Logrolling in Congress

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Abstract

We study vote trading among U.S. Congress members. By tracking roll-call votes within bills across five legislatures and politicians' personal connections made during the school years, we document a propensity of connected legislators to vote together that depends on how salient the bill is to the politicians' legislative agenda. Although this activity does not seem to enhance U.S. Congress members' legislative effectiveness, vote trading is a strong predictor of future promotions to position of leadership.

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I. Introduction

Logrolling is a form of hidden cooperation among politicians that plays a critical role in the legislative process, being a manifestation of the web of alliances that legislators have to make to pass bills for their constituencies. Over the years, a substantive theoretical body of literature has emerged on this subject (Buchanan and Tullock, 1962; Wilson, 1969; Tullock, 1970; Haefele, 1970; Riker and Brams, 1973; Shepsle and Weingast, 1981; Mueller, 2003; Casella and Palfrey, 2019). However, little empirical research has studied the phenomenon. An obvious challenge for such studies is that logrolling is an informal practice that cannot be directly observed and measured (Stratmann 1992).

In this paper, we contribute to the empirical literature on logrolling by providing evidence on the existence of vote trading among legislators knowing each other personally via alumni organizations, and by investigating the motives behind this activity.

Our analysis proceeds in three steps. In the first step, we study the voting patterns of connected legislators across all roll-call votes held in the House of Representatives for five legislatures (i.e., from the 109th to the 113th). We show the legislators' alumni connections are an important determinant of both vote participation and voting decisions, conditional on casting a vote. To isolate the effect of personal contacts from other confounding factors, we use an empirical design based on a comprehensive set of control variables and fixed effects. Our identification strategy relies primarily on the use of fixed effects for each legislator and bill under vote. As a result, we are able to observe the difference between a legislator's voting behavior in a roll-call vote when a given share of alumni connections takes a common stance and the legislator's behavior in a different roll-call vote held on the same bill when a different share of his/her alumni connections happen to vote in the same way, controlling for time-varying roll-call and individual characteristics.

Results show legislators are more likely to vote in the same way as their alumni connections when the majority of them choose to take a common stance, that is, voting *Yeah*, *Nay*, or abstain. The effect of alumni connections on a legislator's behavior is positive and statistically significant over and beyond the influence exerted on the legislator by his/her party, State delegation, and committee colleagues. The inclusion of bill fixed effects in our model specification helps us to rule out the hypothesis that the estimated network effects are determined by a specific predisposition of legislators and their social connections toward the characteristics of the bill under vote

In the second step of our analysis, we investigate the extent to which the propensity of connected legislators to vote together is a reflection of vote trading. To this goal, we examine whether the propensity of legislators to conform to the voting behavior of their alumni connections varies according to their interest in the outcome of the vote. Regarding voting decisions conditional on casting a vote, we find peer influence depends on the relevance of the vote under roll call for the legislator's own political agenda, party, State delegation, and committee colleagues. Alumni connections exert the strongest influcence on a legislator's voting behavior when the bill under vote is not of interest to his/her political agenda or his/her party, State delegation, or committee colleagues, whereas the lowest influence is recorded when the bill under vote is of interest to his/her political agenda and either his/her party, or State delegation, or committee colleagues. Remarkably, the effects are similar in magnitude across outcomes (i.e., voting *Yeah*, *Nay*). A legislator may be 55 times more likely to conform to the voting behavior of his/her personal connections when comparing the former with the latter case. This evidence shows logrolling is most likely to occur between two connected colleagues when one of them has a vested personal interest in the outcome of the vote, and the other does not. Regarding vote participation, we instead find vote participation of the alumni connections matters only if the issue under vote is not of interest to the legislator's political agenda, irrespective of whether the vote is relevant for the agenda of his/her party, State delegation, or committee colleagues.

In the third step of our analysis, we present a first investigation on why politicians engage in vote trading, by analyzing its impact on their legislative effectiveness and careers. To this end, we pull together novel and hand-collected information on politicians' carreers in the U.S. House of Representatives, by recording when a legislator assumes a major role in the House (i.e., becomes part of a powerful committee or chair of a committee for the first time), raises in the ranks of the party by entering in the party leadership, or assumes a more prestigious office (i.e., becomes a Senator or a member of the executive). In addition, we introduce a novel approach to describe the web of voting alliances among Congress members: the *logrolling graph*. The logrolling graph is a network representation of the market for votes that allows us to assess the effect of both direct and indirect voting alliances. More specifically, the logrolling graph is a directed network in which two legislators are connected if they have an alumni connection, and the strength of the tie connecting one to the other is proportional to the number of times one conformed to the vote of the other when the vote was important only to the latter one. We then calculate a measure of the extent to which a legislator benefits from being involved in the practice of logrolling within this network. We adopt a measure that has consistently emerged as key in describing how social connections affect the behavior and outcome of the members of a network, that is, the Katz-Bonacich centrality, or one of its variants (Bonacich, 1987; Calvo-Armengol et al., 2009). We quantify the returns to vote trading by estimating the impact of an increase in the centrality of a legislator in the logrolling graph on his/her legislative performance and career path.

Our results show engaging in logrolling activities does not provide an edge in advancing the political agenda of U.S. Congress members: neither of those receiving support, nor of those providing it. On the other hand, vote trading has a positive and statistically significant impact on legislators' chances to obtain a promotion. Specifically, both those who receive support from vote trading, and those who provide this support, benefit from logrolling in terms of career advancements. This finding suggests logrolling may be used as a signal of loyalty among peers, and to support them in career advancements in the hope that they will represent their goals and contribute to their achievements.

This paper complements a prominent line of inquiry in the literature showing legislators use social networks to influence the voting behavior of their colleagues. Research shows this usage by legislators connected by networks created by their cosponsorship activities (Koger, 2003; Fowler, 2006; Kirkland, 2011), their membership in a legislative caucus (Victor and Ringe, 2009), their participation in press events (Desmarais et al., 2015), their alumni connections (Cohen and Malloy, 2014; Battaglini et al. 2023), and the proximity of their seat on the chamber floor (Matthews and Stimson, 1975; Masket, 2007, 2008; Harmon, et al. 2019), their office (Rogowski and Sinclair, 2017), and their residence (Young, 1966; Bogue and Marlaire, 1975; Minozzi and Caldeira, 2021). However, none of them analyze how legislators use social networks for vote exchanges. The only empirical evidence of logrolling can be found in Cohen and Malloy (2014), who focused, however, on U.S. Senators.[1] Besides the fact that we look at the House of Representatives, our analysis differs methodologically from theirs in many respects. First, we improve on the identification strategy by adopting a within-bill design: this design is essential to rule out the possibility that connected legislators vote together because of common interests in the bill under vote. Second, we propose a richer characterization of voting patterns (distinguishing between voting in support of or against the passage of a bill, and abstention), and measure more precisely the personal agenda of each legislator.[2] We are moreover able to control for the salience of the vote for the legislator's party leadership, constituency (as signalled by the voting behavior of his/her state delegation), and committee colleagues. Finally, and perhaps most importantly, we are the first to present an investigation into why politicians engage in vote trading, by analyzing its predictive power for their legislative performance and career.[3]

[1] A previous empirical analysis of logrolling in the U.S. Congress is presented by Clinton et al. (2004). This paper focuses on the voting behavior of 66 members on 46 proposals during a single Congress, i.e., the first (1789-1791). In a different strand of research, Aksoy (2012) and Kardasheva (2013) provides empirical evidence that voting rules, the content of a bill, and the urgency of the proposal under vote influence the frequency of position changes of the members of the European parliament.

[2] We propose a novel approach to identify "salient votes" for a legislator, i.e., votes important to a legislator's agenda. This approach combines information on the legislator's sponsorship and cosponsorship activity with the actual content of the bill under vote. This is done by identifying the most recurrent policy issue in the bills sponsored or cosponsored by a legislator, and then selecting the set of roll-call votes in which this issue is discussed. Prior research measured the "salience" of a bill to a legislators by looking at the extent to which the economic activities of the legislator's district could be potentially affected by the outcome of the roll-call vote. This was done by categorizing the content of a roll-call vote as being related to a certain industry, and then assuming that the vote's outcome is relevant for the economy of the legislator's district if there is at least one public firm in that industry in the district (Cohen and Noll, 1991, Cohen and Malloy, 2014).

[3] On this line of research, Esteves et al. (2021) already provided some evidence that logrolling can have been used for political rent-seeking in the British Parliament during the XIX century. However, the analysis does not consider the voting behavior of all legislators over the universe of bills under vote across

The remainder of the paper proceeds as following. In section 2, we describe the data collected for our analysis and their original use. In section 3, we document the voting patterns of connected legislators. In section 4, we examine whether such patterns are consistent with vote trading. In section 5, we consider the empirical salience of two possible motives for vote trading: to enhance legislative effectiveness and to advance in their career path. Finally, section 6 concludes.

II. Data and Definition of Variables

We assemble data from several sources providing information about the characteristics of US Congress members, their legislative activities, voting participation, voting behavior conditional on casting a vote, careers, and social connections over five US Congress cycles: from the 109th to the 113th (2005-2015). All the data are detailed and stored online at www.congressindata.com.

With these data, we investigate the voting behavior of US politicians, and examine the practice of logrolling, by constructing the following variables.

Voting behavior. We track voting participation and voting decisions conditional on casting a vote (either *Yeah* or *Nay*) on all roll-call votes that took place in the House of Representatives in the time span considered. To this aim, we create three dummy variables. The first is $Yeah_{ijb}$ and takes a value of 1 if legislator i voted *Yeah* during roll-call vote j on bill b, and 0 if the legislator voted *Nay* or abstained. The second is Nay_{ijb} and takes a value of 1 if the legislator voted *Nay* during roll-call vote j on bill b, and 0 if the legislator voted *Yeah* or abstained. Finally, the third is $Abstain_{ijb}$ and takes a value of 1 if the legislator i abstained or was not present during roll-call vote j on bill b, and 0 otherwise. Because we do not observe whether a legislator decides to abstain from a vote or is simply missing from the House that day, we construct a control variable measuring competing obligations that a legislator may have during a day and that can prevent participation in some votes (Poole and Rosenthal, 1997, Battaglini et al. 2023). We use *Abstained more than once that day*$_{ijb}$ as a dummy variable that takes a value of 1 if vote j occurred on a day in which Congress member i abstained from more than one vote, and 0 otherwise.

Potential demand for votes from personal connections. We retrieve data on alumni networks to measure the potential demand that a legislator receives from personal connections to sway votes. We obtain the social network by using information from the Biographical Directory of the United States Congress (http:// bioguide.Congress.gov/biosearch/ biosearch.asp) on the high schools and higher-education institutions that legislators attended for both undergraduate and graduate degrees. In the alumni network, a connection between two Congress members is assumed to exist if they graduated from the same educational institution within

different legislatures, but only the voting behavior of legislators working in the committees deciding over the authorizations of railway constructions. Moreover, rather than conducting a longitudinal analysis, they separately analyze the voting behavior of committee members during 1845 (210 votes) and 1846 (508 votes).

four years of each other. We combine these data with the data on legislators' voting behavior, and we register when the alumni connections of legislator i take a common stance during roll-call vote j on bill b. We create three dummy variables: $AlumniYeah_{ijb}$, which takes a value of 1 if the majority of the legislator's alumni connections vote *Yeah* on vote j on bill b, and 0 otherwise; $AlumniNay_{ijb}$, which takes a value of 1 if the majority of the legislator's alumni connections vote *Nay* on vote j on bill b, and 0 otherwise; $AlumniAbstain_{ijb}$, which takes a value of 1 if the majority of the legislator's alumni connections abstain on vote j on bill b, and 0 otherwise.

Potential demand for votes from other networks. To measure the influence of a legislator's party, State delegation, and committee colleagues on his/her vote, we combine the information on the voting behavior of the legislator with data on his/her party affiliation, district of election, and committee memberships. Then, we create three dummy variables to register when a legislator is pressured to vote *Yeah*: $PartyYeah_{ijb}$, which takes a value of 1 if the legislator's party leadership vote *Yeah* on vote j on bill b, and 0 otherwise; $StateYeah_{ijb}$, which takes a value of 1 if the majority of i's State delegation vote *Yeah* on vote j, and 0 otherwise; $CommitteeYeah_{ijb}$, which takes a value of 1 if the majority of i's colleagues from one of his/her committees vote *Yeah* on vote j, and 0 otherwise. Mirroring this case, we similarly create three dummy variables to register when a legislator is pressured to vote *Nay*: $PartyNay_{ijb}$, $StateNay_{ijb}$, and $CommitteeNay_{ijb}$. Regarding abstention, we measure the factors that influence a legislator's vote participation in the following way: $PartyKeyVote_{ijb} = PartyYeah_{ijb} + PartyNay_{ijb}$, $StateKeyVote_{ijb} = StateYeah_{ijb} + StateNay_{ijb}$, $CommitteeKeyVote_{ijb} = CommitteeYeah_{ijb} + CommitteeNay_{ijb}$. The idea is that if a clear consensus exists among these groups, a legislator has more difficulty abstain.

Vote salience. An important driver of voting behavior is the salience of the subject under vote for the Congress member's agenda. The standard approach in prior research is to measure vote salience by looking at the extent to which the outcome of the roll-call vote could affect the economic activities of the legislator's district. This measurement is taken by categorizing the content of a roll-call vote as being related to a certain industry, and then assuming the vote's outcome is relevant for the economy of the legislator's district if that industry has at least one public firm in the district (see, e.g., Cohen and Noll, 1991; Cohen and Malloy, 2014). In this paper, we instead follow the approach proposed by Battaglini et al. (2023). To this goal, we merge information on the legislator's sponsorship and cosponsorship activity with the content of the bill under vote. First, for each bill sponsored or cosponsored by a legislator i, we identify a prevalent policy issue. We do so by using data retrieved from the Policy Agendas Project (PAP) topic system (www.comparativeagendas.net/us). PAP data provide information about the policy content of all roll-call votes held on bills. Specifically, PAP associates the policy content of each roll-call vote with one out of 250 topic subject categories, which are uniquely associated with one out of 20 major policy areas: Macroeconomics, Civil Rights, Health, Agriculture, Labor, Education, Environment, Energy, Immigration, Transportation, Law and Crime, Social Welfare, Housing, Domestic Commerce, Defense, Technology, Foreign Trade, International Affairs, Government Operations, Public Lands, and Culture. Then, for each bill b under roll-call j, we construct a dummy variable $NAME_{b,j,i}$ equal to 1 if the policy issue in b under roll-call j is the most recurrent policy in the bills sponsored by i.[4]

Mechanisms. To further our analysis on the motives behind the practice of logrolling, we also retrieve data to test two different hypotheses that can explain the incentive of a legislator to sway votes. The first hypothesis is that legislators engage in logrolling activities to obtain credit with their peers that is useful when they need support for their political agenda. To test this hypothesis, we retrieve data on the Legislative Effectiveness Scores (LESs) of the legislators included in our sample. This score is a general metric of individual legislative effectiveness in the U.S. Congress developed by Volden and Wiseman (2014), which identifies differences across legislators in formulating meaningful bills and moving them through the legislative process from introduction to the ultimate signing into law during Congress t. We denote this variable as LES_{it} and we use it to register changes in the legislative performance of Congress members. In addition, we collect data on factors previously highlighted in the literature as important drivers of legislative effectiveness. These variables capture information on whether the Congress member is in the first year of tenure, a party leader, chair of a committee, or member of a powerful committee.[5] We merge these data with voting behavior to provide insights on whether logrolling activities show an association with legislative effectiveness, in addition to the traditional drivers.

The second hypothesis we test is that legislators engage in logrolling to further their own career. To this goal, we hand-collected information when legislator i after Congress t does the following: (i) assumes a major role in the House by becoming part of a powerful committee or chair of a committee for the first time;[6] (ii) is put in charge of the coordination of party activities, by becoming one of its leaders;[7] (iii) is elected to a prestigious office, namely the Senate or the executive.[8] We then construct a dummy variable that takes a value of 1 if

[4]The PAP topic coding system is mutually exclusive; that is only one topic is assigned to a bill. Topics are assigned using bill titles. Becasue bill titles (and substance) can change over time, the topic category assigned to them can change across roll-call votes. A precise definition of the policy content related to each PAP category is available at https://www.comparativeagendas.net/pages/master-codebook. Decriptive statistics and further details on this metric can be found in section 1 of the online appendix of Battaglini et al (2023).

[5]Following Battaglini and Patacchini (2018), we define as powerful committees: Appropriations, Budget, Rules and Ways and Means.

[6]Source: the "House Committee Assignments Data," http://web.mit.edu/17.251/www/data page.html#2

[7]Source: the Office of Clerk of the U.S. House of Representatives, http://clerk.house.gov/member info/leadership.aspx

[8]Source: "the Comparative Agenda Project," https://www.comparativeagendas.net/us

legislator i after Congress t obtains any of these positions, and 0 otherwise. We refer to this variable as $Promoted_{it}$. We merge this additional information with our data on legislators' voting behavior, characteristics, legislative effectiveness, and social networks. On average, the percentage of legislators promoted in each Congress is 12.54.

Further details and statistics on the variables used in the analysis can be found in Table A1.

III. Preliminary evidence

We begin our analysis by examining the voting behavior of US politicians, and how their alumni connections affect this behavior. We investigate the difference between the legislators' voting behavior during a given roll-call vote if the majority of their alumni ties take a common stance on the bill under vote (i.e., they vote in favor, against, or abstain) and the legislators' voting behavior if the majority of the alumni ties do not take a common stance. We focus our analysis on the effects of the majority of peers because, although we find a positive effect of the share of peers' voting decisions on own voting behavior, this effect is non-linear and acquires substantial importance only if the share of peers who take a common stance is greater than 50%.[9]

We consider the three distinct decisions of voting in a roll-call vote: support a bill, vote against a bill, and refrain from voting. First, we examine how the decision of a legislator to vote in favor of a given bill is affected by the decision of his/her peers to support that bill, and we estimate the following regression model:

$$
\begin{aligned}
(1) \qquad Yeah_{ijb} =& \beta_0 + \beta_1 AlumniYeah_{ijb} + \beta_2 PartyYeah_{ijb} + \beta_2 StateYeah_{ijb} + \\
& \beta_2 CommitteeYeah_{ijb} + \upsilon_i + \zeta_b + \epsilon_{ijb},
\end{aligned}
$$

where $Yeah_{ijb}$, is modelled as a function of the choice of i's majority alumni peers to vote *Yeah*, represented by the variable $AlumniYeah_{ijb}$, and of other determinants of a legislator's voting, namely, key votes for the agenda of i's party ($PartyYeah_{ijb}$), State delegation ($StateYeah_{ijb}$), and committees ($Committee\ Yeah_{ijb}$). The model includes individual legislator and bill fixed effects (υ_i and ζ_b, respectively) and a random error term ϵ_{ijb}. The inclusion of individual fixed

[9]In Appendix Table A2, we provide evidence on how a legislator's voting behavior changes with different shares of peers who take a common stance on the bill under vote. When the share of peers who vote in favor (against) of a bill is less than 25%, a legislator's decision to vote in favor (against) that bill is unrelated to the decision of his/her peers. When the share of peers who vote in favor (against) of a bill is between 25% and 50%, the estimated effect of peers' voting behavior on the legislator's voting decision is positive and statistically significant, although very small in magnitude. When the share of peers who vote in favor (against) of a bill is over 50%, the estimated effect of peers on the legislator's decision is positive, statistically significant, and sizable in magnitude. For the abstention behavior, we find that although the abstention behavior of peers is unrelated to a legislator's own behavior when the share of peers who abstain is lower than 50%, it becomes important when higher shares of peers abstain.

effects controls for the effects of time-invariant characteristics of legislators possibly correlated with voting behavior, such as their role in the party (e.g., whether they are party leaders) or in the House (e.g., committee chairs), and whether the Congress member has alumni connections in Congress. Bill fixed effects, which can be included in the model specification because multiple roll-call votes are held on the same bill, control for the specific inclination of the legislator and his/her social connections to the specific issues contained in the bill under vote.

Next, we examine how the decision of a legislator to vote against a given bill is affected by the decision of his/her peers to obstruct that bill. We estimate the following regression model:

$$\begin{aligned} Nay_{ijb} = &\beta_0 + \beta_1 AlumniNay_{ijb} + \beta_2 PartyNay_{ijb} + \beta_2 StateNay_{ijb} + \\ &\beta_2 CommitteeNay_{ijb} + \upsilon_i + \zeta_b + \epsilon_{ijb} \end{aligned} \tag{2}$$

Mirroring the previous scenario, here, Nay_{ijb} is modelled as a function of i's majority alumni peers voting *Nay* ($AlumniYeah_{ijb}$), and whether the vote is key for the agenda of i's party leaders ($PartyNay_{ijb}$), State delegation ($StateNay_{ijb}$), and committee colleagues ($CommitteeNay_{ijb}$). The interpretation of the remaining variables (υ_i, ζ_b, ϵ_{ijb}) is the same one used in equation (1).

Finally, we investigate how the decision of a legislator to abstain from a vote in favor of a given bill is affected by the abstention behavior of his/her peers. We estimate the following regression model:

$$\begin{aligned} Abstain_{ijb} = &\beta_0 + \beta_1 AlumniAbstain_{ijb} + \beta_2 PartyKeyVote_{ijb} + \\ &\beta_3 StateKeyVote_{ijb} + \beta_4 CommitteeKeyVote_{ijb} + \\ &\beta_5 \textit{Abstained more than once that day}_{ijb} + \\ &\upsilon_i + \zeta_b + \epsilon_{ijb}, \end{aligned} \tag{3}$$

where $Abstain_{ijb}$ is a function of the choice of i's majority alumni peers to vote abstain ($AlumniAbstain_{ijb}$), the salience of the bill under vote for the agenda of i's party ($PartyKeyVote_{ijb}$), State delegation ($StateKeyVote_{ijb}$), and committee colleagues ($CommitteeKeyVote_{ijb}$), and of the potential competing obligations that the legislator may have during the roll-call vote ($\textit{Abstained more than once that day}_{ijb}$). The interpretation of the remaining variables (υ_i, ζ_b, ϵ_{ijb}) is the same used in equations (1)-(2).

Equations (1), (2), and (3) are estimated using a linear probability model, and errors are clustered at the individual level. The results are contained in Table 1. To ease the comparison of estimated coefficients, we report standardized estimation results.[10]

[10] We standardize the estimated effects using the formula $\frac{sd(x)}{sd(y)}\beta_x$, where β_x is the estimated effect

Column (1) presents the estimates of model (1). Consistent with the expectations, we find the key being important to the agenda of a legislator's party, State delegation, and committee has an impact on his/her voting decision. In fact, when one of these groups supports the passage of the bill under a roll-call vote, it exerts a positive and statistically significant effect on the propensity of the legislator to vote *Yeah*. Most importantly, even controlling for these determinants of voting, we find that the decision of a legislator's alumni connections to support a bill has a positive and statistically significant effect on his/her decision to vote *Yeah*. To better understand the importance of this effect, observe that its magnitude is higher than the impact exerted by $CommitteeYeah_{ijb}$, and almost equal to that of $StateYeah_{ijb}$. That is, the impact of the alumni network on the legislator's voting behavior is stronger than that exerted by committee colleagues, and almost equal to that exerted by the incentive to vote *Yeah* stemming from one's own State delegation.

In column (2), we report the estimates of model (2). Perhaps not surprisingly, we find the same pattern as in column (1). Specifically, the decision of a legislator's party, State delegation, and committee to obstruct the passage of a bill and vote *Nay* has a positive and statistically significant effect on his/her decision to vote *Nay*. Even controlling for these effects, the decision of a legislator's alumni connections to vote against a bill has a positive and statistically significant effect on his/her decision to vote *Nay*.

Finally, in column (3), we show the estimates of model (3). Interestingly, we find legislators are less prone to abstain when the vote is key to their party and their committee colleagues. On the contrary, the legislator's decision to skip the vote does not seem to be influenced by his/her State delegation. Importantly, we again find evidence of the role played by alumni connections in the behavior of the legislator. In fact, we find the decision of a legislator's alumni connections to abstain has a positive and statistically significant effect on his/her decision to abstain.

Taking our evidence as a whole, the voting patterns of US Congress members reveal a propensity of connected legislators to vote together, which is true for the legislators' decisions to support the passage of a law or to obstruct it, as well as their decisions to abstain or cast a vote.

IV. Logrolling

In Table 2, we investigate whether the propensity of connected legislators to vote together reflects vote trading. Panels (a), (b), and (c) show the results for the outcomes *Yeah*, *Nay*, and *Abstain*, respectively. We begin our analysis by comparing the cases in which the vote is relevant or irrelevant to a legislator's

of variable x, whereas $sd(x)$ and $sd(y)$ indicate the standard deviation of the variable x and dependent variable y, respectively.

Table 1
Voting Behavior and Networks
Preliminary evidence

Dep. Variable	Voted Yeah (1 = Yes)	Voted Nay (1 = Yes)	Abstained (1 = Yes)
School-connected Congress members voted	Yeah	Nay	Abstained
Party, State delegation, and committee colleague voted	Yeah	Nay	Yeah-Nay
	OLS	OLS	OLS
	(1)	(2)	(3)
School connected votes	0.0958***	0.0799***	0.0067***
	(0.0108)	(0.0091)	(0.0011)
Party key vote (1 = Yes)	0.6956***	0.6920***	-0.0134***
	(0.0052)	(0.0052)	(0.0013)
State key vote (1 = Yes)	0.0116***	0.0105***	-0.0010
	(0.0017)	(0.0015)	(0.0010)
Committee key vote (1 = Yes)	0.0628***	0.0788***	-0.0083***
	(0.0054)	(0.0057)	(0.0010)
Num.Obs.	2,506,964	2,506,964	2,506,964
R2	0.538	0.569	0.514
Congress member fixed effects	Yes	Yes	Yes
Bill fixed effects	Yes	Yes	Yes

Note: Results for model (1) are reported in column (1). Results for model (2) are reported in column (2). Results for model (3) are reported in column (3). Standardized OLS estimated coefficients are reported. Standardization of coefficients is obtained using the formula $\frac{sd(x)}{sd(y)}\beta_x$, where β_x is the point estimate associated to control variable x, while $sd\,(x)$ and $sd\,(y)$ indicate the standard deviation or respectively control variable x and dependent variable y. Robust standard errors are reported in parentheses. Robust standard errors are adjusted for clustering at the Congress member-level. In column (3), we include but do not report the coefficient associated to the variable *Abstained more than once that day.* For a precise definition of the variables, see Section 2 of the paper. *, **, *** indicate statistical significance at the 10, 5 and 1 percent level.

party agenda. To this purpose, we split the target variables of equations (1), (2), (3), namely, $AlumniYeah_{ijb}$, $AlumniNay_{ijb}$, $AlumniAbstain_{ijb}$, into two dummy variables, which take a value of 1 if the majority of a legislator's alumni connections take a common stance on roll-call vote j on bill b (i.e., they vote $Yeah/Nay$/abstain), and the outcome of the vote is respectively (i) relevant to the party (i.e., party leadership votes in favor/against) (ii) not relevant to the party. The results obtained from this exercise are presented columns (1), (4), and (7). For all considered outcomes, we find the impact of the alumni network on the legislator's voting behavior is positive and statistically significant, regardless of whether the vote is relevant to the party. Most importantly, however, we observe that the magnitude of the effect stemming from the alumni network is 10 times higher when the vote is not relevant to the party than the case when the vote is relevant to it. This evidence is consistent with the hypothesis that legislators are more likely to sway votes when the outcome of the vote is not relevant to their

Table 2
Voting Trading and Networks
Main Results

	Panel A			Panel B			Panel C		
Dep. Variable	Voted Yeah (1 = Yes)			Voted Nay (1 = Yes)			Abstained (1 = Yes)		
School-connected Congress members voted	Yeah			Nay			Abstained		
Party, State delegation, and committee colleague voted	Yeah			Nay			Yeah-Nay		
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School connected votes *									
Party key vote (1 = Yes)	0.0122**			0.0079**			0.0019**		
	(0.0053)			(0.0038)			(0.0009)		
Party key vote (1 = No)	0.1262***			0.1012***			0.0091***		
	(0.0127)			(0.0117)			(0.0012)		
State key vote (1 = Yes)		0.0122***			0.0079***			0.0016*	
		(0.0026)			(0.0018)			(0.0009)	
State key vote (1 = No)		0.0960***			0.0798***			0.0065***	
		(0.0107)			(0.0090)			(0.0011)	
Committee key vote (1 = Yes)			0.0663***			0.0502***			0.0035***
			(0.0078)			(0.0057)			(0.0009)
Committee key vote (1 = No)			0.0804***			0.0679***			0.0104***
			(0.0094)			(0.0087)			(0.0014)
Party key vote (1 = Yes)	0.7431***	0.6955***	0.6945***	0.7277***	0.6920***	0.6916***	-0.0128***	-0.0134***	-0.0133***
	(0.0050)	(0.0052)	(0.0053)	(0.0051)	(0.0052)	(0.0053)	(0.0013)	(0.0013)	(0.0013)
State key vote (1 = Yes)	0.0113***	0.0175***	0.0117***	0.0104***	0.0139***	0.0106***	-0.0010	-0.0011	-0.0010
	(0.0017)	(0.0024)	(0.0017)	(0.0015)	(0.0019)	(0.0015)	(0.0010)	(0.0010)	(0.0010)
Committee key vote (1 = Yes)	0.0602***	0.0627***	0.0777***	0.0752***	0.0788***	0.0860***	-0.0083***	-0.0083***	-0.0075***
	(0.0054)	(0.0054)	(0.0057)	(0.0057)	(0.0057)	(0.0061)	(0.0010)	(0.0010)	(0.0009)
Wald Test [p-value]	160.4336***[0]	86.2931***[0]	7.0721**[0.0078]	87.0567***[0]	82.1119***[0]	8.4956**[0.0036]	25.939***[0]	13.6152***[0.0002]	19.608***[0]
Num.Obs.	2,506,964	2,506,964	2,506,964	2,506,964	2,506,964	2,506,964	2,603,970	2,603,970	2,603,970
R2	0.544	0.538	0.539	0.572	0.569	0.569	0.514	0.514	0.514
Congress member fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bill fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Results for model (1) are reported in panel A. Results for model (2) are reported in panel B. Results for model (3) are reported in columns panel C. Standardized OLS estimated coefficients are reported. Standardization of coefficients is obtained using the formula $\frac{sd(x)}{sd(y)}\beta_x$, where β_x is the point estimate associated to control variable x, while $sd\,(x)$ and $sd\,(y)$ indicate the standard deviation or respectively control variable x and dependent variable y. Robust standard errors are reported in parentheses. Robust standard errors are adjusted for clustering at the Congress member-level. In Panel C, we include but do not report the coefficient associated to the variable *Abstained more than once that day.* The variable *School connected votes - Party key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's party, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - Party key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to the legislator's party, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - State key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's State delegation, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - State key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to the legislator's State delegation, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - Committee key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's committee colleagues, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). The variable *School connected votes - Committee key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to the legislator's committee colleagues, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). For a precise definition of the other variables, see Section 2 of the paper. The Wald χ^2 test in columns (1), (4), and (7) evaluates the statistical difference of point estimates between variables *School connected votes - Party key vote (1 = Yes)* and *School connected votes - Party key vote (1 = No)*. The Wald χ^2 test in columns (2), (5), and (8) evaluates the statistical difference of point estimates between variables *School connected votes - State key vote (1 = Yes)* and *School connected votes - State key vote (1 = No)*. The Wald χ^2 test in columns (3), (6), and (9) evaluates the statistical difference of point estimates between variables *School connected votes - Committee key vote (1 = Yes)* and *School connected votes - Committee key vote (1 = No)*. *, **, *** indicate statistical significance at the 10, 5 and 1 percent level.

party. We continue our investigation by contrasting the cases in which the vote is relevant or irrelevant to a legislator's State delegation agenda. We do so by splitting our target variables using the same procedure followed in the previous exercise. This time, one dummy variable is used to register when the majority of peers take a common stance and the vote is relevant to the State delegation, whereas the other records when the majority of peers take a common stance and the vote is not relevant to the State delegation. The results obtained from this exercise are presented in columns (2), (5), and (8). Similarly, we look at the difference between cases in which the vote is relevant or irrelevant to a legislator's committee colleagues. In this case, the target variables are split into two dummies so that one tracks when the majority of peers take a common stance and the vote is relevant to committee colleagues, whereas the other records when the majority of peers take a common stance and the vote is not relevant to committee colleagues. The results obtained from this exercise are presented in columns (3), (6), and (9). All the results show a common pattern: (i) the impact of the alumni network on the legislator's voting behavior is positive and statistically significant, regardless of the situation considered (e.g., the vote is relevant or not to the State delegation or committee colleagues) and (ii) the strongest effect of the alumni network is registered when stakes are low (e.g., the vote is relevant to the State delegation or committee colleagues).[11]

We conclude our investigation by considering all previous cases (i.e., when the vote is either relevant or irrelevant to a legislator's party, State delegation, and committee colleagues) and comparing the different scenarios with the case in which the vote is relevant or not to a legislator's political agenda. In practice, this comparison is done by splitting our target variables into four dummy variables, which take a value of 1 if the majority of a legislator's alumni connections take a common stance on roll-call vote j on bill b and the outcome of the vote is respectively: (i) relevant both to the party and the legislator's agenda, ii) relevant to the party but not the legislator's agenda, (iii) not relevant to the party but relevant to the legislator's agenda, (iv) not relevant to the party and the legislator's agenda. The results obtained from this exercise are presented in Table 3. Table 3 has the same structure of Table 2, with panels (a), (b), and (c) showing the results for the outcomes *Yeah*, *Nay*, and *Abstain*, respectively.

Turning our attention to voting participation (panel c), we observe that the alumni network is not correlated with the decision to abstain when the vote is relevant to the legislator's agenda. By contrast, it exerts a positive and statistically significant impact on abstention behavior when the vote is not relevant

[11] For all regression estimates contained in Table 2, we conduct a Wald test to test the difference in the estimated effect of the alumni network when the vote is relevant to the party/State delegation/committee colleagues and when it is not. All tests confirms differences are statistically significant. The results of the Wald test for each model are reported at the bottom of the corresponding column of Table 2.

Table 3
Voting Trading, Networks, and Legislators' Political Agenda
Further Evidence

	Panel A			Panel B			Panel C		
Dep. Variable	Voted Yeah (1 = Yes)			Voted Nay (1 = Yes)			Abstained (1 = Yes)		
School-connected Congress members voted	Yeah			Nay			Abstained		
Party, State delegation, and committee colleague voted	Yeah			Nay			Yeah-Nay		
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School connected votes *									
Party key vote (1 = Yes) *									
Legislator key vote (1 = Yes)	0.0023***			0.0017***			0.0005		
	(0.0006)			(0.0004)			(0.0006)		
Legislator key vote (1 = No)	0.0121**			0.0078**			0.0018**		
	(0.0053)			(0.0038)			(0.0009)		
Party key vote (1 = No) *									
Legislator key vote (1 = Yes)	0.0093***			0.0087***			0.0006		
	(0.0015)			(0.0014)			(0.0008)		
Legislator key vote (1 = No)	0.1260***			0.1009***			0.0090***		
	(0.0126)			(0.0116)			(0.0012)		
State key vote (1 = Yes) *									
Legislator key vote (1 = Yes)		0.0017***			0.0011*			-0.0001	
		(0.0004)			(0.0006)			(0.0001)	
Legislator key vote (1 = No)		0.0121***			0.0078***			0.0016*	
		(0.0026)			(0.0018)			(0.0009)	
State key vote (1 = No) *									
Legislator key vote (1 = Yes)		0.0091***			0.0078***			0.0008	
		(0.0013)			(0.0010)			(0.0007)	
Legislator key vote (1 = No)		0.0958***			0.0796***			0.0065***	
		(0.0107)			(0.0090)			(0.0010)	
Committee key vote (1 = Yes) *									
Legislator key vote (1 = Yes)			0.0064***			0.0057***			0.0005
			(0.0010)			(0.0007)			(0.0007)
Legislator key vote (1 = No) *			0.0661***			0.0499***			0.0035***
			(0.0078)			(0.0057)			(0.0009)
Committee key vote (1 = No)									
Legislator key vote (1 = Yes)			0.0065***			0.0054***			0.0006
			(0.0011)			(0.0011)			(0.0008)
Legislator key vote (1 = No)			0.0802***			0.0678***			0.0104***
			(0.0094)			(0.0087)			(0.0014)
Party key vote (1 = Yes)	0.7431***	0.6955***	0.6945***	0.7277***	0.6920***	0.6916***	-0.0128***	-0.0134***	-0.0133***
	(0.0050)	(0.0052)	(0.0053)	(0.0051)	(0.0052)	(0.0053)	(0.0013)	(0.0013)	(0.0013)
State key vote (1 = Yes)	0.0113***	0.0175***	0.0117***	0.0104***	0.0139***	0.0106***	-0.0010	-0.0011	-0.0010
	(0.0017)	(0.0024)	(0.0017)	(0.0015)	(0.0019)	(0.0015)	(0.0010)	(0.0010)	(0.0010)
Committee key vote (1 = Yes)	0.0602***	0.0627***	0.0777***	0.0752***	0.0788***	0.0860***	-0.0083***	-0.0083***	-0.0075***
	(0.0054)	(0.0054)	(0.0057)	(0.0057)	(0.0057)	(0.0061)	(0.0010)	(0.0010)	(0.0009)
Wald Test [p-value]	0.3976[0.5283]	2.3605[0.1244]	70.0172***[0]	0.0687[0.7932]	0.0003[0.9864]	73.124***[0]	1.0307[0.31]	0.4467[0.5039]	5.7485**[0.0165]
Num.Obs.	2,506,964	2,506,964	2,506,964	2,506,964	2,506,964	2,506,964	2,603,970	2,603,970	2,603,970
R2	0.544	0.538	0.539	0.572	0.569	0.569	0.514	0.514	0.514
Congress member fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bill fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Results for model (1) are reported in panel A. Results for model (2) are reported in panel B. Results for model (3) are reported in panel C. Standardized OLS estimated coefficients are reported. Standardization of coefficients is obtained using the formula $\frac{sd(x)}{sd(y)}\beta_x$, where β_x is the point estimate associated to control variable x, while $sd\,(x)$ and $sd\,(y)$ indicate the standard deviation or respectively control variable x and dependent variable y. Robust standard errors are reported in parentheses. Robust standard errors are adjusted for clustering at the Congress member-level. In columns (7)-(9), we include but do not report the coefficient associated to the variable *Abstained more than once that day.* The variable *School connected votes - Party key vote (1 = Yes) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's party and to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - Party key vote (1 = Yes) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is relevant to the legislator's party but not to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - Party key vote (1 = No) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to his/her own agenda but not to his/her party, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - Party key vote (1 = No) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to his/her own agenda and to his/her party, and his/her school connected legislators vote *Yeah* (column 1), vote *Nay* (column 4), abstain (column 7). The variable *School connected votes - State key vote (1 = Yes) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's State delegation and to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - State key vote (1 = Yes) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is relevant to the legislator's State delegation but not to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - State key vote (1 = No) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to his/her own agenda but not to his/her State delegation, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - State key vote (1 = No) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to his/her own agenda and to his/her State delegation, and his/her school connected legislators vote *Yeah* (column 2), vote *Nay* (column 5), abstain (column 8). The variable *School connected votes - Committee key vote (1 = Yes) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to the legislator's committee colleagues and to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). The variable *School connected votes - Committee key vote (1 = Yes) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is relevant to the legislator's committee colleagues but not to his/her own agenda, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). The variable *School connected votes - Committee key vote (1 = No) - Legislator key vote (1 = Yes)* is a dummy variable which takes 1 if the vote is relevant to his/her own agenda but not to his/her committee colleagues, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). The variable *School connected votes - Committee key vote (1 = No) - Legislator key vote (1 = No)* is a dummy variable which takes 1 if the vote is not relevant to his/her own agenda and to his/her committee colleagues, and his/her school connected legislators vote *Yeah* (column 3), vote *Nay* (column 6), abstain (column 9). The Wald χ^2 test in columns (1), (4), and (7) evaluates the statistical difference of point estimates between variables *School connected votes - Party key vote (1 = Yes) - Legislator key vote (1 = No)* and *School connected votes - Party key vote (1 = No) - Legislator key vote (1 = Yes).* The Wald χ^2 test in columns (2), (5), and (8) evaluates the statistical difference of point estimates between variables *School connected votes - State key vote (1 = Yes) - Legislator key vote (1 = No)* and *School connected votes - State key vote (1 = No) - Legislator key vote (1 = Yes).* The Wald χ^2 test in columns (3), (6), and (9) evaluates the statistical difference of point estimates between variables *School connected votes - Committee key vote (1 = Yes) - Legislator key vote (1 = No)* and *School connected votes - Committee key vote (1 = No) - Legislator key vote (1 = Yes).* In columns (7)-(9), we do not report the coefficient associated to the variable *Abstained more than once that day.* *, **, *** indicate statistical significance at the 10, 5 and 1 percent level.

to the legislator's agenda. In this latter case, moreover, the effect stemming from the alumni network is 5 times larger when the vote is also not relevant to the party than when the vote is relevant to the party. All in all, we observe that the less relevant the vote is to the legislator, the strongest the propensity to conform to the behavior of his/her peers. For abstention, the most important factor shaping the influence of the alumni network among the considered ones is the legislator's political agenda. Notably, these findings not only corroborate our previous results on the existence of a logrolling mechanism among connected legislators, but also offer new evidence on the practice of logrolling in Congress by showing the individual preferences of the legislator for the outcome of the vote may be an important predictor of vote trading. Our results in columns (1) and (4) show the alumni connections exert the least influence on a legislator's voting behavior (once a vote is cast) when the vote is relevant to both the legislator's party and political agenda. Intuitively, this finding indicates legislators are less prone to sway votes with their alumni connections when the stakes are high. We use this case as our baseline. With respect to the baseline, the magnitude of the estimated influence of alumni connections is approximately 4 times higher when the vote is not relevant to the party but relevant to the legislator's agenda, as well as when the vote is relevant to the party but not relevant to the legislator's agenda. This finding suggests the party line and one's own political agenda have a similar influence for discouraging vote trading. Most importantly, we find the strongest effect of the alumni network when the vote is neither relevant to the party nor to the legislator's agenda, that is, the situation in which the supply of votes that can be swayed among peers is expected to be the highest. With respect to the baseline, the magnitude of the alumni-network effect in this case is approximately 55 times higher. In columns (2), (5), and (8), we perform a similar exercise to assess the impact of the alumni network when the vote under roll call is (i) relevant both to the State delegation and the legislator's agenda, (ii) relevant to the State delegation but not the legislator's agenda, (iii) not relevant to the State delegation but relevant to the legislator's agenda, (iv) not relevant either to the State delegation or the legislator's agenda. Columns (3), (6), and (9) consider instead the cases in which the vote under roll call is (i) relevant both to committee colleagues and the legislator's agenda, (ii) relevant to committee colleagues but not the legislator's agenda, (iii) not relevant to committee colleagues but relevant to the legislator's agenda; iv) not relevant to either committee colleagues or the legislator's agenda. Different columns refer to different outcomes. The patterns discussed above are qualitatively confirmed. First, the lowest influence of the alumni network is detected when stakes are high, that is, when the outcome of the vote is relevant both to the legislator and the State delegation or committee colleagues. Second, when the legislator casts a vote, his/her voting decisions are influenced by his/her own political agenda as much as he/she is influenced by State delegation or committee colleagues. However, if the legislator has to decide whether to vote or abstain, he/she is likely to conform to the voting behavior of alumni connections only if the vote is not of interest to his/her agenda, regardless of the voting behavior of State delegation, or committee colleagues. When the vote is of interest to his/her agenda, the propensity to sway votes is smaller than that observed when the vote is of interest to his/her State delegation or committee colleagues.[12] Third, the strongest effect of the alumni network (i.e., the highest propensity to sway votes) is observed when the vote is not relevant at all; that is, it is not relevant to the State delegation or committee colleagues or to the legislator's agenda.

V. Why politicians engage in vote trading?

V.I. Introducing the Logrolling Graph

To describe the "market" for votes and its impact on the legislators' effectiveness and careers, we construct a network representation of the vote exchanges. We refer to this network representation as the *logrolling graph.*

In this network, legislators are the nodes, and the links between two nodes, i and j, reflects the intensity and direction of the logrolling activity. The link between i and j is measured by the variable $lgr_{i,j}$, a variable that records the number of times legislator j voted as legislator i in his/her alumni network, when the vote was relevant to i's political agenda but not to j's agenda. We normalize the values of this variable by the number of votes relevant to i's political agenda. This approach gives us a directed network in which the link $lgr_{i,j}$ measures the support provided by legislator j to his/her colleague i through logrolling activities.

Table 4 shows key features of this market. On average, 42% of connected legislators are active in the vote-trading market in each Congress. In this market, the probability that a legislator supports an alumni connection by logrolling is 63%, on average, and the strength of this connection (i.e., $lgr_{i,j}$) is very high: the percentage of times legislator j votes as legislator i in his/her alumni network, when the vote is relevant to i's political agenda but not relevant to j's agenda, is 71%, on average. Given that a legislator decides to support only a fraction of his/her alumni connections, but the strength of the support provided is considerable, we can conjecture that substantial search costs are invested in deciding whom to support, and that a large effort is dedicated to mantaining these relationships. Perhaps not surprisingly, the support received through vote trading is almost always reciprocated. The probability that i supports j, given that j supported i, is higher than 90%. Specifically, a legislator receives support from 2.40 colleagues, whereas he/she provides support to 2.43 colleagues. Finally, Table 4 shows logrolling activities are often conducted within cliques of legislators: the

[12]For all regression estimates contained in Table 3, a Wald test is conducted to test the difference in the estimated effect of the alumni network when the vote is relevant to the party/State delegation/committee colleagues and not to the legislator's agenda, and when the vote is relevant to the legislator's agenda and not to the to the party/State delegation/committee colleagues . All tests confirms that differences are statistically significant. The results of the Wald test for each model are reported at the bottom of the

Table 4
The Logrolling Graph
Summary Statistics

<table>
<tr><td colspan="2">% of connected legislators
42%</td><td colspan="2">% of supported alumni
63%</td><td colspan="2">% of relevant bills supported
71%</td></tr>
<tr><td colspan="3">% of mutual connections
90%</td><td colspan="3">% of connections within a clique
44.53 %</td></tr>
<tr><td colspan="6">Avg. Number of legislators</td></tr>
<tr><td colspan="3">receiving support from
2.40</td><td colspan="3">providing support to
4.43 %</td></tr>
</table>

Note: We report mean values of key features of the Logrolling Graph in the 109-113th Congress.

probability that i and j engage in logrolling activities when they have a common connection in the logrolling graph is 44.53% higher than when they do not have a common connection, on average. In other words, the exchange of votes often occur within groups, rather than between single pairs of legislators.

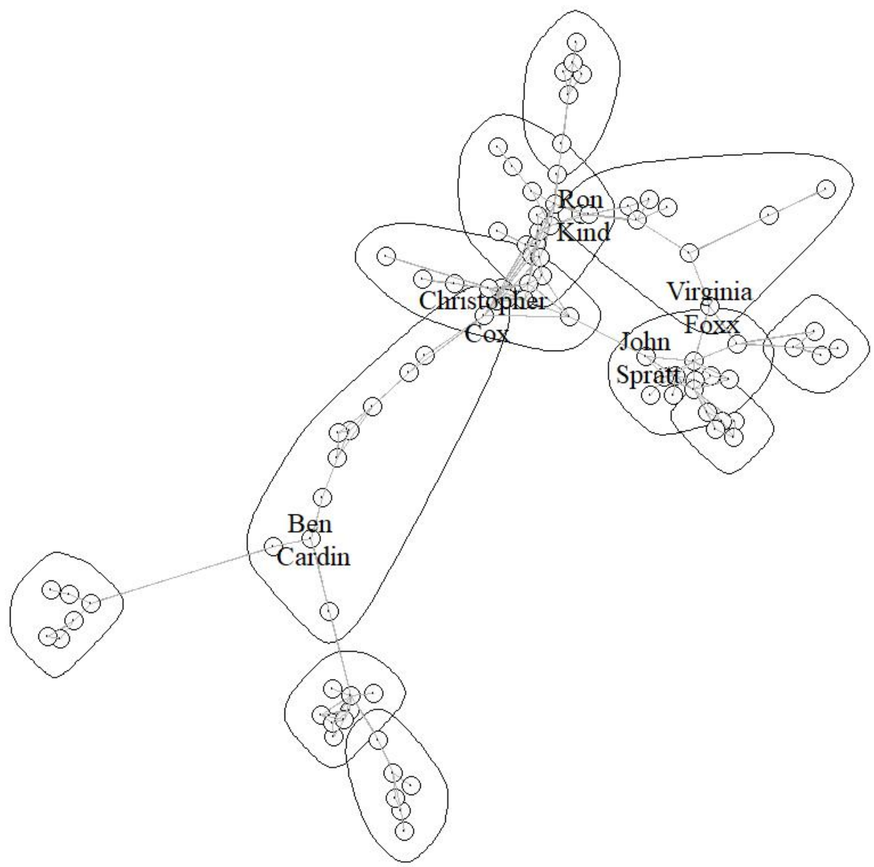
In Figures 1 and 2, we report the structure of the main component of the logrolling graph in, respectively, the first and last Congress considered in this study, namely the 109th and the 113th.[13] Nodes indicate Congress members, and a connection between two nodes signals one is receiving the support from the other through vote trading. Circled areas around nodes indicate communities, namely, clusters of legislators strongly connected with each other, and more sparsely connected with the rest of network.[14] In the figures, we report the names of the legislators associated with nodes connecting different communities, thus playing a central role in the network by working as a bridge between different groups of legislators and facilitating the exchange of votes among them. Notably, all the legislators indicated in these graphs had an important career in the House of Representatives, the party leadership, and the executive. The network representation described above, gives us a tool to assess the direct and indirect benefits of logrolling enjoined by a legislator. To this goal, first, we calculate the support that legislator i receives from his/her direct contacts in the network, by summing the strength of his/her connections: $d_{i,1} = \sum_j lgr_{ij}$. In matrix form, this sum is equal to $d_1 = \mathbf{G}1$, where $\mathbf{G}$ is a matrix with the generic entry i, j being equal to lgr_{ij} for the pair of legislators i and j who have an alumni connection, and 0 otherwise, and 1 is a vector

corresponding column of Table 3.

[13]The main component of a network is the largest set of nodes directly or indirectly connected to each other.

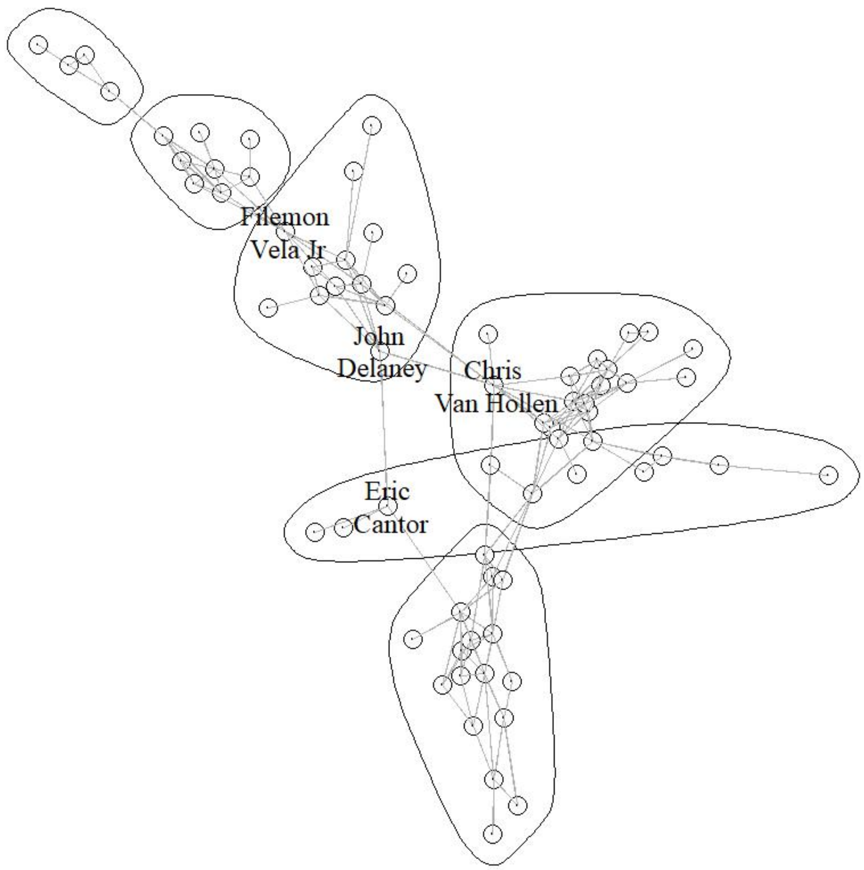
[14]Communities are detected using the spinglass community detection algoritm, which is specifically suited to deal with directed weighted graphs (Reichardt and Bornholdt, 2006), as the logrolling graph.

Figure 1.
Alumni Network
Main Component in the 109th U.S. Congress



Note: The plot represents the main component of the alumni network of the legislators elected for the House of Representatives in the 109th U.S. Congress. The main component is the largest set of nodes connected through a path. Two Congress members are connected if they graduated from the same school within a 4-year window and engaged in logrolling activities. Circled areas around nodes indicate communities, i.e., cluster of legislators strongly connected with each other, and more sparsely connected with the rest of network. Communities are detected using the spinglass community detection algoritm (Reichardt and Bornholdt, 2006). The names of the legislators connecting different communities is reported.These are: Ron Kind, who served as Chairman of the New Democrat Coalition, House Democrats' chief deputy, and member of the Committee on Ways and Means; Christopher Cox, who served as Chairman of the Homeland Security Committee in Congress after 9/11, and Chairman of the Securities and Exchange Commission; Virginia Foxx, who served as Secretary of the House Republican Conference, and Chairwoman of the House Committee on Education and Labor; John Spratt, who served as Chairman of the U.S. House Committee on the Budget, and President of the National Commission on Fiscal Responsibility and Reform; Ben Cardin, who served as member of the Committee on Ways and Means and then was elected in the Senate, becoming the Ranking Democratic member on the Senate Foreign Relations Committee. Later, he became member of the Commission on Security and Cooperation in Europe (i.e., the U.S. Helsinki Commission).

Figure 2.
Alumni Network
Main Component in the 113th U.S. Congress



Note: The plot represents the main component of the alumni network of the legislators elected for the House of Representatives in the 113th U.S. Congress. The main component is the largest set of nodes connected through a path. Two Congress members are connected if they graduated from the same school within a 4-year window and engaged in logrolling activities. Circled areas around nodes indicate communities, i.e., cluster of legislators strongly connected with each other, and more sparsely connected with the rest of network. Communities are detected using the spinglass community detection algoritm (Reichardt and Bornholdt, 2006). The names of the legislators connecting different communities is reported. These are: Eric Cantor, who served as Republican Whip of the House; John Delaney, who was candidate in the 2020 Democratic presidential primaries; Chris Van Hollen, who served as Chairmain of the Democratic Congressional Campaign Committee, and as ranking member on the Budget Committee; Filemon Vela Jr, who became vice chairmain of the Democratic National Committee.

of ones. Because we expect i's connections to be able to conscript their friends to advance i's agenda, we also calculate the strength of i's connections with his/her friends of friends. For i's generic indirect contact k, we calculate his/her support to i mediated by i's friends as $d_{i,2k} = \sum_j lgr_{ij}lgr_{jk}$, so that the total support received by i from his/her indirect contacts is equal to $d_{i,2} = \sum_k \sum_j lgr_{ij}lgr_{jk}$. In matrix form, this sum is equal to $d_2 = \boldsymbol{G}^2 1$. We also consider the support that i's friends of friends may provide by conscripting their connections to the legislator's agenda, that is, $d_3 = \boldsymbol{G}^3 1$. Iterating this process, we can summarize the support received by a legislator from the logrolling network as $\sum_{n=1}^{\infty} d_n = \sum_{n=1}^{\infty} \boldsymbol{G}^n 1$. Of course, we expect that indirect contacts will provide less support to the legislator with respect to direct contacts. For this reason, we use a rescaling factor, ϕ, with a value between 0 and 1, to weight the support that more distant connections provide to a legislator with respect to those who are closer to him/her, and we express the total support that a legislator obtains from the logrolling network as $\sum_{n=1}^{\infty} \phi^n \boldsymbol{G}^n 1$. Without loss of generality, we apply an affine transformation to this equation, that is, $1 + \sum_{n=1}^{\infty} \phi^n \boldsymbol{G}^n 1 = \sum_{n=0}^{\infty} \phi^n \boldsymbol{G}^n 1$, so that the equation takes the form of a known Taylor expansion that allows us to express the support that a legislator receives from his/her direct contacts in the network in a compact form:

$$\sum_{n=0}^{\infty} \phi^n \boldsymbol{G}^n 1 \cong (\mathbf{I} - \phi \mathbf{G})^{-1} 1 = KC.$$

Note $KC = (KC_1, ..., KC_n)$ is an n-dimensional vector, whose jth element measures the support received by j . KG is proportional to the Katz-Bonacich centrality (Bonacich, 1987; Calvo-Armengol et al., 2009) of a legislator in the network. This measure consistently emerged as key in describing how social connections affect the behavior and outcomes of the members of a network. The intuition behind this measure is that a member of Congress is central in the network if he/she is connected to other members of Congress who are central (i.e., who can conscript many others to the Congress member's agenda), and the centrality of a member of Congress depends on the centrality of the other connected members. In other words, centrality is expressed in a recursive way: as a weighted sum of the centralities of the other connected members of Congress, where the weights are given by the intensity of the social connections (e.g., their lgr). As for the term ϕ, this parameter can be interpreted as a measure of the strength of network effects stemming from the logrolling practice (see Battaglini et al., 2018, for a microfoundation of this measure in a different context). The parameter can be estimated jointly with the one capturing the impact of centrality on outcomes, using a non-linear least-squares estimator.[15]

[15] Details on this estimation method can be found in Bates (1988) and Battaglini et al. (2021). For an application of this method to the study of the role of alumni connections in determining how interest groups allocate campaign contributions, see Battaglini et al. (2018).

V.II. *Returns to logrolling*

In this section, we estimate the extent to which engaging in vote-trading predicts the future legislative performance of Congress members and their career advancement. To this purpouse, we use the measures of centrality described in the previous section as follows. We consider the model:

$$Y_{it+1} = \alpha(\mathbf{I} - \phi\mathbf{G})^{-1}1 + \beta\mathbf{X}_{it} + \upsilon_i + \zeta_c + \epsilon_{it}, \tag{4}$$

where the outcome of legislator i in Congress *t+1,* Y_{it+1} (either LES_{it} *or* $Promoted_{it}$) is a function of his/her KC in the logrolling network at time t, and of other relevant time-varying characteristics. The model includes a random error term, ϵ_{it}, and individual and Congress fixed effects (respectively, υ_i and ζ_c). The inclusion of fixed effects allows us to control for the potential impact exerted by time-invariant characteristics of the legislator and other contextual effects. For legislative effectiveness, the set $\mathbf{X}_t$ comprises controls about whether the legislator is in the first year of tenure, is a party leader, a chair of a committee, or a member of a powerful committee (Volden and Wiseman, 2014). For career advancements, the literature provides little guidance regarding variables to be included in $\mathbf{X}_t$. The limited research conducted in this field (see, e.g, Masters, 1961; Posler et al., 1997) suggests a member's chances to obtain a promotion should increase when the legislator is coming from a district where chances of being re-elected are high, because this would allow him/her to support controversial decisions on major policy questions without fear of reprisals at the polls, and when he/she has long tenure in Congress, during which he/she earned a reputation as a "responsible" legislator. Moreover, Volden et al. (2014) suggest greater effectiveness may influence a member's assignment to a position of responsibility. Consistent with this literature, we include the following variables in $\mathbf{X}_t$. The first is the support a legislator receives from his/her constituency, proxied in our data with the percentage of votes that a legislator received to enter in Congress. The second is a dummy variable that takes a value of 1 if the Congress member is in his/her first year of tenure, and 0 otherwise. The third is legislative effectiveness. We can advance two hypotheses on the role this variable may play. On the one hand, one can expect that legislators who are better at passing a piece of legislation may be entrusted with a position of responsibility to help others in advancing specific issues through the floor. On the other hand, more effective legislators may have little time to dedicate to networking and other activities that are crucial to obtaining the trust of their peers, and as a result, they might be penalized in obtaining support for promotion. We proxy this measure with the variable LES_{it} that we use in the previous model.[16]

[16]Observe that our results remain qualitatively unchanged even when removing the variable LES_{it} from our model specification.

The estimation of equation (4) has two parameters of interest. The first is ϕ, which captures the strength of network effects in the network of votes exchanges. The second is α, which measures the impact of a marginal increase in the Katz-Bonacich centrality of a legislator on the outcome (i.e., either his/her legislative effectiveness or likelihood of being promoted). We interpret α as an estimate of the returns from logrolling.

The results that are obtained when using legislative effectiveness as an outcome are reported in Table 5. We look at the extent to which engaging in logrolling activities predict both present and future legislative effectiveness (columns (1) and (2), respectively). Results show centrality in the logrolling networks does not predict legislative effectiveness. The results for the control variables are in line with the existing literature. We find party leaders and chairs of committees in a Congress are more effective legislators than other colleagues who are not in leadership positions in that Congress. This finding is expected because party leaders and committee chairs are in a position to be able to conscript many colleagues to their own political agenda. Although their position of leadership is correlated with their legislative performance at time t, this correlation does not predict their legislative performance at time $t+1$. On the contrary, being a member of a powerful committee is not associated with a statistically significant impact on legislative performance both at time t and time $t+1$. A possible explanation is that these committees request a lot of effort to contribute to the efficient operation of these groups; hence, members of these committee have less time to dedicate to their own legislative activity. We continue our analysis by testing whether logrolling predicts the future promotion of a legislator. Results are presented in Table 5, column (3). Our estimates show more effective legislators are also less likely to obtain a promotion. This finding is consistent with the hypothesis that those who exert more effort in the legislative activity often penalize other important activities in Congress that might be crucial to obtaining the support of colleagues to advance in their career. At the same time, obtaining considerable support from one's own constituency as measured by the percentage of votes or seniority in Congress are associated with non significant effects on carreer prospects. However, we find evidence that the ability of legislators to conscript help from their colleagues by engaging in logrolling activities with them affects one's chances of obtaining a promotion: i.e., an increase in the centrality in the logrolling networks has a positive and statistically significant impact on the likelihood of being promoted.

Until now, we have focused our analysis on the investigation of the impact of logrolling activities on those who receive support through this practice. We now investigate whether trading votes produces returns for those who provide support to their colleagues. To investigate this hypothesis, we re-estimate equation (4), but this time, we transpose matrix G. Consequently, whereas the generic cell i, j was previously registering the support that i received from j, it now measures the support that i provides j. We denote the centrality of this matrix $KC^* =$

Table 5
Vote Trading
Returns

Dep. Variable	Legislative effectiveness Score at time t	Legislative effectiveness Score at time $t+1$	Promoted at time $t+1$ (1 = Yes)	Legislative effectiveness Score at time t	Legislative effectiveness Score at time $t+1$	Promoted at time $t+1$ (1 = Yes)
Matrix	G	G	G	G^T	G^T	G^T
	NLLS	NLLS	NLLS	NLLS	NLLS	NLLS
	(1)	(2)	(3)	(4)	(5)	(6)
α	-0.0002	0.0022	0.0153**	-0.0004	0.0022	0.0161**
	(0.0043)	(0.0082)	(0.0074)	(0.0015)	(0.0079)	(0.0073)
ϕ	0.6087***	0.5772***	0.1457***	0.4329***	0.5776***	0.1462***
	(0.1304)	(0.0166)	(0.0082)	(0.0007)	(0.0184)	(0.0078)
Freshman year (1 = Yes)	-0.2119*	-0.0739	0.0373	-0.1934*	-0.0736	0.0374
	(0.1102)	(0.1910)	(0.0317)	(0.1103)	(0.1910)	(0.0317)
Party leader (1 = Yes)	0.6845**	0.4529		0.6844**	0.4518	
	(0.2745)	(0.4662)		(0.2739)	(0.4662)	
Committee chair (1 = Yes)	3.8597***	-0.1057		3.9006***	-0.1057	
	(0.1499)	(0.2289)		(0.1503)	(0.2289)	
Member of powerful committee (1 = Yes)	0.0912	0.0546		0.0861	0.0557	
	(0.1313)	(0.2151)		(0.1309)	(0.2152)	
Legislative Effectiveness Score			-0.0276***			-0.0275***
			(0.0064)			(0.0064)
Percentage of votes			-0.0621			-0.0612
			(0.0966)			(0.0966)
Num. Obs.	1,993	1,273	1,993	1,993	1,273	1,993
AIC	6672.9478	4840.9402	1703.7224	6664.6560	4841.0159	1703.2715
Congress member fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Congress fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Results for model (4). NLLS estimated coefficients (and standard errors) are reported. For a precise definition of the variables, see Section 5 of the paper. *, **, *** indicate statistical significance at the 10, 5 and 1 percent level.

$(KC_1^*, ...KC_n^*)$. The results when considering the legislative effectiveness now or at a future time are reported in Table 5, columns (4) and (5), respectively.

KC^* centrality of legislators also appear not to have a statistically significant association with their legislative performance. In other words, engaging in logrolling activities does not predict a significant advantage in terms of legislative effectiveness or to those who receive support from their colleagues or to those who provide support. The results on the control variables confirm a major predictor of legislative effectiveness is the role held by a legislator in the party and within a committee. In Table 5, column (6), we report the results obtained when considering a legislator's promotion as alternate dependent variable. Results show an increase of a legislator's centrality has a positive and statistically significant impact on his/her chances of obtaining a promotion. This finding suggests legislators who are more likely to obtain a position of responsibility are not only those who are able to conscript support from their colleagues, but also all those who provide their votes to colleagues. One possible interpretation for this finding is that participation in the vote-trading market per se signals loyalty to the network and is enough to trigger support from other network members. We also find more effective legislators are less likely to be promoted, whereas those in their first year of tenure and those with stronger support from their constituency are not more likely to advance in their careers.

VI. Conclusions

This paper documents the existence of vote-trading patterns among legislators who know each other personally via alumni organizations. We develop a novel approach to estimate the returns to vote trading based on a network representation of vote alliances. Our results show that, although logrolling does not seem to enhance U.S. Congress members' legislative effectiveness, this activity is a strong predictor of being selected for position of power in the future. As a result, our analysis provides new insights on the reasons these relationships are cultivated by politicians even many years after graduation.

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Appendix

Table A1
Data Descriptives

	Variable Definition	**Mean**	**St. Dev.**
Voted Yeah (1 = Yes)	Dummy variable. It takes the value of one if Congress member i voted *Yeah* on roll call vote j, and zero if voted *Nay* or abstained.	0.59	0.49
Voted Nay (1 = Yes)	Dummy variable. It takes the value of one if Congress member i voted *Nay* on roll call vote j, and zero if voted *Yeah* or abstained	0.41	0.49
Abstained (1 = Yes)	Dummy variable. It takes the value of one if Congress member i abstained on roll call vote j, and zero otherwise	0.04	0.19
School Connected Votes			
Voted Yeah (1 = Yes)	Dummy variable. It takes the value of one if more than 50% of Congress member i's alumni peers voted *Yeah* on roll call vote j, and zero if voted *Nay* or abstained.	0.26	0.44
Voted Nay (1 = Yes)	Dummy variable. It takes the value of one if more than 50% of Congress member i's alumni peers voted *Yeah* on roll call vote j, and zero if voted *Nay* or abstained.	0.17	0.38
Abstained (1 = Yes)	Dummy variable. It takes the value of one if more than 50% of Congress member i's alumni peers abstained on roll call vote j, and zero otherwise.	0.01	0.09
Party Key Vote			
Voted Yeah (1 = Yes)	Dummy variable. It takes the value of one if Congress member i's party leadership voted unanimously *Yeah* on roll call vote j, and zero otherwise.	0.44	0.5
Voted Nay (1 = Yes)	Dummy variable. It takes the value of one if Congress member i's party leadership voted unanimously *Nay* on roll call vote j, and zero otherwise.	0.29	0.46
Voted Yeah-Nay	Dummy variable. It takes the value of one if Congress member i's party leadership voted unanimously either *Yeah* or *Nay* on roll call vote j, and zero otherwise.	0.73	0.44
State Key Vote			
Voted Yeah (1 = Yes)	Dummy variable. It takes the value of one if the majority of Congress member i's state delegation voted *Yeah* on roll call vote j, and zero otherwise.	0.03	0.16
Voted Nay (1 = Yes)	Dummy variable. It takes the value of one if the majority of Congress member i's state delegation voted *Nay* on roll call vote j, and zero otherwise.	0.01	0.11
Voted Yeah-Nay	Dummy variable. It takes the value of one if the majority of Congress member i's state delegation voted either *Yeah* or *Nay* on roll call vote j, and zero otherwise.	0.04	0.19
Committee Key Vote			
Voted Yeah (1 = Yes)	Dummy variable. It takes the value of one if the majority of Congress member i's colleagues from one of his/her committee voted *Yeah* on roll call vote j, and zero otherwise.	0.58	0.49
Voted Nay (1 = Yes)	Dummy variable. It takes the value of one if the majority of Congress member i's colleagues from one of his/her committee voted *Nay* on roll call vote j, and zero otherwise.	0.34	0.47
Voted Yeah-Nay (1 = Yes)	Dummy variable. It takes the value of one if the majority of Congress member i's colleagues from one of his/her committee voted either *Yeah* or *Nay* on roll call vote j, and zero otherwise.	0.9	0.3
Legislator Key Vote	Dummy variable. It takes the value one if the policy issue in b under roll call j is the most recurrent policy in the bills sponsored by i, and zero otherwise.	0.01	0.10
Abstained More than Once that day	Dummy variable. It takes the value of one if Congress member i abstained more than once the day in which roll call vote j was held, and zero otherwise.	0.05	0.21
N. Obs.		2,506,964	
Legislative Effectiveness Score	Weighted average of the number of bills introduced, that received any action in committee and beyond committee, passed the House, and became law, sponsored by a Congress member in a given Congress. It differentially weights commemorative, substantive and significant legislation. Created by Volden C. and Wiseman A. E. (2014).	1.01	1.5
Promoted	Dummy variable. It takes the value of one if legislator i after Congress t: i) assumes a major role in the House by becoming part of a powerful committee or chair of a committee for the first time; ii) is put in charge of the coordination of party activities, by becoming one of its leaders; iii) is elected to a prestigious office, i.e., the Senate or the executive, and zero otherwise.	0.12	0.33
Freshman year (1 = Yes)	Dummy Variable. It takes the value of one if Congress Member i during Congress t served for the first time as member of the House of Representatives.	0.12	0.32
Party leader (1 = Yes)	Dummy Variable. It takes the value of one if legislator i during Congress t served at least for one day as member of the party leadership, and zero otherwise.	0.02	0.17
Committee chair (1 = Yes)	Dummy variable taking value of one if the member of Congress is a chair of at least one committee, and zero otherwise.	0.05	0.21
Member of powerful committee (1 = Yes)	Dummy Variable. It takes the value of one if legislator i during Congress t was a member of a powerful committee, and zero otherwise. Following Battaglini and Patacchini (2018), we define as powerful committees: Appropriations, Budget, Rules and Ways and Means.	0.55	0.49
Percentage of votes	Percentage of votes received by Congress Member i to enter the House of Representatives in Congress. t.	0.67	0.12
N. Obs.		1,993	

Table A2
Voting Behavior and Networks
Non-linear Effects

Dep. Variable	Voted Yeah (1 = Yes)	Voted Nay (1 = Yes)	Abstained (1 = Yes)
School-connected Congress members voted	Yeah	Nay	Abstained
Party, State delegation, and committee colleague voted	Yeah	Nay	Yeah-Nay
	OLS	OLS	OLS
	(1)	(2)	(3)
School connected votes (1 = Less than 25% voted togheter)	-0.0088	-0.0050	0.0002
	(0.0060)	(0.0048)	(0.0010)
School connected votes (1 = Between 25% and 50% voted togheter)	0.0291***	0.0186***	0.0008
	(0.0055)	(0.0036)	(0.0008)
School connected votes (1 = Between 50% and 75% voted togheter)	0.0559***	0.0380***	0.0040***
	(0.0072)	(0.0055)	(0.0008)
School connected votes (1 = More than 75% voted togheter)	0.1023***	0.0715***	0.0046***
	(0.0126)	(0.0087)	(0.0010)
Party key vote (1 = Yes)	0.6719***	0.6800***	-0.0120***
	(0.0052)	(0.0052)	(0.0013)
State key vote (1 = Yes)	0.0111***	0.0101***	-0.0010
	(0.0016)	(0.0014)	(0.0008)
Committee key vote (1 = Yes)	0.0735***	0.0812***	-0.0071***
	(0.0055)	(0.0056)	(0.0009)
Num.Obs.	2,506,964	2,506,964	2,506,964
R2	0.556	0.607	0.544
Congress member fixed effects	Yes	Yes	Yes
Bill fixed effects	Yes	Yes	Yes

Note: Standardized OLS estimated coefficients are reported. Standardization of coefficients is obtained using the formula $\frac{sd(x)}{sd(y)}\beta_x$, where β_x is the point estimate associated to control variable x, while $sd\,(x)$ and $sd\,(y)$ indicate the standard deviation or respectively control variable x and dependent variable y. Robust standard errors are reported in parentheses. Robust standard errors are adjusted for clustering at the Congress member-level. In column (3), we include but do not report the coefficient associated to the variable *Abstained more than once that day*. For a precise definition of the variables, see Section 2 of the paper. *, **, *** indicate statistical significance at the 10, 5 and 1 percent level.