2016); and Brulle (2018).

Carbon dioxide emissions and climate policy

Greenhouse gases reduce the atmosphere's radiation of heat energy into space and so contribute to global warming. Greenhouse gases are the most important human-controlled factor contributing to climate change, though aerosol emissions play an important secondary role (Hansen et al., 2011). In 2016, carbon dioxide (CO_2) accounted for 81% of US greenhouse gas emissions, while methane, nitrous oxide, and flourinated gases accounted for the remaining 10%, 6% and 3%, respectively.[8] CO_2 emissions therefore account for the major part of anthropogenic climate change.

In the United States in 2006, 30.4% of human-caused CO_2 emissions were generated by energy use and other emissions from households and 4.8% from government entities.[9] The remaining 64.8% were created by industries, most prominently manufacturing (25.0%) and and transportation (15.1%). These numbers are illustrated across key sectors of the economy in Figure 1; note that emissions from utilities are assigned to utility-consuming end-users. These sectors differ dramatically in the *intensity* of carbon emissions, which is the ratio of emissions generated to the value of the output produced by a given industry or sector. CO_2 intensity is measured here in millions of metric tons per billion dollars of real gross output using constant 2007 dollars, abbreviated $MmtCO_2$/b.$. Transport, mining, and intermediate manufacturing (which includes wood products, chemicals, plastics, and cement manufacturing) are the most carbon-intensive.

These sectoral averages mask considerable heterogeneity in carbon intensity within sectors. As an example, Lime manufacturing (NAICS Code 327410) has a measured carbon intensity of 21.8 $MmtCO_2$/b.$ in 2006, the highest in our data among manufacturers. Abrasive product manufacturing (NAICS Code 327910) has an intensity of only .15. Figure 1 provides a mean-normalized measure of the variation in carbon-intensity within sectors, illustrating the great variation of carbon intensity in the manufacturing and transport industries.Overall, carbon-intensity is highly heterogeneous and right-skewed across US industries, with a median of .123, a mean of .430 and a standard deviation of 2.49.

[8] These figures are provided from https://www.epa.gov/ghgemissions.

[9] These data are taken from Henry, Khan and Cooke-Hull (2010).

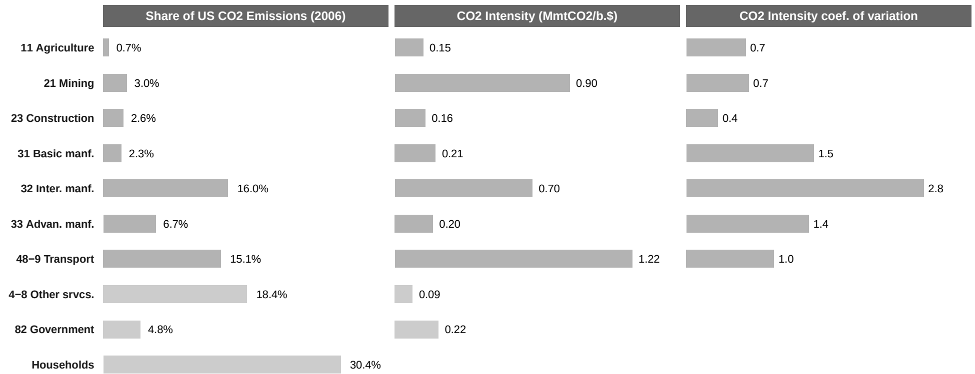

Figure 1: CO_2 emissions and intensities across US sectors [goods+ sectors in dark gray; utilities (22) emissions allocated to consuming industries].

Figure 2 provides running examples of US industries (organized at the 6-digit NAICS level) and the intensity of their CO_2 emissions. To illustrate, we focus on the industries in the center of the implied supply chain. Phosphate rock mining generates roughly 4 million metric tons of CO_2 for every billions dollar in revenue produced. Note that this is a measure of only the 'direct' CO_2 emissions of the phosphate rock mining industry, that is, emissions that they generate in the course of mining phosphate rocks and not, for example, through the purchase from, or sale to, emitting industries. Cement manufacturing is also carbon-intensive, generating around 11 $MmtCO_2$/b.$.

Because carbon dioxide is by far the largest manmade contributor to climate change, any credible effort to mitigate climate change must reduce carbon emissions. This may be achieved by putting a price on carbon though a cap on carbon emissions (paired with trading) or an emissions tax/fee, for example. Technology standards may also be employed. Any of these approaches will impose additional costs on direct emitters of carbon dioxide, and so acts like a tax whose statutory burden is likely to fall most heavily on the direct emitters of carbon dioxide. In particular, carbon intensity is likely to be the most relevant metric for the statutory burden of any policy that raises the price of carbon. For example, the non-transportation services industries account for a significant share of total US CO_2 emissions (18.4%) but also a vast share of the US economy. As such, the impact of a carbon tax on their bottom line is likely to be quite modest. In contrast, carbon-intensive industries like phosphate rock mining, cement manufacturing, and fossil fuel electricity

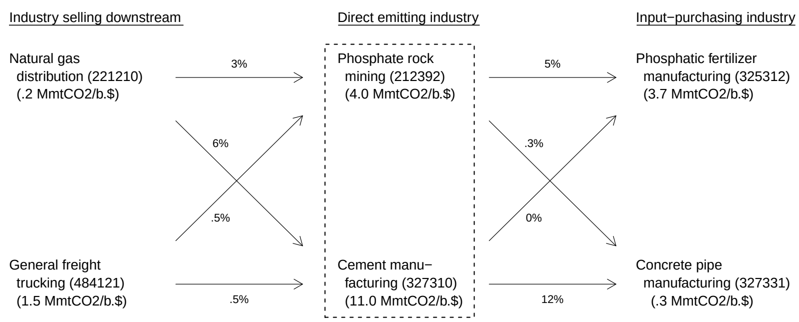

Figure 2: Illustrating the carbon supply chain.

generation are likely to face a large bill from efforts to put a price on carbon.

These are general statements, and three important caveats are in order. First, the design and implementation of policies shape their distributive effects. Technical decisions about the measurement of emissions totals and intensities will impact the burden of a tax, as could decisions about activities/technologies to include or exclude. As a corollary, political power will affect the design and implementation of carbon policies. Industries may carve out exceptions from regulation, or secure favorable treatment in the distribution of carbon credits. Industries may also secure countervailing tax breaks, subsidies, or other preferential treatment that compensate for losses generated by reductions in carbon emissions (Bayer, Marcoux and Urpelainen, 2013).

Second, the capacity to reduce carbon-intensity may vary across firms and industries. An industry that is carbon-intensive *ex ante* carbon pricing may have easy access to substitute technologies or energy sources that emit far less carbon. A higher price on carbon can therefore be avoided with minimal pain. Other industries may lack such substitutes and so will have to adjust to a world of higher taxes, or pay a large bill to identify and invest in new technologies which emit less carbon.

Third, and most importantly, the statutory burden of a tax is not the same as the economic burden of the tax. As carbon taxes raise carbon-intensive producers' costs, they are likely to lower the profits of these firms. In response, some firms will be able to raise their prices, passing some of the incidence of the new tax onto their customers. Firms are usually not able to raise their prices to completely cover the costs imposed by new taxes because consumption will fall too sharply, but most firms can raise prices somewhat, effectively sharing the costs of the tax between themselves and their customers. We now develop this point further.

Carbon emissions, up and down the supply chain

Carbon-intensity of input suppliers For the reasons just described, the consumers of carbon-intensive products can be hurt by a carbon tax as well as the producers of those products. Put simply, the prices of carbon-intensive products are likely to grow as the price of carbon grows. Some of these costs will be borne by ordinary individual consumers, but many of the customers of carbon-intensive products are not individuals, but firms, industries, farmers, and other *producers*. Indeed, indirect exposure via consumption of carbon-intensive inputs may be a far greater concern for industries than exposure through their own inputs. In this way, the costs of a carbon tax may be spread beyond the small set of highly carbon-intensive industries.

To see this idea illustrated, consider again Figure 2, although this time we will look at two downstream industries that are supplied by phosphate rock mining companies and cement manufacturers. Phosphatic fertilizer production is itself carbon-intensive, but also relies very heavily on a carbon-intensive industry: phosphate rock mining. Manufacturers of fertilizer are therefore doubly exposed to a carbon tax, from whatever incidence of the tax falls on their own manufacturing's direct emissions, and through their consumption of phosphate rock, which will likely be more expensive once the price of carbon increases. Concrete pipe manufacturing is an even more dramatic case, suffering little direct exposure to a carbon tax but significant indirect exposure due to its reliance on cement. In sum, industries that rely heavily on carbon-intensive inputs are likely to have to pay higher costs if the price of carbon dioxide goes up. In this way, opposition to a carbon tax can propagate forward through the supply chain, as heavy consumers of carbon-intensive products face higher input bills when carbon becomes priced.

Carbon-intensity of downstream customers Effective efforts to price carbon will force carbon-intensive industries to contract and to cut input costs and consumption. Reduced sales and increasing price pressures will therefore negatively impact the industries that supply these carbon-intensive customers. Industries that heavily rely on selling their products to carbon-intensive customers are therefore likely to face a significant demand shock associated with increased carbon prices or caps on carbon emissions.

This idea is illustrated in the left and middle of Figure 2. Natural gas distributors account for 3% of the costs in Phosphate rock mining and 6% of the costs in cement manufacturing. Because these are big industries – particularly cement manufacturing – an effective carbon tax could significantly dent demand for natural gas. Similarly, freight trucking could also be harmed by a carbon tax that shrunk these industries, because two important costumers would be facing negative shocks to costs at the same time. In sum, industries that rely heavily on selling their products to downstream carbon-intensive industries are likely to face negative shocks to demand if the price of carbon goes up. In this way, opposition to a carbon tax can propagate backward through the supply chain, as heavy sellers of inputs to carbon-intensive producers face reduced demand for their products as their customers are weakened.

Carbon lobbying, inside and out

How will firms and industries likely to be negatively affected by carbon pricing – whether directly or through their purchases from or supply of carbon-intensive industries – seek to make their preferences on climate policy heard? The first question facing firms is whether to engage actively or remain passive in the policy process (Pinkse and Kolk, 2007). Firms that decide to engage can choose among a variety of mechanisms to convey policy preferences (Meckling, 2015; Downie, 2017): formal meetings with policymakers ('inside' lobbying); the formation of issue coalitions that engage in public or private advocacy ('outside' lobbying); membership in government-formed committees designed to inform policy makers; testimony before Congress; and participation in notice and comment. We focus on the first two of these approaches, especially outside lobbying.

Formal or 'inside' lobbying occurs where interest groups seek to meet directly with policymakers to shape legislation or regulation. It is highly regulated and subject to disclosure requirements under the Lobbying Disclosure Act of 1995. The identities of lobbying groups, their issues of interest, and the volume of their lobbying activities are directly observable from lobby disclosure reports.

Lobby disclosure rules do not require a firm or corporation to describe in detail the content of their lobbying, in particular, whether they lobbied in favor of or against some particular rule or piece of legislation. Positions are unknown absent further information.

'Outside' lobbying is the creation of interest groups, coalitions, or other groups in order to signal to policy makers and potential allies the importance of an issue to that group (Kollman, 1998). Among firms and industries, outside lobbying often takes the form of *ad hoc* or issue-specific coalitions designed to push a particular position in one policy domain or on one piece of legislation. These groups are often of short duration, but are not necessarily so. Indeed, environmental politics in the United States often sees the creation of longer-term organizations which are still *ad hoc* coalitions in that they cover only one policy domain and span many industries. These longer-term organizations provide more informational and political resources, but require more sustained engagement (Hula, 1995; Mahoney, 2007).

Like inside lobbying, outside lobbying is a costly exercise of political influence – groups don't organize or fund themselves, and memberships are often priced – which reveals a meaningful stake in an issue. Data on outside lobbying is not as rich as data on lobbying. For example, it lacks full disclosure on expenditures. The universe of 'outside' lobbying is also not as clearly defined as with 'inside' lobbying. This form of political activity has a crucial advantage however: firms and associations reveal their *positions* on particular issues through their membership in *ad hoc* coalitions with particular positions. For this reason, we focus on membership in *ad hoc* coalitions that have opposed (or favored) policies to reduce carbon emissions or tackle climate change as our primary outcome, and then consider secondarily lobbying on climate change issues.

As a first cut, we then expect that firms (and industries) which face more negative exposure to carbon-pricing will be more likely to join coalitions that are opposed to action to abate climate change. The literature on political action has long noted that larger firms tend to be more politically active than smaller firms. This may be for several reasons: small firms free ride on the efforts of large firms; large firms have more free capital and staff to invest in political efforts; or, large firms are more able to pay fixed costs associated with political action. We therefore introduce the moderating impact of firm size into our initial predictions:

Hypothesis 1. Firms (and associations) that are more exposed to an increase in carbon prices – whether directly via their carbon-intensity, or via their input mix or sales to downstream customers – are more likely to join public coalitions opposed to action on climate change. This should be especially so for larger firms.

Following Brulle (2018), we expect a similar relationship to hold for 'inside lobbying' although we highlight that the argument requires one more theoretical piece. Suppose that the average carbon-intensive firms faces just as significant negative effects from climate action as the average carbon-non-intensive firms faces benefits from climate action. Given this symmetry, we would not expect carbon-intensive firms to be more likely to lobby. Rather we would predict parity between carbon-intensive and non-carbon-intensive firms in lobbying over climate policy, and would be forced to look to data on public positions of firms to understand the effects of carbon intensity.

This set of distributive consequences is unlikely to hold, however. Carbon-intensive firms face significant costs associated with pricing carbon, while many (perhaps most) non-carbon-intensive firms face few real benefits from action to abate climate change. Instead, pockets of strong support for climate change action are likely to be concentrated in particular 'green' industries – alternative forms of energy; non-emitting modes of transportation and construction; environmental consulting and other climate adjustment services. As such, we expect that carbon-intensive industries will be more likely to lobby on climate change policy than non-carbon-intensive industries, and we leave the detailed identification of carbon pricing's supporters to future work.

Hypothesis 2. Firms (and associations) which are more exposed to an increase in carbon prices are more likely to lobby on climate change, especially firms that are large.

Data

Coalitions and lobbying

Ad hoc coalitions are a highly regular feature of environmental politics among producers in the US. To provide two examples, "We Are Still In" is a coalition of over 2900 firms, government agencies, and NGOs which formed to protest the Trump Administration's withdrawal from the

Paris Agreement; "Americans for Balanced Energy Choices" is a coalition of only 27 firms and trade associations that operated from 2000-8, and advocated against action to curtail fossil fuel consumption to abate climate change. We seek to explain why US firms have joined *ad hoc* coalitions opposed to action to address climate change over the past several decades.

To do so, we identify all coalitions that have organized to engage in 'outside lobbying' on climate change over that time span. We consider only coalitions that include at least some membership from American firms or their trade associations. We focus on coalitions that concentrate on climate change as an issue (potentially among others) or are focused on broader environmental issues (energy efficiency, sustainability, energy prices) that are closely tied to climate policy. We have identified 60 such coalitions, which are shown in Table 1 and described in the appendix.

These coalitions differ on many dimensions. Some are focused on climate change; others treat it as one of many interests. A few focus on highly specific aspects of climate policy, like carbon offsets, coal energy, nuclear power, or distributed generation. We see relative balance across positions toward action to slow or stop climate change: 31 of our coalitions took a position strongly in favor of action; 23 have strongly opposed action to halt climate change. A further 12, 7, and 10 have weakly favored, weakly opposed, or been apparently neutral on climate advocacy.[10] Some of our coalitions have existed for decades, others just recently formed or disbanded a few years after forming. Some feature only businesses, others include trade associations, peak associations, NGOs, government entities, inter-governmental organizations (IGOs), and other coalitions. Despite these differences, our view is that systematic patterns in climate preferences and activity can be uncovered by combining these disparate sources.

Overall, we find 13783 unique members that have joined these coalitions and a total of 17776 memberships (because some actors join multiple groups). The modal member (11560 of 13783) has joined only one ad hoc coalition; Duke Energy, an electic utility based in Charlotte, North Carolina has joined 21 coalitions, the most in the data. 10048 of the organizations that have joined coalitions are firms, 764 are trade associations, and 552 are peak associations. We combine our codings of

[10]See appendix A.

Table 1: Climate and climate-related coalitions and lobbying

		Number of:					Number of:		
	Years	Members	Firms	Assocs.		Years	Members	Firms	Assocs.
Coalitions that supported action on climate change:					We Are Still In	2017-	2948	2265	11
Advanced Energy Economy	2012-	189	188	0	We Can Lead	2008-2010	185	181	2
Advanced Energy Management Alliance	2014-	30	28	2	We Mean Business	2014-	1167	1080	8
Alliance for Climate Strategies	2003-2008	15	0	15	World Business Council for Sust. Dev.	2003-	343	343	0
Alliance to Save Energy	1977-	329	221	50	Coalitions that opposed action on climate change:				
American Business for Clean Energy	2010-	132	130	1	Alliance for Energy and Economic Growth	2001-2005	1358	604	706
Am. Col. and Univ. Pres.' Climate Commitment	2009-2015	756	756	0	American Coalition for Clean Coal Energy	2008-	49	44	4
American Council for an Energy-Efficient Economy	1980-	103	82	8	Americans for Affordable Climate Policy	2008-2010	5	5	0
American Council on Renewable Energy	2006-	895	763	36	Americans for Balanced Energy Choices	2000-2008	27	23	4
American Sustainable Business Council	2012-	373	248	45	Balanced Energy Arkansas	2013-	11	7	2
Apollo Alliance	2003-2010	200	91	5	Balanced Energy for Texas	2011-2017	16	14	1
Building Decarbonization Council	2018-	83	48	2	Carbon Utilization Research Council	1998-	119	83	13
Business Council for Sustainable Energy	1999-	84	55	20	Center for Energy and Economic Development	1992-2008	201	143	41
Business Council on Climate Change	2008-	21	19	0	Center for North American Energy Security	2007-	6	4	2
Business Environmental Leadership Council	1998-	77	76	1	Coalition for Affordable and Reliable Energy	2001-2009	63	4	43
Business for Innovative Climate and Energy Policy	2009-	49	48	1	Coalition for American Jobs	2011-2013	6	0	5
California Business Alliance for a Clean Economy	2014-	1368	1304	27	Coalition for Vehicle Choice	1990-2003	148	36	85
Carbon Pricing Leadership Council	2015-	274	171	7	Consumer Energy Alliance	2005-	383	156	166
Ceres	1989-	848	649	5	Cooler Heads Coalition	1998-	45	0	3
Climate Action Business Association	2014-	125	123	1	Domestic Energy Producers Alliance	2011-	33	0	29
Climate and Clean Air Coalition	2015-	226	39	10	Electric Reliability Coordinating Council	2001-	11	11	0
Climate Leadership Council	2017-	33	20	1	Energy Institute of Alabama	2016-	24	14	8
Climate Markets and Investment Association	2017-	19	18	0	Global Climate Coalition	1989-2001	116	70	40
Coalition for Emission Reduction Projects	2009-2011	23	23	0	Informed Citizens for the Environment	1990-1992	8	5	3
Connecticut Sustainable Business Council	2016-	22	15	1	Midwest Ozone Group	1998-	47	37	6
Corporate Climate Alliance	2018-	11	11	0	NextGen Energy Council	2006-2008	12	10	0
Global Alliance for Energy Productivity	2015-	224	166	15	Partnership for a Better Energy Future	2014-	179	3	162
Global Investor Coalition on Climate Change	2009-	731	587	0	Partnership for Affordable Clean Energy	2011-	22	1	14
International Climate Change Partnership	1996-2014	47	35	9	Pennsylvania Coal Alliance	2013-	201	199	1
Interwest Energy Alliance	2008-2018	66	51	2	Utility Air Regulatory Group	1997-2019	58	54	3
Iowa Sustainable Business Alliance	2012-	13	13	0	West Virginia Coal Association Friends of Coal	2002-	388	387	0
Midwest Energy Efficiency Alliance	2001-	346	251	12	Wisconsin Industrial Energy Group	1973-	27	27	0
New Jersey Sustainable Business Council	2018-	27	17	1	Coalitions that were publicly neutral on climate change action:				
North American Climate Smart Agriculture Alliance	2018-	68	13	32	Alliance for Industrial Efficiency	2016-	22	11	4
Northeast Energy Efficiency Partnerships	1996-	128	94	6	Energy2030	2013-	138	93	15
Northwest Energy Coalition	1997-	223	40	9	New Jersey Energy Coalition	2007-	129	98	9
Oil and Gas Climate Initiative	2014-	15	15	0	Northwest Energy Efficiency Alliance	2010-2019	22	14	0
Second Nature	1993-	126	66	4	South Central Partnership for Energy Effciency	2011-	77	59	5
Sustainable Business Network of Massachusetts	1988-	74	69	1	Southeast Energy Efficiency Alliance	2007-	149	109	10
Sustainable Energy Coalition	2002-2019	45	10	13	Southwest Energy Efficiency Project	2001-	128	66	11
Sustainable Silicon Valley	2000-	46	24	0	Western Business Roundtable	2001-2009	57	49	6
The Climate Group	2004-	227	114	0	Summary figures:				
United States Climate Action Partnership	2006-2013	38	31	0	Total coalition members (unique)		13783	10048	1316
University Climate Change Coalition	2018-	19	18	0	Total lobbying groups (unique)		2173	1182	458
Utah Clean Energy	2001-	100	81	0	Total lobbied or joined coalition		15132	10702	1608

the coalition's orientation towards climate action with the membership data to define the set of all firms that have joined a pro- or anti-climate action coalition.

We illustrate the distribution of opposition to climate action across industries in Figure 3. For each firm in our data, we allocate its 6-digit NAICS industries proportionally across the right side of the figure. For example, a firm with two industries contributes .5 to each of those industries' bars in the graph. The left side of the figure does the same thing for industry associations. We find predictably high densities of opposition in mining and utilities, but also evidence of an extended carbon coalition in intermediate and advanced manufactures; construction; and transportation.

Because the extent of opposition outside of fossil fuels and other greenhouse gas-emitting industries is a key descriptive finding, and also motivates our theory, we quantify this feature of the data by asking: What percentage of firms and associations opposing climate action fall outside of the top-20% most CO_2-emitting industries? We find that 73% of firms and 55% of associations that opposed climate action fall outside of the most-emitting industries. How many opposing firms have at least some business activity in a fossil fuel industry?[11] 79% of opposing firms have no participation in these industries. Among associations, 72% have no activity in the main fossil fuel industries. This reinforces the point that there is a need to understand the determinants of opposition to climate action among firms and industries that are not themselves significant direct emitters.

We supplement our data on 'outside' lobbying through coalitions with data on ordinary 'inside' lobbying on climate change. To do so, we use data from the Center for Responsive Politics on lobbying around climate change issues. To identify lobbying about climate change, we use a series of key words and bills for our queries.[12] We use these data to round out the description of firms

[11] Defined here as: oil and gas and coal mining or their support activities; fossil fuel electric power generation and any distribution of electric power or of natural gas; and petroleum refineries.

[12] The key words in the specific issue field are "climate", "Paris agreement", "global warming", "Kyoto", "greenhouse gas", "clean power plan", "carbon emission", and "clean energy". We also examine lobbying on three specific climate bill clusters: the American Clean Energy and Security Act; a cluster of contemporaneous alternatives from the Senate; and the Climate Stewardship Acts of 2003-8. We consider any firm,

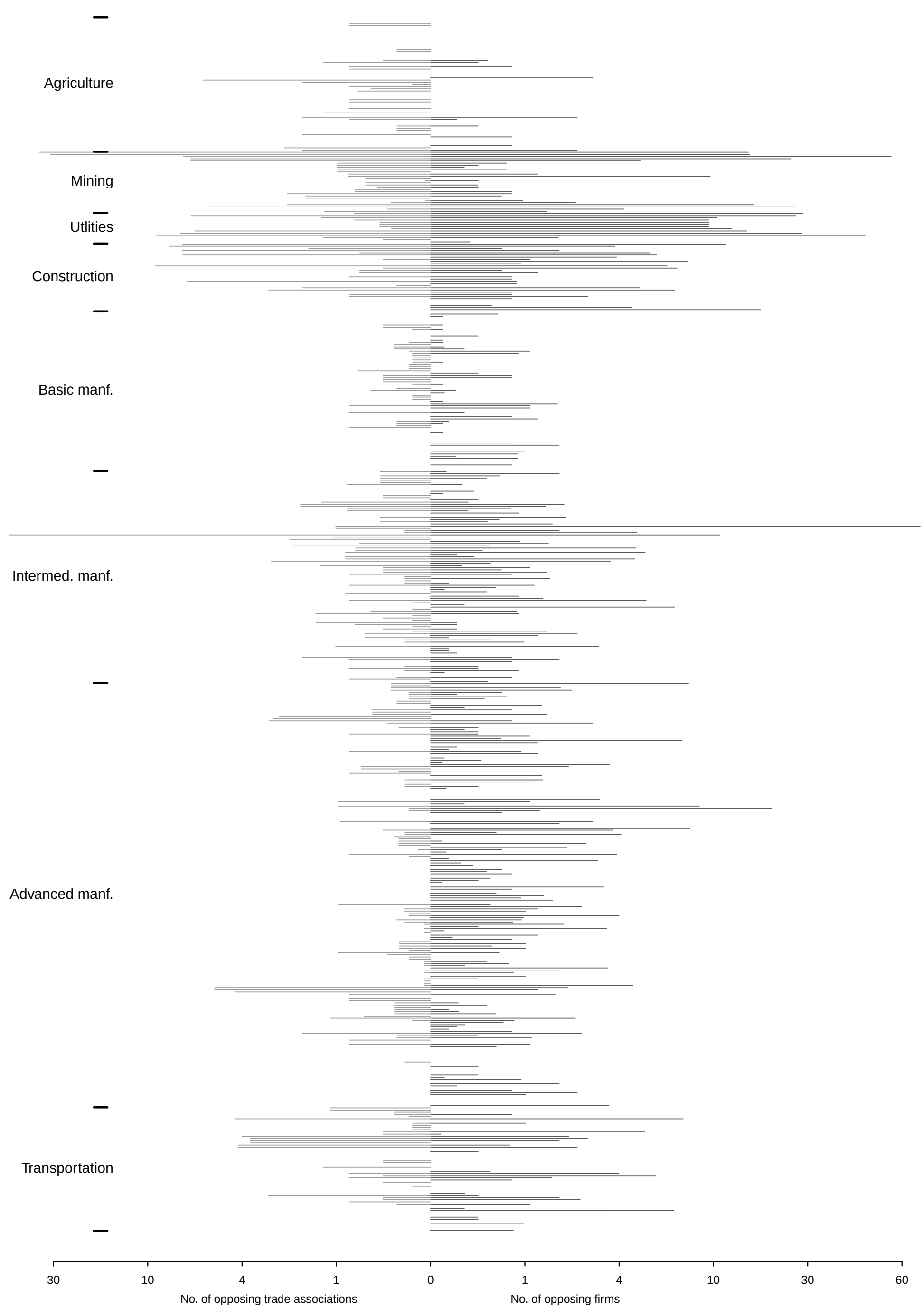

Figure 3: The spectrum of opposition to climate action across US industries.

(and others) that are politically active on climate issues. Overall we identify 2173 groups that lobbied on climate issues, 824 of whom also joined climate coalitions. Among firms, 1182 lobbied on climate issues, 528 of whom joined climate coalitions.

Data on carbon intensity through the supply chain

Henry, Khan and Cooke-Hull (2010) provides estimates of the direct carbon-intensity of US industries for the years 1998, 2002, and 2006. These industries are organized using Inforum's Iliad nomenclature, which is closely related to the industries used in the Bureau of Economic Analysis' input-output tables. Disaggregated estimates of carbon-intensity are available across agriculture, mining, construction, manufacturing and transportation.[13] The remaining sectors are aggregated together at roughly the 2-digit NAICS level, precluding the examination of inter-industry variation in carbon intensity. For this reason, we consider only the sectors mentioned above in our analysis (along with utilities) which we refer to as 'goods+'. We map carbon-intensity using Inforum's industry classification to 6-digit NAICS 2012 industries and call the resulting variable CO_2 intensity_i (where i represents a 2012 NAICS industry) which is measured in $MmtCO_2$/b.\$ as above.

In order to measure the exposure of firms and associations to higher carbon prices through their supply chain, we begin with the Bureau of Economic Analysis's benchmark Input-Output "Direct Requirement Detail" table from 2002.[14] We convert the table into a matrix defined using 2012 6-digit NAICS nomenclature. The resultant matrix $\mathbf{IO}$ is 1019×1019, with each row providing an input and each column providing an output. $\mathbf{IO}_{kl} \leq 1$ is the total value of input k that goes into producing a dollar of output l. We set $\mathbf{IO}_{kk} = 0$ in all calculations so that own-industry value added is not considered part of the input mix.

Using this matrix, we then define a measure of exposure to carbon-intensive inputs for industry

association or other actor that lobbied on one of these approaches as having lobbied on climate policy.

[13]Emissions from utilities (e.g. electricity and natural gas) are allocated to consuming industries. We use estimates of carbon intensity for utilities from the EPA's Greenhouse Gas Reporting Program in separate models in the appendix.

[14]https://www.bea.gov/industry/benchmark-input-output-data#2002data.

i, which we call Inputs CO_2 intensity$_i$. This is given by:

$$\text{Inputs CO}_2\text{ intensity}_i = \sum_k \mathbf{IO}_{ki} \cdot \text{CO}_2\text{ intensity}_k.$$

This measure is effectively a weighted average of carbon-intensity of all input-supplying industries, weighted by the extent to which they contribute to a dollar of industry i's output. Looking at the four-digit NAICS level, the industries with the highest average Input CO_2 intensity are: cement and concrete product manufacturing (3273); other nonmetallic mineral products (3279); resin, rubber, and synthetic filaments (3252); and lime and gypsum product manufacturing (3274).

We also define a measure of the exposure of input-supplying industries to carbon-intensive customers, which we call Downstream CO_2 intensity$_i$. Due to the structure of input-output tables, our definition for this variable is more complicated although it is analogous:

$$\text{Downstream CO}_2\text{ intensity}_i = \frac{\sum_k \mathbf{IO}_{ik} \cdot \text{Sales}_k \cdot \text{CO}_2\text{ intensity}_k}{\sum_k \mathbf{IO}_{ik} \cdot \text{Sales}_k}.$$

This variable is a weighted average of carbon-intensity of all downstream industries supplied by an input producer, weighted by the extent to which those downstream industries are a share of total sales. Looking at the four-digit NAICS level, the industries with the highest average Downstream CO_2 intensity are: ship and boat building (3366); support activities for mining (2131); apparel knitting mills (3151); and nonmetallic mineral quarrying (2123).

Sample and empirical strategy

We wish to examine the impact of firms' carbon-intensity on their opposition to climate action, as manifested by joining an *ad hoc* coalition opposed to climate action over the past two decades. Because we do not have usable variation over time in carbon-intensity (which is measured in 1998, 2002, and 2006 only), we employ the firm as the unit of analysis.

Our representative sample of firms is somewhat complicated, so we describe our process in detail. We begin with all of the groups that have undertaken climate-related political activity in the United States, whether joining coalitions or lobbying (these are 15159). We remove all non-firms, leaving 10703 politically active firms. 459 of these firms could not be matched to NAICS industries, and 6673 of them fall outside of the goods+ industries described above, leaving 3571 firms.[15] Of these, 2758 are US firms. Since we have the population of politically active, American, goods+ firms, we give each of these firms a weight of 1.

Our analysis requires that we sample politically inactive firms. To do so, we undertake a stratified sample of US firms from the Orbis database sampling 100000 firms each of sizes small or medium/large/very large, from both goods industries (agriculture, mining, and manufacturing) and the relevant services industries (utilities, construction, transportation) where intra-industry variation in carbon intensity is available. Our resulting random sample of goods+ firms is 400000, but we remove from this sample any firms that already appear in the population of politically active firms (leaving 399542 randomly sampled politically inactive firms). Sampling weights are based on the true distribution of weights in the Orbis population. Our total sample is therefore 399542 + 2050 = 401592 firms, of whom we lose 41 due to missing data in covariates. Finally, we analyze utilities separate from the other goods+ industries (which are examined as a whole) because utilities' emissions are allocated to energy consumers. The sample size for our main models is therefore 397818 firms, while among utilities our sample size is 3733.

Our main outcome variable is Opposed_f, which equals 1 if firm f has joined at least one coalition strongly or weakly opposed to climate action. Although this outcome is dichotomous, we use linear models so that we may incorporate fixed effects.

We map our industry-based measure of carbon-intensity to firms by using the 2012 NAICS codes of firms supplied by Orbis.We average industry-level variables over all NAICS codes to provide a firm-level estimate of carbon-intensity. For example, CO_2 intensity_f would be equal to the average CO_2 intensity_i for all industries in which f is coded as belonging. The median firm in our data has only one 6-digit industry, and the average firm has 1.87. Note furthermore that we average CO_2 intensity_i over the three years (1998, 2002, 2006) in which data are available.

We draw on Orbis for several firm-level covariates. We measure the size of firms using a four-

[15]The remaining services sectors see substantial participation by firms in wholesale and retail trade (812 firms); finance including pension and investment funds (978); professional services like environmental consulting, architecture, and programming (1878); and education including universities (913).

level measure that ranges from small, medium, large and very large. This is the only measure of firm size that is available for private firms. We collapse the categories large and very large into a dummy variable called Large to facilitate ease of interpretation for our interaction terms. We also gather from Orbis: a variable on whether a firm or its parent owns any foreign subsidiaries ('Multinational'); is currently public ('Listed') or formerly public ('Delisted') as of 2018; and, whether the firm is a subsidiary of a US or of a non-US firm ('Sub. of US parent'; 'Sub. of foreign parent'). Each of these factors might shape motivations to publicly engage in climate politics. In order to investigate whether industries that were willing and able to lower their carbon intensities from 1998-2006 are less likely to oppose climate action, we also control for the averaged change in carbon intensity between 1998 and 2002, and 2002 and 2006. We call this variable 'Δ CO_2 intensity'.

Our primary models of the decision to oppose climate action are variations of the following:

$$\begin{aligned} \text{Oppose}_f \;=\; & \beta_1 \cdot \ln \text{CO}_2 \text{ Intensity}_f + \beta_2 \cdot \ln \text{CO}_2 \text{ Intensity}_f \cdot \text{Large}_f \;+ \\ & \beta_3 \cdot \ln \text{Inputs CO}_2 \text{ Int.}_f + \beta_4 \cdot \ln \text{Inputs CO}_2 \text{ Int.}_f \cdot \text{Large}_f \;+ \\ & \beta_5 \cdot \ln \text{Down. CO}_2 \text{ Int.}_f + \beta_6 \cdot \ln \text{Down CO}_2 \text{ Int.}_f \cdot \text{Large}_f \;+ \\ & \beta_7 \cdot \text{Large}_f \;+\; \gamma_1 \cdot \Delta \text{ CO}_2 \text{ Intensity}_f \;+\; \gamma_2 \cdot \text{Multinational}_f \;+\; \gamma_3 \cdot \text{Listed}_f \;+ \\ & \gamma_4 \cdot \text{Delisted}_f \;+\; \gamma_5 \cdot \text{Sub. of US parent}_f \;+\; \gamma_6 \cdot \text{Sub. of foreign parent}_f \;+\; \mu_s \;+\; \epsilon_f. \end{aligned}$$

where μ_s refers to sectoral fixed effects at the two-digit NAICS level. We examine fixed effects at the four-digit NAICS level in robustness checks. We investigate subsets of this model, in addition, because some of the interaction terms are quite correlated.

Endogeneity of carbon intensity and IV approach A primary shortcoming in assessing the effects of carbon-intensity on opposition to climate action is that our measures of carbon intensity are driven by both the exogenous technological features of particular industries and the endogenous choices of firms. As a simple illustration of this, suppose that for idiosyncratic reasons firms in some industries have an interest in reducing their carbon footprint and contributing to efforts to mitigate climatic change. This interest might lead them to both invest in reducing CO_2 emissions and to refrain from public opposition to climate action. These choices would then lead to a positive correlation between CO_2 intensity and opposition to climate action, but in contrast with our preferred explanation, this relationship has attitudes driving intensity rather than intensity driving attitudes.

To eliminate this undesired reciprocal causation, we develop an instrumental variable strategy. We conceptualize carbon intensity as being driven by: essentially exogenous technological features of industries; idiosyncratic industry-specific tastes for climate action; and, industry- and country-level expectations about policy change. To instrument for the carbon-intensity of US industries, we employ the most disaggregated available measure of the carbon intensity of industries in the European Union.[16] On one hand, we expect that the relatively fixed technological features which drive CO_2 emissions in the US also do so in Europe, so our instrument ought to satisfy the inclusion restriction. On the other hand, we expect that the industry-specific tastes for climate action and industry-specific expectations about climate policy are likely to be only weakly correlated between the US and European industry. Industry-specific policy expectations in the era when carbon intensity is being measured will also be partialed out by the 'Δ CO_2 intensity' variable.We therefore expect that any correlation between EU and US emissions is driven primarily by shared technological features of industries. We also drop all US firms which are the subsidiaries of EU parents and all US firms which own subsidiaries within the EU, to further avoid any contamination of US firms' preferences in the sample with policy expectations or preferences of EU firms. That being said, we acknowledge international competitive dynamics and technological diffusion are still at play, and may violate the exclusion criterion.

Our instrumental variable results follow our reduced form results in terms of model set-up and control variables. We use as instruments in the first stage analogous versions of CO_2 intensity, Inputs CO_2 intensity, and Downstream CO_2 intensity where the measure of US CO_2 intensity is replaced by the same figure from European Union industries along with their interactions with firm

[16]This data comes from Eurostat's "Air emissions intensities by NACE Rev. 2 activity [env_ac_aeint_r2]" dataset, collected as part of the European environmental economic accounts. To maximize comparability with US emissions data, we selected the EU-wide carbon dioxide intensity (kg of CO_2 per euro (2010 prices) for 2008, the earliest year available.

size. We employ weighted two-stage least squares models, noting that the number of instrumented variables equals the number of instrumental variables in all specifications.

Additional empirical implications Our theory suggests several additional testable implications which move us beyond the main tests described above. First, rather than examine the differences between firms which oppose climate action and all other American firms, we examine the differences between firms that have opposed climate action and firms that have supported climate action. This dichotomy is not strict – 100 of the 2413 politically active American goods+ firms that joined some coalition on climate action joined at least one coalition opposing action and another coalition supporting action. We examine these cases in the appendix, and for now compare firms which opposed climate action with firms that supported and never opposed climate action. Our model in these cases is therefore:

$$\begin{aligned}\text{Oppose}_f \;=\;& \beta_1 \cdot \ln \text{CO}_2 \text{ Intensity}_f \;+\; \beta_2 \cdot \ln \text{Input CO}_2 \text{ Int.}_f \;+\\ & \beta_3 \cdot \ln \text{Down. CO}_2 \text{ Int.}_f \;+\; \boldsymbol{\gamma}_{1-3} \cdot \text{Size}_f \;+\; \gamma_4 \cdot \Delta \text{ CO}_2 \text{ Intensity}_f \;+\\ & \gamma_5 \cdot \text{Multinational}_f \;+\; \gamma_4 \cdot \text{Listed}_f \;+\; \gamma_5 \cdot \text{Delisted}_f \;+\\ & \gamma_6 \cdot \text{Sub. of US parent}_f \;+\; \gamma_7 \cdot \text{Sub. of foreign parent}_f \;+\; \mu_s \;+\; \epsilon_f.\end{aligned}$$

We do not need sampling weights for these models because we have the population of firms joining coalitions. Note also that we do not interact our carbon-intensity measures with firm size. Firm size as a crucial enabling condition for becoming and staying politically active. 'Politically active' firms have already overcome the obstacles to political engagement, so we do not expect a larger firm size to increase the effect of carbon-intensity in this population.

Second, we examine an analogous model for industry associations. We have 271 associations in goods+ industries that have supported or opposed climate action, and so we consider whether those that have opposed represent more carbon-intensive industries than those that have supported. Naturally, we do not have the covariates for associations that we do for firms, and so we only control for 1-digit sector fixed effects in our analysis of trade associations.

Finally, to follow up on Hypothesis 2, we examine lobbying activities for firms. For this analysis, we define Lobbied_f as equal to 1 if a firm lobbied on climate issues according to our keyword-and bill-based queries of the lobby data. These models are identical to the main models among the complete sample of politically active and randomly sampled Orbis firms, however we substitute Lobbied_f for Oppose_f as our main outcome variable. We also provide instrumental variable model results in the appendix for these models.

Results

Carbon-intensity and public opposition to climate action

We first examine whether carbon-intensive firms, especially those that are large, are more likely to join coalitions that publicly oppose climate action. These models are presented in Table 2. Before presenting the results, one note: political activity is rare among all firms and effect sizes are small. For this reason, we multiply our dichotomous outcome variables in Tables 2, 4, and 6 by 100 to avoid coefficient estimates that require 4th or 5th decimal places. All coefficients are interpretable as changing the 'percentage chance' of opposition, rather than the probability.

Firms that directly emit more carbon are more likely to join coalitions that oppose climate action. Interpreting the effects sizes from Model 1, moving CO_2 intensity from its median to its 75th percentile increases the percentage change a small or medium firm has opposed climate action by .0006%, which in relative terms is an increase of about 3%. Among large and very large firms, a similar change in carbon intensity increases the percentage chance of opposing climate change by .06%, which is a relative increase of about 58%. These relative effects are large, and we highlight that a lot of the action in political activity occurs in the top tail of the distribution. Increasing CO_2 intensity from the 50th to the 95th percentile in the data increases the likelihood of opposing climate action among large firms by a factor of more than 4.8.

We see very similar patterns when we look at Input CO_2 intensity and Downstream CO_2 intensity in columns 2 and 3. Among large firms, a 100% increase in carbon-intensity is predicted to increase the probability of opposing climate action by .05. Likewise, among larger firms a 100% increase in downstream carbon-intensity increases the probability of support by .03. These are

Table 2: Carbon-intensity drives opposition to climate action

	Oppose			
	1	2	3	4
CO_2 intensity	0.01			0.01
	(0.00)			(0.00)
CO_2 intensity · Large	0.52***			0.43***
	(0.04)			(0.04)
Inputs CO_2 intensity		0.01		0.00
		(0.01)		(0.01)
Inputs CO_2 intensity · Large		0.52***		0.32***
		(0.07)		(0.07)
Downstream CO_2 intensity			0.00	0.00
			(0.01)	(0.01)
Downstream CO_2 intensity · Large			0.50***	0.34***
			(0.06)	(0.06)
Large	0.49***	0.51***	0.37***	0.83***
	(0.03)	(0.05)	(0.03)	(0.06)
Δ CO_2 intensity	−0.00+	−0.00	−0.00	−0.00+
	(0.00)	(0.00)	(0.00)	(0.00)
Multinational	2.20***	2.20***	2.20***	2.21***
	(0.08)	(0.08)	(0.08)	(0.08)
Delisted	0.64***	0.67***	0.64***	0.66***
	(0.07)	(0.07)	(0.07)	(0.07)
Listed	1.25***	1.32***	1.26***	1.25***
	(0.07)	(0.07)	(0.07)	(0.07)
Sub. of US parent	0.22***	0.22***	0.22***	0.22***
	(0.02)	(0.02)	(0.02)	(0.02)
Sub. of foreign parent	0.06**	0.06**	0.06**	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	−0.00	0.00	−0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Sector FE	Yes	Yes	Yes	Yes

Notes: All models are weighted least squares (WLS). Foreign firms, non-goods+ firms, and utilities are excluded. Unweighted sample size is 2296 politically active firms and 396013 randomly sampled firms, hence N = 398309. Sample sizes reflect deleted observations due to missingness. Sector fixed effects are at the 2-digit NAICS level.

relative increases of 29% and 15% respectively.

We note that each of our main estimates is smaller in the model that includes all the forms of carbon intensity simultaneously. This likely occurs because the measures of intensity (particularly ordinary and inputs intensity) are positively correlated, and their interactions with the size variable are especially correlated. Nonetheless, the sign and significance of the findings are similar, and the substantive effects remain large. As a first robustness check of these results, we examine in the appendix the inclusion of 4-digit NAICS industry fixed effects, the most fine-grained fixed effects feasible. We find that our main results are totally robust to the inclusion of these fixed effects.

Our models in Table 2 use as an outcome variable whether a firm joined at least one anti-climate action coalition. We show in Table 3 that we see very similar results using outcomes variables

Table 3: Alternative outcomes to capture intensity of opposition

Outcome Outcome	Strongly oppose	Oppose (climate excl.)	# opp. coalitions	# opp. coalition-years	Wtd. opp. coal. years
CO_2 intensity · Large	0.46***	0.12***	0.20***	0.29***	0.14***
Inputs CO_2 intensity · Large	0.40***	0.11***	0.17***	0.27***	0.10***
Downstream CO_2 intensity · Large	0.46***	0.08***	0.18***	0.27***	0.12***

Notes: Each column is the set of estimates of the relevant CO_2 intensity measure interacted with firm size from models analogous to 1-3 of Table 2. For each column, the dichotomous $Oppose_f$ outcome variable is replaced by a different measure of intensity of opposition: the total number of opposing coalitions ever joined; the total number of opposing coalition-years ever joined; and, the total number of opposing coalition-years joined with each coalition given a total weight of 1. Each of these outcomes is added to 1, logged, and then pre-multiplied by 100 (the latter to avoid too many significant digits). Sample sizes the same as Table 2.

which better capture the intensity of activity. The second column of Table 3 reports the analogous estimates from models 1-3 of Table 2, but using the logged number of opposing coalitions joined as an outcome. The next two columns examples the logged number of coalition-years (for example, if a coalition lasts over many years) and the logged proportion of coalition-years (where each coalition has a maximum of 1). Using these measures of intensity, all three facets of carbon-intensity remain positively correlated with opposition to climate action.

Instrumental variable results In Table 4, we re-examine our main findings using the instrumental variables approach outlined above. First note that all of our instrumental variables pass a standard diagnostic to rule out weak instruments, a series of F tests for first stage regression models to test whether the instrumental variables are significantly predictive of the instrumented variables. We report whether all of these tests were passed or not at the bottom of Table 4. We also provide p-values from a Durbin-Wu test.

Overall our main findings are very similar when we instrument the carbon intensity measures of US firms with measures built off of the intensity of EU firms. Our main explanatory variables remain positively linked to opposition to climate action, and the size of the predicted effects are comparable. This improves confidence that our main results are not being driven by the idiosyncratic political preferences or policy expectations of US firms and industries.

Table 4: Instrumental variable results on carbon-intensity and opposition

	Oppose			
	1	2	3	4
CO_2 intensity	0.00			−0.00
	(0.01)			(0.01)
CO_2 intensity · Large	0.32***			0.06
	(0.06)			(0.09)
Inputs CO_2 intensity		0.02+		0.02
		(0.01)		(0.02)
Inputs CO_2 intensity · Large		0.47***		0.34**
		(0.09)		(0.11)
Downstream CO_2 intensity			0.00	0.00
			(0.01)	(0.01)
Downstream CO_2 intensity · Large			0.61***	0.58***
			(0.07)	(0.08)
Large	0.36***	0.48***	0.44***	0.72***
	(0.05)	(0.07)	(0.04)	(0.07)
Δ CO_2 intensity	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Multinational	1.12***	1.15***	1.12***	1.12***
	(0.12)	(0.12)	(0.12)	(0.12)
Delisted	0.73***	0.76***	0.73***	0.75***
	(0.07)	(0.07)	(0.07)	(0.07)
Listed	0.49***	0.54***	0.47***	0.49***
	(0.07)	(0.07)	(0.07)	(0.07)
Sub. of US parent	0.24***	0.24***	0.24***	0.24***
	(0.02)	(0.02)	(0.02)	(0.02)
Sub. of foreign parent	0.07***	0.07***	0.07***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	−0.00	0.01	−0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
First stage F tests	Passed	Passed	Passed	Passed
Durbin-Wu p-value	0.25	0.00***	0.00***	0.00***
Sector FE	Yes	Yes	Yes	Yes

Notes: All models are weighted 2-stage least squares, using EU measures of the intensity variables as instruments in the first stage with models otherwise unchanged. Foreign firms and non-goods+ firms are excluded. Unweighted sample size is 1700 politically active firms and 396118 randomly sampled firms, hence N = 397818. Sample sizes reflect deleted observations due to missingness. Sector fixed effects are at the 2-digit NAICS level. Coefficients in 'first stage' OLS models of US intensity variables on EU intensity variables including all controls and sector FE are: .53*** (CO_2 intensity); .66*** (Inputs CO_2 intensity); and .55*** (Downstream CO_2 intensity). "Passed" indicates all instrumental variables, including higher order terms, passed an F-test in the first stage regression.

Carbon-intensity among active firms and associations

In this section we consider a different question that generates a distinct but related empirical implication of our theory: among firms that are politically active on climate issues, does carbon-intensity predict opposition to climate action? If climate attitudes are not driven by carbon intensity, then we would expect that carbon-intensity would be orthogonal to attitudes among politically active firms. We examine this question in the top half of Table 5. Note that the models include controls for size, multinationality, publicly listed/delisted, subsidiary status, and 2-digit sector fixed effects. These are suppressed to preserve space. The outcome variable Opposed is not pre-multiplied by 100 as above, because opposition is common among politically active firms. All coefficients are interpreted as changing the probability of opposing (rather than supporting) among firms that have a taken a public position.

We find that carbon intensity, whether directly, via input consumption, or via downstream sales, is strongly associated with opposing climate action among firms that are politically active on climate change. By way of illustration, increasing CO_2 intensity by 100% increases the probability a firm has opposed rather than supported climate action by .10. Increasing input and downstream intensities by 100% have even larger predicted effects, .39 and .21 respectively.

We are able to extend this analysis to trade associations, which provides an additional independent test of our theory. To do so, we construct analogous measures of carbon-intensity using our own hand codings of 6-digit NAICS industries of the trade associations that join public coalitions. The results of these models are reported in the bottom half of Table 5. We see in those models that CO_2 intensity, Inputs CO_2 intensity, and Downstream CO_2 intensity are all positively associated with opposing climate action among politically active trade associations. This is further evidence that carbon-intensity is driving the positions of producers over climate issues.

Carbon-intensity drives lobbying on climate issues

Firms' and industries' decisions to take public positions in opposition to climate action are driven by their carbon-intensity up and down the supply chain. Are their decisions to lobby on climate issues also driven by carbon-intensity? We begin by replicating our empirical strategy from Table 2 but examining instead lobbying on climate issues as our outcome of interest. These models are contained in Table 6. Overall, we see substantively very similar effects of carbon intensity on the choice of whether to lobby. All forms of carbon-intensity are positively associated with the decision to lobby. We also see similar results in our IV models of lobbying in the appendix. Apparently, carbon-intensity is driving firms to Washington to express their preferences about climate policy. As shown above, these concerns are likely to come in the form of opposition to significant action

Table 5: Carbon intensity among firms and associations that have joined coalitions

	Oppose			
	1	2	3	4
Models examining all firms active on climate issues:				
CO_2 intensity	0.26***			0.18***
	(0.02)			(0.03)
Inputs CO_2 intensity		0.32***		0.09
		(0.05)		(0.06)
Downstream CO_2 intensity			0.39***	0.26***
			(0.04)	(0.04)
Intercept	0.33***	0.32***	0.31***	0.45***
	(0.06)	(0.07)	(0.06)	(0.07)
Firm-level controls	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Models examining all trade associations active on climate issues:				
CO_2 intensity	0.18***			0.28***
	(0.04)			(0.05)
Inputs CO_2 intensity		0.42***		0.21^{+}
		(0.10)		(0.11)
Downstream CO_2 intensity			−0.03	−0.17***
			(0.03)	(0.04)
Intercept	0.97***	1.12***	0.81***	1.06***
	(0.07)	(0.09)	(0.07)	(0.09)
Sector FE	Yes	Yes	Yes	Yes

Notes: All models are weighted least squares (WLS). Among firms, sample size is N=1391. Among associations, N = 231. Sector fixed effects are at the 2-digit NAICS level among firms and 1-digit NAICS level for associations. Models of firms include unreported controls for: size (4-level measure); multinational status; publicly listed/delisted; subsidiary status.

to curtail carbon emissions.

To provide an alternative gloss on the findings in Table 6, we look at aggregated lobby spending on climate related issues. We first examine the extent to which lobby spending on climate-related issues is shaped by carbon-intensive firms. To do so, we examined the percentage of lobbying expenditures by firms that are accounted for by firms that lie above the 90%-tile on at least one of our measures of carbon-intensity. Within goods+ industries, we find that 53.0% of lobbying on climate issues is conducted by these firms. If we relax our threshold to the 75%-tile, then 74.7% of lobbying is conducted by carbon-intensive firms.

We then look at the extent to which lobbying on climate issues is conducted by firms (and other actors) that have publicly opposed climate action. These results are in Table 7. The headline figure is that 60.9% of lobbying expenditures on climate change have been done by firms, associations, unions or other groups that have joined coalitions that oppose climate action; and 42.6% by groups

Table 6: Carbon-intensity drives lobbying on climate issues

	Lobby			
	1	2	3	4
CO_2 intensity	0.01*			0.01*
	(0.00)			(0.00)
CO_2 intensity · Large	0.57***			0.51***
	(0.03)			(0.03)
Inputs CO_2 intensity		0.01		−0.00
		(0.01)		(0.01)
Inputs CO_2 intensity · Large		0.58***		0.35***
		(0.06)		(0.06)
Downstream CO_2 intensity			0.00	0.00
			(0.01)	(0.01)
Downstream CO_2 intensity · Large			0.36***	0.17***
			(0.05)	(0.05)
Large	0.46***	0.49***	0.23***	0.76***
	(0.03)	(0.05)	(0.03)	(0.05)
Δ CO_2 intensity	−0.00*	−0.00	−0.00	−0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Multinational	5.54***	5.54***	5.54***	5.55***
	(0.07)	(0.07)	(0.07)	(0.07)
Delisted	0.98***	1.01***	0.98***	1.00***
	(0.06)	(0.06)	(0.06)	(0.06)
Listed	2.70***	2.78***	2.73***	2.72***
	(0.06)	(0.06)	(0.06)	(0.06)
Sub. of US parent	0.07***	0.07***	0.07***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Sub. of foreign parent	0.04*	0.04*	0.04*	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
Intercept	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Sector FE	Yes	Yes	Yes	Yes

Notes: All models are weighted least squares (WLS). Unweighted sample size is 1700 politically active firms and 396118 randomly sampled firms, hence N = 397818. Sample sizes reflect deleted observations due to missingness. Sector fixed effects are at the 2-digit NAICS level.

Table 7: Public positions of firms lobbying on climate issues

	Participation in ad hoc coalitions:			
	None	Oppose only	Opp and favor	Favor only
All actors	16.9	35.7	30.5	17.0
Firms	13.2	9.5	48.0	29.2
Trade associations	28.3	16.9	45.0	9.7
Peak associations	2.4	95.4	1.9	0.2
Labor unions	46.8	5.9	24.2	23.2

Notes: Lobby data from Center for Responsive Politics. Climate lobbying determined using key word search of lobby report specific issues field and search for lobbying on particular bills. Figures are percentages of lobby expenditures accounted for by groups, conditional on their activity in ad hoc coalitions that support or oppose climate action.

that have joined *only* coalitions opposed to climate action. Among firms only, 53.3% of lobbying has been done by firms that have opposed climate action, although a large amount of lobbying

(39.5%) has been done by firms that have both opposed and supported climate action.[17] Among associations the figures are especially striking: 2.5% and 1% of climate lobbying has been done by a trade and peak association, respectively, that has supported climate action, while 49% and 94% respectively has been done by associations that have publicly opposed climate action publicly.

We conclude that firms and industries that are significantly exposed to carbon pricing are much more likely to engage in outside lobbying opposed to climate action; are much more likely to lobby on climate policy; and account for the majority of lobbying expenditures on climate policy.

Conclusion

Firms and industries that intensively emit carbon dioxide are more likely to join public efforts to oppose climate action. This opposition extends to their suppliers and to their customers, both of whom face costs from climate action through the supply chain. As a result, the set of producers negatively affected by efforts to limit GHG emissions extends far beyond the fossil fuel industries. The public coalitional efforts of these actors are significant, and are matched by significant activity in lobbying. These findings on the breadth and organization of producers opposed to climate action may contribute to understanding the repeated failures to comprehensively address climate change, although we do not systematically examine this question.

We conclude with directions for future research. First, our study has focused mainly on the material drivers of opposition to climate action. There is a need for further examination of the material drivers of public support for climate action among producers. Second, we focus on US firms in the 'carbon coalition', although many global firms enter our data through their alliance with US-based firms in the *ad hoc* coalitions we describe. It would be valuable to extend our analysis beyond the United States. Third, it would be valuable to extend our data on public positions to the area of notice and comment, an alternative forum for firms and associations to express their opinions on climate policy. Fourth, we have not clearly connected our data on corporate preferences

[17] We investigate these 'hedgers' in the online appendix, and find that they are disproportionately public, multinationals, and/or foreign.

to data on political outcomes. Future work should examine, for example, the relationship between carbon-intensity, campaign contributions, and Congressional voting on climate-related bills.

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SUPPORTING INFORMATION

The following additional materials are available in the online appendices:

Appendix A: Data collection.

Appendix B: Additional models.