Friends in High Places

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ABSTRACT

We demonstrate that personal connections amongst U.S. politicians have a significant impact on Senate voting behavior. Networks based on alumni connections between politicians are consistent predictors of voting behavior. We estimate sharp measures that control for common characteristics of the network, as well as heterogeneous impacts of a common network characteristic across votes. We find that the effect of alumni networks is close to 60% as large as the effect of state-level considerations. The network effects we identify are stronger for more tightly linked networks, and at times when votes are most valuable. We show that politicians use school ties as a mechanism to engage in vote trading ("logrolling"), and that alumni networks help facilitate the procurement of discretionary earmarks.

* We would like to thank Anup Agrawal, Dan Bergstresser, Ethan Cohen-Cole, Shawn Cole, Josh Coval, Bernard Dumas, David Primo, Ben Esty, Fritz Foley, Ken Froot, Burton Hollifield, Victoria Ivashina, Jim Kau, Harold Mulherin, Lukasz Pomorski, Keith Poole, Roberto Rigobon, Michael Roberts, John Karl Scholz, Bill Schwert, Toby Stuart, Marco van der Leij, Rick Wilson, three anonymous referees, and seminar participants at Arizona State University, Bentley University, UC-Berkeley, Carnegie Mellon University, Columbia University, DePaul University, University of Georgia, Harvard Business School, INSEAD, NYU Stern School of Business, University of Michigan, Rice University, University of Southern California, University of Texas at Austin, University of Texas at Dallas, University of Toronto, Wharton, Jane Street Capital, the State Street Global Markets Annual Research Retreat, the Cambridge Conference on Financial Networks, and the American Finance Association for helpful comments. We also thank David Kim for excellent research assistance. We are grateful for funding from the National Science Foundation.

The passage or failure of any piece of legislation in the U.S. Senate depends ultimately on the individual votes of the legislators. While many influences determine whether a given legislator votes for or against a bill, subtle influences can in some instances be powerful determinants of voting behavior, and thus final vote outcomes. In this paper, we explore one particular channel of influence: that of personal social networks. We show that our identified social networks can have large impacts on voting behavior, beyond those currently explored by the literature. In addition, our empirical strategy to isolate the impact of social networks exploits rich data comprising firms (and employment) in a Senator's home constituency, which allows us to incorporate market information into measures of a bill's importance. Specifically, important bills are defined at the Senator-bill level, which offers a new way to classify the *same* bill as important or unimportant for different sets of Senators. This turns out to be important in mapping Senators' interests, and thus the predicted use of influence, across the social networks we examine.

Exploiting the complete Senate voting record over the past 20 years, we demonstrate that social networks have a significant impact on the voting behavior of U.S. politicians. The primary network measure we exploit is based on the alumni networks of Senators. An advantage of our approach is that unlike many social networks,[1] these education networks are formed decades before the voting behavior we attempt to explain. We utilize these well-defined networks to isolate a widespread pattern of vote trading (or "logrolling") that has typically been difficult to identify empirically in the literature.[2]

Our first main result is that alumni networks influence Senate voting behavior, even after controlling for other well-known predictors of voting behavior. For example, the percentage of Senators in one's alumni network that vote in favor of a given bill is strongly related to a Senator's own likelihood of voting in favor of that bill. Further, the impact of school ties on voting is monotonically increasing with the strength of network, and is robust to a variety of different specifications and controls. Importantly, we also demonstrate that this alumni network effect is not driven by a particular school, Senator, ideology, or time period.

We use alumni networks as a setting in which to examine the practice and implications of logrolling in the U.S. Senate. Logrolling is the colloquial term for vote trading, and refers to the idea

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[1] See Jackson (2005) for a review of network applications in economics, Williams (2009) for a review of network applications in politics, and Fowler et. al (2009) for a discussion of the causality inference problems that arise when studying typical political networks such as cosponsorship networks, which are formed endogenously during the legislative process.

[2] See Stratmann (1992) and Stratmann (1995).

that a politician may, at times, trade away his or her vote on one issue in return for votes on some other issue of more concern to his or her constituents. A key feature of our empirical design is that we are able to examine this issue by exploiting situations where network mechanisms are likely to be more utilized, while the characteristics of the network itself remain constant. We do this by focusing on: i.) votes that are "irrelevant" to those firms located in a Senator's home state, and ii.) votes that are close to passing (or failing to pass). The mechanism behind this approach is to alter the supply of, and demand for, votes within a network while holding network characteristics constant. For example, supplying a vote when the bill in question is irrelevant to one's constituent firms is presumably not very costly. Similarly, close votes are times when the marginal vote is very valuable, and hence demand to influence peers is likely strongest. Thus, these are the exact times that members would be expected to exert the most pressure on fellow network-connected Senators to trade their votes.

To give an illustrative example from our sample of school networks in Congress, consider the voting that took place on the Energy and Water Development Appropriations Act of 2001. This bill was written in part to appropriate a significant amount of money for the energy industry. The vote was split largely along party lines, and as such in order to get the bill to vote (and ultimately pass), the Republican party needed to curry a few Democrats votes. Not surprisingly, this bill was strongly supported by the Texas Senatorial delegation, given the long-running prominence of the energy industry in the Texas economy. One Texas Senator, Republican Phil Gramm, received both his undergraduate and doctoral degrees from the University of Georgia. He shared this alumni network tie with Zell Miller, however not much else, as Miller was a Democrat, and a Senator from Georgia – a state for which the energy industry had a relatively inconsequential presence. However, on this particular bill Senator Miller broke with his fellow Democrats and voted, like Senator Gramm, in favor of the bill. In fact, only six Democrats in the entire Senate voted for the bill, and those others who did came from states such as Arkansas and New Mexico, for which oil and natural gas represented a large and important industry. Senator Miller's state had no tie with the industry, with in fact the other Democratic Senator from Georgia, Max Cleland, voting against the energy bill. The tie that did appear was in the alumni network (in this case across party lines) shared by Senators Gramm and Miller. This example of voting in line with school networks (controlling for other voting determinants, such as party), represents a systematic pattern across the universe of votes in the United States Senate.

Our strategy employs a unique bill classification approach that categorizes each bill over the 1989-2008 period as being related to certain industries, depending upon the text of the bill. We expect those bills that impact firms in the Senator's home state to be the bills that the Senator will have a vested interest in voting either for or against, regardless of network effects; conversely, the remaining "irrelevant" votes for the Senator should be those for which her network should have more persuasive ability in affecting her behavior. We find exactly this pattern in the data. The effect for irrelevant votes is nearly 100% larger. A similar dichotomy can be thought of with respect to close votes. For these votes we again find evidence consistent with Senators using the network to actively influence voting behavior when the marginal value of votes is higher (and again, evidence against a simple unobservable characteristic explanation). On these close votes, the network influence on voting behavior is over twice as large. Finally, on votes that are both irrelevant *and* close, the impact of one's network on voting is over 200% larger than the unconditional effect.

We also try to rule out an alternative explanation based on heterogeneous impacts of our fixed network characteristic. For instance, it may be exactly when a vote is irrelevant to a Senator that her intrinsic preferences are more expressed; preferences which can be correlated across the network. To address this possibility directly, for each vote we separate the Senator's network into those who have a vested interest in the bill, and those to whom it is irrelevant. If the heterogeneous impact of a network characteristic is driving the results, we should see a given Senator's voting *most* correlated with those Senators in her network to whom the bill is irrelevant. By the same logic the Senator's vote should be *less* correlated to those who are voting due to a separate vested interest (i.e., those Senators who have many constituent firms impacted by the given bill). The direct network influence channel works in the exact opposite direction: Senators who have a vested interest do the *most* to curry votes in their favor, while the Senators with no vested interest do little. Thus, if there is a direct channel of influence at work, the given Senator's votes should follow more with these vested-interest Senators. The results from these tests provide evidence against a heterogeneous impact of some fixed network characteristic. In particular, the school effect we mention above is entirely driven by the impact of those school connected votes for whom the vote is relevant. Votes by Senators in the network who do not have a vested interest in the bill have no impact on the given Senator's votes.

To give an idea of the magnitude of the school network effect, we find that a one standard deviation increase in the percentage of school connected Senators with a vested interest in a bill who vote in favor of a bill implies a 5 percentage point increase in the likelihood of a given Senator voting in favor of a bill (controlling for party influences, state influences, congress-session effects, and a host of other controls). To put this into context, we compare it to the effect of state-level considerations for the Senator. State-level considerations are arguably one of the largest determinants of Senator behavior, as state constituents ultimately determine re-election outcomes. We find that the alumni network effect is close to 60% of the size of the state-level effect, indicating that network effects are significant in magnitude.

To better pin down the mechanism behind the logrolling we document in this paper, and how these logrolling networks may be playing out in the Senate, we also explore variation in influence within a given network. Specifically, we find evidence suggesting that Senators are more likely to logroll with network members who are on more powerful Senate committees. We also examine another potential benefit of being in a logrolling network with school-tied friends, namely in securing discretionary funding for one's state. In particular, we show that having a member of one's alumni network on a powerful Senate committee is positively related to the acquisition of discretionary earmark funding for one's own state, above and beyond the usual determinants of earmarks.

Collectively, our findings provide evidence that a new form of personal connections, namely those based on past educational links, have a significant impact on the voting behavior of U.S. politicians. Further, the magnitude of these network effects is economically significant. And although pinning down a causal effect of networks is of course extremely difficult, we believe that taken as a whole, our results present a compelling circumstantial case that networks have a direct impact on political behavior. Hence, our results imply important considerations for constituents regarding their legislators; specifically, the size and scope of the networks to which legislators have access in order to curry favor for votes can potentially be an important state variable to their constituents (both individuals and firms).

The remainder of the paper is organized as follows. Section I describes the related literature; Section II describes the data; and Section III explores the network characteristics in the U.S. Senate. Section IV presents the basic impact of alumni networks on Senate voting behavior; Section V then examines the logrolling mechanism in greater depth; and Section VI examines the role of school ties in securing discretionary funding for one's state. Section VII provides a series of robustness checks; Section VIII discusses the implications of our results; and Section IX concludes.

I. Related Literature

Our paper adds to a large literature that studies the factors that influence the behavior of elected officials. In addition to political party and constituent interests (see, for example, Stigler

(1971) and Peltzman (1985)), we demonstrate that personal connections are an important determinant of politicians' voting behavior.[3] Importantly, we demonstrate that even after controlling for the impact of political ideology (see Clinton, Jackman, and Rivers (2004), Kau and Rubin (1979, 1993), Lee, Moretti, and Butler (2004), McCarty, Poole and Rosenthal (1997), McCarty, Poole and Rosenthal (2006), and Poole and Rosenthal (1985), (1997), (2007)), network ties influence legislator behavior.[4]

Our focus on alumni networks also adds to a growing body of work that explores the impact of different types of social networks in Congress (see, for example, Bogue and Marlaire (1975), Burkett and Skvoretz (2006), Caldeira and Patterson (1987), Fowler (2006a, 2006b), Patterson (1959), Porter et. al (2005, 2006), Routt (1938), Young (1966), and Williams (2009)). An advantage of our approach relative to many of these studies is that our network measure is exogenous to the political process itself. Further, our network ties are formed decades before the voting behavior we attempt to explain. Lastly, we show that these clearly delineated alumni networks offer a window into the practice of logrolling in Congress, which has been generally been difficult to identify empirically in the literature (see Stratmann (1992) and Stratmann (1995) for theory and evidence on this issue).

Since our focus is on isolating a specific channel through which network effects operate in Congress, namely through well-defined alumni networks, our work also relates to a vast literature that demonstrates that neighbors, peers, parents, and siblings can impact a long list of individual behaviors ranging from educational attainment,[5] to welfare decisions (Bertrand et. al (2000)), to spousal choices (Fernandez et. al (2004)).[6]

II. Data

We use a variety of novel data sources to create the sample in this paper. First we hand-collect the complete biographical record of all Senators from the 101st through 110th Congresses, using the Biographical Directory of the United States Congress available online.[7] From this website,

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[3] See also Hibbing and Marsh (1991), Stratmann (2000), Pande (2003), Chattopadhyay and Duflo (2004), and Washington (2007) for evidence that personal characteristics such as service length, age, religion, race, gender, and the presence of a daughter in one's family can affect the behavior of elected officials.

[4] See also Levitt (1996), Ansolabehere et. al (2001), Synder and Groseclose (2000), Kalt and Zupan (1990), and Mian et. al (2009) for various perspectives on separating out the impact of ideology versus party interests, constituent interests, and special interests.

[5] See, for example, Black et. al (2005), Dahl and Lochner (2005), Hanushek et. al (2003), Hoxby (2000), Ruhm (2004), and Sacerdote (2001,2007).

[6] See also Manski (1995) and Gaviria and Raphael (2001).

[7] See http://bioguide.Congress.gov/biosearch/biosearch.asp. All of the results in the paper pertain to the U.S. Senate only; however, we show in the Appendix Table A6 that our main results hold in the U.S. House of Representatives as well.

and from the individual websites of the Senators, we extract information on academic institutions attended, religious affiliations, birthdates, home towns, and past work experience. We use this data to create the alumni connection and other connection variables that we exploit in our analysis.

Another key source of data that we collect is the complete legislative record of all Senators on all bills from the 101st through 110th Congresses. We collect this from the Library of Congress' Thomas database. Each "Congress" is two years long, and is broken into two one-year-long "Sessions." Therefore, 10 Congresses represents twenty years of Congressional data from 1989-2008. We collect the result of each roll call vote for the twenty-year period in each chamber of the Congress, and record the individual votes for every Congressman voting on the bill (or abstaining). We choose to start with the raw bill data, rather than use alternate, publicly available versions of the Congressional roll call data (see, for example, the Voteview website, as well as McCarty, Poole and Rosenthal (1997), McCarty, Poole and Rosenthal (2006), Poole and Rosenthal (1985), (1997), (2007), among many others), or the Political Institutions and Public Choice (PIPC) House Roll Call Database (Aldrich, Brady, de Marchi, McDonald, Nyhan, Rohde, and Tofias (2008)), because we exploit the text of each piece of legislation as described below.

Specifically, in a number of our tests, we utilize the content of the bills being voted on. To do so, we download the full text of all bills being voted on over our sample. We collect the full-text data jointly from the websites of the Government Printing Office (GPO), and from the Thomas database. We then parse and analyze the full bill text to classify each bill into its main purpose. For our tests, we attempt to assign each bill to one (or more) of the 49 industry classifications used in Fama and French (1997).[8] To do this we first construct a set of keywords for each industry. We then create an executable (shown in Figure 1), in which we input all bills and their corresponding full-text and assign bills to industries based on the count of the number of times these keywords appear in a given bill. We only assign a bill to an industry if the number of instances of a particular keyword exceeds a certain threshold of frequency on a given bill relative to its overall frequency in the entire population of bills.[9] Individual bills can be assigned to more than one industry; however, we use a conservative assignment procedure such that our procedure only results in industry assignments of any kind for less than 20% of all bills, and specifically only those bills where we can confidently gauge that an

[8] The "Fama-French 49" industry definitions map specific 4-digit SIC (standard industry classification) codes to 49 different industry categories, and are publicly available online from: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

[9] We have experimented with various thresholds, and our results are not sensitive to the particular threshold we employ. Please see the Appendix for more details on our bill classification procedure.

industry is likely to be affected by the bill in question.

Figure 1 presents an example of a particular bill that was assigned only to the Fama-French industry #30: Petroleum and Natural Gas, based on the relative frequency of pre-specified keywords in the bill that pertain to this industry. Figure 1 displays the summary text at the top of the bill, which indicates that the bill clearly pertains to the oil and gas industry. The data Appendix provides more details on our bill assignment procedure. We have compared our bill categorizations to those used in other work (see, for example, Aldrich, Brady, de Marchi, McDonald, Nyhan, Rohde, and Tofias (2008), among others), but prefer our approach because it achieves our explicit goal of assigning each bill to the specific industries (and thus *firms*) that are potentially affected, rather than to the specific policy issues under consideration.

III. Social Networks in the U.S. Senate

Table I presents summary statistics for our sample. Our sample covers the 20-year period of the 101st-110th Congresses. The unit of observation in our analysis is the Senator-vote level. For example, Senator Clinton's vote of "yea" in the 110th Congressional Session on Recorded Vote No. 2 (regarding Senate Joint Resolution 9) is a single observation. Table I shows that we have roughly 650,000 vote-level observations for the Senate, made by 209 Senators over this twenty year period. The total number of Senators over this 20 year period may seem low, however the incumbency re-election rate is quite high for the U.S. Senate. Of the votes cast, over 65% are "yes" votes. The remainder of Table I presents additional summary statistics. Each "PctSumYes*" variable measures the percentage of the group in question that votes yes for a given bill, on average. So, for instance, the average percentage of Senators from the same school as a Senator that vote yes is 63.8%. These percentage measures are, not surprisingly, on average nearly identical regardless of grouping, and roughly match the overall sample average percentage of yes votes. The sum variables are measured similarly, but simply add the number of Senators that vote yes on a given bill. For instance, the average number of total yes votes from a given Senator's party on an average bill is 31 (roughly half the sample average).

Note that we have run all the tests in this paper using samples that consist only of final passage votes (i.e., the final votes on each of the bills in our sample), as well as samples that consist only of bills where we can ascertain that at least one industry is affected by the bill (and hence that the bill is relevant to at least one Senator), and our results are unchanged. Thus our results are not driven by multiple versions of the same bill, or by non-substantive and/or procedural votes.[10]

Table II examines in more detail two specific characteristics of Senators. The first is the main network measure we use in the paper, namely alumni networks. We define everything at the degree level in Panel A. Thus, each of the 209 Senators that served in the Senate over this period is included once in these tabulations, but Senators often have degrees from more than one academic institution, hence the total number of degrees exceeds the total number of Senators. So, our 209 Senators earned 375 degrees that we could match back to colleges and universities. We list in this table those universities that represent the largest number of degrees in the U.S. Senate. The most connected university to the U.S. Senate is Harvard University, followed by Yale, Virginia, Stanford, and Georgetown.[11] In addition, a number of the Senators were Rhodes Scholars, leading to a surprisingly high position of Oxford University on the connectedness list. Panel B contains the religious affiliations of the U.S. Senate. As can be seen, religious affiliation was unavailable for 42 of the Senators, so we have a total of 167 with religious group information. The most common religious affiliation is Roman Catholic, which accounts for nearly 25% of all Senators, followed by Methodist, Presbyterian, Episcopalian, Jewish, and Baptist.[12]

IV. The Impact of Networks on Senate Voting Behavior

We first examine the voting behavior of U.S. politicians, and how this behavior is affected by social networks. In order to test whether a politician's network affects her voting behavior, we need to define measures of possible groups that could influence her behavior. The key network we focus on is the alumni network.

IV.A The Impact of School Ties on Senate Voting

Our key tests focus on the impact of alumni networks on the voting behavior of each Senator. The primary measure we employ in our tests is the percentage of Senators in a given Senator's alumni network that vote in favor of the bill. The idea behind this measure is that it proxies for the amount

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[10] Note that this separation into final votes is very similar to Theriault (2006), which separates procedural and non-procedural votes. Our final votes category matches closely to his "Substantive Votes" category. Please see the data Appendix for more details on the subsamples we have analyzed.

[11] We demonstrate later in the paper (in Table VI) that our results are not driven by Harvard or any other single school.

[12] An expanded version of Table II that includes detailed information on the composition of each of the networks in terms of political affiliation, religion, and geographic location is included as Table A3.

of potential prodding a Senator could be receiving from within his or her alumni social network to vote for the given bill.[13] The main dependent variable we use is simply whether the given Senator voted yes (or no) on the given bill.

To control for other determinants of a Senator's voting we construct a number of control variables. The first is the percentage of the Senator's party voting in favor of the given bill. For instance, if we are considering a Democrat, it would be the percentage of all other Democrats voting in favor of the given bill, and equivalently for Republicans. The intuition behind this measure is that it will control for anything that is party-agenda related at the very fine level of the given vote on the specific bill in question. We also compute a dummy equal to one if the other Senator from the same state votes in favor of the bill; the idea behind this measure is that it will again control for anything that is important at a state-agenda level for the given vote on the specific bill. In sum, to stress the granularity of these variables, these are quite fine controls for the party- and state-level importance of the *given* vote for the *specific* bill being voted upon. And finally, when constructing these measures for a particular Senator-vote observation we always remove the impact of each individual Senator's *own* votes, such that these measures reflect only the behavior of *other* Senators who are from the same school network, same party, or same state, as the Senator in question.

Lastly, we include a number of fixed effects in the specifications. First, we include a fixed effect for the given Senator. This captures a Senator's average propensity to vote yes on any given bill, which could vary across Senators. We also include a fixed effect for Congress (as we mention in Section II, our detailed voting and biographical data cover the 101st-110th Congresses). As different Congresses often focus on quite different legislation (e.g., defense vs. healthcare vs. fiscal policy, etc.), this is meant to capture anything specifically related to these different agendas covered, and voted upon, across Congresses. Lastly, we also include in many specifications quite fine fixed effects at the Congress-session-vote level. That is, these are fixed effects for the specific vote on the specific bill, in the given Congress and session. These control for anything special that might affect all Senators' votes on the specific bill (e.g., deadline for approval). We obviously cannot include both this fixed effect and the Congress fixed effect in the same regression (as Congress is a linear combination of

[13] We also explore a measure that uses the *sum* of Senators in a given Senator's alumni network that vote in favor of the bill; the sum measure exploits the idea that it is the absolute number of fellow Senators putting pressure on a Senator that has the biggest effect on voting. One benefit of the percentage measure is that it abstracts from the size of network, while the sum measure is jointly measuring the behavior of the network and the size of the network. To narrow the focus more on behavior, we focus mainly on the percentage measure; however, we also show results for both the percentage and sum measures.

Congress-session-vote), so we use varying specifications including either fixed effect. Lastly, we adjust all standard errors for clustering at the Senator level to account for the fact that Senators may exhibit a tendency to vote in a similar way on multiple roll-call votes.

Table III presents the results of these voting behavior regressions. The observation-level is a given Senator's vote on the Senate roll-call (recorded) vote in question for the specific bill. Thus, for a given roll-call Senate vote we average 97 observations, or recorded yea, nay, or abstain votes (as there are occasionally a few Senators who miss a given vote). The dependent variable we focus on is *Yes*, which is a categorical variable equal to 1 if the given Senator votes yes on the given roll-call vote, and 0 otherwise. In this table we run regressions in a linear probability model; however in Table VII we also run logit and probit specifications and show that these imply slightly larger school effects in magnitude and significance. We prefer to use the linear framework as we can include relatively granular fixed effects, better controlling for fixed variation on a number of dimensions.[14] In columns 1-3 of Table III we focus on the % measures of the independent variables, and in columns 4-7 we show results for the sum measures. The variable of interest in Column 1 is *School Connected Votes*, which is the percentage of the other Senators in the given Senator's alumni network who vote yes on the given bill. We also include controls for *State Votes* and *Party Votes*, which represent the percentage of the Senator's state and other party members voting in favor of the bill, respectively.

Column 1 indicates that the voting of other members of a Senator's alumni network is significantly related to the Senator's own vote, even after controlling for general party voting, the voting of the other Senator in one's state, and both Congress and Senator fixed effects. In Column 2, we include these same controls, plus both Senator and the finest Congress-session-vote level fixed effects, and find a similar result. The coefficient on *School Connected Votes* of 0.052 (t=3.31) in Column 2 implies that controlling for the general voting on the given bill, the Senator's own tendency to approve legislation, the party's views on the given bill, and the state-implied importance level of the given bill, a one standard deviation increase in the percent of the Senator's network voting for the bill implies a roughly 2 percentage point increase in the Senator's likelihood to vote in favor of the bill. In Section V, we construct sharper measures of the direct influence exerted through the network, and for this cleaner measure of direct influence, the magnitude of the network effect more than doubles.

[14] See Greene et al. (2002) for a discussion of the statistical problems associated with the use of fixed effects in non-linear regression frameworks.

IV.B Alternate Measure and Variation in Strength of Network

Next we re-define the alumni network measure using sums (as opposed to percentages) in the Senate. The coefficient in Column 3 of Table III of 0.008 (t=3.44) implies that a one standard deviation increase in the number of Senators in the given Senator's alumni network voting in favor of the bill increases the Senator's likelihood of voting for the bill by 3.4 percentage points.[15] This is comparable, although somewhat larger in magnitude to the effect using the percentage measure.

In the last two columns of Table III we exploit variation in the *strength* of alumni network links. If it is the alumni network impacting voting, then we would expect that the stronger the network connection, the more influence the network should have on a given Senator's voting behavior. Therefore, in Columns 4 and 5 we create two new measures of increasing connectedness. First, Column 4 measures the effect on a Senator's voting of those Senators that have not only gone to the same school as the Senator, but also have the same degree from that school (e.g., both have JDs from Yale). Even stronger, Column 5 measures the effect for networks of Senators that have gone to the same school, received the same degree, and overlapped on campus at the same time (e.g., both Harvard MBAs in 1965).[16] Consistent with the alumni network having an influence on voting, the impact of schools is monotonically increasing with the strength of network. From Column 7, the impact of the most connected network measure is over twice as large (0.020 (t=2.49)) as the other two measures (0.010 and 0.008).

V. Logrolling and the Network Mechanism

In this section, we use alumni networks as a setting in which to examine the practice and implications of logrolling in the U.S. Senate. As noted earlier, an advantage of our empirical strategy is that we are able to examine the practice of logrolling by exploiting situations where network mechanisms are likely to be more utilized, while the characteristics of the network itself remain constant.

We start to examine vote trading by focusing on: i.) votes that are "irrelevant" to those firms

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15 Appendix Table A6 shows this basic result, using both the percentage and the sum measure, for the U.S. House of Representatives as well.

16 The percentage of regression observations (out of 671,520 total Senators' votes from Table I) that have at least one other Senator voting on the bill who is connected to the given Senator through either: (i) same school, (ii) same school and degree, or (iii) same school, degree, and year, are 65.8%, 52.6%, and 37.3%, respectively. Additionally, Table A3 contains more detailed information on the composition of each of the networks in terms of political affiliation, religion, and geographic location. Tables A4 and A5 then show the top 20 schools and top 20 Senators, ranked by their propensity to vote with the school network.

located in a Senator's home state, and ii.) votes that are close to passing (or failing to pass). The idea behind this approach is that these are times when the supply of votes that can be swayed by peers is high (irrelevant votes to some Senators in the network), and the demand by peers to sway them is also high (votes close to passing). Thus, these are the exact times that members would be expected to exert the most pressure on fellow Senators (Stratmann (1992)).[17] We then further explore (in Section V.A) a very strict test controlling for the possibility of heterogeneous effects of fixed network characteristics across votes.

Our approach helps to rule out an alternative explanation for the alumni network findings that is based on a common characteristic of the network causing voting behavior to be related, rather than the direct effect of the network itself causing voting behavior to be related. For example, perhaps instead of Georgetown Senators using their Georgetown network to curry the votes they need to pass a bill, it might be that Georgetown Senators are related to each other in some unobservable way. This relation could come from common experiences at Georgetown, but need not, and could be any common characteristic that they share (correlated with both attending Georgetown, as opposed to another university). By varying the times when network impact is likely to be strongest, we can directly evaluate this alternative explanation. If our results are simply due to a common, unobserved characteristic, the characteristic and its predicted impact on Georgetown Senators' voting should impact all Georgetown Senators in the same manner across votes (as it is, by definition, a common characteristic across the network). However, if our effects are driven by Senators using their alumni networks to curry votes to help pass a bill, we can identify the exact times, and the exact Senators, *within* a given network, that will be impacted differentially from all other network agents, in an ex-ante predictable way.

To identify "irrelevant" votes for a Senator, we first use the bill classification system explained in Section II to classify each bill as being related to certain industries, depending upon the text of the bill. For the given bill, we then check whether any of the industries the bill addresses have operations in each Senator's state.[18] Thus, for each bill and Senator, we classify whether the bill is relevant for the given Senator by whether it covers industries that have operations in the Senator's state. In other words, we expect those bills addressing matters of relevance to firms in the Senator's state to be the bills that the Senator will have a vested interest in voting either for or against. We then examine the

[17] See also Duggan and Levitt (2002) for evidence of payment-in-kind behavior in sumo wrestling, where the incentive structure of promotion in the sport leads to gains from trade between different wrestler types.
[18] Here we identify operations as any public firms domiciled in the state.

complement of this set of bills for each Senator. The complement of this set should represent those bills that the Senator has less of an interest (on average) in voting in one direction or the other, since these bills are essentially unrelated to any industries represented in his or her home state. Thus, it should be exactly these "irrelevant," uninterested votes for the Senator on which her network should have the most persuasive ability (relative to those bills in which the Senator herself has a direct interest).

Similarly, for a second measure, we define all votes that are close to passing or failing. Here, we use all votes that are within a close distance of 60 yeas. The reason we use a window around 60 votes is that in modern-day Congress the practice of filibustering, or the credible threat of filibustering, is enough to defeat votes that cannot meet the 60-vote threshold needed to avoid a filibuster.[19] We do not center our "close" measure around 50 votes, since votes with say 40 yea votes would not need any filibustering, because the idea of a filibuster is to prevent a vote from coming to the floor (i.e., to block a vote that was likely to pass), and votes with this magnitude of support are almost never brought to the floor for a vote, given their unlikely chance of passage.

The idea behind exploring close votes is that these are the exact votes where the marginal value of a vote is especially high, so that Senators might be expected to utilize a mechanism of influence to secure these votes. Thus, this may be a time of especially high exerted influence through the network channel. However, and most importantly, for both the close and the irrelevant measures the underlying characteristics of the network remain constant, and thus a common unobservable characteristic explanation predicts no change in network impact across network agents.

Table IV presents the results of these tests. The dependent variable is again the vote of each Senator, *Yes*. The first variable of interest is *Close*, measured three distinct ways, as a categorical variable equal to 1 for those votes that are either (±3%), (±5%), or (±7%) from 60% yeas, and 0 otherwise. We then interact this variable with *School Connected Votes (SCV)*, measured as the percentage of the other Senators in the given Senator's alumni network voting yes for the given vote on the given bill. This interaction term measures the increased impact of networks on voting behavior for the *Close* votes. The next variable of interest is *Irrelevant To Me*, measured as a categorical variable equal to 1 if the given bill does not address any industries (and hence firms) domiciled in the Senator's state, and 0 otherwise. The same controls from Table III are included in every specification. Finally, because the *Close* measure is identified at the vote level, and identifies a subset of all votes, we cannot include Congress-session-vote fixed effects in these regressions (as the close variable would be

[19] See Beth and Heitshusen (2012) for details and rules regarding the practice of filibustering in the U.S. Senate.

a linear combination of a subset of these fixed effects). Therefore we instead include both Congress and Senator fixed effects in all regression specifications, and continue to adjust standard errors for clustering at the Senator level.

Columns 1-3 of Table IV show the differing impact of alumni networks for close vs. non-close votes. Columns 1 and 2 estimate separate regressions for each set of votes (close and non-close), while Column 3 estimates a single specification with the interaction term of *Close* and *School Connected Votes* (denoted *Close*SCV* in the table). All three give the same implication: alumni networks exert significantly more influence over voting behavior when they are expected to be more utilized, namely in close votes. From the interaction term in Column 3 (0.035 (t=3.28)), the effect of networks nearly doubles at times of close votes. Column 4 then confirms a similar result using a slightly more moderate measure of *Close* ((±5%) as opposed to (±3%)). Column 5 then does the same for the (±7%) range. The differential impact of networks is still significant for (±7%), but is monotonically decreasing in point estimate from (±3%) to (±7%), as we would predict given that these we are decreasing in the level of closeness of the overall vote, and thus the marginal value of a given vote.

Columns 6-8 examine the differing impact of networks on votes that are irrelevant vs. relevant to the Senator who is voting. These columns suggest that networks have a greater influence over voting behavior when the bills being voted on are not relevant to the given Senator (again where relevance is defined as pertinent to industries represented in one's home state). Comparing the coefficients on *School Connected Votes* in Columns 6 and 7 (and examining the interaction term in Column 8), the impact of networks on voting behavior is over 50% as large when a vote is not relevant to the given Senator.[20]

Column 8 of Table IV combines these close and irrelevant measures to examine the effect of school networks at times when the vote is both a close vote *and* not pertinent to the Senator who is voting. The interaction term from Column 8 (0.060 (t=2.20)) implies that at these times, the network has an impact over 3 times larger than for all other votes.

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[20] These regressions only include votes on bills for which we can ascertain that at least one industry is affected by the bill, and hence that the bill is relevant to at least one Senator. We have also run all of the tests in Columns 6-10 on all bills, where we designate bills that we cannot confidently assign to at least one industry as being "irrelevant" to all Senators, and the results are very similar to those presented here. In fact, the coefficient on the interaction term on (Irrelevant Votes*SCV), the analog of Column 8 in Table IV, is significant in this sample, 0.023 (t=2.56). We prefer the sample in which we can confidently assign all bills to sets of industries.

V.A. Isolating the Network Mechanism

A remaining potential concern is that even though we show network impact is strongest precisely when there is: i.) the most demand to sway votes, and ii.) the most willing supply, there could still be a common characteristic that has varying impacts across votes. To be more specific, it is not implausible that there could be heterogeneous effects of the static network characteristic across votes.[21] Further, with respect to irrelevant votes, it may be exactly when a vote is otherwise irrelevant to a Senator that you observe her relying more on intrinsic preferences, which could be correlated across the network, and thus the correlation with the mean network vote will be higher in these cases (giving the results in Columns 6-8 of Table IV).

In order to try to rule out the possibility of a varying impact of a fixed characteristic, we construct new measures in order to yield the sharpest estimate of the network impact on voting. Specifically, we create a new variable called *School Connected Votes Relevant (SCVR)*, which is the percentage of school friends for whom the bill is a "relevant" bill (i.e., who have a firm in that industry operating in their state) who vote yes on that bill. This variable is a subset of the *School Connected Votes* (defined as the percentage of *all* school friends who vote yes on the given bill), however an especially informative one. The idea behind separating out these votes is that out of all the school friends voting on the bill, these are those that have an active *vested* interest in obtaining a certain outcome of the vote. For all other of the school friends, the vote is irrelevant, and thus they have no interest in swaying votes.

This is where the sharp contrast arises in predictions between the explanations of a correlated characteristic (with heterogeneous impacts), and the *direct* impact of influencing votes through the network. If it were simply an underlying, correlated network characteristic, this characteristic should be expressed *more* prevalently by the group of Senators in the network for whom the given vote is irrelevant, as they have (on average) no other interests clouding their voting, and so their expressed vote is a better measure of the correlated network characteristic on the given vote. Thus, the vote of this group should be more correlated with the given Senator's vote, while the corresponding vote of the SCVR (those school connected Senators for whom the vote is relevant) should be less related. In contrast, if it is the direct influence channel driving these results, then the Senator's vote should be more correlated with the SCVR, as it is precisely these Senators that have an interest in currying votes

[21] For instance, Snyder and Groseclose (2000) show that the impact of party on voting behavior (a fixed characteristic, just as network is), varies over time and votes.

in their favor. The Senators with no vested interest in the bill, by contrast, will have no reason to exert influence on the Senator for the given bill.

We perform exactly this test between the two potential explanations in Columns 1-3 of Table V. In Column 1, we find that all of the school effect is indeed driven by the SCVR, *School Connected Votes Relevant*. Including this measure in the regression, its coefficient is large and significant, while the coefficient on *School Connected Votes (SCV),* which now measures the impact of those school connected votes for whom the given bill is irrelevant, is small and insignificant.[22] This evidence is in line with the predictions of the mechanism of direct influence through the network, while it is opposite to what is predicted by the mechanism of a heterogeneous impact of a common characteristic.

Column 2 offers an even sharper test of the network influence channel. It replicates Column 9, but solely on the sample of votes that are irrelevant to the Senator who is voting. The findings are similar to Column 1, with the point estimate on SCVR even larger; again the votes of all Senators in the network for whom the vote is irrelevant has no reliable impact on the Senator's voting behavior.

Column 3 then offers the sharpest test of the network influence channel by examining the effect of school ties (and specifically, the votes within one's network for whom the bill is relevant, i.e. *School Connected Votes Relevant (SCVR)*) at times when the vote is both a close vote *and* not pertinent to the Senator who is voting. These are times when demand to influence voting is high (since the vote is close), willingness to supply the vote is high (since the vote is irrelevant to the Senator who is voting), and where the school effect has been refined to capture solely the yes votes of the network members for whom the bill is relevant. Column 3 indicates that these are precisely the times when network influence is strongest: the interaction term in Column 3 (*Close & Irrelevant To Me * SCVR*) is large and significant (.097, *t*=2.47), and the magnitude of this coefficient implies that network effects at these times are over 6 times larger than for all other votes.

In fact, the estimate from Column 3 implies that controlling for the Senator's own tendency to approve legislation, the party's views on the given bill, and the state-implied importance level of the given bill, a one standard deviation increase in the percent of the Senator's network who have a vested interest in the bill and vote yes (SCVR) results in a roughly 5 percentage point increase in the

[22] For brevity of exposition, (since we already use SCV in all previous specifications) we report the coefficients for SCV and SCVR. We could have equivalently (containing the same information), explicitly split the network votes into SCVR, and SCVnotR (i.e., School Connected Votes Not-Relevant). This leads to identical conclusions. For instance, if we replicate Column 1 but explicitly splitting the network into the two components, the coefficient on SCVnotR is -0.021 (*t*=-1.67), while that on SCVR is again large, positive, and significant, at .049 (*t*=2.16).

Senator's likelihood to vote yes. To gain a better sense of what this magnitude means, consider it relative to the effect of state-level considerations. After the overall party agenda, this is arguably the largest determinant of what is expected to drive a Congressman's voting behavior. Comparing to a one standard deviation in state-level movement,[23] the alumni network effect is roughly 57% the size of the state effect.

In sum, these results on both close and irrelevant votes, as well as the impact of votes that are especially relevant to the members of one's network, suggest that school ties have an influence on a Senator's voting behavior though direct network effects. In contrast, these results are inconsistent with the alumni network results we find simply capturing some common characteristic. More importantly, the tests of Columns 1-3 in Table V are inconsistent with heterogeneous impacts of a fixed characteristic driving our results.

V.B. The Impact of Powerful Senators within a Network

In this section we employ additional network-specific analyses to further flesh out the mechanism at work in these Congressional alumni networks. For example, if a Senator's goal is to try to pass legislation in his or her self-interest and then trade votes as necessary to accomplish this task, one implication is that more powerful Senators within a network may be particularly useful in marshaling additional support for a bill. Specifically, the voting of powerful Senators might have a large impact on less powerful Senators within a given network, while the converse (i.e., that non-powerful Senators' voting impacts powerful Senators) might not be true. To test this idea, we build on a large political science literature that documents the impact and importance of various types of Senate committees, and classify Senators as "powerful" based on the particular committees they sit on. We use data on congressional committees from Stewart and Woon (2009) and Nelson (2005). We first classify whether any given Senator is on a given committee (i.e., Appropriations Committee) in every year of the sample. We then link this to our school-tie data, and measure how many members of each Senator's school-tied network sit on each given committee. We use the list of the top 10 most influential committees from Edwards and Stewart (2006); for the Senate these

[23] While we realize that the state-level percentage measure for the Senate can only by 0 as 1, we still use the standard deviation of the measure here in order to get a measure that is standardized and comparable to that of the school network-level measure.

committees are Finance, Veterans Affairs, Appropriations, Rules, Armed Services, Foreign Relations, Intelligence, Judiciary, Budget, and Commerce.[24]

This approach allows us to break up each school network into powerful and non-powerful Senators (for example Top 3 committee network members versus non-Top 3 committee network members), and then test the impact of powerful network members on the voting behavior of non-powerful network members. Columns 4 and 5 of Table V show that if we focus on the votes of all non-Top 3 Senators, the impact of powerful network members (*School Connected Votes Top 3*) is large and significant (coefficient=0.042, *t*=3.26), while the impact of non-powerful network members is essentially zero. Meanwhile in unreported results we find that the converse is not true; focusing on the votes of powerful members within a network, we still find a large and significant impact of powerful network members on the votes of other powerful members, and a small and insignificant impact of non-powerful members.[25] These findings suggest that powerful Senators are indeed an important part of the logrolling process within a network; in order to marshal support for a bill, it is the votes of key members within a network that are critical.[26]

VI. Network Ties and Pork Barrel Spending

In this section, we examine another potential benefit of being in a logrolling network with school-tied friends: namely, in securing discretionary funding for your state. In particular, we examine whether the school-tie networks we examine, and friends a Senator trades votes with, can also help secure discretionary earmark funding for the Senator's state.

We collect congressional earmark data from Citizens Against Government Waste, which collects earmark data by state starting in 1991. An earmark is defined as a line item in an appropriations bill that designates tax dollars for a specific purpose in circumvention of established budgetary procedures.[27] As in Section V.B, we use data on congressional committee membership, and again utilize the rankings of how influential each committee is from Edwards and Stewart (2006).

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[24] See also Cohen, Coval, and Malloy (2011) for a similar categorization.
[25] We have also run these tests with Top 5 versus non-Top 5 members, and Top 10 versus non-Top 10 members and the results are very similar.
[26] In unreported tests, we have also explored the potential costs of deviating from network objectives. Grouping all Senators within each network into those who conform versus those who deviate, we find evidence that deviation is costly. We find that by failing to be swayed oneself by the network, deviants are then unable to sway others, even in situations where those others are generally easily swayed (e.g., in situations where those other network members might be voting on an issue that is irrelevant to them and hence would normally be willing to trade their vote).
[27] The data collection, matching, and cleaning procedure are described in detail in Cohen, Coval, and Malloy (2011).

The dependent variable in our tests is total earmarks to a given state in a given year. The independent variables of interest are a Senator's committee membership (On Top Committee) and the committee membership of a Senator's network (Friends on Committee). We examine membership on the Appropriations Committee (as this committee has broad power on appropriations line items), as well as Top 3, Top 5 and Top 10 committee memberships. We also include controls for state-level population, per capita income, per-capita income growth, and unemployment. In addition, we cluster standard errors by state, to correct for correlations of earmark allocations over time within the same state.

The results are reported in Table VI. From Column 2, members on the Appropriations Committee get roughly 16.5% (t=4.09) higher earmark spending directed to their states. The coefficient on Friends on Committee implies that a one standard deviation move in school-links to the Appropriations Committee results in roughly 4.2% more earmark spending (t=1.72). Column 4 implies similar impacts for school links to one of the Top 3 most influential committees. While membership on a Top 3 committee results in a 10.8% increase in earmarks for the Senator's state, a one standard deviation increase in school-links to Top 3 committees increases earmarks by 5.4% (t=2.51). As the influential committee grouping is broadened, while still positive, the effects weaken for school-links to (and membership itself on) Top 5 and Top 10 Committees.

VII. Robustness: Controlling for Ideology; Interactions with School Ties; and Regressions by School and Senator

In Table VII, we include a number of additional controls that have been shown to affect voting in the past literature. The first additional control variable we include is how a given Senator votes with respect to other Senators that possess the same political ideology as the Senator in question. We utilize the DW-Nominate measure of ideology, which is widely used in studies of Congressional roll-call voting (see Clinton, Jackman, and Rivers (2004), McCarty, Poole and Rosenthal (1997), McCarty, Poole and Rosenthal (2006), Poole and Rosenthal (1985), (1997), (2007)). All legislators are given a dynamic DW-Nominate score, which places them during each Congress into common space coordinates along two dimensions based on their historical voting record; for example, one dimension can be interpreted as "liberal/conservative" in the modern era.[28] We take

[28] The other dimension, which is less empirically important over our sample period, can be interpreted as the Northern/Southern Democrat divide.

these two dimensions and split them according to their medians and thereby create four quadrants. We label Senators that lie in the same quadrant as having similar ideologies. We then use a variable that is equal to the percentage of these ideologically like-minded Senators that vote in favor of the given bill, which we label *Ideology Votes*.[29]

We also include the voting of the Religious group to which the given Senator belongs. From Table II, there is large variation in religious affiliation, and the literature has shown evidence of this affecting voting patterns (Hibbing and Marsh (1987)). Religious affiliation is also plausibly related to ideology, at least on certain issues. We create a measure called *Religious Votes*, which is the percentage of those Senators of the same religious group as the given Senator that vote in favor of the bill. Finally, we also explore the impact of votes by Senators who sit on the same Senate Committee as the Senator in question, and construct a measure analogous to those above called *Same Committee Votes*.

Table VII presents the regression results including these control variables. The specifications are identical to those in Table III, with the dependent variable being the voting of a given Senator on a given roll call vote (*Yes*), controls included for *Party Votes* and *State Votes*, and fixed effects for Senator and Congress-Session-Vote included. Table VII shows that the *Ideology Votes* variable is strongly related to a Senator's voting pattern across all specifications. Including the ideology variable has a modest effect on the magnitude of the alumni network effect, but the network effect remains strong in significance and magnitude even in the presence of this variable. Also note that including the ideology variable in all the regressions in Table IV, where we explore the impact of networks around close and irrelevant votes, has no effect on these results. Meanwhile the *Religious Votes* variable is a positive but insignificant predictor of voting behavior. Finally, Columns 3 and 4 show that the yes votes of common committee members are negative predictors of yes votes, after controlling for school connected votes, party votes, and state votes. This is explained by the fact that we are controlling for party vote here already, and committees are typically organized with half the members in one party and half in the other. The committee variable is thus (after controlling for party vote) largely picking up the voting preferences of the opposing party, resulting in the negative sign. Importantly, none of these control variables explain the influence of the alumni networks on Senator voting behavior. We have also included additional controls for voting by groups of similar age, Congressional cohort, gender, ethnicity, and geographic region (as measured by Census region),

[29] We have experimented with a variety of other specifications for ideology, for example forming quintile (or decile) groups based solely on the first DW-Nominate dimension, and our results are unchanged across these different specifications.

and none of these additional control variables affect the results reported here.

Columns 7-9 of Table VII explore interactions of the alumni effect with the control variables designed to capture the impact of party, state, and ideological influences on voting. Consistent with the finding in Mian et al (2009) that ideology helps to mitigate pressure from outside groups, we find a smaller impact of the alumni network on voting when the intrinsic interest in the vote is stronger. In fact, Columns 7-9 indicate that when an issue is important to one's party, one's state, or one's ideological peers, the school effect is significantly smaller (all three interaction terms are negative, and significant). These results lend additional support to our earlier findings that whenever a particular vote is inherently important to a Senator who is voting, outside influences on their voting are weaker.

Next, in Table VIII we explore a variety of different specifications designed as robustness checks for our main findings. In Columns 1 and 2 we run probit and logit regressions, respectively, that include the same explanatory variables as those in Table III. Specifically, Column 1 is run as a probit regression, with the coefficient estimate shown being the implied marginal effect of school ties on the probability of voting yes. Again we see that *School Connected Votes* is a strong predictor of voting behavior in the Senate. To give an idea of magnitudes, for the probit coefficient from Column 1 (0.095, t=3.65), a one standard deviation increase in the percent of the Senator's network voting for the bill implies a 3.71% increase in probability of voting yes for the given Senator (compared with a 2% estimated effect from the OLS estimates from Table III). Column 2 is run as a logit regression, and once again we see a large and significant effect of alumni networks on voting.[30]

Next in Columns 3-5 we employ a Fama-MacBeth type framework, where the regression specifications (with controls and fixed effects) are run at the level of each group indicated separately. Then the coefficient estimates are averaged across the groups, with the standard errors calculated as the standard error of the individual group coefficients. For example, in Column 3 we run the regressions of the alumni network effect for each school separately; this approach effectively mitigates the impact of any single school that may be driving our results, as the reported coefficient is an equal-weighted average of the school effects across all schools in our sample. Columns 4 and 5 perform a similar procedure, running the regressions separately for every Senator and for every Congress-Session (i.e., year), respectively. The reported coefficients are then the equal-weighted average across Senators (Column 4) and across years (Column 5). Columns 4 and 5 thus specifically rule out any

[30] We have also replicated Table IV using probit and logit specifications, and as above, the results are in fact slightly larger, and strongly significant. We choose the linear probability model so that we can control more finely for a number of fixed effects that can impact voting behavior.

particular (or a few) Senators or years from driving the results we find.

Thus, if our results were driven by a certain subsample, or a small set of subsamples, the equally-weighted average of the coefficients across subsamples would look much different in magnitude than the pooled regressions (and likely significance, given the then implied differences in estimates across subsamples), and so these tests would yield different implications. Columns 3-5 all indicate that running the regressions by school, by Senator, or by Congress-Session has no effect on our main conclusions: the alumni network effect we document in this paper is not driven by a particular school, or a particular Senator, nor is it concentrated in a particular year.

Lastly, we have also performed a variety of additional robustness checks that we do not report here in order to conserve space. For instance, using the full-specification of the last column of Table III (including Senator- and vote-level fixed effects), we also include school-level fixed effects to control for the propensity of a given school (or any common characteristic correlated with attendance at that school) to impact voting (on average) in a specific way. Including these school fixed effects has nearly no impact on our direct measure of the network's influence on a given Senator's voting for that *particular* bill. The coefficient on *School Connected Votes* on the given bill is 0.052 (t=3.31).[31]

Taken as a whole, our results demonstrate that the impact of alumni networks on Senate voting behavior: a) is robust to a variety of different specifications, b) is not driven by a particular school, Senator, or time period, and c) does not appear to be capturing some common characteristic.

VIII. Discussion

We lastly step back to ask the larger question of what implications these documented voting patterns have for legislators, constituents (both firms and individuals), and perhaps even some broader measures of welfare. First, in terms of legislators, we believe the surprising (and important) aspect of these results is how large of a factor networks are in impacting legislator behavior. What amplifies this importance is that the networks appear particularly useful in currying votes on *precisely* those pieces of legislation that are most important to the legislator. As mentioned earlier in the paper, the magnitudes of these network effects are roughly 60% of the state-level considerations. We believe the magnitude of these network effects have not been fully appreciated in the literature, nor by

[31] In addition, we have run all regressions on the sample of only measures (the final versions of the bills voted on in the chamber), we have included total network size in all of these regressions, and we have included squared or cubed versions of the control variables *Party Votes, State Votes,* and *Ideology Votes* (in order to test if the alumni effect is simply capturing a non-linear effect of one of these control variables). In all cases, *School Connected Votes* remains large and significant.

legislators' constituents, as they simply have not been quantified in as systematic a fashion as we do here both across the legislative process and over many decades.

Second, in terms of constituents, first considering individuals, we believe voters would be quite surprised to find exactly how large an effect these networks have on their elected officials' voting behavior. Perhaps more importantly, they would likely be interested to know exactly how helpful these networks can be in terms of currying the specific votes on which they (and thus their legislator) have a large vested interest. Thus, thinking about the networks to which these voters' elected official has access should potentially be a non-trivial aspect of any voter's decision, especially as these networks appear most useful precisely when the issue appears to be most welfare-increasing to the voters as constituents (i.e., helps the most important industries in the state in terms of employees, revenues, etc.). For firms, as the legislation directly impacts them, their industries, and their competitive environments, we expect the firms to be interested in the ability to access richer legislative networks to impact legislation most important to them.

Lastly, we can also consider the implications of our results for broader measures of welfare. However, this issue is not straightforward. While it is certainly true that state level constituents would benefit from their congressmen currying votes from the Congressman's networks at times that are most crucial, the impact on other states is also important. We provide evidence that the members within the network that supply their votes are those who have the least interest in the outcome of the votes. While this net transfer would seem positive within the network, the net effects outside the network are harder to quantify. In other words, say that Congress is voting on legislation to build plants in Massachusetts instead of in the neighboring states of New Hampshire or Rhode Island. The Massachusetts Congressmen can use their networks, say in California to vote in favor of the bill, and potentially pass it. While this is positive for Massachusetts, and has nearly no impact on California, it obviously has a negative impact for the constituents of New Hampshire and Rhode Island. We would need to add up all of these spillovers, some of which are subtle and difficult to quantify, in order to get a measure of the total social welfare implications. Thus, the net effects of these networks are unclear. On the other hand, it appears that the networks provide one way for votes to have some notion of a "market price," (even if that is a constrained market to within-network), as votes are traded based on private valuations within the network. If legislators are acting in constituents best interests, it may be welfare-increasing for them to sell a vote on an issue that their constituents do not care about for reciprocal votes on issues that have large welfare implications for their constituents. If the networks allow for these market trades to take place in a less costly way, it may be a better state of the world than if no market at all (or a more costly market) existed for these votes.

IX. Conclusion

In this paper we examine the impact of personal connections on the voting behavior of U.S. politicians. Using a new, hand-collected database that constructs linkages between members of the U.S. Congress, we show that social networks influence Senate voting behavior.

The network measure we use is based on the alumni networks of Senators. An advantage of these education-based networks is that they are formed decades before the voting behavior we attempt to explain. We show that even after controlling for known voting determinants, a Senator's school network has a large and significant impact on their voting behavior. Using our sharpest measure of direct influence, a one-standard deviation increase in the percentage of a Senator's interested alumni network voting in favor of a bill implies a roughly 5 percentage point increase in the Senator's own likelihood of voting in favor of a bill. The magnitude of this effect is close to 60% of the effect of state-level considerations. Further, the impact of school ties on voting is monotonically increasing with the strength of network, is not driven by a particular school, Senator, or time period, and is robust to a variety of different specifications and controls.

We show that alumni networks offer a unique window into the widespread practice of logrolling, or vote trading, in the U.S. Senate. By exploiting situations where the network mechanisms are likely to be more utilized, while the characteristics of the network itself remain constant, we demonstrate that the alumni network effect increases significantly at times when the network is plausibly the most important, such as for close votes, for votes that are less important to the Senator who is voting, and particularly for votes that are both close *and* irrelevant to the Senator who is voting. In addition, we find evidence suggesting that Senators are more likely to logroll with network members who are on more powerful Senate committees. Finally, we examine another potential benefit of being in a logrolling network with school-tied friends, and show that having a member of one's alumni network on a powerful Senate committee can help a Senator secure additional discretionary earmark funding for his or her own state.

As legislators, individuals, and firms all have large stakes in the outcomes of the legislative process, our evidence provides important insights into the nature of vote passage in the US legislative landscape. Collectively our findings illustrate the power that informal social networks can have on the behavior of lawmakers, and underscore the need for a deeper understanding of the network forces that shape individual behavior more generally.

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Table I: Summary Statistics

This table reports summary statistics for the sample. Yes is a dummy variable equal to 1 if the Senator voted "Yes" or "Yea" on a given vote. SumSameSchool is equal to the number of Senators (repreSenatives) who attended the same university as the Senator (repreSenative) in question, SumYesSameSchool is equal to the number of Senators (Representatives) who attended the same school as the Senator in question (Representative), and PctSumYesSameSchool is equal to (SumYesSameSchool/SumSameSchool). Analogous variables are computed for SameSchoolDegree (which requires common attendance at the same university and for the same degree), as well as similar variables for Party, State, Religion, Census Region, and Ideology (based on the DW-Nominate coordinates). CloseSeat4 is a measure of Senate Chamber Seat Distance from one Senator to another (see Table VII). Top 40 is a dummy variable equal to 1 if the Senator went to a Top 40 university as ranked by the U.S. News and World Report, and Important Vote is equal to 1 if the given vote is important to that Senator (see Table A2).

	101st-110th Congresses (1989-2008), Senators = 209			
	Mean	Median	Standard Deviation	Nonmissing Observations
Yes	0.653	1.00	0.476	651,705
SumSameSchool	3.952	1.00	5.937	671,520
SumYesSameSchool	2.528	1.00	4.258	671,520
PctSumYesSameSchool	0.638	0.75	0.389	441,746
SumSameSchoolDegree	2.074	1.00	3.275	671,520
SumYesSameSchoolDegree	1.327	0.00	2.354	671,520
PctSumYesSameSchoolDegree	0.639	0.75	0.393	353,063
SumYesSameParty	31.139	39.00	18.668	671,520
PctSumYesSameParty	0.633	0.82	0.369	668,438
SumYesSameState	0.633	1.00	0.481	671,520
PctSumYesSameState	0.634	1.00	0.482	671,240
SumYesSameIdeology	16.365	17.00	10.675	671,520
PctSumYesSameIdeology	0.633	0.81	0.370	670,839
SumCloseSeat4	10.616	11.00	2.850	668,534
SumYesCloseSeat4	6.745	7.00	4.546	668,534
PctSumYesCloseSeat4	0.633	0.80	0.376	668,534
SumYesCloseSeat8	15.782	17.00	9.404	668,534
PctSumYesCloseSeat8	0.633	0.78	0.353	668,534
SumYesCloseSeat16	33.482	36.00	17.533	668,534
PctSumYesCloseSeat16	0.634	0.72	0.318	668,534
SumYesSameCensusRegion	6.743	6.00	3.955	671,520
PctSumYesSameCensusRegion	0.634	0.67	0.289	671,520
SumYesSameReligion	5.954	5.00	5.721	671,520
PctSumYesSameReligion	0.634	0.67	0.302	573,853
Measure	0.256	0.00	0.437	671,520
Top 40 School	0.423	0.00	0.494	671,520
Important Vote	0.080	0.00	0.271	671,520

Table II: Academic Institutions and Religions Represented in the U.S. Senate (101st-110th Congresses)

This table shows summary statistics of the academic institutions and religions that are most represented in the 101st-110th Congresses of the Senate. Each of the 209 Senators that served in the Senate over this period is included once in these tabulations, but Senators often have degrees from more than one academic institution, hence the total number of degrees exceeds the total number of Senators. Religion information is unavailable for 42 of the 209 Senators.

	Panel A: Schools Represented in the Senate			Panel B: Religions Represented in the Senate			
Rank	Academic institution	# of degrees	% of total	Rank	Religion	# of Senators	% of total
1	Harvard University	35	9.33	1	Roman Catholic	38	22.75
2	Yale University	23	6.13	2	Methodist	25	14.97
3	University of Virginia	10	2.67	3	Presbyterian	22	13.17
4T	Stanford University	8	2.13	4	Episcopalian	17	10.18
4T	Georgetown University	8	2.13	5T	Jewish	16	9.58
6T	Oxford University	7	1.87	5T	Baptist	16	9.58
6T	Vanderbilt University	7	1.87	7	Lutheran	7	4.19
6T	University of Chicago	7	1.87	8	Congregationalist	6	3.59
9T	Princeton University	6	1.60	9	Mormon	5	2.99
9T	University of Georgia	6	1.60	10	United Church of Christ	4	2.40
9T	University of Alabama	6	1.60				
9T	University of Mississippi	6	1.60				
9T	University of Minnesota	6	1.60				
All Degrees		375	100	All		167	100

Table III: The Impact of School Ties on U.S. Senate Voting Behavior

This table reports panel regressions of individual votes on the voting behavior of different Senate groupings. The dependent variable is equal to 1 if the Senator voted "Yea," and zero otherwise. In Columns 1-2, School Connected Votes is the percentage of Senators from the same school as the Senator in question who voted yes on the given bill. In Columns 5-7, School Connected Votes is the sum of Senators from the same school as the Senator in question who voted yes on the given bill; School Connected Votes (School and Degree) is the sum of Senators from the same school (and who received the same degree) as the Senator in question who voted yes on the given bill; and School Connected Votes (School, Degree, and Year) is the sum of Senators from the same school (and who received the same degree and who were born within 3 years of each other) as the Senator in question who voted yes on the given bill. State Votes is a dummy variable equal to one if the Senators from the same state as the Senator in question voted yes on the given bill. Party Votes is the percentage (in Columns 1-2), or sum (in Columns 3-5), of Senators from the same party as the Senator in question who voted yes on the given bill. Congress fixed effects, Congress-Session-Vote (C-S-Vote) fixed effects, and Senator-fixed effects are included where indicated. All standard errors are adjusted for clustering at the Senator-level, and these clustered standard errors are included in parentheses below the coefficient estimates. ***Significant at 1%; **significant at 5%; *significant at 10%.

Dependent Variable: Vote(Yes/No)					
	(1)	(2)	(3)	(4)	(5)
Measure of Connections	Percentage	Percentage	Sum	Sum	Sum
School Connected Votes	0.045***	0.052***	0.008***		
	[0.016]	[0.016]	[0.002]		
School Connected Votes (School and Degree)				0.010***	
				[0.004]	
School Connected Votes (School, Degree, and Year)					0.020**
					[0.008]
State Votes	0.119***	0.122***	0.144***	0.144***	0.144***
	[0.013]	[0.012]	[0.012]	[0.012]	[0.012]
Party Votes	0.926***	0.945***	0.018***	0.018***	0.018***
	[0.022]	[0.024]	[0.000]	[0.000]	[0.000]
Fixed Effects	Congress	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote
Fixed Effects	Senator	Senator	Senator	Senator	Senator
Adjusted R^2	0.64	0.64	0.62	0.62	0.62
No. of Obs.	425653	425653	651705	651705	651705

Table IV: Logrolling Through Alumni Networks

This table reports panel regressions of individual U.S. Senator votes on the voting behavior of other Senators. The dependent variable is equal to 1 if the Senator voted "Yea," and zero otherwise. The sample of votes examined is indicated in each column: i.) *Close Votes* are all votes that are functionally won or lost by (±3) or (±5) or (±7) votes as indicated (described in Section V), ii.) *Non-Close Votes* are the complements to these votes, iii.) *Relevant To Me* are those votes where the given bill addresses an industry that has public firms operating in the voting Senator's home state, iv.) *Irrelevant To Me* are those votes that don't address any public firms operating in the given voting Senator's home state, and v.) *All* include all votes in the sample. The independent variables of *Close Votes*, *Irrelevant Votes*, and *Close & Irrelevant To Me*, are defined as categorical variables equal to 1 if the given vote being considered corresponds to the respective classification (as described above in i-iv), and is equal to 0 for all other votes. Interaction terms are then constructed between these three categorical variables and *School Connected Votes (SCV)*, which is the percentage of Senators from the same school as the Senator in question who voted yes on the given bill. The controls of *Party Votes* and *State Votes* are included in all regressions (as indicated) and are described in Table III. Both Senator fixed effects and Congress-Session (Cong-Sess) fixed effects are included where indicated. All standard errors are adjusted for clustering at the Senator level, and these clustered standard errors are included in parentheses below the coefficient estimates. Significance levels are denoted by: *** for the 1%; ** for the 5%; and * for the 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Votes Sample:	Non-Close	Close	All	All	All	Relevant To Me	Irrelevant To Me	All	All
Measure:	(±3)	(±3)	(±3)	(±5)	(±7)				(±5)
School Connected Votes (SCV)	0.043***	0.068***	0.041**	0.040**	0.039**	0.029**	0.052**	0.030**	0.026*
	[0.016]	[0.021]	[0.016]	[0.016]	[0.016]	[0.015]	[0.026]	[0.011]	[0.014]
Close * SCV			0.035***	0.027***	0.021**				
			[0.011]	[0.010]	[0.010]				
IrrelevantToMe * SCV								0.017	
								[0.011]	
Close & IrrelevantToMe * SCV									0.060**
									[0.027]
Close Votes			-0.019*	-0.013	-0.008				
			[0.011]	[0.010]	[0.010]				
IrrelevantToMe								-0.022	
								[2.19]	
Close & IrrelevantToMe									-0.028
									[0.021]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess	Cong-Sess
Fixed Effects	Senator	Senator	Senator	Senator	Senator	Senator	Senator	Senator	Senator
Adjusted R^2	0.66	0.54	0.64	0.64	0.64	0.59	0.60	0.59	0.59
No. of Obs.	382894	42759	425653	425653	425653	54075	15559	69634	49551

Table V: Isolating the Network Mechanism

This table reports panel regressions of individual U.S. Senator votes on the voting behavior of other Senators. The dependent variable is equal to 1 if the Senator voted "Yea," and zero otherwise. The sample of votes examined is indicated in each column: i.) *All* include all votes in the sample, ii.) *Irrelevant To Me* are those votes that don't address any public firms operating in the given voting Senator's home state, iii.) *Not Top 3* includes the subset of all votes made only by Senators who are not members of one of the "Top 3" most powerful committees (Finance, Veterans Affairs, and Appropriations). The independent variables of *Close Votes*, *Irrelevant Votes*, and *Close & Irrelevant To Me*, are defined as categorical variables equal to 1 if the given vote being considered corresponds to the respective classification (as described above in i-iii), and is equal to 0 for all other votes. *School Connected Votes Top 3* equals the percentage of Senators from the same school as the Senator in question *and* who are members of a Top 3 committee, who voted yes on the given bill. The controls of *Party Votes* and *State Votes* are included in all regressions and are described in Table III. Both Senator fixed effects and Congress-Session (Cong-Sess) fixed effects are included where indicated. All standard errors are adjusted for clustering at the Senator level, and these clustered standard errors are included in parentheses below the coefficient estimates. Significance levels are denoted by: *** for the 1%; ** for the 5%; and * for the 10% level.

	(1)	(2)	(3)	(4)	(5)
Votes Sample:	All	Irrelevant To Me	All	Not Top 3	Not Top 3
School Connected Votes (SCV)	-0.014	-0.022	0.011		
	[0.024]	[0.046]	[0.032]		
School Connected Votes Relevant (SCVR)	0.044**	0.056**	0.016		
	[0.021]	[0.025]	[0.032]		
Close & IrrelevantToMe * SCVR			0.097***		
			[0.039]		
School Connected Top 3				0.042***	
				[0.018]	
School Connected Not Top 3					-0.009
					[0.017]
Adjusted R^2	0.59	0.56	0.59	0.67	0.66
No. of Obs.	60557	8538	46823	178265	161316

Table VI: Network Ties and Pork Barrel Spending

This table reports panel regressions of earmarks on Senate committee membership, and membership of network connected friends. The dependent variable is ln(state-level annual earmarks). On Appropriations Committee (On Top 3, 5, or 10 Committee) is a categorical variable equal to one if the Senator is a member of the given committee (or set of top committees), and zero otherwise. Friends on Committee is the percentage of the given committee that is school network-connected to the given Senator. Control variables include ln(state-level population), the state-level average of ln(per capita income) over the past 6 years, and lagged values of state-level ln(per-capita income growth) and state-level unemployment rates. Year-fixed effects and state-fixed effects are included in all regressions. All standard errors are adjusted for clustering at the state level, and t-stats using these clustered standard errors are included in parentheses below the coefficient estimates. Significance levels are denoted by: *** for the 1%; ** for the 5%; and * for the 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
On Appropriations Committee	0.159***	0.165***						
	[0.041]	[0.040]						
On Top 3 Committee			0.098***	0.108***				
			[0.034]	[0.033]				
On Top 5 Committee					0.049	0.051		
					[0.040]	[0.040]		
On Top 10 Committee							-0.007	-0.009
							[0.054]	[0.056]
Friends on Committee	0.083*	0.085*	0.098**	0.109**	0.019	0.018	0.011	0.007
	[0.048]	[0.049]	[0.040]	[0.043]	[0.043]	[0.044]	[0.044]	[0.046]
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	State	State	State	State	State	State	State	State
Fixed Effects	Year	Year	Year	Year	Year	Year	Year	Year
Adjusted R^2	0.77	0.76	0.77	0.76	0.76	0.75	0.76	0.75
No. of Obs.	1788	1688	1788	1688	1788	1688	1788	1688

Table VII: Controlling for the Impact of Ideology and Interactions with School Ties

This table reports panel regressions of individual Senate votes on the voting behavior of different Senate groupings. The dependent variable is equal to 1 if the Senator voted "Yea," and zero otherwise. School Connected Votes (SCV) is the percentage of Senators from the same school as the Senator in question who voted yes on the given bill. Religious Votes is the percentage of Senators of the same religious affiliation as the Senator in question who voted yes on the given bill. Ideology Votes (DW-Nominate) is the percentage of Senators in the same DW-Nominate Ideology quadrant as the Senator in question who voted yes on the given bill. Same Committee Votes is the percentage of Senators on the same committee as the Senator in question who voted yes on the given bill. The controls of *Party Votes* and *State Votes* are included in all regressions (as indicated) and are described in Table III. We also include interactions of School Connected Votes (SCV) and the control variables Party Votes, State Votes, and Ideology Votes where indicated. Congress-Session-Vote (C-S-Vote) fixed effects and Senator-fixed effects are included where indicated. All standard errors are adjusted for clustering at the Senator level, and these clustered standard errors are included in parentheses below the coefficient estimates. ***Significant at 1%; **significant at 5%; *significant at 10%.

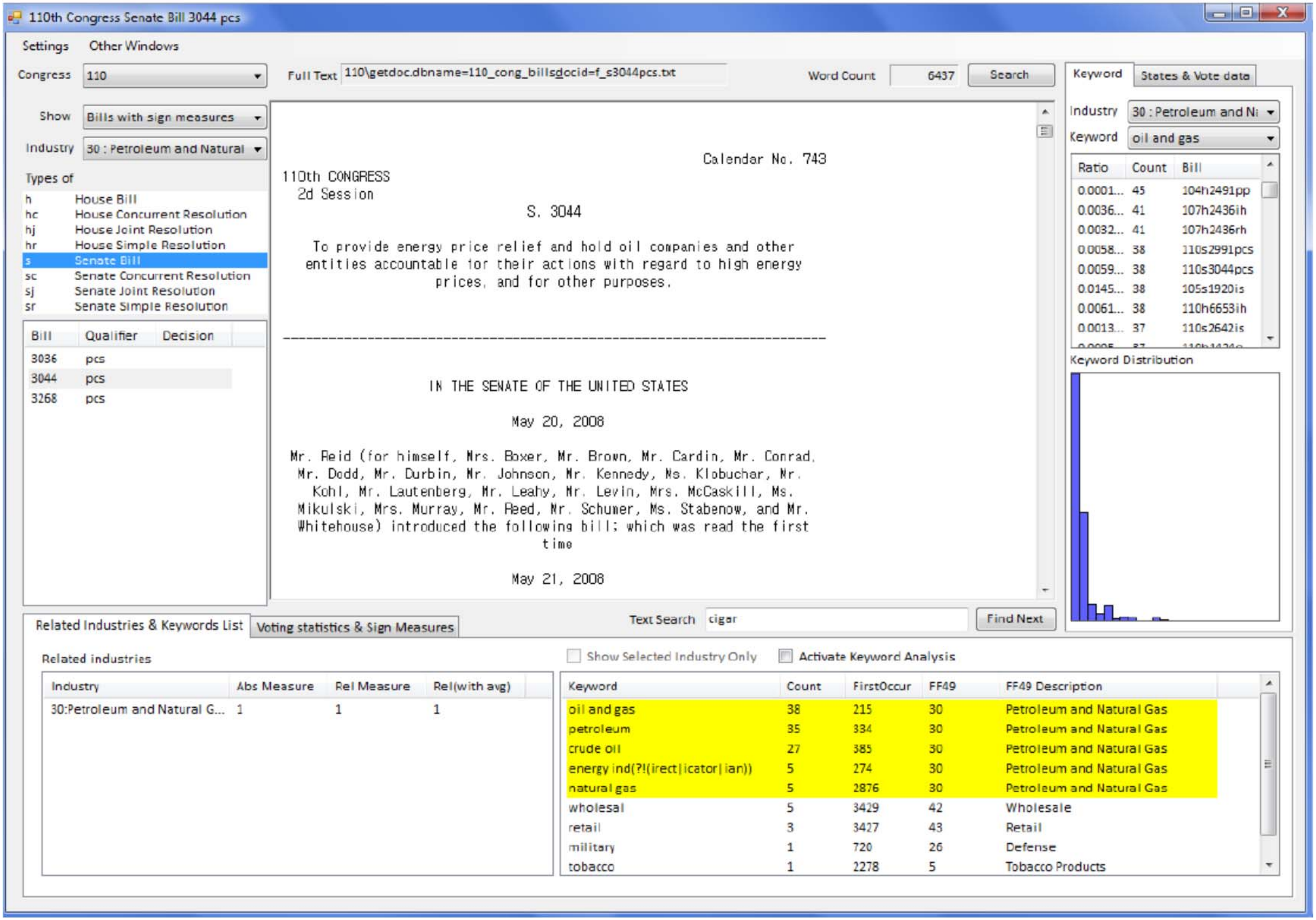
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School Connected Votes (SCV)	0.051***	0.040***	0.053***	0.050***	0.038***	0.037***	0.074***	0.051***	0.074***
	[0.017]	[0.013]	[0.017]	[0.018]	[0.013]	[0.014]	[0.016]	[0.014]	[0.015]
Religious Votes	0.041			0.035	0.022	0.013			
	[0.031]			[0.035]	[0.022]	[0.024]			
Ideology Votes (DW-Nominate)		0.409***			0.397***	0.398***	0.407***	0.408***	0.441***
		[0.035]			[0.039]	[0.039]	[0.035]	[0.035]	[0.035]
Same Committee Votes			-0.337***	-0.341**		-0.347***			
			[0.070]	[0.080]		[0.075]			
SCV * Party Votes							-0.064***		
							[0.013]		
SCV * State Votes								-0.023***	
								[0.007]	
SCV * Ideology Votes									-0.063***
									[0.012]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote	C-S-Vote
Fixed Effects	Senator	Senator	Senator	Senator	Senator	Senator	Senator	Senator	Senator
Adjusted R^2	0.64	0.65	0.63	0.64	0.65	0.66	0.65	0.65	0.65
No. of Obs.	351202	424991	384143	318745	350540	318314	424991	424991	424991

Table VIII: Alternate School Ties Specifications

This table reports regressions of individual votes on the voting behavior of different Senate groupings. The dependent variable in all regressions is equal to 1 if the Senator voted "Yea," and zero otherwise. Column 1 is run as a Probit regression, with the coefficient estimate shown being the implied marginal effect on the probability of voting yes. Column 2 is run as a Logit regression. Columns 3-5, are run in a Fama-MacBeth type framework, where the regression specifications (with controls and fixed effects) are run at the level of each group indicated separately. Then the coefficient estimates are averaged across the groups, with the standard errors calculated as standard error of the group coefficients. School Connected Votes is the percentage of Senators from the same school as the Senator in question who voted yes on the given bill. Votes that are *Close & Irrelevant to Me* are defined as those votes that are functionally won or lost by (±5) votes, and that do not address any public firms operating in the given voting Senator's home state. Controls for Party Votes and State Votes are included in all regressions, and are described in Table III. Ideology Votes (DW-Nominate) is the percentage of Senators in the same DW-Nominate Ideology quadrant as the Senator in question who voted yes on the given bill. Congress, Senator, and Congress-Session (Cong-Sess) fixed effects are included where indicated. All standard errors are adjusted for clustering at the Senator level, and these clustered standard errors are included in parentheses below the coefficient estimates. ***Significant at 1%; **significant at 5%; *significant at 10%.

Dependent Variable: Vote(Yes/No)					
	(1)	(2)	(3)	(4)	(5)
Regression Specification	Probit	Logit	OLS by: School	OLS by: Senator	OLS by: Congress-Session
School Connected Votes (SCV)	0.095*** [0.026]	0.544*** [0.149]	0.052*** [0.016]	0.073*** [0.023]	0.047*** [0.004]
Controls	Yes	Yes	Yes	Yes	Yes
Fixed Effects			Congress	Congress	Senator
Fixed Effects			Senator		
Adjusted R^2	0.59	0.58			
No. of Obs.	425653	425653	106	156	20

Figure 1: Congressional Bill Industry Assignment Example



Friends in High Places:
Internet Appendix

In this Appendix we describe in more detail the method and data cut-offs we use to classify bills into industries. We also describe additional variations in vote samples that we have explored.

A.1 Industry Classification, Keywords, and Cut-offs

As described in the data section, we first download the full text of all bills jointly from the Government Printing Office (GPO) and Congress's Thomas database. We then parse each bill's entire text, and use a list of matching words to classify each bill into the industries to which it applies. Table A1 displays the words we use to classify into the Fama-French 49 industries, for three sample industries. We are happy to provide the entire list upon request, for all 49 industries (but including them all in the appendix table made this a 13 page table). Again, the Fama-French 49 industries are somewhat analogous to the SIC 2 digit industry classification, with some improvements and aggregations of similar SIC 2 sub-industry components. As Table A1 shows, we obviously attempt to use a number of keywords to capture the bill's relevance to a given industry. However, we balance this by not choosing too many keywords to induce false positives. In the table, we include when a given industry (or keyword) was removed because it was capturing too many false positives in the industry assignment process.

To give a few examples, we remove the word "soda" from the "Candy and Soda" industry, as it kept matching with "soda ash" and "soda mountain" from a number of bills, both having nothing to do with the desired industry. As another example, for the "Personal Services Industry," we initially included the keyword "beauty shop." Unfortunately, nearly all of the instances of this keyword in bills refer to the "House Beauty Shop," referencing a (debate about) and the eventual closing of this service in one of the House of Representative buildings, and so we remove this keyword as well.

Another important aspect of this table is that after deciding upon keyword roots, we then go through each extension and conjugation that we see in the bills in order to determine which extensions and conjugations reasonably refer to the given industry. So, for instance, for the "Utilities" industry, we use the keyword root "utilit-." While this matches correctly "utility" and "utilities," it incorrectly picks up "utilize" and "utilitarian," which also appear in bills. We thus remove all of the final two matches from the bill matched sample to Utilities through "utilit-." We do this for every keyword root in every industry to ensure that the given keyword root matches to the intended industry.

The last element of the process is then choosing threshold frequencies for each keyword appearing in a given bill relative to that keyword's use across all bills, in order to classify a given bill as referring to that keyword's industry. We use two potential methods for this, the first is the absolute count of the keyword, and the second is the ratio of that word to the entire number of words in the bill. For instance, the word "electricity" has a frequency cut-off of 11 times, representing the 95th percentile of that keyword's distribution amongst bills. We have used cut-offs for both measures ranging from the 75th-95th percentile, and the results in the paper are unaffected. All results reported in the paper are for the middle of this range, 85th percentile, using the absolute number of keyword appearances.

The outcome of this process is a match of relevant industries to each bill considered in congress. We believe we have a quite conservative match process, but match fairly definitively 20% of all bills to a relevant industry (or industries).

A.2 Vote Subsamples

All results that we report in the paper's tables include all votes. However, it is important to note that we have looked at a number of other subsets of votes as well, and that the results are robust across all of these subsamples. First, looking only at final votes on bills that eventually are passed into law gives roughly identical results in terms of magnitude and significance.[32] The reason we report results for all votes in the paper is that we believe vote-trading within the social network may be going on across many types of votes.

Second, in Table VI in the paper we show a number of vote subsamples according to important economic sub-classifications within our sample, and show that no single subsample drives our results. Specifically, we split our sample out separately for every school, every Senator, and every Congress-Session. We then run our tests separately for every sub-set (for instance, in the school case, we run our tests separately for every school that appears in our sample), and report average coefficients across the subsets (along with the cross-sectional t-stat across all school estimates). Using this method drastically reduces power, but *equally weights* across each subsample we consider (in the case of Congress-Session, for example, we only have 20 estimates (20 years) that enter into the average coefficient estimate, and 20 observations entering into the standard error measurement). Thus, if our results were driven by a certain subsample, or a small set of subsamples, the equally-weighted average of the coefficients across subsamples would look much different in magnitude than the pooled regressions (and likely significance, given the then implied differences in estimates across subsamples), and so these tests would yield different implications. From Table VI, we see that our school network effects are remarkably consistent across all subsamples, using school, Senator, or Congress-Session. Again, we are happy to provide the sub-sample estimates for every Senator, every school, and every Congress-Session.

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[32] Note that this separation into measures is very similar to Theriault (2006), which separates procedural and non-procedural votes. Our measures category matches closely to his "Substantive Votes" category.

Lastly, we have used variation in "important" bills to each Senator. We considered using measures of important votes identified by Mayhew (1991) and updated on his website,[33] and also Edwards et al. (1997, 2000). These are certainly valid measures of important bills at the bill level. However, we instead opt to use a measure of "important" bills defined at the Senator-bill level. In other words, we allow the *same* bill to be important or unimportant for *different* sets of Senators. We define "importance" quite flexibly throughout the paper, using important to the given Senator's party, state (through industries domiciled there), and ideology. We then interact these measures of important bills for the given Senator (or use varying subsamples),[34] and show how our estimated impacts vary. Throughout the paper, we show that school networks do have quite a different impact across important and unimportant votes to the given Senator (and also important and unimportant votes to other Senators in the given Senator's school network). We think these are important and strong validating pieces of evidence. In sum, the subsample analyses we have done helps to pin down and strengthen the mechanism of school network influence.

[33] http://pantheon.yale.edu/~dmayhew/data3.html

[34] These two methods are obviously nearly equivalent, except that the subsample method allows all regression coefficients to vary (be freely estimated) across subsamples, whereas the interaction method (including main effects) only allows the intercept and interacted coefficient to vary. In Table IV where we use both, you can see that the two methods (not surprisingly) yield nearly identical results in our sample.

Table A1: Industry Assignment Keywords and Cut-offs

This table shows the keywords used in assigning the full text of each bill in our sample to the resultant industries covered by the bill, along with the cut-offs for the percentile in the distribution of that keyword for the entire sample. We assign the given industry to a bill if any one of its keywords is above the 85th percentile cut-off given in the table. We choose a subset of the 49 industries (Fama-French Industry Classification) that we use, as the table would otherwise be prohibitively long. We are happy to provide the entire table of keywords and cut-offs upon request.

Fama-French Industry # / Industry Name	Keyword	Count Greater Than / Equal To	Count Percentile
	agricultur-	12	85
	animal feed	7	85
	corn	4	85
1 – Agriculture	crop(s)	14	85
	farm(s)(land)	11	85
	fishing	8	85
	livestock	7	85
	wheat	8	85
	air force	31	85
	Ammunition	15	85
	armed force(s)	10	85
	Army	13	85
	gun(s)(runners)(powder)	8	85
26 – Defense	marine corps	30	85
	Military	11	85
	missile(s)	23	85
	national guard	30	85
	Navy	19	85
	Ordnance	7	85
	space vehicle(s)	3	85
	Tanks	9	85
	weapon(s)	15	85
	broker dealer(s)	3	85
	closed end	2	85
	commodity broker(s)	14	85
	financial services firm(s)	2	85
	investment bank(s)	8	85
	investment firm(s)	2	85
48 – Trading	investment management	6	85
	investment trust(s)	12	85
	mutual fund(s)	3	85
	reit(s)	44	85
	broker-dealer(s)	No Keyword Count Information Available	
	closed-end	No Keyword Count Information Available	
	security broker(s)	Keyword removed : Only 2 bills with the keyword, and all appear in definition clauses	
	unit trust(s)	No Keyword Count Information Available	

Table A2: Industry Assignments by State

This table shows the 3 most important industries for each state at the beginning, midpoint, and endpoint of our sample. "Importance" is measured by summing up the market equity of all publicly traded firms in each industry residing in a state, and then ranking industries. We thus show below the three largest industries operating in each given state over each Congress. We choose a subset of states and Congresses, as the table would otherwise be prohibitively long. We are happy to provide the entire table of states, industries operating in those states, and most important industries for each state and Congress upon request.

State	Fama-French Industry #	Industry Name	Congress
TX	30	Oil	101
TX	31	Utilities	101
TX	32	Telecom	101
TX	30	Oil	105
TX	32	Telecom	105
TX	35	Computers	105
TX	30	Oil	110
TX	31	Utilities	110
TX	32	Telecom	110
NY	45	Banks	101
NY	46	Insurance	101
NY	48	Trading	101
NY	45	Banks	105
NY	46	Insurance	105
NY	48	Trading	105
NY	45	Banks	110
NY	46	Insurance	110
NY	48	Trading	110
CA	32	Telecom	101
CA	35	Computers	101
CA	43	Retail	101
CA	35	Computers	105
CA	36	Software	105
CA	37	Electronic Equipment	105
CA	35	Computers	110
CA	36	Software	110
CA	37	Electronic Equipment	110

Table A3: Expanded Information on School Networks

This table shows an expanded version of Table II. It includes a more detailed breakdown of political affiliations within each network, along with the same information for religion affiliations within each network. Additionally, it includes a list of the states that are represented in each network, along with the most represented state within each network.

Schools Represented in the top 10 School Networks in the US Senate														
Rank	Academic institution	#degrees	%total	#senators	# Rep	# Dem	# Indep	Most Represented Religions	# in that religion	total # reported religion	# unique states	Most Represented State	# from that state	All States
1	Harvard University	35	9.33	30	12	17	1	Catholic, Methodist, Jewish	4	25	24	MI	3	AK, CO, DE, FL, HI, ID, IL, LA, MA, MD, MI, NC, NH, NJ, NM, NY, PA, RI, SD, TN, VT, WA, AI, WV
2	Yale University	23	6.13	20	8	10	2	Episcopalian, Presbyterian, Jewish	3	15	13	PA	3	CA, CT, FL, MA, MN, MO, NY, OH, OK, PA, RI, VT, WY
3	University of Virginia	10	2.67	9	4	5	0	Episcopalian	2	5	7	VA	3	FL, IN, MA, MO, RI, TX, VA
4T	Stanford University	8	2.13	8	1	7	0	Jewish	2	6	6	OR, CA	2	CA, CO, MT, ND, NM, OR
4T	Georgetown University	8	2.13	6	2	4	0	Roman Catholic	4	5	6	AK, IL, ME, VA, VT, WY	1	AK, IL, ME, VA, VT, WY
6T	Oxford University	7	1.87	7	3	4	0	Methodist	3	6	7	IN, LA, MD, NC, NJ, OK, TX	1	IN, LA, MD, NC, NJ, OK, TX
6T	Vanderbilt University	7	1.87	5	2	3	0	Baptist	2	4	1	TN	5	TN
6T	University of Chicago	7	1.87	7	2	4	1	Presbyterian, Assemblies of God, United Church of Christ, Roman Catholic	1	4	6	MO	2	IL, MN, MO, NJ, PA, VT
9T	Princeton University	6	1.6	6	3	3	0	Episcopalian, Presbyterian	2	5	5	MO	2	MD, MO, NJ, RI, TN
9T	University of Georgia	6	1.6	4	3	1	0	Methodist	2	2	2	GA	3	GA, TX
9T	University of Alabama	6	1.6	4	3	1	0	Presbyterian, Methodist	2	4	2	AL	3	AL, CA
9T	University of Mississippi	6	1.6	3	3	0	0	Southern Baptist	3	3	1	MS	3	MS
9T	University of Minnesota	6	1.6	4	2	1	1	Congregationalist, Lutheran	1	2	3	MN	2	CO, MN, ND
All Degrees		375	100											

Table A4: Top Senators by School Connected Voting

This table lists the top 20 Senators in our sample in terms of their propensity to vote with their school networks. In particular, the ranking was made using the separate regressions run for each Senator described in Table VIII (Column 4). The ranking is then based on their coefficient estimate on School Connected Votes (SCV). The top 20 Senators based on this ranking over our sample period of the 101st-110th Congresses are then listed below in alphabetical order of last name.

Name	Birthdate	Birthplace	Party	Employment	State	Undergraduate	Graduate
John B. Breaux	3/1/1944	Crowley, LA	Democrat	Attorney	LA	University of Southwestern LA	Louisiana State University (LSU)
Thomas Richard Carper	1/23/1947	Beckley, WV	Democrat	Public official	DE	Ohio state University	University of Delaware
John H. Chafee	10/22/1922	Providence, RI	Republic	Attorney	RI	Yale University	Harvard University
Larry E. Craig	7/20/1945	Council, ID	Republic	Rancher	ID	University of Idaho	
Wyche Jr. Fowler	10/6/1940	Atlanta, GA	Democrat	Attorney	GA	Davidson College	Emory University
H. John III Heinz	10/23/1938	Pittsburgh, PA	Republic	Businessperson	PA	Yale University	Harvard University
Daniel K. Inouye	9/7/1924	Honolulu, HI	Democrat	Attorney	HI	University of Hawaii	George Washington University
Johnny Isakson	12/28/1944	Atlanta, GA	Republic	Realtor	GA	University of Georgia	
James M. Jeffords	5/11/1934	Rutland, VT	Democrat	Attorney	VT	Yale University	Harvard University
Dirk Kempthorne	10/29/1951	San Diego, CA	Republic	Public Official	ID	University of Idaho	
Mary L. Landrieu	11/23/1955	Arlington, VA	Democrat	Real Estate Agent	LA	Louisiana State University (LSU)	
Harlan Mathews	1/17/1927	Walker County, AL	Democrat	Public Official	TN	Jacksonville State University	Vanderbilt University
James A. McClure	12/27/1924	Payette, ID	Republic	Attorney	ID	Idaho State University	University of Idaho
Zell Bryan Miller	2/24/1932	Young Harris, GA	Democrat	Public Official	GA	University of Georgia	University of Georgia
Earl Benjamin (Ben) Nelson	5/17/1941	McCook, NE	Democrat	Attorney	NE	University of Nebraska	University of Nebraska
Samuel A. Nunn	9/8/1938	Perry, GA	Democrat	Attorney	GA	Emory University	Emory University
David Pryor	8/29/1934	Camden, AR	Democrat	Attorney	AR	University of Arkansas	University of Arkansas
Mark Pryor	1/10/1963	Fayetteville, AR	Democrat	Attorney	AK	University of Arkansas	University of Arkansas
Arlen Specter	2/12/1930	Wichita, KS	Republic	Attorney	PA	University of Pennsylvania	Yale University
Steven D. Symms	4/23/1938	Nampa, ID	Republic	Farmer	ID	University of Idaho	

Table A5: Top Schools by School Connected Voting

This table lists the top 20 schools in our sample in terms of their propensity to have Senators vote with their school networks. In particular, the ranking was made using the separate regressions run for each school described in Table VIII (Column 3). The ranking is then based on their coefficient estimate on School Connected Votes (SCV). The top 20 schools based on this ranking over our sample period of the 101st-110th Congresses are then listed below in alphabetical order name. The second column of the table then lists whether the school was also on the top 10 list of schools most represented in the 101st-110th Congresses (shown in Table II).

University	One of the Most Represented Schools in the Senate
University of Alabama	Yes
Colorado School of Mines	
Davidson College	
University of Delaware	
Emory University	
University of Georgia	Yes
George Mason University	
Huntington College	
University of Idaho	
Idaho State University	
Jacksonville State University	
Louisiana State University	
University of Mississippi	Yes
Mount Saint Agnes College	
Oregon State University	
University of Pennsylvania	
University of Southwestern LA	
Stanford University	Yes
St. Joseph s University	
University of Washington	
Yale University	Yes

Table A6: The Impact of School Ties on Voting Behavior in the U.S. House of Representatives

This table reports panel regressions of individual votes on the voting behavior of U.S. Representatives. The dependent variable is equal to 1 if the Representative voted "Yea," and zero otherwise. In Columns 1, School Connected Votes is the percentage of Representatives from the same school as the Representative in question who voted yes on the given bill; in Column 2, School Connected Votes is the sum of Representatives from the same school as the Representative in question who voted yes on the given bill. State Votes is the percentage (in Column 1), or sum (in Column 2), of Representatives from the same state as the Representative in question who voted yes on the given bill. Party Votes is the percentage (in Column 1), or sum (in Column 2), of Representatives from the same party as the Representative in question who voted yes on the given bill. Congress fixed effects, Congress-Session-Vote (C-S-Vote) fixed effects, and Representative -fixed effects are included where indicated. All standard errors are adjusted for clustering at the Representative level, and these clustered standard errors are included in parentheses below the coefficient estimates. ***Significant at 1%; **significant at 5%; *significant at 10%.

Dependent Variable: Vote(Yes/No)		
	(1)	(2)
Votes Sample	House	House
Measure of Connections	%	Sum
School Connected Votes	0.019***	0.004***
	[0.004]	[0.001]
School Connected Votes (School and Degree)		
School Connected Votes (School, Degree, and Year)		
State Votes	0.160***	0.004***
	[0.012]	[0.000]
Party Votes	0.995***	0.005***
	[0.001]	[0.000]
Fixed Effects	C-S-Vote	C-S-Vote
Fixed Effects	Rep	Rep
Adjusted R^2	0.57	0.54
No. of Obs.	3444036	3444036