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Explaining U.S. climate inaction

Influences on cap-and-trade votes in Congress

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Preface

Ever since the U.S. Senate unanimously passed the Byrd-Hagel resolution in 1997, thereby making clear that it would not ratify the Kyoto Protocol, the U.S. attitude towards international climate negotiations has been the topic of vigorous study. Many theories exist about why the U.S. as an international actor seems so reluctant to commit to extensive climate action: politicians are pressurized by carbon-intensive industries; the public has little interest in the issue; civil society is not sufficiently active on the topic, and so forth. This study is an attempt to put some of these theories to the test, and to bring us closer to an empirical answer to the question of why the U.S. behaves the way it does in international climate negotiations. But it is only one possible answer: writing this thesis has taught me yet again that every scientific endeavor leads to theoretical and methodological problems that have more than one solution.

There are many people have accompanied me on this path from question to conclusion. First of all, my advisor, professor Bart Kerremans, who always expected quality work but also urged me to be keep an eye on the limited time and resources. I want to thank him for keeping my perfectionism in check. Second, I would like to thank my friend and partner Michele, who taught me (almost) everything I know about data, and who often saw his wise and thoughtful advice to me audaciously ignored. Furthermore, my gratitude goes to Frank, Ljubica and Muhammed, who have constantly functioned as my mentors and discussion partners and who made for the most stimulating work environment a person can wish for. Finally, I want to thank my mom for proofreading this text, and both my parents for continuing to show interest in my work—or at least pretending to. Thank you all for helping me to make this happen.

1 Introduction

On December 11, 1997 in Kyoto, Japan, the 3rd Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) decided to adopt the first-ever binding international greenhouse gas reduction agreement: the Kyoto Protocol. The protocol has since been signed and ratified by 191 countries, encompassing almost all U.N. member states. In the Protocol, 37 industrialized countries committed to binding greenhouse gas emission targets, to be reached in the period 2008-2012 (which in the 2012 Doha COP was extended to 2020). Full compliance with the targets would have meant a 5.2% reduction of greenhouse gas emissions below base year.

The only signatory state that has not ratified the protocol, however, is also one of the largest greenhouse gas emitters: the United States. Subsequent climate conferences have not been able to pull the U.S. aboard. In this, it differs from many other developed countries who are currently taking costly action to mitigate climate change. Climate change could certainly have costly consequences in the U.S. (Stern, 2007; Ackerman & Stanton, 2008); in fact, one study has indicated that the costs of climate change for the country could be so high that it would be worthwhile for the country to pay the climate change mitigation costs for the entire world rather than allowing a business-as-usual scenario to unfold (Freeman & Guzman, 2009). In addition, participation by the U.S. would likely convince several countries to increase their commitments or to participate for the first time. Why, then, has the country been so reluctant to adopt binding emission targets?

International climate negotiations, like all other negotiations on the international level, are influenced by more than one level of governance. To gain insight in this complexity, Putnam (1988) looked at these negotiations as two-level games: two sets of negotiations conducted by actors on both the domestic and the international level, with both levels constantly influencing each other. This means that actors in all international negotiations need to find a solution that is acceptable both for their international counterparts and for domestic key actors. In other words, the final agreement needs to be part of the 'win-set', the set of acceptable policy results, for both domestic and international veto players. If the win-set of domestic actors allows only for a limited amount of deviation from the status-quo, it will be difficult for international negotiators to make any substantial changes.

In the U.S., the veto player par excellence on the domestic level is Congress. This is because the Senate needs to ratify international treaties before they can become law in the U.S. In addition, both the House of Representatives and the Senate will need to pass legislation that helps execute the provisions of the treaty. In particular, their approval is necessary for allocating part of the federal budget to the implementation of the treaty, and possibly for giving executive agencies the power to act. Thus, if Congress makes clear

that it will not accept a treaty with binding emission targets, approval of such a treaty by international actors (including signature of the treaty by the president) is quite meaningless.

Is opposition in Congress an important cause of the U.S.'s current reluctance to join a Kyoto-like climate treaty? Events in the past decade indicate that this is indeed the case. For example, in 1997 the U.S. Senate unanimously approved the Byrd-Hagel resolution, in which it made clear that it did not intend to ratify the Kyoto Protocol. Moreover, legislation aimed at reducing greenhouse gas emissions has so far been systematically rejected by Congress. This includes the energy tax law (the so-called BTU tax) advocated by then-president Bill Clinton in 1993, as well as the four cap-and-trade bills that will be discussed in this study (Falkner, 2001). Many other proposals were never subjected to a plenary vote (Jobber & Sieminski, 2009). In the language of two-level games we can say that the win-set of Congress does not seem to include binding emission targets, and this may make it more difficult for negotiators to believably accept an agreement on the international level.

If the reluctance of Congress to accept stringent measures to limit climate change partly explains why the U.S. has not signed a climate treaty with binding targets so far, it seems important to investigate the causes of this reluctance. One approach to answering this question is to look at congressional votes that have been held so far on domestic cap-and-trade legislation. Because cap-and-trade bills set annual emission limits which the economy as a whole must meet, they essentially have the same effect as a binding international emissions target. In consequence, the reasons why Congress has not passed any cap-and-trade bill are likely to be similar to the reasons why as an institution, it seems to be taking a conservative stance on international climate agreements with binding emission limits. In other words, if we can find out why Congress members do or do not support domestic cap-and-trade legislation, this may also indicate why the majority of them seem to oppose similar targets at the international level.

In this study, we will investigate which factors determine whether a Congress member favors the passage of cap-and-trade legislation in the U.S. Using information about constituency interests, electoral position, campaign funding, and party affiliation, we will explain the votes cast by Congress members regarding those cap-and-trade bills that have so far been discussed in Congress. On the basis of the results of these analyses we will attempt to explain why Congress members support or oppose domestic cap-and-trade legislation, and thus also why as a group, they seem unwilling to accept an international climate treaty.

The rest of this thesis is structured as follows. In section 2 we will describe which bills will be analyzed in this study, what they entail, and in what context they were voted upon in Congress. In sections 3, 4 and 5 we will set out some of the factors that may explain the voting behavior of Congress members regarding climate legislation. In section 6 we will describe the method

that we used to measure each factor, and to analyze the data. In section 7 we will present the results of the analyses for each piece of legislation. We will then discuss the consequences of these results, the limitations of the research, and the questions that remain unanswered in section 8. In the concluding section, we will summarize our findings and their implications.

2 Cap-and-trade Bills

In order to understand the factors motivating members of Congress in their decisions about climate legislation, we analyzed their votes on legislative proposals that proposed to implement a cap-and-trade system for greenhouse gases within the U.S. (which we will refer to as 'cap-and-trade bills'). By a cap-and-trade system, we mean that the bills included an overall greenhouse gas emission limit, to be achieved by selling or distributing a restricted amount of emission allowances to firms. The firms could then sell allowances to other firms if they decided to pollute less than their allowances permitted them, or buy more if they wanted to pollute more (Stavins, 2003). Although other legislative proposals where submitted with the aim of limiting the amount of greenhouse gases that the U.S. emits, such proposals were not included in this study because they did not set binding emission targets as cap-and-trade bills do.

To be of use for our analysis, a plenary vote regarding the bill had to have taken place in at least one of the two congressional chambers; the results of these plenary votes are what we attempt to explain in this study. Four cap-and-trade bills answered to this criterion:

- the Climate Stewardship Act of 2003 (or McCain-Lieberman bill) and its successor,
- the Climate Stewardship and Innovation Act of 2005
- the America's Climate Security Act of 2008 (or Lieberman-Warner bill)
- the American Clean Energy and Security Act of 2009 (or Waxman-Markey bill)

In the following sections, we will discuss the content and legislative history of each bill in more detail.

2.1 Climate Stewardship Acts of 2003 and 2005

The Climate Stewardship Act of 2003 was the very first bill proposing an economy-wide cap-and-trade system for greenhouse gas emissions to be subjected to a plenary vote in U.S. Congress. The central provision of this bill was a reduction in greenhouse gas emissions to the level reached in 2000, to

be achieved by 2010. Exempting some sensitive sectors, the cap-and-trade system would cover between 70% and 85% of greenhouse gas emissions in the U.S (Parker & Yacobucci, 2004). The Secretary of Commerce would determine the amount of allowances to be distributed for free and the amount to be auctioned. Proceeds from the auction would be used to reduce energy costs of consumers and assist disproportionately affected workers. In addition, the bill would create a grant program at the National Science Foundation for students and researchers specializing in climate change.

The Climate Stewardship Act (S.139) was sponsored by Senators McCain (R-AZ) and Lieberman (D-CT). At the time of its introduction in 2003, the failure to ratify Kyoto was still fresh in mind, and debate about climate change in the Senate focused heavily on potential losses to U.S. industries and consumers (Fisher, 2006). Still, a revised version of the Act (S.Amdt.2028) reached the Senate floor for debate in October 2003. It was defeated by 55 votes to 43.

Though submitted under a slightly different name, the Climate Stewardship and Innovation Act of 2005 (S. 342) had very similar content to its predecessor. One modification was that it would create a Climate Change Credit Corporation, which would auction off allowances and distribute the proceeds to assistance, training, adaptation, and technology programs. In addition, the bill increased incentives for researching and developing technologies for low-carbon energy generation, including nuclear energy. Sponsored only by Senator McCain (R-AZ), the Climate Stewardship and Innovation Act was submitted to the Senate in 2005. A revised version (S.AMDT.826) was voted upon on the Senate floor in June of the same year. With only 38 votes in favor and 60 against, the bill attracted even less support than its predecessor—presumably because of its pro-nuclear content.

2.2 America's Climate Security Act of 2008

Like the the Climate Stewardship Acts of 2003 and 2005, the America's Climate Security Act was a national climate and energy legislation proposal that would establish an economy-wide, greenhouse gas cap-and-trade system. Rather than a single emissions target, however, the America's Climate Security Act set a series of progressively strict limits. Thus, greenhouse gas emissions from covered sectors would be reduced by 4% below 2005 levels by 2012; 19% below 2005 levels by 2020; and 71% below 2005 levels by 2050. Somewhat less comprehensive than the two previous bills, the cap-and-trade program would encompass approximately 80% of U.S greenhouse gas emissions (Center for Climate and Energy Solutions, 2008b). At first, the large majority of emission allowances would be distributed for free to designated industries; later, the majority of allowances would be auctioned. In addition to the cap-and- trade provisions, America's Climate Security Act featured a range of complementary measures to aid the transition to a low-emission

economy. It would also provide financial support for climate-related research and introduce a low-carbon fuel standard.

The America's Climate Security Act was first introduced to Congress at a time when the institution was almost flooded with cap-and-trade proposals: in the fall of 2007, one was added to the institution's agenda on an almost weekly basis (Deutsch, 2008). The America's Climate Security Act was designed to be a compromise of all major proposals. A first version of the bill (S.2191) was introduced to the Senate in October 2007 by Senators Liebermann (ID-CT) and Warner (R-VA) but never reached the floor of the Senate. A revised version (S.3036) was introduced in 2008 and debated in plenary session in June. However, during the debate on one of the proposed amendments to the bill (The Boxer Substitute Amendment, S.Amdt. 4825), the Senate failed to pass a motion of cloture. This motion, which requires the support of at least 60 Senators, would have ended the debate and allowed the Senate to proceed to voting on the amendment. With only 48 votes in favor of cloture and 36 votes against, the debate could not be closed, and the bill was withdrawn from the Senate floor.

A vote in favor of cloture does not necessarily have to indicate support for the bill itself: often, legislators use procedural votes like these to follow their party line, only to abandon it when it comes to a vote on the substance of bill, as these votes are more visible to constituents. In fact, 9 of the Democrats who voted for cloture later stated their opposition to the bill in its current form (Center for Climate and Energy Solutions, 2008a). However, in this study we will interpret a vote for cloture as a vote in favor of cap-and-trade. After all, 16 Republicans and 13 Democrats decided to either abstain or vote against their party's position, indicating that at least some members of Congress still allowed their vote to depend on factors other than the party line.

2.3 American Clean Energy and Security Act of 2009

Like the America's Climate Security Act of 2008, the American Clean Energy and Security Act proposes increasingly stringent emission limits for the U.S. economy. Greenhouse gas emissions were to be reduced to 3% below their 2005 levels in 2012, 17% below 2005 levels in 2020, 42% below 2005 levels in 2030, and 83% below 2005 levels in 2050. Like its predecessor, this bill planned to gradually reduce the amount of allowances to be given away, and to increase the amount that would be auctioned off. Entities covered by the bill together contribute about 85% of U.S. greenhouse gas emissions (Montgomery et al., 2009). Apart from this cap-and-trade system, the bill would also create a renewable electricity standard (RES) that would require large utilities to sell an increasing percentage of electricity from renewable

sources (Sheppard, 2009). Moreover, it would provide for investment in new clean energy technologies and energy efficiency and set up energy-saving standards for new buildings and appliances. Several measures were included to protect consumers from potential energy price increases caused by the bill.

The American Clean Energy and Security Act (H.R. 2454) was introduced to the House of Representatives by Henry Waxman (D-CA) and Ed Markey (D-MA) in May 2009. It was explicitly supported by president Barack Obama, as climate change action was an important campaign promise for the newly elected president (Lee, 2009). The House passed the bill in June 2009, by a vote of 219 to 212, after which it was passed on to the Senate. There, however, discussions progressed very slowly and Senators proved deeply divided over the issue (Eilperin, 2009; Broder, 2010). The failure to reach a new international climate treaty in Copenhagen that year worsened the prospects of the bill even further (Meng, 2013). A last major effort to push the cap-and-trade bill through Senate in the summer of 2010 failed, since it was clear that the 60 votes required to pass a motion of cloture were not present (Boyle, 2010). In July 2010, the Senate formally ceased to deliberate over a cap-and-trade bill comparable to the Clean Energy and Security Act.

To conclude, in this study we will analyze the outcome of plenary votes regarding four cap-and-trade bills in U.S. Congress: the Climate Stewardship Act of 2003, the Climate Stewardship and Innovation Act of 2005, the America's Climate Security Act of 2008 and the American Clean Energy and Security Act of 2009. Specifically, we will use the characteristics of Senators and Representatives and their constituencies to explain their voting behavior on each bill. In the following section, we will discuss the explanatory factors that we will take up in this analysis.

3 Constituency Interests

Members of Congress are constantly subject to the pressure exerted by their constituents, whether it is through elections, campaign contributions, lobbying or any other instrument of policy influence. In the following sections, we will discuss three groups of constituents who are likely to exert pressure on legislators regarding cap-and-trade legislation: actors associated with industries that would be harmed by cap-and-trade, those associated with industries that would gain from it, and citizens concerned about the consequences of climate change.

3.1 Disadvantaged Industries

Although the real economic impact of cap-and-trade depends on many factors, it is certain that cap-and-trade will have a significant effect on the U.S.

economy. The cost of emitting CO_2 will increase inevitably, even though estimates of future CO_2 prices are varied. As a result, the inputs for firms (especially energy) will become more expensive, and production costs will rise (Goettle & Fawcett, 2009). Moreover, many industries will see their international competitiveness decrease, because companies in countries without emission limits will be able to operate at lower prices (an effect called *carbon leakage*). Industry sectors that are likely to suffer higher-than-average losses due to cap-and-trade will be referred to in this study as *disadvantaged industries*. In general, constituents who depend on disadvantaged industries for their income (for example, employees and shareholders of firms in the disadvantaged sectors) are expected to suffer serious economic consequences under any type of cap-and-trade legislation.

When a group of constituents foresee that they will be economically harmed by a policy proposal, they are likely to exert pressure to prevent this policy from being enacted. The representatives of their district or state in Congress are often the main target of their efforts. This is because constituents not only have electoral power over their representatives; in the words of Fordham and McKeown (2003), they may also "control jobs and working conditions in the members districts, choose to invest or disinvest, and hold other politically relevant assets—for example, an ability to shape local media content—that make their interests particularly important to the local representative". Previous research by Fisher (2006) indicated that such pressure from disadvantaged groups is real and can be effective: Senators were significantly more likely to reject the Climate Stewardship Act of 2003 if they represented a state which was heavily dependent on coal and/or oil extraction (both very carbon-intensive industries). In this study, then, we tested the hypothesis that a strong presence of disadvantaged industries in a legislator's district makes that legislator less likely to vote in favor of cap-and-trade.

3.2 Benefiting Industries

Although the overall effect of cap-and-trade on economic activities is expected to be negative (Paltsev et al., 2008; Goettle & Fawcett, 2009; Jorgenson, Goettle, Ho, & Wilcoxen, 2012), some particular industries are likely to experience a rise in competitiveness and income under a cap-and-trade system. For example, producers of 'clean' energy will probably see their markups increase, as energy from carbon-intense sources becomes more expensive. Industries that are likely to profit from cap-and-trade will be referred to as *benefiting industries*. Although losses are generally thought to be a stronger mobilizing factor than gains, several studies in the domain of trade politics have found instances where interest groups took political action in order to secure a potential source of profit (e.g. Busch & Milner, 1994; Chase, 2003; Panagariya & Findlay, 1994; Grossman & Helpman, 1992). Thus, constituents who depend on benefiting industries may pressurize policymakers

to support cap-and-trade bills, in the same way that constituents associated with disadvantaged industries pressurize them to oppose these bills. In consequence, we hypothesized that the presence of benefiting industries in a legislator's district may make him or her more likely to approve of cap-and-trade legislation.

3.3 Public Concern about Climate Change

If climate change will be even nearly as costly for the U.S. as some authors claim it to be, then mitigation of greenhouse gas emissions is likely to eventually bring net benefits for many U.S. citizens (Freeman & Guzman, 2009). This is especially the case for those who risk to suffer the most severe consequence of climate change, like citizens living close to the seaside or in areas that are vulnerable to droughts. One would assume, then, that self-interest would motivate at least some citizens to be concerned about climate change. In addition, citizens may care about environmental causes like climate change because they feel that it advances the welfare of their fellow citizens, or out of an ideologically motivated concern for the biosphere (Popp, 2001; Schultz, 2001). Whatever their motivation, citizens who are concerned about the consequences of climate change should be more likely to exert political pressure in favor of climate action, including cap-and-trade.

There are several reasons why the pressure on Congress coming from climate-conscious citizens may not be as strong as the pressure from constituents associated with industries (DeSombre, 2000, p. 152-153). First of all, the costs of a business-as-usual scenario are uncertain: it is particularly difficult to make projections of the effects of climate change, both for U.S. citizens and for the rest of the world (Freeman & Guzman, 2009; Tol, 2003). Second, the adoption of cap-and-trade legislation in the U.S. will not have an instantly detectable effect on climate change. To mention just one reason, the cap-and-trade bills discussed in this study covered only 70-85% of greenhouse gas emissions in the U.S., which as a country is responsible for 'only' about one-fifth of global greenhouse gas emissions (World Resources Institute, 2012). Lastly, the most severe consequences of climate change will likely be located in the (distant) future. Since constituents usually tend to value the future less than they value the present, this will decrease their interest in advocating cap-and-trade (Manne, 1995). All this makes the environmental benefits of cap-and-trade less salient, compared to the certain and immediate costs of the policy.

There is another variable that distinguishes constituents who take an interest in climate change from industry-associated constituents: group size. Namely, the number of climate-concerned citizens in a constituency could be much larger than the group of constituents that are associated with disadvantaged or benefiting industries. Whether large group size is an asset or a handicap, however, is the subject of a hot debate in collective action theory.

On the one hand, theoretical analyses have shown that when the group members are striving together for a public good (like cap-and-trade legislation), larger groups have more resources available because each member can contribute only so much time and money towards the common goal (Pecorino & Temimi, 2008; Esteban & Ray, 2001; Isaac & Walker, 1988). On the other hand, members in small groups may know each other and thus be subject to social pressure to cooperate (Udehn, 1993). In other words, it is not clear how the potentially large group size of climate-concerned citizens will affect their capability to exert political influence.

To conclude, there are several reasons why citizens may be concerned about climate change, and thus why they may be willing to pressurize legislators into supporting cap-and-trade legislation. Their motivation may be self-interest, altruism, or a combination of both. Whereas some theorists would assert that climate-concerned citizens face substantive hurdles in organizing themselves, others would argue that their large group size will function as an asset in exerting political influence. In consequence, we hypothesized that if more people in a constituency were concerned about climate change, representatives of that constituency would be more likely to vote in favor of cap-and-trade bills.

4 Pathways for Influence

In the sections above, we have identified three groups of constituents that are likely to pressurize Congress members regarding cap-and-trade policy. Even though each of these groups arguably have reasons to try and influence legislators when it comes to policy decisions on cap-and-trade, it is another question whether and how they are able to do so. In the next sections we will introduce two pathways through which groups of constituents may influence the voting behavior of Congress members: elections and campaign contributions.

4.1 Elections

Elections are the most well-known pathway for constituents to influence policy decisions. By threatening not to re-elect incumbents that do not act in their interest, voters can (at least in theory) make sure that legislators follow the preferences of the majority. Thus, if large groups of constituents are dependent on cap-and-trade-sensitive industries, then we generally expect Congress members from that constituency to oppose cap-and-trade bills, for fear of losing the next election. On the other hand, if many are dependent on benefiting industries like nuclear plants or hydroelectric power plants, then their representatives are generally expected to favor cap-and-trade. The same goes if many constituents are concerned about the negative consequences of

climate change. In sum, the ever-present prospect of elections forces legislators to take their constituents' preferences into account.

If an incumbent has won the last election with only a small amount of leeway, he or she can probably expect a competitive race in the next elections, too. This means that if legislators' decisions are influenced by the 'threat' of upcoming elections, then legislators with a narrow electoral margin should be more sensitive to the preferences of their constituencies (Li, 2010; Jacobson, 1993; Stein & Bickers, 1994). 'Safe' legislators, on the other hand, should be more likely to be influenced by other factors such as party discipline or campaign contributions. Thus, we expect the presence of disadvantaged industries in a constituency to affect congressional voting behavior mainly when its Congress members were elected by a narrow margin. The same is true for constituents who depend on benefiting industries or who are concerned about the consequences of climate change: the narrower the electoral margin of their Congress members, the larger their expected influence.

For cap-and-trade bills that were voted upon in the Senate, there is an additional factor we can take into account. The Senate is elected on a rotating basis, with one-third of the seats being open for election every two years. This means that at the moment each cap-and-trade bill was voted upon in the Senate, some Senators were much closer than others to the day their position would be subject to election. It is possible that Senators are more sensitive to their voters' preferences regarding cap-and-trade as their next election date approaches (Thomas, 1985). For the bills that were voted upon in the Senate, we thus hypothesized an interaction between constituency interests and the proximity of elections for a Senator. That is, we expected disadvantaged industries, benefiting industries and public concern to have greater impact on the voting behavior of Senators who are closer to their election date. Again, this would imply that elections are one instrument that groups of constituents use to influence voting outcomes.

Note that elections do not only work as a threat that modifies legislators' policy preferences after they have been elected: another possibility is that voters tend to elect candidates whose preferences are already in accordance with theirs. If this is the case, a narrow electoral margin may still be associated with large effects of constituency interests on congressional votes. This is because in 'battleground' constituencies, the preferences of relatively small societal groups may affect the outcome of elections more than in constituencies where the electoral competition is effectively decided before it has begun. However, if voters influence Congress mainly by electing legislators whose policy preferences match theirs, then the proximity of elections should not have any influence on the effect of constituency interests. In that case, the behavior of these legislators is not expected to depend on the timing of the electoral cycle.

4.2 Campaign Contributions

In the U.S., the cost of electoral campaigns tends to be very high. In 2008, newly elected Senators had spent on average $8.5 million on their campaigns; for Representatives (i.e. members of the House) this number was $1.3 million (Opensecrets.org, 2008). To provide these funds, most Congress members rely mainly on donors, rather than on support from their parties: for example, in the 2008 general elections, parties were responsible for 1 percent of campaign expenditures for House candidates. For aspiring Senators, the number was 2 percent (The Campaign Finance Institute, 2010). Thus, the total amount that candidates can spend on their campaigns depends largely on contributions, both from individual donors and from Political Action Committees (PACs, organizations created with the purpose of raising and spending money to campaign for or against candidates). As a result, campaign donations may be an important pathway for groups of constituents to influence congressional votes. For this to be the case, two steps must be taken: there must be an effect of constituency interests on campaign contributions, and contributions must affect congressional voting behavior.

Campaign donations are becoming more and more delocalized: interdisctrict funding has increased strongly in the last decades, meaning that the average candidate now receives two-thirds of his or her contributions from outside his or her own constituency (Gimpel, Lee, & Pearson-Merkowitz, 2008). Still, we expect constituency interests to have a substantial influence on the composition of their representatives' campaign contributions, for several reasons. First, campaign contributions form an interesting alternative to elections for influencing policy outcomes: for interest groups that have access to large amounts of funding, they may be the most attractive instrument. Second, interdistrict funding may also be driven by local constituency interests. For example, in accordance with findings by Gimpel et al., local constituents may use their networks to convince non-locals to donate to their preferred candidate. In sum, we expect the interests of a constituency to affect the composition of campaign donations to members of Congress. Thus, if certain disadvantaged (or benefiting) industries are strongly present in a constituency, we expect candidates in that constituency to receive more contributions from those industries. If many citizens in a constituency are concerned about climate change, we also expect more donations to come from organizations associated with environmental causes.

As for the second step, campaign donations can affect the voting behavior of a Congress member essentially in two ways: through selection or through influence (Fordham & McKeown, 2003). By selection, we mean that campaign contributions can affect the outcome of elections: in at least some circumstances, candidates who were able to raise more campaign money have a better chance of obtaining a seat in Congress (Stratmann, 2006; Gerber, 2004). Thus, interest groups may use their contributions to affect which can-

didate is elected, supporting those candidates whose voting preferences align with theirs. Alternatively, campaign donations may lead to political influence: either directly, by changing the incumbent's voting preferences, or indirectly, by 'buying' increased access to the legislative process (Langbein, 1986; Hall & Wayman, 1990; Baldwin & Magee, 2000). As a result of this influence, recipient legislators will be more likely to take the interests of their donors into account when they decide how to vote. In general, there is more empirical support for the former mechanism than for the latter (Burdett Loomis & Strolovitch, 2011, p. 411-414), but both of these mechanisms will lead to an effect of campaign contributions on congressional voting behavior. Thus, we expect the voting behavior of Congress members to depend in part on the organizations that contributed to their campaign, with contributions from disadvantaged industries decreasing support for cap-and-trade, and with contributions from benefiting industries or environmental groups increasing it.

In sum, we hypothesized that campaign contributions partially mediate the effect of constituency interests on voting behavior. This implies that first, we expected constituency interests to affect the amount of campaign contributions from different sources: the presence of certain industries was thought to result in increased contributions from those industries, and high public concern about climate was thought to lead to increased contributions from environmental organizations. Second, we expected these contributions to affect congressional voting behavior: contributions from disadvantaged industries were expected to be connected with votes against cap-and-trade, and contributions from benefiting industries or environmental organizations were expected to have the opposite result. If both of these conditions are fulfilled, this suggests that campaign contributions are one way in which constituents affect the voting behavior of their representatives.

5 Party Affiliation

It is quite clear from past party platforms that the two major parties in U.S. Congress—Democratic and Republican—have maintained significantly different views on climate change. In its 2008 platform, for example, the Democratic party states that:

> We understand that climate change is not just an economic issue or an environmental concern—this is a national security crisis.

On cap-and-trade, the platform asserts that:

> We will implement a market-based cap and trade system to reduce carbon emissions by the amount scientists say is necessary to avoid catastrophic change and we will set interim targets along the way to ensure that we meet our goal.

Although the Republican platform of 2008, too, mentions climate change as a problem, it seems more hesitant to promise bold or potentially costly steps:

> While the scope and longterm consequences of [climate change] are the subject of ongoing scientific research, common sense dictates that the United States should take measured and reasonable steps today to reduce any impact on the environment.

At the same time, cap and trade is not mentioned at all in the platform. This indicates that the Republican party does not attach as much importance to climate action as their Democratic counterparts, and that it does not explicitly support cap and trade.

Thus, on the basis of party platforms, we hypothesized there would be a connection between party affiliation and voting behavior: Democrats were expected be more likely to support cap-and-trade legislation than Republicans. However, we must be careful in interpreting the meaning of such a correlation. We cannot consider party affiliation as a variable independent from constituency interests: constituents may elect legislators associated with certain parties because they know that these legislators will have voting preferences that align with theirs (Fordham & McKeown, 2003). For example, constituencies with stronger public concern about climate change may tend to elect Democrats rather than Republicans, precisely because the party affiliation of a candidate says something about how he or she will vote. Thus, to see if party affiliation has an impact that cannot be reduced to the influence of known constituency preferences, we must test if party affiliation is connected to voting behavior after controlling for industry presence and public concern.

To summarize, in this study we tested the influence of several factors on the voting decisions of Congress members regarding cap-and-trade bills. Three types of constituent groups may play a role: constituents who depend on disadvantaged industries, those who depend on benefiting industries, and constituents who are concerned about climate change. We also investigated the extent to which these groups use elections and campaign contributions as instruments to pressurize Congress members. To test the importance of these instruments we evaluated (1) whether a legislator's electoral margin in the previous election and the proximity of the next election date moderate the effects of constituency interests on voting behavior, and (2) how campaign contributions mediate these effects. Finally, we tested the hypothesis that party affiliation exerts an influence on voting behavior over and above the influence exerted by constituents. In the section below, we will describe the methods that we used to test these assertions.

6 Method

In order to model the factors affecting the voting behavior of Congress members, two characteristics of the data need to be taken into account. First, our response variable (i.e. voting behavior regarding cap-and-trade bills) is binary: we are only interested in two possible outcomes (i.e. a vote for or against cap-and-trade). This means that classical linear regression is not applicable, as the assumptions of homoscedasticity, linearity and normality are violated (Menard, 2001, p. V). Instead, we chose to apply logistic (or logit) regression, in which the value of the independent variables is not expected to be linearly connected to the value of the response variable. Instead, the independent variables are used to predict the logarithm of the odds that the binary response variable takes on one value rather than another (in this case, the odds of a vote in favor of cap-and-trade). The regression equation for a logistic regression takes the following form:

$$E[Y_i|x_{1,i},...,x_{n,i}] = logit(p_i) = ln(\frac{p_i}{1-p_i}) = \beta_0 + \beta_1 x_{1,i} + ... + \beta_N x_{n,i}$$

In which Y_i is the value of the response variable for observation i; $x_{k,i}$ is the value of independent variable x_k for observation i; $E[Y_i|x_{1,i},...,x_{m,i}]$ is the expected value of the response variable for observation i given a certain value of the independent variables; ln is the natural logarithm; p_i is the probability of the response variable taking on a certain value; β_0 is the intercept; and β_K is the slope parameter of independent variable x_k.

By fitting a logistic regression model, we were able to estimate how much a change in the independent variables would affect the odds (and thus, the probability) that a Congress member would vote in favor of cap-and-trade.

A second feature of the data that affects which models should be used, is its clustered structure. Specifically, Congress members are grouped together at the level of the state: Senators who represent the same state, or Representatives whose district is located in the same state, may have relatively similar voting behavior. This means that our data violate the assumption of independence, which underlies all generalized linear models, including logistic regression models (Breslow, 1996).

One possible solution for this problem is to estimate a logistic random intercept model: this is a logistic regression model in which the regression equation is allowed to have a different intercept for different groups of observations. A logistic random intercept model consists of two regression equations: a level 1 logistic regression equation in which the response variable is predicted on the basis of the values of individual-level variables; and a level 2 equation in which the value of the intercept of the level 1 equation is

estimated on the basis of group-level variables. The equations of a random intercept regression model take the following form:

Level 1 logistic regression equation (with individual-level variables):

$$E[Y_{ij}|x_{1,i},...,x_{m,i}] = logit(p_i) = \beta_{0,j} + \beta_{1,j}x_{1,ij} + ... + \beta_{N,j}x_{n,ij}$$

In which Y_{ij} is the value of the response variable for individual i in group j; $x_{k,ij}$ is the value of individual-level independent variable x_k for individual i in group j; $E[Y_{ij}|x_{1,ij},...,x_{m,ij}]$ is the expected value of the response variable for individual i in group j, given certain values of the independent variables; $\beta_{0,j}$ is the intercept for individuals in group j; and $\beta_{k,j}$ is the slope parameter of independent variable x_k for individuals in group j.

Level 2 regression equation (with group-level variables):

$$E[\beta_{0,j}|w_{1,j},...,w_{m,j}] = \gamma_{0,0} + \gamma_{0,1}w_{1,j} + ... + \gamma_{0,M}w_{m,j}$$

In which $E[\beta_{0,j}|w_{1,j},...,w_{n,j}]$ is the expected value of intercept β_0 for group j, given certain values of the group-level independent variables; $w_{l,j}$ is the value of group-level independent variable w_l for group j; $\gamma_{0,0}$ is the intercept; and $\gamma_{0,L}$ is the slope parameter of group-level independent variable w_l (as a predictor of the intercept for group j).

In our case, estimating a logistic random intercept model means that both individual-level predictors (i.e. variables measured at the level of Senators or Representatives), and group-level predictors (i.e. variables measured at the level of the state) can be used to predict voting behavior, and that Congress members from the same state are allowed to have relatively similar voting behavior. For each model discussed in the remainder of this section, we will specify whether variables were treated as individual-level predictors (to be added to the level 1 equation) or a group-level predictors (to be added to the level 2 equation). See Table 1 for a summary of all the predictors used in our models.

6.1 Voting Behavior

To construct the dependent variable, voting behavior, we used the GovTrack.us bill database to retrieve outcomes for each of the congressional votes to be analyzed. Votes in favor of cap-and-trade were coded as 1, votes against it were coded as 0. Absence from the vote and abstention were treated as missing data. During the vote on the Climate Stewardship Act of 2003 (S.Amdt.2028), 43 Senators voted for, 55 voted against and 2 did not vote. When the Climate Stewardship and Innovation Act of 2005 was voted upon in plenary sitting (S.AMDT.826), 38 Senators voted for, 60 voted against

Name	Description	Unit	Level
Crude oil and gas extraction Gas utilities Petroleum refining Coal mining	industry payroll relative to gross personal income of constituency	$ per $1.000 of gross personal income	state[a]
Nuclear energy[b] Renewable energy[b]	no. of establishments relative to total no. in constituency	no. per 1.000 establishments	state
Public concern	public concern about climate change relative to other states	standard deviations from mean	state
Electoral margin	electoral margin of incumbent in most recent election	% of votes	legislator
Proximity[b]	proximity of next election date for incumbent	no. of days	legislator
Crude oil and gas PAC contributions Gas utilities PAC contributions Petroleum refining PAC contributions Coal mining PAC contributions Nuclear energy PAC contributions Renewable energy PAC contributions	PAC contributions from industry relative to total PAC contributions	$ per $1.000 of PAC contributions	legislator
Environmental PAC contributions	PAC contributions from environmental organizations relative to total PAC contributions	$ per $1.000 of PAC contributions	legislator
Party affiliation	Republican or Democratic/independent party affiliation	0 or 1	legislator

Table 1: The predictors used in our models, their units and levels of measurement. State-level variables were entered into the models as group-level predictors, whereas variables measured at the level of legislators were entered as individual-level predictors. [a] measured at the district-level, and thus at the level of the legislator, for Representatives who voted upon the American Clean Energy and Security Act. [b] not measured for Representatives who voted upon the American Clean Energy and Security Act.

and 2 did not vote. During the vote on the motion of cloture of debate on the America's Climate Security Act of 2008 (S.Amdt. 4825), 36 Senators voted for, 48 voted against and 16 did not cast their vote. Finally, when the American Clean Energy and Security Act of 2009 was voted upon in the House (H.R. 2454), 219 Representatives voted for, 211 voted against, and 3 Representatives did not vote.

Note that if absence and abstentions were treated as missing observations, then most likely these observations were not missing completely at random (MCAR). Rather, some Congress members may have been absent or abstained for reasons to do with other variables in our data (a situation named 'missing at random' or MAR): for example, members of the Democratic party who also had a strong presence of disadvantaged industries in their district may have been more likely to abstain from voting. Worse even, the voting behavior data might be not missing at random (NMAR), meaning that their missingness actually depended on the value of the missing variable (even when controlling for other variables in the analysis). This would be the case, for example, if Congress members who were absent would have most likely voted against had they been present (perhaps because they used absence as a less conspicuous way to prevent the bill from passing), and if this behavior could not have been predicted purely on the basis of variables included in the analysis. Data that are MAR and MNAR can bias the results of statistical analyses, particularly when the number of missing values is moderate to high, as in the case of the America's Climate Security Act of 2008. The possibility of such a bias must be taken into account when interpreting the results of our analyses.

6.2 Model 1: Constituency Interests

6.2.1 Disadvantaged Industries

In order to determine the presence of disadvantaged industries in each legislator's constituency, we first had to knowing which industries were predicted to lose most under a cap-and-trade system. On the basis of the so-called Inter-temporal General Equilibrium Model (IGEM), Goettle and Fawcett (2009) calculated what percent of their income different industries in the U.S. could lose due to cap-and-trade by 2030. Four industries were foreseen to be especially vulnerable to cap-and-trade legislation: crude oil and gas extraction, gas utilities, petroleum refining and coal mining. By 2030, these industries were predicted to lose up to 38% of their revenues due to to cap-and-trade (see Table 2); no other industry was expected to lose more than 5% of their revenues compared to the baseline. As the costs associated with cap-and-trade appear to be concentrated in these sectors, they fit well with our description of disadvantaged industries. Legislators with a high presence of these industries in their constituencies should be less likely to support

IGEM code	Industry name	Revenue loss by 2030
4	Crude oil and gas extraction	-8.74%
31	Gas utilities (services)	-9.62%
16	Petroleum refining	-10.48%
3	Coal mining	-38.01%

Table 2: The most disadvantaged industries and their projected revenue loss under cap-and-trade compared to baseline by 2030. Source: Goettle and Fawcett (2009).

cap-and-trade.

For the analyses involving cap-and-trade bills voted upon in the Senate, industry presence was calculated at the state level, as states form the geographical constituencies of Senators. After converting the IGEM codes used by Goettle and Fawcett to 4-digit NAICS codes, we used U.S. Economic Census Bureau County Business Patterns data on the geographical distribution of industry groups to calculate the total payroll of each disadvantaged industry in every state, during the year in which the bill was voted upon. The U.S. Census Bureau withholds data if they risk disclosing information on individual businesses; when this was the case, we took the total payroll of that industry for the entire U.S. and subtracted the amount that could be ascribed to particular states. We then divided the rest of the payroll between all states for which data were missing, in proportion to the states' gross personal income in that year as calculated by the U.S. Bureau of Economic Analysis.

After calculating total industry payrolls for every state, we corrected our measure for the size of the state's economy, as an equal decrease in an industry's payroll was thought to be more important for a state with a small economy than for a state with a large one. Thus, we divided statewide industry payrolls by the gross personal income in that state in the same year (based on data from the U.S. Bureau of Economic Analysis). Finally, the proportions were multiplied by 1.000 to achieve workable values. The result of these calculations was a number indicating the relative presence of each disadvantaged industry in each state at the time our cap-and-trade bills were subjected to a plenary vote in the Senate. Since these indicators were measured at the state level, they were identical for Senators from the same state; thus, they were treated as group-level predictors in our random intercept models.

For the American Clean Energy and Security Act, which was voted upon in the House, the procedure was slightly different. The relevant geographical level of detail here was the level of congressional districts, since these are the constituencies in which Representatives are elected. As the U.S. Economic Census Bureau does not provide payroll data at the level of the district, we

worked in two steps: first, we obtained indicators at the county level; then, we aggregated those data at the level of the congressional district. Thus, we first obtained the total payroll of each industry in each county from U.S. Economic Census Bureau 2009 County Business Patterns data. When industry revenue data were withheld at the county level for a certain industry, we took the total payroll of that industry on the state level and subtracted all the pay that could be ascribed to a particular county in that state. We then divided the rest of the payroll between all counties within that state for which data were missing, in proportion to the counties' gross personal income in 2009.

As a second step, we needed to aggregate the payroll data at the level of congressional districts. Thus, for each district, we summed the total payrolls of all counties located within the district. When a county was located in multiple districts, its payroll was weighted by the percentage of its population that was located in the district, based on 2002 data from the Missouri Census Data Center. Next, in order to correct for differences in economy size, we summed the gross personal income of all counties in the district in 2009 (according to U.S. Bureau of Economic Analysis data), again weighting the amounts by the degree of population overlap between county and district. We then divided the total district payroll by the total district gross personal income. Finally, the resulting proportion was multiplied by 1.000 to obtain workable values. The result of these calculations indicated the relative presence of each disadvantaged industry for each congressional district, at the moment the American Clean Energy and Security Act was voted upon. Unlike for Senators, the industry indicators were different for each Representative (because each has his or her own congressional district); they were thus treated as individual-level predictors.

6.2.2 Benefiting Industries

When we look for industries that could experience large positive impacts from a cap-and-trade scheme, two obvious candidates are the renewable and nuclear energy sectors. Although these sectors are currently fairly small in the U.S., they are almost certain to gain from a system in which energy prices rise but production costs stay relatively low compared to other, more carbon-intensive energy production methods. Paltsev et al. (2008) assert that with a cap-and-trade system similar to (but somewhat less ambitious than) the America's Climate Security Act of 2008, nuclear electricity generation could increase sixfold by 2050. And even though projections for energy from renewable sources are not as impressive, all cap-and-trade bills except the Climate Stewardship Act of 2003 provided at least some support for clean energy research and development. In addition, with its renewable energy standard, the American Clean Energy and Security Act of 2009 included an explicit mandate to increase the usage of renewable energy.

To determine the presence of nuclear and renewable energy plants in each

constituency, we used a similar method as for the disadvantaged industries. However, because the number of plants per state is quite low on average, the majority of state-level payroll data was withheld by the U.S. Economic Census Bureau for confidentiality reasons. We thus used County Business Patterns data regarding the number of renewable or nuclear energy companies, which are more readily available at the state level. We divided this number by the total number of businesses in each state according to County Business Patterns data, assuming that for states with fewer businesses each business is of greater importance. Next, we multiplied the results by 1.000 to make the values more workable. The results of these calculations indicated the relative presence of the renewable and nuclear energy sectors per state.

For smaller geographical units like counties, data regarding the number of businesses in benefiting industries were largely withheld by the U.S. Census Bureau. Thus, measures of benefiting industry presence could not be constructed for Representatives' constituencies, and as a consequence the effect of benefiting industries could not be evaluated for the American Clean Energy and Security Act. In all other cases, they were measured at the state level and thus treated as group-level predictors of voting behavior.

6.2.3 Public Concern

To obtain estimates of public concern about climate change in each state, we looked at the results of 16 surveys, administered to nationwide samples between 2003 and 2009. Each of the surveys included one of three questions, which probed the respondent's concern about climate change. The first question asked whether respondents considered global warming to be a *very serious problem*, rather than *somewhat serious*, *not too serious*, or *not a problem* (Pew Research Center, question included in 6 surveys between 2006 and 2009). The second question probed whether respondents thought that global warming was already *causing a serious impact now*, rather than having an impact *sometime in the future*, or *not having a serious impact* (CBS News/New York Times, question included in 7 surveys between 2003 and 2009). In a third and last question, respondents were asked whether the statement *"Global climate change has been established as a serious problem, and immediate action is necessary"* most closely reflected their opinion, rather than less concerned statements about climate change (NBC/Wall Street Journal, question included in 3 surveys between 2006 and 2009).

Since constituents who are strongly concerned about climate change are most likely to take action, we were most interested in estimating what share of constituents in each state could be classified as such. Thus, for each of the 16 surveys that included one of the above-mentioned questions, we counted the percentage of respondents from each state that gave the *most climate-concerned answer* to the question being asked. For example, in a 2007 Pew Research Center survey, 45% of respondents from Alabama stated that global

warming was a very serious problem, thus giving the most climate-concerned answer to the question they were asked. For each survey, we then converted these percentages to standardized scores, based on how respondents from other states responded to the same question. For example, in the same 2007 Pew Research Center survey, 42% of nationwide respondents thought global warming was a very serious problem, and state averages differed from this nationwide average with a standard deviation of 19%. Thus, for the 2007 Pew Research Center survey, Alabama would get a standardized score of 0.15 (45% minus 42%, divided by 19%).

This way, for each state we obtained a standardized score for each survey, which indicated how many respondents in that state had given the most climate-concerned answer compared to respondents from other states. Next, for each state we summed all of these 16 standardized scores, with scores based on larger sample sizes getting larger weights. For example, Alabama's score for the 2007 Pew Research Center survey was based on a sample size of 20 respondents. Since over 16 surveys we had a total of 130 respondents from Alabama, the score of 0.15 obtained from the 2000 survey received a weight of 15.4% (20 divided by 130) in the calculation of Alabama's overall score. This way, for each state we obtained a weighted average score, indicating how many respondents from this state could be classified as 'strongly climate-concerned', compared to respondents from other states. Finally, these weighted average scores were again standardized to obtain a public concern indicator with a mean of 0 and a standard deviation of 1.

By aggregating information from 16 surveys, we aimed to compensate for small and variable sample sizes (after aggregating over all questions we reached a satisfactory average state sample size of 341, although its standard deviation was still quite high at 303.5) and for possible sampling biases. Since survey data were not available at the level of congressional districts, we used state-level public concern indicators to predict voting behavior of Representatives as well as Senators. We considered it reasonable to assume that within each U.S. state, the electorate in different districts would be similarly concerned about climate change. Public concern was thus treated as a group-level variable in all models.

In sum, the first random intercept logistic regression model we estimated (model 1) included a presence indicator for each of the four disadvantaged industries, one for each of the two benefiting industries, and one indicator for public concern about climate change. We will collectively refer to these variables as *constituency interest indicators*. By adding indicators of all constituency interests to the model simultaneously, we sought to gauge the effect of each indicator, over and above that of the others. For example, it is possible that some of the disadvantaged industries have a particularly strong presence in rural areas, in which the electorate may generally be less concerned about climate change. Similarly, in constituencies where many inhabitants are dependent on a disadvantaged industry, public concern about

climate change could be low as a consequence. By estimating the effect of industry presence along with that of public concern, we aimed to avoid ascribing influence to one factor where it was actually serving as a proxy for another.

6.3 Models 2A-G and 3A-G: Electoral Margin and Proximity of Elections

To calculate the electoral margin of a candidate, we used data provided by the Federal Election Commission's Public Records Office on the results of congressional elections between 1998 and 2008. We simply took the percentage of votes that went to this candidate when they were last elected, and subtracted the percentage of votes that went to the second most popular candidate in their constituency. For Congress members that were unopposed in their most recent election we used the electoral margin they obtained last time they faced competitive elections. For the two members who had been appointed by their state governor after a seat had become vacant in the course of the term (both in 2007), data on the electoral margin were considered missing. In this case, there was reason to believe that data were missing completely at random (MCAR), since we did not expect appointed members to differ from elected members in any systematic way relevant to our analyses.

In order to evaluate the interaction between electoral margin on the one hand, and constituency interest indicators on the other hand, we fitted a series of logistic random intercept models (models 2A-G). Each model included all indicators that were present in model 1, as well as a direct effect of electoral margin on voting behavior, and a interaction effect between margin and one of the constituency interest indicators. Note that although we did not hypothesize any direct effect of margin on voting behavior, we did include it in the model, because omitting it would seriously complicate the interpretation of model results (see, for example, Cox, 1984). Because electoral margin was measured at the level of individual Congress members, this indicator and its interaction terms with constituency interests were treated as individual-level variables.

To calculate the proximity of future elections for Senators who voted on one or more of the cap-and-trade bills, we first identified when each of these Senators was elected. For example, Senators who voted on the Climate Stewardship Act of 2003 may have been elected in 1998, in 2000 or in 2002. On the basis of this date, we calculated the number of days that this Senator was removed from his or her next election date. As was the case for electoral margin, we fitted a series of logistic random intercept models (models 3A-G) which added to model 1 a direct effect of election proximity as well as an interaction between proximity and one of the constituency interest indicators.

Again, election proximity and its interaction terms with other variables were considered individual-level variables. Models 3A-G were not fitted to the data regarding the American Clean Energy and Security Act, because Representatives are not elected on a rotating basis (meaning that the proximity of elections was identical for all Representatives).

The evaluation of interaction effects in nonlinear models is complicated by the fact that the size of the interaction effect depends on the value of all independent variables (Ai & Norton, 2003). This means that in contrast to linear models, the sign and size of the interaction term's regression coefficient cannot be easily interpreted. Thus, if the coefficient of an interaction term proved to be (at least marginally) significant, we applied the visualization approach suggested by Greene (2010). Based on the estimated regression coefficients, we graphed the partial effect of constituency interests on voting behavior for different levels of electoral margin (or proximity of elections) while holding the covariates constant. By plotting the effect of constituency interests given different levels of electoral margin or proximity, we aimed to visualize how the latter two variables affected the influence of the former. We only modeled interaction effects for the independent variables in model 1 whose effects were estimated to be significant at the .10 level, reasoning that if statistical power was too small to detect a main effect, then it would likely be too small to draw any conclusions about interactions.

6.4 Models 4A-G: Campaign Contributions

To determine the composition of campaign contributions to each legislator, we used data from Opensecrets.org. These data contain information on which PACs (Political Action Committees) contributed what amounts of money to which candidates' campaigns, as well as on the industries or ideologies that these PACs are predominantly associated with. First, for each legislator we calculated the total amount that PACs contributed to their most recent electoral campaign, in the form of both direct contributions and indirect expenditures in favor of the candidate. Next, we calculated what share of these funds came from PACs associated with each of the disadvantaged industries, with each of the benefiting industries, and with environmental organizations. Finally, we multiplied the shares by 1.000 to achieve workable values. The resulting measure indicated the relative importance of contributions connected to each of our constituency interests, during the most recent electoral campaign of each legislator.

To determine whether campaign contributions mediate the effect of industry presence and public concern on voting behavior, we followed Baron and Kenny's four steps to establish the presence of a mediation effect (Baron, Kenny, et al., 1986). First, Baron and Kenny require that the independent variable must significantly predict the criterion—that is, constituency interests must predict the voting behavior of Congress members. Only for

constituency interests whose effect on voting behavior was significant at the .10 level in model 1 did we deem this criterion to be fulfilled. If the first criterion was met, we proceeded to evaluate the second.

The second requirement towards establishing mediation according to Baron et al., is that the predictor must significantly predict the mediating variable—in other words, constituency interests must predict campaign contributions. To test this, we estimated a series of random intercept compound Poisson linear models. Compound Poisson linear models are models used to estimate the effect of predictors on a criterion, which is thought to follow a compound Poisson distribution: a continuous distribution on the positive reals, with an added mass at zero (Jørgensen, 1997, p. 231). This seemed to be the case for PAC contributions: values were never lower than zero, but were often equal to zero since not all legislators received contributions from each of the PAC types. Each model used one of the constituency interest indicators as a predictor, and its corresponding campaign contributions indicator as criterion. For example, we would estimate a model with coal mining as a predictor, and with coal mining PAC contributions as a criterion. In this case, Baron and Kenny's second criterion would be fulfilled if the presence of coal mining was a significant predictor of coal mining PAC contributions.

The third criterion for mediation is that the mediator must predict the criterion–that is, PAC contributions should be significant predictors of voting behavior. To test this, we estimated a series of random intercept logistic regression models, with all constituency interest indicators as covariates and voting behavior as the criterion. In addition, each model had one of the PAC Contribution indicators as an individual-level predictor (models 4A-G). For example, to test the effect of Coal Mining on voting behavior, we would fit a model including coal mining PAC contributions as a predictor, as well as covariates for all other constituency interests. In this way, we could test the direct effect of PAC contributions on voting behavior, while controlling for other variables which may also affect voting behavior. Since PAC contributions were different for each legislator, they were teated as individual-level variables.

Finally, if all previous conditions have been fulfilled, a fourth step allows us to determine the strength of the mediation. Specifically, we need to evaluate to what extent the effect of an constituency interest indicator on voting behavior is weakened by adding its corresponding PAC contribution indicator to the model. If the size of this effect is reduced to zero, we speak of *full* mediation. Otherwise, the effect of constituency interests on voting behavior is said to be *partially* mediated by PAC contributions.

6.5 Model 5: Party Affiliation

To identify the party affiliation of each Congress member at the time each cap-and-trade bill was voted upon, we used the GovTrack.us bill database. In

the 105th Congress, which voted upon the Climate Stewardship Act of 2003 (S.Amdt.2028), 48 Senators were Democratic and 51 were Republican. During the 107th Congress, when the Climate Stewardship and Innovation Act of 2005 was voted upon (S.AMDT.826), there were 45 Democratic Senators and 54 Republicans. The 110th Congress, which decided upon America's Climate Security Act of 2008 (S.Amdt. 4825), had 50 Democratic Senators and 48 Republican ones. Finally, during the 111th Congress, when the American Clean Energy and Security Act of 2009 was voted upon, 255 House members were Democrats and 179 were Republicans. A Republican party affiliation was coded as 0; a Democratic affiliation was coded as 1. Since all three independent Congress members in our data set were to some extent linked to the Democratic party in this time period, we grouped them together with Democratic members, coding their affiliation as 1 also.

Previously, we described the possibility that party affiliation serves only as a proxy of constituency interests: constituents may simply vote for the candidate whose voting preferences best represent their interests. In this way, the party affiliation of a legislator comes to indicate the characteristics of his or her constituents without necessarily having explanatory power of its own. We thus estimated a final random intercept logistic regression model (model 5) including all indicators present in model 1 as well as a party affiliation indicator. This way, we could evaluate the effect of party affiliation over and above constituency interests. Furthermore, if adding party affiliation to the model diminished the effect size of constituency interests compared to model 1, this would be a first indication that party affiliation was in fact serving as a proxy for constituency interests. Since party affiliation can be different for legislators from the same state, it was treated as an individual-level variable.

7 Results

In the following sections we will describe the results of fitting the above-mentioned models to the data regarding the Climate Stewardship Act of 2003, the Climate Stewardship Act of 2005, the America's Climate Security Act of 2008, and the American Clean Energy and security Act of 2009. All logistic random intercept models were fit by means of maximum-likelihood estimation with adaptive Gauss-Hermite approximation with 9 quadrature points, implemented using the lme4 package in statistical computing program R (Bates, Maechler, & Bolker, 2012). For all relevant fixed effects, we will report the following statistics:

- β: the estimated regression coefficient, denoting an estimate of the expected change in the log-odds of a vote in favor of cap-and-trade given a one-unit increase in the independent variable. Positive values indicate that an increase in the independent variable is expected to

result in increased odds of a vote in favor of cap-and-trade; negative values indicate that it is expected to result in decreased odds.

- *SE*: the standard error of the estimated regression coefficient.
- $\exp(\beta)$ or *odds ratio*: the exponent of the estimated regression coefficient, denoting the factor by which the odds of a vote in favor of cap-and-trade are expected to change, given a one-unit increase in the independent variable. A value above 1 denotes that the odds of a vote in favor of cap-and-trade are expected to increase; a value below 1 denotes that the odds are expected to decrease.
- p: the result of likelihood ratio tests comparing the log-likelihood of the current model to the log-likelihood of an identical model that did not include the effect being tested. P-values below 0.1 are taken to reflect weak evidence that the current model has a better fit than the reduced model; p-values below 0.05 are taken to reflect moderate evidence; p-values below 0.01 are taken to reflect strong evidence and p-values below 0.001 are taken to reflect very strong evidence.
- *McFadden* R^2: a pseudo-R^2 based on comparison the same two log-likelihoods, calculated according to the method proposed by McFadden (1973). Varies between 0 and 1; larger values indicate that adding this variable to the model led to a large increase in likelihood, and that the effect is estimated to uniquely explain a large amount of variance in the response variable.

Compound Poisson models were estimated by means of maximum-likelihood estimation with Laplace approximation, implemented using the cplm package in R (Zhang, 2012). For the fixed effects in these models, we reported the same statistics as in logistic random intercept models, except for $\exp(\beta)$, which has no intuitive meaning in the case of compound Poisson models. Finally, in all cases, missing data were handled through pairwise deletion. On the one hand, pairwise deletion is more likely to lead to biased estimates compared to listwise deletion; on the other hand, it makes cross-model comparisons easier, since the sample size on which specific parameter estimates are based does not change across models (Kim & Curry, 1977).

7.1 Climate Stewardship Act of 2003

7.1.1 Model 1: Constituency Interests

The results of fitting model 1 to the data provided moderately strong evidence for an effect of crude oil and gas extraction ($\beta = -0.461, SE = 0.240, \exp(\beta) = 0.631, p = 0.020,$ *McFadden* $R^2 = 0.063$): the stronger the presence of this industry in a state, the less likely its Senators were to vote in favor of cap-and-trade. The same was true for the presence of

the gas utilities industry ($\beta = -3.172, SE = 1.744, \exp(\beta) = 0.042, p = 0.050, McFadden\ R^2 = 0.046$) on voting behavior. We did not find definite evidence for any other disadvantaged or benefiting industry affecting the odds that a Senator voted for or against the Climate Stewardship Act of 2003. We also found very strong evidence for an effect of public concern (($\beta = 1.842, SE = 0.490, \exp(\beta) = 6.311, p < .001, McFadden\ R^2 = 0.185$)): the more the electorate in a state was concerned about climate change, the more likely its Senators were to vote in favor of cap-and-trade. As noted above, interaction and mediation effects were only investigated for constituency interest indicators that were found to be significant at the .10 level in model 1: this was the case for crude oil and gas extraction, gas utilities and public concern.

7.1.2 Models 2A-G and 3A-G: Electoral Margin and Election Proximity

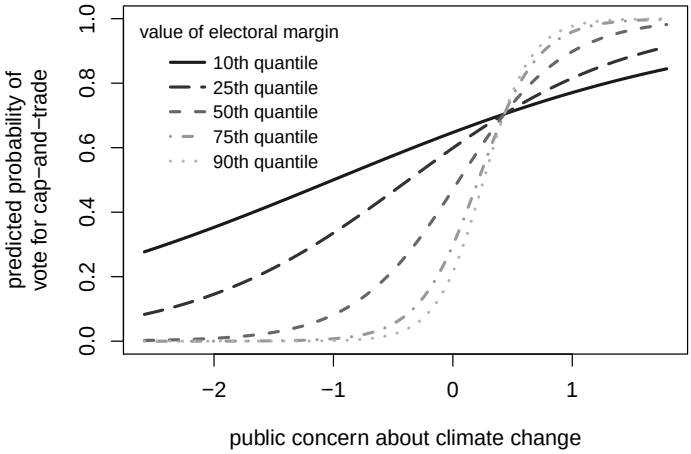

Figure 1: Partial effect of public concern on support for the Climate Stewardship Act of 2003, given different levels of electoral margin, keeping all other covariates constant at their mean.

The results of fitting models 2B, 2D and 2G led us to conclude that only the interaction effect between margin and public concern was significant ($\beta = 0.074, SE = 0.031, \exp(\beta) = 1.077, p = 0.005, McFadden\ R^2 = 0.105$). To interpret this interaction, we plotted the partial effect of public concern on voting behavior given different levels of electoral margin, holding all other covariates constant at their mean (see Figure 1). The levels of electoral

margin correspond to the 10th, 25th, 50th, 75th and 90th quantiles of this variable. Steeper slopes correspond to stronger effects of public concern. Surprisingly, the interaction seemed to be opposite to what we expected: overall, larger electoral margins corresponded to stronger effects of public concern on voting behavior. Finally, according to the results of fitting model 3B, 3D and 3G, none of the interaction effects between constituency interests and election proximity was significant.

7.1.3 Models 4A-G: Campaign Contributions

Fitting compound Poisson models resulted in very strong evidence for an effect of crude oil and gas extraction ($\beta = 0.084, SE = 0.017, p < .001$, *McFadden* $R^2 = 0.025$) and strong evidence for an effect of gas utilities ($\beta = 0.728, SE = 0.242, p = 0.004$, *McFadden* $R^2 = 0.011$): the stronger the presence of these industries, the more campaign contributions that Senators received from PACs associated with them. Similarly, there was moderate evidence for an effect of climate concern on environmental PAC contributions ($\beta = 0.742, SE = 0.316, p = 0.028$, *McFadden* $R^2 = 0.013$): the more concerned a Senator's electorate was about climate change, the more contributions he or she received from environmental groups. Thus, Baron and Kenny's second condition seemed to be satisfied for each of these constituency interest variables.

In accordance with Baron and Kenny's third condition, the results of fitting model 4B provided very strong evidence for an effect of crude oil and gas extraction PAC contributions on voting behavior ($\beta = -0.148, SE = 0.044, \exp(\beta) = 0.863, p < .001$, *McFadden* $R^2 = 0.176$). The larger these contributions, the less likely a Senator was to vote in favor of cap-and-trade. Moreover, the effect of crude oil and gas extraction in this model was greatly reduced in size compared to model 1, so that it did not differ significantly from zero any longer. The same was not true for gas utilities PAC contributions: based on the parameter estimations of model 4D, these contributions were not significant predictors of voting behavior ($\beta = -0.051, SE = 0.034, \exp(\beta) = 0.950, p = 0.149$, *McFadden* $R^2 = 0.026$). In contrast, fitting model 4G resulted in very strong evidence for an effect of environmental PAC contributions on voting behavior ($\beta = 1.034, SE = 0.326, \exp(\beta) = 2.812, p < .001$, *McFadden* $R^2 = 0.243$), with larger contributions being associated with higher odds of a vote in favor of cap-and-trade. The size of the effect on public concern was not diminished compared to model 1. In sum, both for crude oil and gas extraction and for public concern, all conditions for mediation through PAC contributions were fulfilled. However, only the effect crude oil and gas extraction came close to being fully mediated by PAC contributions.

7.1.4 Model 5: Party affiliation

The results of fitting model 5 to the data confirmed that there was very strong evidence for an effect of party affiliation on voting behavior ($\beta = 5.177, SE = 1.269, \exp(\beta) = 177.103, p = 0.001, McFadden\ R^2 = 0.470$): as expected, Republicans were less likely to vote in favor of cap-and-trade than Democrats (and independents). Furthermore, adding party affiliation to the model moderately reduced the effect size of crude oil and gas extraction (though not those of gas utilities or public concern), and rendered all effects except that of public concern non-significant.

7.2 Climate Stewardship and Innovation Act of 2005

7.2.1 Model 1: Constituency Interests

Fitting model 1 to the data, we found strong evidence for an effect of crude oil and gas extraction on voting behavior ($\beta = -0.282, SE = 0.134, \exp(\beta) = 0.755, p = 0.010, McFadden\ R^2 = 0.078$). However, we did not find definite evidence for any other disadvantaged or benefiting industry affecting voting behavior. We also found very strong evidence for an individual effect of public concern on voting behavior ($\beta = 2.147, SE = 0.455, \exp(\beta) = 8.559, p < .001, McFadden\ R^2 = 0.285$). Since only the effects of crude oil and gas extraction and public concern were found to be significant at the .10 level in model 1, we only evaluated interaction effects with electoral variables and mediation by campaign contributions for these two constituency interest indicators.

7.2.2 Models 2A-G and 3A-G: Electoral Margin and Election Proximity

The results of fitting model 2B indicated that there was weak evidence for an interaction effect between crude oil and gas extraction and electoral margin ($\beta = -0.015, SE = 0.008, \exp(\beta) = 0.985, p = 0.062, McFadden\ R^2 = 0.045$). A visualization of the partial effect of crude oil and gas extraction suggested that the interaction effect was opposite to what we expected: slopes (and thus partial effects) were generally stronger with higher levels of electoral margin (see Figure 2). Fitting model 2G also resulted in strong evidence for an interaction effect between public concern and electoral margin ($\beta = 0.087, SE = 0.036, \exp(\beta) = 1.077, p = 0.004, McFadden\ R^2 = 0.108$). Again, a visualization suggested that the effect was opposite to what we hypothesized: larger margins were generally associated with steeper slopes, meaning that the effect of public concern was expected to be larger for Congress members with larger margins (see Figure 3). Finally, after fitting models 3B and 3G we concluded that neither of the interaction effects between constituency interests and election proximity was significant.

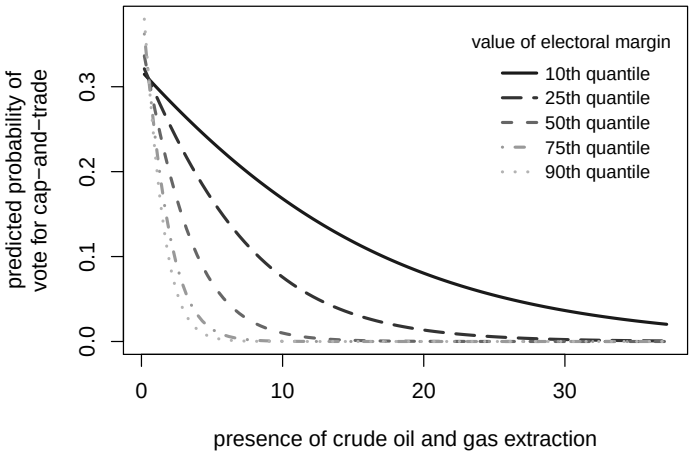

Figure 2: Partial effect of the presence of crude oil and gas refining on support for the Climate Stewardship Act of 2005, given different levels of electoral margin, keeping all other covariates constant at their mean.

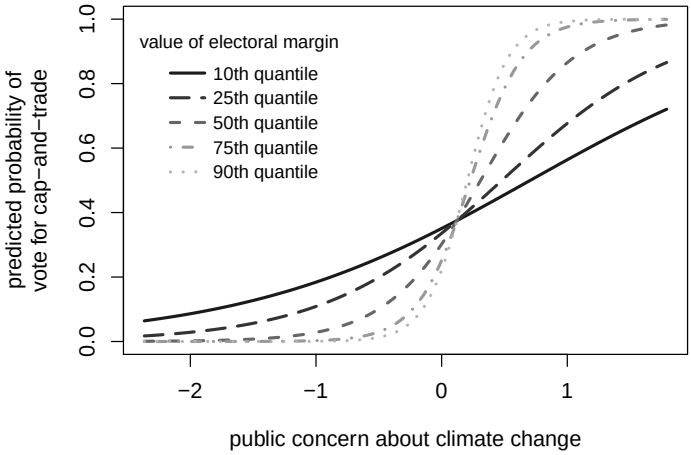

Figure 3: Partial effect of public concern on support for the Climate Stewardship Act of 2005, given different levels of electoral margin, keeping all other covariates constant at their mean.

7.2.3 Models 4A-G: Campaign Contributions

Fitting compound Poisson models resulted in very strong evidence that the presence of crude oil and gas extraction in a state predicted the amount of campaign contributions that Senators received from PACs associated with that industry ($\beta = 0.066, SE = 0.014, p < .001, McFadden\ R^2 = 0.022$). There was also moderately strong evidence for an effect of public concern about climate change on the amount of contributions received from environmental PACs ($\beta = 0.725, SE = 0.328, p = 0.036, McFadden\ R^2 = 0.012$). Baron and Kenny's second condition was thus fulfilled for both of these constituency interests.

The results of fitting model 4B indicated that Baron and Kenny's third criterion, too, was fulfilled for crude oil and gas extraction: PAC contributions from this industry were a significant predictor of voting behavior ($\beta = -0.084, SE = 0.034, \exp(\beta) = 0.919, p = 0.007, McFadden\ R^2 = 0.094$). Furthermore, the direct effect of crude oil and gas extraction was strongly diminished in comparison to model 1 and no longer differed significantly from zero. The results of fitting model 4G, however, did not allow us to conclude the same for public concern: environmental PAC contributions were not a significant predictor of voting behavior ($\beta = 0.01, SE = 0.019, \exp(\beta) = 1.001, p = 0.576, McFadden\ R^2 = 0.004$). In sum, only for crude oil and gas extraction did all conditions for mediation through PAC contributions seem to be fulfilled. In addition, the effect of crude oil and gas extraction came close to being fully mediated by PAC contributions.

7.2.4 Model 5: Party Affiliation

The results of fitting model 5 provided very strong evidence for an effect of party affiliation on voting behavior ($\beta = 3.174, SE = 0.834, \exp(\beta) = 23.893, p < .001, McFadden\ R^2 = 0.262$). Furthermore, adding party affiliation to model 1 somewhat diminished the effect sizes of crude oil extraction and public concern, leaving only public concern as a significant predictor of voting behavior.

7.3 America's Climate Security Act of 2008

7.3.1 Model 1: Constituency Interests

The results of fitting model 1 to the data provided strong evidence for an effect of crude oil and gas extraction on voting behavior ($\beta = -0.347, SE = 0.161, \exp(\beta) = 0.707, p = 0.005, McFadden\ R^2 = 0.107$). We did not find definitive evidence for an effect of any other disadvantaged or benefiting industry on voting behavior. Furthermore, there was very strong evidence for an individual effect of public concern on voting behavior ($\beta = 2.957, SE = 0.940, \exp(\beta) = 19.239, p < .001, McFadden\ R^2 = 0.269$). Interaction and

mediation were thus only evaluated for the effects of crude oil and gas extraction and of public concern, as these were the only effects found to be significant at the .10 level in model 1.

7.3.2 Models 2A-G and 3A-G: Electoral Margin and Election Proximity

Fitting model 2B did not result in definite evidence for an interaction effect between crude oil and gas extraction and electoral margin. The same was true for model 2G: no conclusive evidence was found for an interaction between public concern and electoral margin. A similar conclusion was reached for election proximity: fitting models 3B and 3G did not provide definite evidence that either of the constituency interest indicators interacted with proximity to affect voting behavior.

7.3.3 Models 4A-G: Campaign Contributions

The estimation of compound Poisson models resulted in strong evidence for an effect of crude oil and gas extraction on the amount of campaign contributions coming from PACs associated with this industry ($\beta = 0.037, SE = 0.011, p = 0.002, McFadden\ R^2 = 0.01$). However, there was no definite evidence for a connection between public concern and the amount of PAC contributions received from environmental PACs ($\beta = 0.319, SE = 0.315, p = 0.367, McFadden\ R^2 = 0.002$). Thus, Baron and Kenny's second condition for mediation was only met for crude oil and gas extraction.

The third criterion, too, seemed to be fulfilled for crude oil and gas extraction: PAC contributions from this industry were a significant predictor of voting behavior ($\beta = -0.030, SE = 0.010, \exp(\beta) = 0.971, p < .001, McFadden\ R^2 = 0.317$). Furthermore, the direct effect of crude oil and gas extraction was reduced in size and no longer differed significantly from zero in model 4B. Similar conclusions were drawn from the fitting of model 4G: environmental PAC contributions were a significant predictor of voting behavior ($\beta = 0.047, SE = 0.022, \exp(\beta) = 1.048, p < .001, McFadden\ R^2 = 0.194$), and adding this effect slightly diminished the significance of the effect of public concern compared to model 1. In sum, for only crude oil and gas extraction did the results meet all conditions for mediation through PAC contributions. Moreover, the effect of crude oil and gas extraction approached the fourth criterion for full mediation by PAC contributions.

7.3.4 Model 5: Party affiliation

Unlike with the other data sets, when model 5 was applied to the data regarding the America's Climate Security Act of 2008, the parameter estimates did not converge. This was the case when we used adaptive Gauss-Hermite

approximation, but also when we tried other approximation methods. Since the cause of this non-convergence was likely to be overfitting, we fit the model again without the parameters indicating benefiting industries; this time, estimates did converge. As before, fitting this model resulted in very strong evidence for an effect of party affiliation ($\beta = 8.647, SE = 3.077, \exp(\beta) = 5691.614, p < .001, \textit{McFadden } R^2 = 0.658$). Adding party affiliation as a factor did not decrease the effect sizes of crude oil and gas extraction of public concern; both remained significant predictors of voting behavior.

7.4 American Clean Energy and Security Act of 2009

7.4.1 Model 1: Constituency Interests

The results of fitting model 1 to the data provided very strong evidence for an effect of crude oil and gas extraction on voting behavior ($\beta = -0.107, SE = 0.034, \exp(\beta) = 0.898, p < .001, \textit{McFadden } R^2 = 0.024$). Moreover, and surprisingly, we found moderately strong evidence for an effect of gas utilities, with a sign opposite to what was predicted ($\beta = 0.511, SE = 0.220, \exp(\beta) = 1.666, p = .025, \textit{McFadden } R^2 = 0.01$). In other words, the stronger the presence of gas utilities in a congressional district, the more likely its Representative was to vote in favor of cap-and-trade. There was no definite evidence for an effect of any other disadvantaged industry on voting behavior. Furthermore, we found very strong evidence for an individual effect of public concern on voting behavior ($\beta = 0.964, SE = 0.144, \exp(\beta) = 2.623, p < .001, \textit{McFadden } R^2 = 0.078$). Since only the effects of crude oil and gas extraction, gas utilities and public concern were found to be significant at the .10 level in model 1, we only analyzed interactions with and mediation of these three effects.

7.4.2 Models 2A-G: Electoral Margin

In order to evaluate the interactions between crude oil and gas extraction, gas utilities and public concern on the one hand, and electoral margin on the other hand, we fitted models 2B, 2D and 2G to the data. None of the results, however, provided definite evidence for an interaction effect between margin an constituency interests. Note that models 3A-G could not be meaningfully fitted to the data regarding the American Clean Energy and Security Act, since the proximity of upcoming elections is equal for all Representatives.

7.4.3 Models 4A-G: Campaign contributions

After fitting a series of compound Poisson models predicting PAC contributions on the basis of constituency interests, we concluded there was very

strong evidence for an effect of crude oil and gas extraction on the amount of PAC contributions coming from this industry ($\beta = 0.057, SE = 0.008, p < 0.001, McFadden\ R^2 = 0.009$). Similar findings were not obtained for gas utilities: the presence of that industry in a district was not found to affect the amount of PAC donations contributed by this industry ($\beta = 0.119, SE = 0.074, p = 0.119, McFadden\ R^2 = 0.001$). As for public concern, on the other hand, there was very strong evidence for a connection with environmental PAC contributions ($\beta = 0.641, SE = 0.159, p < .001, McFadden\ R^2 = 0.006$). In sum, Baron and Kenny's second criterion for mediation appeared to be fulfilled for oil and gas contributions and for public concern.

As for the third criterion, we fitted models 4B, 4D and 4G to investigate the effect of PAC contributions on voting behavior. The results for model 4B provided very strong evidence for an effect of PAC contributions from the crude oil and gas extraction industry ($\beta = -0.016, SE = 0.002, \exp(\beta) = 0.984, p < .001, McFadden\ R^2 = 0.230$). Moreover, adding this PAC contribution indicator strongly diminished the direct effect of crude oil and gas extraction, rendering its effect non-significant. Similarly, the results for model 4D provided moderately strong evidence for an effect of PAC contributions from the gas utilities industry ($\beta = -0.002, SE = 0.001, \exp(\beta) = 0.998, p = 0.012, McFadden\ R^2 = 0.012$), although the direct effect of gas utilities was not diminished or rendered non-significant. In contrast to the direct effect of gas utilities, the effect of gas utilities PAC contributions was in the expected direction, so that larger contributions were associated with decreased odds of a vote in favor of cap and trade. Finally, the results of fitting model 4G indicated that there was very strong evidence for an effect of environmental PAC contributions on voting behavior ($\beta = 0.029, SE = 0.006, \exp(\beta) = 1.030, p < .001, McFadden\ R^2 = 0.07$). Adding environmental PAC contributions to the model only slightly decreased the effect size of public concern; the effect remained significant. In sum, the effects of both crude oil and gas extraction and public concern seemed to be mediated by PAC contributions. Only crude oil and gas PAC contributions seemed to approach being fully mediated by PAC contributions.

7.4.4 Model 5: Party Affiliation

Fitting model 5 led to very strong evidence for an effect of party affiliation ($\beta = 5.199, SE = 0.487, \exp(\beta) = 181.179, p < .001, McFadden\ R^2 = 0.525$). Adding party affiliation to the model did not decrease the effect size of crude oil and gas extraction, gas utilities or public concern, and none of these effects was rendered non-significant.

8 Discussion

In the previous section, we have described the results of fitting several models explaining the voting behavior of Congress members regarding four cap-and-trade bills: the Climate Stewardship Act of 2003; the Climate Stewardship and Innovation Act of 2005; the America's Climate Security Act of 2008; and the American Clean Energy and Security Act of 2009. In the following sections, we will interpret the results, dealing separately with each of the groups of variables we introduced to explain voting behavior.

8.1 Constituency Interests

8.1.1 Disadvantaged industries

Regarding the effect of disadvantaged industry presence on voting behavior, our expectations were largely disconfirmed: most of the disadvantaged industries were not found to affect voting behavior the way we expected them to. When disadvantaged industries were found to have an effect, the pattern was unexpected: crude oil and gas extraction, the disadvantaged industry that was predicted to lose least under a cap-and-trade scenario, was most consistently found to have a significant effect on voting behavior. The only other industry that was once found to have a statistically significant negative effect was gas utilities, which was the second least disadvantaged industry. The presence of the industry that was predicted to lose by far the most under cap-and-trade, namely the coal mining industry, was never found to have a statistically significant effect on voting behavior. The same was true for the second most disadvantaged industry, petroleum refining. Moreover, pseudo-R^2 of disadvantaged industry effects were very low: even crude oil and gas extraction was estimated to explain only a very limited amount of variance in our models.

Four observations can help us gain insight in these somewhat surprising results. First, not all industries are equally concentrated or dispersed across the U.S.: some industries have roughly the same presence in most states (or districts), whereas other industries are strongly present in some places and practically absent in others. We would expect the latter type of industries to have larger explanatory power, since industries that are equally present everywhere are unlikely to explain differences between legislators across constituencies. Indeed, the crude oil and gas extraction industry is an example of an industry with highly variable presence: among the disadvantaged industries, its indicator always had the highest variance. This can help explain why its effect was always found to be significant, despite its relatively small regression coefficients. In the case of the other disadvantaged industries, which have a less variable presence, such small effects would probably have been undetectable.

Second, and on a similar note, the disadvantaged industries that we delineated may have been too narrow. In our data, the means of the industry indicators never exceeded 0.4%, indicating that the average state or district never derived more than 0.4% of its income from any of the disadvantaged industries. In other words, even though all four of the industries would suffer large losses due to cap-and-trade, they may not have affected enough constituents to lead to a large mobilization of resources. Still, when we constructed a composite measure combining the presence of all industries (by IGEM code) weighted by their predicted revenue loss under cap-and-trade, this was never a significant predictor of voting behavior either. This suggests that constituencies' overall economic vulnerability to cap-and-trade did not influence congressional votes, despite being a much broader measure than the presence of particular disadvantaged industries.

Third, it is possible that we were wrong to treat industry presence as a continuous variable: a critical degree of presence may need to be reached before an industry exerts any influence at all. For example, Fleisher (1985) argues that Congress members do not take decisions based on a detailed estimation of how costly a policy would be for their district. Rather, they classify their constituency as having 'low benefit' or 'high benefit' from a policy decision. This account could help explain the difference between our study and that of Fisher (2006), which successfully predicted Senators' voting behavior regarding the Climate Stewardship Act of 2003 on the basis of whether natural resource extraction in their state exceeded a certain threshold. However, since operationalization was the same for all disadvantaged industries, this reasoning cannot account for the unexpected pattern in our findings, where the most consistent effect was found for the least disadvantaged industry.

A fourth and last observation relates to the actual costs of cap-and-trade legislation for the disadvantaged industries we identified. The revenue losses estimated by Goettle and Fawcett (2009) assume that all emission allowances would be either distributed for free or auctioned off. In reality, however, each bill provides for some, but not all, allowances to be handed out for free to vulnerable sectors. Some disadvantaged industries are also protected by special transitional measures. Still, these protection measures and exemptions provide only part of the answer at best. First of all, no combination of measures can realistically compensate for all the costs of cap-and-trade. Second, most of these protection measures are only temporary: many transition programs and allowance giveaways would be phased out in the course of the coming years or decades. Finally, none of the special provisions can fully account for the lack of evidence for an effect of the coal mining sector. Few of the protection measures are directed specifically toward the coal mining industry, and none of them are likely to compensate for the fact that this industry is facing revenue losses three times higher than any other disadvantaged industry. Thus, the provision of free permits and transitional measures cannot fully explain the patterns we are finding here.

8.1.2 Benefiting industries

Results regarding the nuclear and renewable energy sector were very consistent over bills: so far, no evidence was found for an effect of these industries on voting behavior regarding cap-and-trade. This was not entirely unexpected. First, we used a very crude measure of benefiting industry presence: because withheld data were too pervasive for more sophisticated measures, we merely counted the relative number of nuclear and renewable energy generation establishments in each state. This indicator makes no distinction between a business with 3 employees and one that employs thousands of people, and it gives only a very rough indication of the real economic impact of the industry on the constituency. For that reason, it should not surprise us if such a measure does not allow us to detect any effect of benefiting industries on the policy process.

Second, compared to the relative certainty of the losses for disadvantaged industries, it seems to be much less clear how large the gains from cap-and-trade can be for benefiting industries. For example, the prediction of spectacular nuclear sector growth by Paltsev et al. (2008) depends entirely on the elimination of 'non-economic limitations' to expansion of the sector. Similarly, the EPA estimates that a cap-and-trade scenario like that proposed in the American Clean Energy and Security Act would not lead to any short-term increase in renewable energy generation compared to the baseline, mainly because increased energy efficiency would suppress the demand for new generating capacity (Power, 2009; EPA, 2009). Thus, industries like nuclear or renewable energy generation will may not to weigh very heavily on cap-and-trade legislation until the potential advantages become less uncertain.

Third, and perhaps most importantly, there is no straightforward connection between the current geographical location of benefiting industries and the locations that will benefit economically from the introduction of a cap-and-trade system. This is one of the reasons why potential gains are generally assumed to be less mobilizing than potential losses. Although job loss and facility closure due to cap-and-trade must by definition occur in locations where the industry is already present, the same is not true for job creation and the opening of new facilities. For example, nuclear expansion does not have to happen in states that are already hosting many nuclear plants; on the contrary, it may even be more likely to occur in states that currently have a weak presence of the nuclear sector. This is another reason why constituents who are dependent on benefiting industries may not have an interest in advocating cap-and-trade.

8.1.3 Public concern

Expectations regarding the effect of public concern on voting behavior were largely confirmed by the data: strong evidence was consistently found that Congress members from more 'climate-concerned' states were more likely to vote in favor of cap-and-trade. Moreover, pseudo-R^2s were consistently high compared to other constituency interests, indicating that the unique contribution of public concern to explaining voting behavior was relatively strong. In part, the strength of the effects of public concern may be due to the sheer number of people involved: for example, the share of respondents who said they considered global warming to be a very serious problem (aggregated over all surveys including this question) varied between 23% (in North Dakota) and 60% (in Delaware). As noted earlier, larger interests groups may have an advantage over smaller ones, since they can potentially mobilize larger amounts of resources. Apparently, the coordination obstacles associated with larger group sizes did not prevent these citizens from exerting their influence–and neither did the large uncertainty about the benefits of cap-and-trade.

In sum, findings on the effect of constituency interests on voting behavior were varied: disadvantaged and benefiting industries were found to have either absent or weak effects, but public concern was found to be a strong predictor. Before we move on, note that in this study, we only tested for the effect of industry presence and public concern on the voting behavior of local Congress members; that is, members representing the district or state in which the industry or the concern citizens were located. This may have caused us to underestimate the true effect of constituency interests in two ways. First of all, it is possible that industry-related actors and climate-concerned constituents influenced the voting behavior of legislators *other* than those representing their district. Perhaps constituents mainly directed their pressure towards those Congress members they thought would be pivotal players in the decision on whether or not to pass the bill, or towards important committee members.

Second, it is possible that rather than influencing plenary vote outcomes, industry-related actors and concerned citizens exert their pressure mainly in other stages of the legislative process (Smith, 1995). Perhaps they invest more in influencing the agenda setting; or they try to affect when and whether a given cap-and-trade bill is submitted to Congress, who sponsors it, how and when it is treated in (sub)commission meetings, and whether it reaches the floor for a plenary debate. If so, constituency interests could have had an influence even without affecting plenary votes at all. Remark that the same is true for PAC contributions: these, too, may affect other stages of congressional decision-making in addition to their influence on voting behavior (Conway, 1991,Sorauf, 1994, p. 168). In sum, the fact that we only investigated the influence of constituents on the voting behavior of their

local representatives may have led us to undervalue their impact.

8.2 Pathways for Influence

8.2.1 Electoral Margin and Election Proximity

Findings on the interaction between constituency interests and electoral margin were not in accordance with our hypotheses: none of the fitted models provided evidence that smaller electoral margins increased the effect of constituency interests. Moreover, we sometimes found evidence for an interaction effect between public concern and electoral margin that went the other way: larger margins were associated with larger effects of public concern. This may indicate that Congress members prefer to follow public opinion on issues like climate change, but feel that they can only afford to do this when their electoral position is already safe. Note how this implies that most candidates assume not many votes can be won by following public opinion on climate change issues; otherwise, we would expect incumbents with small margins to be at least as eager to try and win them. As for the interaction between constituency interests and proximity of elections, hypotheses were again not supported by the data: we did not find definite evidence that Senators who are closer to their election date are more likely to be affected by constituency interests when deciding how to vote on cap-and-trade bills.

In sum, we did not find much evidence in this study that Congress members let their decision on climate change legislation depend on whether and how their vote would affect their re-election prospects. There are several reasons why this might be the case. First of all, Congress members may not have regarded climate change as a theme that would be important in future elections. Such a conviction would not have been without grounds; for example, in a New Models National Brand Poll administered in November 2008, only 2% of respondents ranked 'environment' as the top issue determining their vote for Congress. Second, Congress members may have felt that their electoral prospects depended on too many other factors (e.g., performance of the majority party, amount of campaign funds, media coverage preceding the election), for their voting behavior to have a substantial influence on these prospects. Both explanations are reinforced by the fact that in the last three decades, reelection rates have never been below 75% for the U.S. Senate, and 80% for the House of Representatives (Opensecrets.org, 2010). For this reason, Congress members may let their votes depend more on factors such as the party line or their own ideological preferences, rather than directly on the preferences of their constituency. Taken to the extreme, this would mean that voters might influence who gets elected, but do not influence congressional voting behavior after the election—at least in the domain of climate change legislation. Further research will be needed to determine whether this conclusion is warranted.

8.2.2 Campaign Contributions

As noted in the 'Methods' section, we used Baron and Kenny's four steps to evaluate mediation of the effect of constituency interests on voting behavior (Baron et al., 1986). In all cases expect one, there was evidence for campaign contributions mediating the effect of crude oil and gas mining: the presence of this industry was always a significant predictor of PAC contributions coming from this industry, and these PAC contributions almost always had a significant effect on voting behavior. Evidence for mediation of the effect of public concern was sparser: although public concern was often a significant predictor of environmental PAC contributions, and those PAC contributions often had a significant effect on voting behavior, simultaneous fulfillment of both conditions occurred only for two out of the four bills. The effect of gas utilities was never found to be mediated by PAC contributions according to Baron and Kenny's criteria.

As for the magnitude of mediation effects, adding crude oil and gas extraction PAC contributions as a predictor to the model usually diminished the effect size of crude oil and gas extraction substantially. According to Baron and Kenny's fourth step, this is a sign that these PAC contributions came close to fully mediating the effect of the corresponding constituency interests. In contrast, the addition of environmental PAC contributions to the model almost never diminished the effect of public concern, suggesting that environmental PAC contributions were hardly ever an important pathway for constituents to influence congressional votes. Moreover, the pseudo-R^2s of the effect of crude oil and gas PAC contributions were larger than those of the effect of environmental PACs, indicating that the latter type of contributions explained more variance in the voting behavior of Congress members.

It is not so surprising that evidence for mediation by environmental PAC contributions was not as consistent or strong as that for crude oil and gas extraction. On the one hand, concern about climate change is not synonymous to concern about the environment in general: therefore, the states with the highest public concern about climate change may not be the states that contribute most to environmental PACs. Moreover, climate-concerned constituents may be more likely to contribute individually–whereas constituents who are already organized in industries may tend to contribute through PACs. On the other hand, relative contributions of environmental PACs were very small, with 90% of Congress members receiving less than 5% of their PAC contributions from this type of PAC. Given the fact that PAC contributions themselves make up only about 15% of campaign contributions for Senators and 33% of contributions for Representatives, such amounts can hardly be expected to have a large effect on voting behavior (The Campaign Finance Institute, 2010).

Even when we found strong evidence for the fulfillment of Baron and Kenny's criteria, however, we can still question whether PAC contributions

were really functioning as mediators of constituency interests. Specifically, the very small pseudo-R^2s of constituency interests as predictors of PAC contributions, in contrast with the relatively large pseudo-R^2s of these contributions as predictors of voting behavior, raise doubts about this assertion. These findings suggest that PAC contributions were not only functioning as mediators of constituency interests: they may also have signaled other characteristics of legislators, like their party affiliation, their previous voting behavior, or the extent to which they were subject to interest group lobbying after they were elected. Another finding pointing in this direction is that PAC contributions from disadvantaged industries were often highly intercorrelated, whereas the presence indicators of the four disadvantaged industries were not. The design of this study does not allow us to distinguish between the explanatory power of PAC contributions and that of unknown confounding variables correlated with these contributions. As a result, the findings on campaign contributions in this study can at best be regarded as preliminary evidence for mediation of the effects of constituency interests by PAC contributions.

8.3 Party Affiliation

As expected, party affiliation had a significant and comparatively large effect on voting behavior: Democratic (and independent) Congress members were much more likely to vote in favor of cap-and-trade than Republican members. As a rule, effect sizes of constituency interests were not strongly reduced when party affiliation was added to the model: this suggests that at most some, but often none of the variance previously explained by constituency interests was now explained by party affiliation. The substantial pseudo-R^2s of party affiliation confirmed that this predictor was estimated to have made a large unique contribution to the explanatory power of the model; moreover, additional analyses showed that constituency interests only explained small amounts of the variance in party affiliation.

There are several possible explanations for this effect of party affiliation on voting behavior, over and above the effects of industry presence and public concern (Krehbiel, 2000). First, Democratic and Republican legislators may represent constituencies with different preferences, which are not captured by the presence of certain industries, and/or by public concern about climate change. For example, most Republican Congress members may represent mainly voters who are, in general, opposed to market interventions. In consequence, Republican legislators may be likely to vote against cap-and-trade. Second, the Democratic and Republican parties may unite legislators that have similar personal ideologies when it comes to cap-and-trade, independent of their constituents' interests or of party pressure. Third, we may be seeing an effect of party discipline: Democratic and Republican party lead-

ers, whips and fellow party members may be using their leverage to make legislators comply with party platforms.

Although current analyses did not allow us to differentiate between these accounts, our findings provide preliminary support for the third explanation. Namely, the effect of party affiliation was by far strongest for the America's Climate Security Act of 2008; this was the only bill for which we analyzed a procedural vote (on a motion of cloture), rather than a substantive one. Since party discipline is known to be stronger for procedural votes (Ansolabehere, Snyder Jr, & Stewart III, 2001), this observation suggests that such discipline is at least partly responsible for the effect of party affiliation on voting behavior. To distinguish conclusively between these explanations, however, we would need further insight in the characteristics of the legislators, their constituencies and their parties.

8.4 Limitations

Although this study led to some interesting conclusions regarding the determinants of Congress members' voting behavior regarding cap-and-trade legislation, a number of problems may limit the generalizability of our results or confound their interpretation. First, the amount of data we had available was restricted, as was its quality. In total, we analyzed about 700 observations; however, their variability was limited in that they were both clustered (as Congress members from the same state had relatively similar factor values) and autocorrelated over time (as many of the factors did not vary much between bills). Thus, it is not clear to what extent the four data sets we worked with here are independent samples, and thus how much evidence we really have for rejecting our null hypotheses. Moreover, data quality was sometimes limited: for example, payroll data for disadvantaged industries were often missing at the level of geographical detail we desired. Another example is our measure of public concern regarding climate change: as a result of having to combine several national surveys, sample sizes were quite variable and there was no guarantee that samples were representative for the states' populations. Lastly, data that was not missing completely at random may have led to biased parameter estimates in some cases.

Second, due to the complex network of causality in which most variables are entangled, understanding cause-effect relationships in the policy process is often very difficult. For example, although campaign contributions were found to have an effect on voting behavior, we are unsure as to whether they were functioning as proxies of other variables, or whether they have explanatory power of their own. Similarly, although we are seeing a large effect of party affiliation, it is unclear whether party affiliation serves as an indicator of constituency interests or personal ideology, or whether we can speak of a genuine effect of party discipline. Furthermore, even assuming that we know the directions of some of the causal relationships, the underlying

mechanisms are not always clear. For example, do campaign contributions exert influence by bearing upon who gets elected, or by driving the voting behavior of incumbents after the elections? What techniques do party leaders use to enforce party discipline? These are questions that the current design cannot answer definitively.

Lastly, the results of this study may not generalize well to other countries and time periods, since they depend in part on the variance of factors across different states, districts and Congress members in the U.S. If a factor did not vary much across observations, then we were less likely to find sufficient evidence for an effect of this variable on voting behavior, especially when sample sizes were limited and/or effect sizes were small. For example, it may well be that all legislators are constantly under a certain amount of pressure from the petroleum refining industry, and that without this pressure, they would vote differently. However, as long as all legislators are equally pressurized by this industry, such an effect would not show up in our results. In other words, when a factor was not found to explain much of the variance in the voting behavior of Congress members in our data, this does not mean that this factor has no causal effect on congressional votes at all. For that reason, interviews with key players in the political process may form an interesting complement to the analyses in this study.

8.5 Future Research

The results of this study provide only partial insight in the motivations of Congress regarding climate policy; moreover, they raise questions of their own on what determines the politics of climate legislation. We will thus conclude with some suggestions for future research.

First of all, we were very intrigued by the lack of evidence for an effect of most of the disadvantaged industries on voting behavior. This made us wonder whether the estimating the economic consequences of cap-and-trade for different industries was too complex of a calculation for most actors dependent on those industries. Perhaps the perceived consequences, rather than the actual consequences, were important in determining the reactions of constituents and Congress members. A recent study by Meng (2013) examined the reaction of prediction market prices and stock returns to events regarding the American Clean Energy and Security Act of 2009. Reactions were stronger for sectors with higher carbon and energy intensity, import penetration, and exposure to U.S. (rather than international) product markets. Thus, it may be interesting to investigate the connection between the voting behavior of a Congress member and the extent to which industries in his or her district fit these characteristics.

Second, our findings about the factors affecting voting behavior in Congress raise questions about other levels of governance within the U.S. For example, the EPA reports that at this date, 32 U.S. states have designed their own

Climate Change Action Plans (EPA, 2016). Would the factors we found to be influential also affect which states have developed such a plan, and how stringently the plan limits greenhouse gas emissions? Similarly, what factors predict which states joined the Regional Greenhouse Gas Initiative (RGGI) launched in 2009? And how can we explain which members of the U.S. Conference of Mayors signed the 2005 Climate Protection Agreement? The current study contains several hints as to which variables may be important in predicting state-level and local-level climate action.

Lastly, although this study provides some insight into why Congress seems hesitant to support binding emission targets for the U.S., it does not make the comparison between the U.S. and other parties in international climate negotiations. For that reason, it would be interesting to investigate whether the variables that explain differences between Congress members also explain differences between countries. On the one hand, many other factors may come into play, like economic development of the country, openness of the political system to pressure from interest groups, or strength of national environmental organizations. On the other hand, we may still expect countries with a strong presence of disadvantaged industries, or with high public concern about climate change, to take a particular stance in the climate debate. Although (Dolsak, 2001) already made an effort to systematically explain the differences between countries in their commitment to climate change, she calculated only a country's general economic incentives to mitigate climate change. We expect an up-to-date analysis that includes detailed economic interests as well as non-economic variables to generate interesting results.

9 Conclusion

In this study, we attempted to explain the attitudes of U.S. Congress members toward climate legislation, so as to understand the position of the U.S in international climate negotiations. Specifically, we wanted to investigate why U.S. Congress members seem so reluctant to limit the amount of greenhouse gases emitted by the U.S., in order to clarify why the country has not ratified any international agreement that imposed binding limits on greenhouse gas emissions. For this reason, we performed rigorous quantitative analyses of the factors influencing Congress members' voting behavior regarding four cap-and-trade bills, including the presence of certain industries, public concern about climate change, electoral margins, the proximity of elections, campaign finance, and party affiliation.

The analyses generated some surprising results. Among the industries that were predicted to be heavily affected by cap-and-trade, only one was found to have a small but consistent effect on voting behavior. None of the industries that seem likely to benefit from a cap-and-trade system seemed

to have an effect. Public concern came out as an important determinant of congressional votes: Congress members from states with high public concern about climate change were more likely to vote in favor of cap-and-trade. However, analyses of the effects of electoral margin, proximity of elections and campaign contributions so far provided little clarity regarding the way in which these constituency interests affected voting behavior. Finally, we found a strong connection between party affiliation and voting behavior, although the underlying mechanisms of this effect are still unclear.

In sum, the results of this study tell us that public concern, partisan politics, and to a smaller extent the presence of particular disadvantaged industries, are key elements in explaining congressional decisions on cap-and-trade. This suggests that factors like a more climate-concerned electorate, a larger presence of Democrats in Congress, and possibly more intensive transitional measures for disadvantaged industries, have the potential to modify the position of pivotal Congress members regarding climate legislation. Insofar as Congress weighs upon the negotiating position of the U.S., this may also cause a shift in international climate negotiations–although that should be the subject of yet another future study.

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