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THE ORIGIN OF PARTIES: THE UNITED STATES CONGRESS IN 1789–1797 AS A TEST CASE

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Why do political parties form? I test a theory of party formation in which legislators coalesce into voting blocs to coordinate their votes and influence policy outcomes. I use historical roll-call data from the United States Congress. During the First and Second Congresses (1789–1793), there were no organized political parties. By the Fourth Congress (1795–1797), the Federalist and Republican parties shaped Congress. The analysis uses the Roll-call data from the first two Congresses to predict which legislators will coalesce into parties in future Congresses. I compare this prediction with the parties that eventually emerged in the House and in the Senate. I find strong support for the theory in the Senate, and favorable but less significant results in the House.

1. INTRODUCTION

When the United States Congress first met in 1789, congressmen were not organized into political parties. In fact, they were philosophically opposed to the notion of partisan or factional politics (see Cunningham, 1965; Chambers, 1963). Politicians of all creeds shared a “common conviction of the baneful effect of the spirit of party” (Hofstadter, 1969). Hamilton and Madison warn against partisan politics in The Federalist Nos. 9 and 10. Nevertheless, political parties quickly formed: parties were sufficiently prominent by the Fourth Congress (1795–1797) that Washington decried “the baneful effect of the spirit of party” in his Farewell Address in 1796.

Why do parties form? Most political parties in western democracies are “parties of parliamentary origin,” which came into existence when legislators serving in representative assemblies coalesced to coordinate their actions in the assembly (Duverger, 1959). In the United Kingdom’s Parliament, the centralization of legislative power in the Cabinet weakened the role of individual legislators and strengthened political parties (Cox, 2005). In the United States Congress, the formation of two voting blocs, and the eventual transformation of these blocs into fully organized parties has been described at length by Aldrich (1995), Chambers (1963), Cunningham (1965), Harlow (1917), Henderson (1973), Hoadley (1980, 1986), and Martis et al. (1989), among others.

Can we predict which parties will form in a legislative assembly? The goal of this study is to answer this question. I assess whether our theoretical understanding of the coalition formation process that leads to party formation is good enough not only to describe ex-post how legislators formed parties, but to predict ex-ante which legislators will form what parties in any given assembly.

The literature on the formation of parties of parliamentary origin distinguishes between the formation of a majority party for the purpose of gaining control of the legislative agenda (Cox and McCubbins, 2007; Diermeier and Vlaicu, 2011) and the

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emergence of parties as voting blocs formed by agents who use party discipline to coordinate their votes and affect the policy outcome in the assembly (Aldrich, 1995; Aldrich and Rohde, 2001); Baron, 1989; Dewan and Spirling, 2011; Eguia, 2011a, b; Fox, 2006; Jackson and Moselle, 2002; Koford, 1982; Patty, 2008; Rohde, 1991; Schwartz, 1977; Stratmann, 1992; Weingast, 1979).[1]

Empirical tests of any of these theories are subject to the "Krehbiel critique" (Krehbiel, 1998): voting cohesion (legislators who vote together along party lines) is no evidence of voting discipline (legislators who vote against their sincere preference to toe the party line). Krehbiel's (1998) argument is that parties are ineffective, mere labels we attach to like-minded legislators who would vote together anyway in the absence of parties. As we observe voting records but not the sincere preferences, we cannot say that parties affect votes or policy outcomes.

The United States Congress in the early days of the Republic provides data that allows us to circumvent this objection: as legislators were not initially aligned to parties, each congressman was free to vote on any given bill according to his individual preference. Voting records during the First and Second Congresses are untainted by party discipline. In this study, I describe a specific theory of parties as voting blocs, and I analyze the predictive power of this theory using the voting records available in 1793 as input for legislators' preferences that the theory needs to deliver a prediction on party formation. I then compare this prediction with the observed partition into Federalist and Republican parties during the Fourth Congress (1795–1797).

The study answers the following specific question: using only data available at the closure of the Second Congress in March 1793 (when there were no organized parties in Congress) can we predict the formation of parties and the change in voting patterns that had occurred in the U.S. House and the U.S. Senate by the Fourth Congress in 1795–1797?

The theory I propose assumes that legislators care about policy outcomes. Legislators can affect these outcomes forming a voting bloc that coordinates votes. Given a sequence of policy decisions that an assembly has to make, and the individual preferences of individual legislators over these decisions, I calculate the incentives for coordination among any group of legislators. A stable partition of the assembly into voting blocs is one in which no legislator or group of legislators wishes to deviate by abandoning their voting bloc or joining another. The theory allows us to determine which hypothetical party systems constitute stable partitions and which ones do not. To maximally refine the set of stable partitions, I sequentially apply increasingly restrictive criteria for inclusion in the set of solutions. The partition(s) that are stable for the longest sequence of inclusion criteria constitute the prediction(s) of the theory. This prediction consists of a prediction on the number of parties that form and on the affiliation of legislators to these parties. Given an assembly, an agenda of issues put to a vote, and the sincere preferences of legislators over these issues, two testable implications follow:

1. The predicted partition of the assembly into parties closely approximates the observed party configuration in the assembly.

[1] Theories on the extra-parliamentary formation of parties, where parties form as electoral coalitions, have noted that parties provide winning labels (Ashworth and Bueno de Mesquita, 2008; Snyder and Ting, 2002), screening of candidate quality (Caillaud and Tirole, 1999, 2002), credible commitments (Levy, 2004), coordination for voters (Morelli, 2004), or cost-cutting synergies (Osborne and Tourky, 2008).

2. Legislators predicted to join the same party change their voting behavior to vote together more often than if they followed their sincere preferences.

The testable implications (1) and (2), respectively, claim that party labels and changes in voting patterns occurred as predicted based on the incentives to form voting blocs. I evaluate these claims according to the reduction in individual classification errors made by the predictions; using Selten's (1991) measure of predictive success for sets; and using parametric (Ordinary Least Squares regression) and non-parametric (Spearman order correlation) tests to measure the relation between the predictions and the change in voting behavior. The main results use the data from the First and Second Congress as input, and I repeat the analysis using only the data from the First Congress (i.e., data available in 1791) as a robustness check.

Results are similar using either the First and Second Congresses or only the First Congress as input data: while the results of all the tests are positive, in the House only some of them are statistically significant. Results are stronger in the Senate: all coefficients are significant and of greater magnitude. I argue that institutional differences in the election method and length of term of service in each chamber can explain why the theory is more successful in the Senate. The aggregate results from both chambers are again positive and significant, and taken together, they provide support for the theory.

2. THE UNITED STATES CONGRESS IN 1789–1797 AS A TEST CASE

Political parties did not operate in Congress during George Washington's first term in office. Despite sharp divisions within state legislatures and state electorates between advocates and opponents of greater centralization prior to the adoption of the Constitution (Riker and Calvert, 1996), there had been little or no indication of any partisan discipline or long-lasting coalitional logrolls in the Continental Congress (Jillson and Wilson, 1987) or in the 1787 Constitutional Convention (Heckelman and Dougherty, 2007; Jillson, 1981). In the words of Aldrich and Grant (1993): "Voting was effectively unstructured in the First Congress (1789–91), with voting blocs developing only gradually."

Martis et al. (1989) provide the best source for factional or partisan affiliation in the early United States Congress. They describe the first three Congresses as a "no party" period, and they classify legislators in two factions: Pro- and Anti-Administration. They caution that the assignation of factional labels at this early period remains controversial. Starting with the Fourth Congress (1795–97), Martis et al. (1989), p. 23, find that "members of Congress participated in Congressional parties as opposed to modern organized electoral parties of the late nineteenth and twentieth-century" and they assign the party labels (Federalist and Republican). According to Chambers (1963), both Federalists and Republicans fought the 1796 election at the end of the Fourth Congress along partisan lines.

We cannot be sure if the voting record of a given Federalist or Republican legislator in the Fourth Congress represents or not his true preferences. But the most senior among these legislators had served in Congress since 1789. Reassured by the consensus among historians, political scientists, and contemporary observers that political parties did not function at all in the First Congress and not much, if at all, in the Second Congress, I assume that the votes of these senior legislators during the First and Second Congresses revealed their true preferences at the time they had cast those votes.

The roll-call voting data containing the information on these past preferences serve as proxy for the true preferences of the most senior legislators during the Fourth Congress and I use it as input to generate predictions on party formation among this subset of legislators.

Junior legislators during the Fourth Congress had not served in the First Congress, so we do not have a voting record that we can trust as evidence of their revealed preferences. Lacking means to discover their true preferences, we cannot make predictions about these junior legislators, and while their preferences influence the process of party formation, we are restricted to test the predictive power of the theory looking only at the subset of the assembly for which we have reliable information on their true preferences. This limitation on the data on true preferences is a handicap that makes success in the empirical tests more difficult. There is a second complication in the data: changes in the political agenda. The First Congress was oriented around constructing a working federal government, whereas the Third and Fourth were largely about foreign wars and violent political confrontation (see White, 1956). The theory takes preferences as input, and generates a party prediction as output. Lacking the ideal input, the recorded votes from 1789–93 are a good proxy only if they correlate well with the distribution of sincere preferences over the issues put to a vote in 1795–97.

If parties form to coordinate votes, its members ought to exhibit a great degree of voting cohesion, and as parties gradually formed in the United States Congress in the 1790s, congressmen should have increasingly voted together along party lines. Poole and Rosenthal (2007) show that indeed, voting cohesion greatly increased from the First to the Fourth Congress. The increased voting cohesion is consistent with the theory. In fact, Harlow (1917) pp. 184–187 documents several instances from 1796 to 1801 in which Federalists and Republicans met in a party caucus to coordinate their votes in a subsequent meeting of the House or Senate.

The ultimate goal is to use this specific historical instance to help us understand party formation more generally, and to predict the formation of parties in other democratic assemblies. The specific historical application to the early days of the United States Congress serves to test the predictive power of the theory.

3. THEORY

The theory to be tested is adapted from Eguia (2011a, b). The underlying intuition is that legislators form parties to coordinate their votes to affect the policy outcome for ideological gain.

Let N be an exogenously given set of n legislators. Let there be an exogenously given set of M policy proposals, one on each of M independent issues. Proposals are put to a vote sequentially and the legislature decides by simple majority. If a simple majority of agents vote in favour of a given proposal, this proposal is implemented; otherwise, the status quo remains in place on this issue.

I assume that legislators have binary preferences on each issue, preferring either the status quo or the policy proposal, with no intensity and no discounting. The utility function of a given legislator is the number of decisions in which the policy outcome coincides with the preference of the legislator.

Assume that legislators can form voting blocs. If a set of legislators C forms a voting bloc (a party), they commit to vote together on all M issues, according to the simple majority preference of the members of the voting bloc. That is, each voting bloc meets at a caucus before the meeting of the assembly, members of the bloc express their preferences by voting at the caucus on each issue, and the majority at the caucus determines how the bloc votes in the assembly, unless there is a tie at the caucus, in which case members vote freely in the assembly. All members commit to cast their votes together for the position (in favour or against the proposal) preferred by the majority of the bloc, and this commitment is binding.[2]

In the United States Congress there were no commitment mechanisms. A strict interpretation of the theory is immediately falsified by the data: parties did not exhibit the perfect cohesion expected of them in Eguia (2011a, b). In this study, I depart from such strict interpretation: the theory identifies which legislators would benefit from forming hypothetical disciplined voting blocs. The prediction I test is that legislators who would have benefitted from forming such disciplined blocs formed parties and these parties partially coordinated their members' votes despite the lack of commitment.

Legislators can join at most one party, or they can remain independent. Parties and the set of independents are mutually disjoint sets whose union is the whole legislature. Formally, let Π_0 be the set of agents who remain independent, and for any number of parties K and any $i = 1,2,\ldots,K$, let Π_i be the set of three or more agents who form party i. Then let $\Pi = (\Pi_0; \Pi_1, \ldots, \Pi_K)$ denote a **party configuration**, which is a partition of the assembly into parties of size three or more, where the first element of the partition denotes the (possibly empty) set of agents who remain independent. The set of possible outcomes of the party formation process is the set of all possible party configurations in the assembly.

Because there are only two possible outcomes on each issue, deviations from sincere voting do not survive the iterative elimination of weakly dominated strategies. Therefore, even if voters are strategic, they vote sincerely on every issue, at the internal meeting of their party if they belong to any or in the assembly if they are independents (note that agents who belong to a party are bound by their commitment to party discipline to vote with the majority of their party and they do not make a strategic choice in the assembly). The coordination of votes inside parties affects voting outcomes and the utilities of every agent. As agents vote sincerely and there is no uncertainty, for any party configuration we can calculate the indirect utility of each agent as a function of the partition of the assembly into parties.

Let $u_i(\Pi)$ be the policy utility for legislator i when the party configuration in the assembly is Π. Once agents form parties, this utility measures the number of decisions in which the outcome coincides with the true preference of the agent, and not necessarily with their vote.

A party configuration Π is stable if there is no feasible deviation to an alternative configuration Π' in which all the deviating agents become better off. This is an intuitive but loose definition. It remains to be stated what is a *feasible* deviation.

The literature on coalition formation (surveyed by Carraro, 2003; Humphreys, 2008; Ray, 2007) has proposed a myriad of definitions of stability and equilibrium refinements, depending on whether agents can coordinate deviations with other agents or not, and on how other agents react to a deviation. Instead of arbitrarily choosing one of the many available solution concepts, I consider multiple classes of deviations

[2]Commitment is a simplifying assumption; see the Appendix for an extension of the theory under the assumption that parties cannot enforce commitment.

from a given party configuration. I order these classes of deviations from easier to more difficult to execute. The two main criteria to order them are as follows:

1. An individual deviation is easier to execute than a coordinated deviation by a subset of agents, and
2. Leaving a party is easier than joining a party or forming a new one.

I consider all possible party configurations in which each party is of size at least three.[3] The algorithm to reach a prediction is as follows. In the first step, I check if each configuration survives all the possible deviations of the first class. In the second step, I check which of the party configurations that survived the first step also survive any deviation of the second class. I proceed sequentially, checking in step k which of the party configurations that survived all deviations of classes 1 through $k - 1$ also survive against any deviation of class k. As each step allows for more deviations, each step makes it more difficult for a given party configuration to be stable up to that step, generating an ever increasingly strict solution concept. I keep considering new classes of deviations until the set of party configurations that survive the latest deviation is empty. The party configurations that survived up to the previous class of deviations are the most robust party configurations, and I use them as the prediction of my theory about the formation of parties.

In all cases, I assume that if the policy utility for an agent is the same under two configurations, every agent prefers to be independent than in a party and every agent prefers to stay in their current party than to move to another one. That is, agents only deviate to another party for a strict gain, but they deviate to independence unless becoming independent generates a loss for them.

I consider 14 classes of deviations, described in detail in the Appendix. These 14 classes are divided into three families: Exit deviations, in which agents leave a party to become independent; Formation deviations, in which agents create a new party; and Entry deviations, in which agents join a pre-existing party. Within the Entry family, I classify deviations according to the rule of admission of new members into parties: whether all, some, at least one, or not even one of the pre-existing party members must benefit from the admission of the new member(s) in order for the new member (s) to be admitted into the party.

Let $\Pi = (\Pi_0; \Pi_1, \ldots, \Pi_K)$ be the partition before the deviation. $D1$ is the class of individual deviations by an agent $i \in \Pi_J$ who leaves the party to become an independent, assuming that party J disbands if i leaves. $D2$ is the class of individual deviations by an agent $i \in \Pi_J$ who leaves the party to become an independent, assuming that remaining members in party J stay together after i leaves.[4] $D3$ is a collective version of $D2$, where a subset of a party coordinate to all become independents.

$D4$ and $D5$ are collective deviations by a subset of independents ($D4$) or a subset of a party ($D5$) who all coordinate to form a new party. $D6$, $D8$, $D10$, $D12$, and $D14$ are individual deviations by an agent i who joins a party. If i defects from a party, the party stays in place. Under $D6$, i can only enter a party where every member becomes weakly better off by the admission of i. $D8$ requires instead that the

[3]A party of size two behaves exactly as if the two agents remain independent because there is never an internal minority in a two-agent party so the party does not coordinate votes.

[4]Stability concepts $D1$ and $D2$ correspond respectively to Nash equilibrium in the simultaneous games of coalition formation Γ ($D1$) and Δ ($D2$) studied by Hart and Kurz (1983).

TABLE 1 DEVIATION CLASSES

	Exit		Formation	Entry			
	Disbands	Remains		All	Some	One	None
Individual	*D*1	*D*2		*D*6	*D*8,*D*10	*D*12	*D*14
Collective	*D*1	*D*3	*D*4,*D*5	*D*7	*D*9,*D*11	*D*13	–

number of members who become strictly better off be strictly greater than the number who become strictly worse off. *D*10 requires that the aggregate utility of the party strictly increases after *i* joins. *D*12 weakens this to require that only one member become strictly better off, and *D*14 weakens it entirely allowing *i* to deviate to any party. These difference correspond to admission rules that assign a veto to each member (*D*6), that function by relative majority (*D*8), by a utilitarian criterion (*D*10), by invitation by one member (*D*12), or an entirely open admission rule (*D*14).[5] *D*7, *D*9, *D*11, and *D*13 are the collective versions of these entry deviations, where it is a subset of a party, or a subset of independents who seeks entry into an existing party.

The columns in Table 1 show the 14 deviation classes grouped by families. The rows in the table distinguish between individual deviations, and collective deviations coordinated by a set of agents. A cell immediately below another one corresponds to a stricter solution concept. Within the Entry family, a cell immediately to the right of another corresponds to a stricter stability concept.

4. EMPIRICAL ANALYSIS

The data on the identity of legislators in Congress, the content of each bill put to a vote, and the result of each roll-call vote that I use as input were compiled by the Inter-university Consortium for Political and Social Research (ICPSR) (2009).[6]

Of the set of legislators who served in the Fourth Congress (1795–1797), 11 Representatives and seven Senators had previously served in the First (1789–1791) and Second (1791–1793) Congresses and therefore we can compare the evolution of their voting behavior from a time when voting was unstructured by parties to a period of strong voting cohesion within two clearly defined voting blocs. These 18 representatives, with state initials and party affiliation in the Fourth Congress (Federalist or Republican) in parenthesis, are as follows:

Representatives Gilman (NH, F), Ames (MA, F), Thacher (MA, F), Hartley (PA, F), Hiester (PA, R), Madison (VA, R), Moore (VA, R), Page (VA, R), Parker (VA, F), Smith (SC, F), and Baldwin (GA, R); and Senators Langdon (NH, R), Strong (MA, F), Foster (RI, F), King (NY, F), Henry (MD, F), Butler (SC, R), and Gunn (GA, F).

According to my theory, members of a party coordinate their votes. A preliminary testable implication is that within the sample of 18 legislators for which we can compare their voting behavior before and after parties form, we should observe that legis-

[5]*D*14 corresponds to Nash equilibrium of the game of coalition formation with open membership studied by Yi (1997).

[6]The code written in R to generate the list of stable party configurations using the roll-call input data, and additional files in Excel and Stata to replicate all the calculations in the empirical tests, are available from the author. For the Senate, I provide as well legislators' utilities for each possible party configuration.

lators who join the same party vote together more often in the Fourth Congress than in the First and Second congresses. Let the agreement score between a pair of legislators be the proportion of votes in which both legislators cast the same vote, out of all votes in which both legislators cast a vote. Agreement scores for all pairs of legislators may all increase or all decrease depending on the details of the agenda put to a vote. The implication is not about absolute values of agreement scores; rather, it is a difference-in-differences comparison.

> Hypothesis 0a: The average change in the agreement score from the First and Second Congresses to the Fourth Congress is greater for pairs of legislators who belong to the same party in the Fourth Congress than for other pairs of legislators.

This hypothesis is verified by the data. Among the 11 House Representatives who served from the First Congress to the Fourth Congress, the average agreement scores for pairs of legislators who joined the same party increases from 0.62 in the First and Second Congresses to 0.75 in the Fourth Congress, whereas the average agreement score for pairs of legislators who joined different parties remains steady. The precise difference-in-differences calculation in the House is as follows:

$$(0.748 - 0.624) - (0.459 - 0.465) = 0.130 > 0,$$

where the first difference is the change for pairs of legislators in the same party and the second is for pairs of legislators not in the same party. In a linear regression where the unit of analysis is a pair of legislators, the dependent variable is the change in agreement score, and the only independent variable is binary, with value one if the pair belonged to the same party in the Fourth Congress and zero otherwise, we find that the OLS coefficient (0.1302) on the independent variable is significantly greater than zero (t-value of 3.79).

Repeating the same analysis in the Senate, the difference-in-differences is as follows:

$$(0.761 - 0.465) - (0.359 - 0.514) = 0.452 > 0,$$

where 0.452 interpreted as an OLS coefficient has a t-value of 6.02.

I also look at the change in DW-Nominate scores that estimate the ideal policy position of each legislator over time (see Carroll et al., 2009). To the extent that DW-Nominate scores pick up underlying preferences over two fundamental policy dimensions[7] and changes to the agenda are captured by changes in the estimated position of the "yes" and "no" policies of each roll call, changes in the DW-Nominate estimated ideal point of each legislature capture changes in the revealed preferences of the legislator. An implication of a theory of party formation in which parties coordinate their votes to form voting blocs is that the distance between legislators who serve from the First to the Fourth Congress and belong to the same party in the Fourth Congress must decrease once they join their party.

> Hypothesis 0b: The average distance in DW-Nominate scores for pairs of legislators who belong to the same party in the Fourth Congress decreases from the First to the Fourth Congress.

[7]Carroll et al. (2009) argue that the first dimension captures economic preferences, while the second, in this period, is harder to interpret.

The average distance in DW-Nominate scores for the 25 pairs among the Representatives who serve from the First Congress and belong to the same party in the Fourth Congress decreases from 0.320 in the First Congress to 0.266 in the Fourth. The difference of 0.054 is statistically different from zero (*t*-value −2.29). Among the 11 pairs of Senators who serve from the First Congress and belong to the same party in the Fourth Congress, the distance decreases from 0.773 to 0.609. Despite the small sample, the difference of 0.164 is statistically different from zero (*t*-value −2.23). For comparison, average distances for legislators paired across parties increase from 0.555 to 0.593 in the House and from 0.774 to 1.085 in the Senate.

Although this preliminary result provides some validity to the argument that parties increase voting cohesion and are not merely formed by agents who already agree to begin with, the purpose of the theory is to predict in advance which legislators will coalesce. I seek not to describe ex-post, but to identify ex-ante which agents will form a party and will increase their agreement scores as if their ideal policies had converged in space.

The roll-call votes from the First (1789–1791) and Second (1791–1793) Congresses are the input data. Treating them as if they represent the true preference of each legislator, I calculate how each legislator in Congress would have voted for any given party configuration in which the 11 Representatives and 7 Senators in the sample coalesced into disciplined parties of size at least three in each chamber, holding the votes of all other legislators outside the sample fixed. All these party configurations are counterfactuals. I calculate the utilities that they would have generated to each Congressman, according to the preferences revealed by the actual roll-call data. On the basis of these calculated utilities, I make a prediction about party formation. I compare the prediction with the actual Federalist and Republican parties that emerged in Congress during the Fourth Congress (1795–1797).

In the House, with a sample of 11 Representatives, there are 99,585 possible party configurations. In the Senate, with a sample of seven Senators, there are 205 possible configurations. None of these party configurations survives against all deviations in deviation classes $D1$ through $D12$, but five configurations in the House and three in the Senate survive against every deviation in deviation classes $D1$ through $D11$. These party configurations are my theory's predictions. I list the five predictions for the House in the Appendix. The three predictions for the Senate are as follows:

$$\begin{aligned}
&\Pi_1^1 = \{Gunn, Foster, Henry, King, Strong\}, \Pi_0^1 = \{Butler, Langdon\};\\
&\Pi_1^2 = \{Butler, Gunn, Foster, Henry, King, Strong\}, \Pi_0^2 = \{Langdon\};\ \text{and}\\
&\Pi_1^3 = \{Gunn, Foster, Henry, Langdon, Strong\}, \Pi_0^3 = \{Butler, King\}.
\end{aligned} \tag{1}$$

Superscripts denote the three different predictions. The first prediction is indeed the observed outcome, separating the five agents who join the Federalist party from the two who do not join.[8]

These predictions generate two types of theoretical claims to be tested. The first is directly about the quality of the predictions on the party affiliations in the Fourth

[8]The Republican party in this sample is of size two. The theory only recognizes parties of size three or more; members of a smaller party would appear listed in H_0. Accordingly, if the set of H_0 contains less than three agents, I interpret it as a small party, whereas if it contains three or more agents, I interpret it as a set of independent agents.

Congress of the 11 Representatives in the House and the seven Senators who served from the First to the Fourth Congress.

> Hypothesis 1: The party configurations predicted by the theory are similar to or coincide with the observed party configuration.

To check whether a party configuration exactly matches the observed outcome is straightforward. Neither of the five predictions in the House is the exact observed outcome. One of the three predictions in the Senate is the observed outcome.

This binary measure of success is crude. I seek a more discriminating test that can assess the quality of an imperfect prediction that does not exactly match the observed outcome. To this end, I compare my predictions to two benchmarks.

The first is a random prediction, which selects any of the possible party configurations with equal probability. As this is in expectation a poor prediction, I also compare my predictions to an alternative based on a plausible rule of thumb: look at the past voting record and predict that Congress will split into two parties, one formed by those who supported the Administration more often than they opposed it, and the second formed by those who opposed the Administration more often than they supported it. I refer to this intuitive alternative as the **Past Factions** benchmark, and I list its prediction for the House and Senate in the Appendix.

Notice that the theory's predictions and the Past Factions predictions are not directly comparable because the theory must predict the number of parties that form (from zero to four given the size of the sample of legislators), whereas the Past Factions predictions benefits from hindsight to assume by construction (instead of trying to forecast) the correct number of parties that emerged in Congress (two). As such, the Past Factions prediction is not an alternative theory of party formation usable in other applications; rather, it is a high benchmark to measure predictive success in this environment in contrast to the low benchmark set by the random prediction.

Party configurations (both the predicted and the observed) are partitions of the set of legislators under consideration. As there is no unambiguously superior notion or measure of distance between partitions, I use two alternative criteria: the number of individual classification errors and Selten's (1991) measure of predictive success for sets.

The test based on the number of classification errors asks how many legislators must be reassigned to a different party to make the predicted partition match the observed partition. For instance, the prediction that all 11 agents in the House form a single party has five errors: it is necessary to reassign five agents to a second party to generate the true outcome.

Both in the House and Senate, the theory yields a set of predicted party configurations, not a unique one. I average the number of errors for each of these predicted party configurations, and I compare them with the average number of errors over all possible configurations, to calculate the percentage of reduction (or increase) in errors in my prediction relative to a random prediction that assigns equal weight to any party configuration.

In the optimal classification literature, where the standard problem is to estimate a binary-dependant variable, it is more common to estimate the individual values of the dependant variable, and compare the reduction in error in this estimation relative to

TABLE 2 CLASSIFICATION ERRORS TEST

	Random Benchmark	Past factions Benchmark	Theory
House: fraction of errors	0.541	0.091	0.400
House: error reduction	–	0.832	0.2612
(*p*-value)		(0.0002)	0.0019
Senate: fraction of errors	0.471	0.429	0.143
Senate: error reduction	–	0.090	0.695
(*p*-value)		(0.5317)	(0.0004)
Avg: fraction of errors	0.506	0.260	0.271
Avg: error reduction	–	0.487	0.464
(*p*-value)		(0.0049)	(0.0000)

the benchmark in which the dependant value always takes the modal outcome. In my case, this benchmark would be that every agent joins the same party. This would be the correct benchmark if there existed two exogenous parties, and the goal was to predict the individual decision of each legislator to join one or the other party. The problem at hand is more complex. Legislators do not choose individually which of two existing parties to join. Legislators collectively choose which parties to form. The number of available parties is an endogenous variable. There could be none, one, two, three, or more. I predict the party configuration that emerges and not the individual decision of each agent which is not well defined in isolation.

I display the results according to this test in Table 2. The theory is significantly better than random in both chambers. The Past Factions prediction is significantly better than random only in the House.

On average, a random model correctly classifies 5.04 Representatives and makes 5.95 errors out of 11 legislators in the House.[9] In the Senate it correctly classifies 3.72 Senators and makes 3.28 errors.

The Past Factions prediction correctly classifies 10 Representatives and makes one error in the House, an error reduction relative to the random prediction of 83%, whereas it correctly classifies four Senators and makes three errors in the Senate, an error reduction of 9%.

The theory's predictions correctly classify (on average over all five predictions) 6.6 Representatives and make 4.4 errors in the House, whereas in the Senate they correctly classify (on average over all three predictions) six Senators and make one error. This is a success rate of 60% in the House, with a reduction in error of 26%; and a success rate of 86% in the Senate, with a reduction in error of 69%.

Let G_H be the distribution function of the number of correct individual classifications among all 99,585 party configurations. Let G_{H5} be the distribution of the average over five independent draws of G_H. For a sufficiently small ε, $G_{H5}(6.6 - \varepsilon) = 0.9981$. Therefore, the probability of obtaining at least 6.6 average correct individual classifications over five randomly chosen predictions is less than 0.2%. Similarly, define G_S for the distribution function among all 205 party configurations in the Senate, and G_{S3} for the average over three draws of G_S. Then $G_S(6 - \varepsilon) = 0.9996$ so the proba-

[9]The average success of a random model in the House is less than one half because unlike in a model with a binary-dependant variable, with a set of 11 legislators, up to three parties can form, so for each legislator there is only one way for the prediction to be right, but there are many ways to be wrong.

bility of randomly obtaining a result at least as good as the theoretical prediction (the p-value in Table 2) in the Senate is negligible. The theoretical prediction is significantly better than random in both the House and Senate.

The success rate of the theoretical predictions, averaged over both chambers, is 73% for an average fraction of error reduction of 46%. The probability of randomly achieving this average reduction in error, approximated to four digits, is zero.

The second criterion to assess the quality of a predicted partition tests whether the prediction is able to discriminate between pairs of legislators who join the same party and pairs of legislators who do not. The unit of analysis is the pair of legislators. With 11 Representatives and seven Senators, there are 55 pairs in the House and 21 pairs in the Senate. Consider all pairs where both legislators joined the same party in the data. There are 25 of these in the House and 11 in the Senate. This is the target area; denote it as T. For any given prediction, let $g(T) \subseteq T$ be the subset of pairs in the target area such that both legislators in the pair are predicted to join the same party. Let $|X|$ be the size of any set X. Then $\frac{|g(T)|}{|T|}$ is the fraction (in size) of the target area successfully predicted. Let A be the whole area, that is, the set of all pairs of legislators in each chamber. Then Selten's (1991) measure of success of the theory, shown to be characterized by desirable axiomatic properties, is

$$success = \frac{|g(T)|}{|T|} - \frac{|g(A)|}{|A|}.$$

The measure calculates how much more likely the theory is to predict observed outcomes than outcomes that are not observed. A value of zero means that the theory is no more likely to predict observed or unobserved outcomes. The modal prediction that has all legislators joining the same party scores a zero, and the expected score of a random model is also zero. Values are always contained in $[-1,1]$, but the highest possible value depends on the sizes of the observed and unobserved sets. I display the results according to Selten's criterion in Table 3.

The measure of success of the theoretical prediction is positive in each chamber, but significant only in the Senate and in the aggregate of both chambers.

The two tests together show that the theoretical predictions about party affiliations are better than the random benchmark but not as good as the Past Factions benchmark in the House, whereas they are better than either benchmark in the Senate, so that in the aggregate over both chambers they are better than random and about as good as the Past Factions benchmark.

I considered as well an alternative benchmark based on sectional alliances; that is, a prediction that parties will form corresponding to geographic regions. Hoadley (1980) finds that in the First Congress, "*evident* [⋯] *are three voting blocs, which are best*

Table 3 Selten's Measure

	Past factions	Theory
House: Selten's measure	0.345	0.013
(p-value)	(0.0009)	(0.2869)
Senate: Selten's measure	−0.065	0.231
(p-value)	(0.7317)	(0.0009)
Avg.: Selten's measure	0.140	0.122
(p-value)	(0.0199)	(0.0011)

described as sectional groupings." The three regions are the Northeast (NH, MA, RI, CT, NY), the Mid-Atlantic (NJ, PA, DE, MD), and the South (VA, NC, SC, GA). We can predict that parties form according to these sectional alignments. Unlike the past factions benchmark, this geographic prediction predicts the number of parties that emerge and the affiliation of legislators to them, so it is directly comparable to my theory. Alas, the geographic prediction is not very good: the fraction of classification errors averaged over both chambers is 0.40, compared to 0.26 using Past Factions and 0.27 using my theory; and the Selten score averaged across chambers is negative (worse than a random prediction). Due to these poor results, I omit the geographic prediction from the tables.

The theory not only predicts party configurations. It also provides a rationale (the coordination of votes) for the formation of these parties, which generates an empirical prediction: if the predictions on party affiliation and the causal mechanism in the theory are correct, legislators predicted to join the same party should change their voting behavior, exhibiting a greater increase in voting cohesion from the First and Second to the Fourth Congress than those predicted not to join the same party, and reducing their DW-Nominate score distances.

This is the theory's main claim: given only the voting patterns in the First and Second Congresses, the theory identifies legislators who have incentives to coalesce into voting blocs, changing their voting behavior to coordinate their votes. The theory predicts that these legislators will follow their incentives to form voting blocs, increasing their agreement scores and voting as if their preferences were more aligned. This leads to the following testable hypotheses.

> Hypothesis 2a: The average change in the agreement score from the First and Second Congresses to the Fourth Congress is greater for pairs of legislators predicted to join the same party, than for other pairs of legislators.

> Hypothesis 2b: The average distance in DW-Nominate scores for pairs of legislators predicted to join the same party decreases from the First to the Fourth Congress.

These Hypotheses replicate Hypotheses 0a and 0b, but now applied to the predicted parties, instead of to the actually observed parties.

The unit of analysis for this hypotheses is the pair of legislators, and the independent variable is the whether or not the pair of legislators is predicted to join the same party. For hypothesis 2a, the dependent variable is the change in the agreement score between the first two Congresses and the Fourth Congress, and as in the testing of the preliminary Hypothesis 0, the effect of the independent variable should be positive.

Let i be an arbitrary pair of legislators who served from the First to the Fourth Congresses in one of the two chambers, let x_i be the fraction of theoretical predictions in which pair i is predicted to join the same party, and let y_i be the agreement score of legislators in the Fourth Congress minus the agreement score of legislators in the First and Second Congresses combined. As the theory makes five predictions for the House and three in the Senate, x_i takes values in $\{0,1/5,2/5,3/5,4/5,1\}$ for pairs of Representatives and values in $\{0,1/3,2/3,1\}$ for pairs of Senators. Let $x_i^{PF} \in \{0,1\}$ be the Past Factions prediction for the given pair of legislators.

If we use OLS to estimate α and β in the linear regression

$$y = \alpha + \beta x + \varepsilon, \tag{2}$$

where ε is the disturbance term, the Past Factions benchmark obtains insignificant estimates in both chambers (positive in the House, negative in the Senate). The theoretical predictions obtain stronger results in both chambers, but significant only in the Senate. Full details are available in the working paper version, but these results are untrustworthy: OLS is a problematic estimation method for this data. In particular, the disturbance terms ε_i cannot be independent and uncorrelated with each other. If legislators a and b, and legislators b and c increase their agreement score to now agree almost always, then the agreement score of a and c must also increase. Given the concerns about the OLS estimate of β, it is appropriate to use non-parametric tests to evaluate the theory.

I calculate Spearman's rank correlation coefficient ρ for the variables x (fraction of theoretical prediction in which a pair is included) and y (change in agreement score). Spearman's rank correlation is the Pearson's correlation between the ranks of observations of two variables. A positive rank correlation coefficient implies that pairs in which both legislators are predicted to join the same party increase their agreement score more than other pairs.

The Past Factions benchmark obtains $\rho_H^{PF} = 0.0943$ in the House and $\rho_S^{PF} = -0.1589$ in the Senate. As shown in Table 4, neither of these values is significant. The value in the Senate is not even in the right direction.

The theoretical prediction obtains a Spearman value $\rho_H = 0.1136$ in the House, positive but not significant, with p-value of 0.20. In the Senate, the rank correlation is $\rho_S = 0.5525$, positive and significant, with p-value of 0.00.

As shown in Table 4, the theory performs better than either benchmark and significantly better in the Senate. As predicted, legislators who given the voting patterns in the First and Second Congresses faced an incentive to coordinate, indeed changed their voting behavior to vote together more often in the Fourth Congress.

The dependant variable for **Hypothesis 2b** is the change in the distance between the DW-Nominate scores of the two legislators in each pair. I repeat the tests used for Hypothesis 2a. If we use OLS to estimate β in the linear regression,

$$w = \alpha + \beta x + \varepsilon, \tag{3}$$

where w_i is the change in distance between the DW-Nominate scores of each pair of legislators i from the First to the Fourth Congresses, a successful theory should obtain a negative estimate $\hat{\beta}$, as the predictions should lead to a decrease in distance. The Past Factions benchmark obtains positive (worse than random) estimates of β in each chamber. The theoretical prediction obtains a negative (better than random) estimate in both chambers, but significance only in the Senate. OLS being flawed, I again turn to the

Table 4 Rank Correlation Between Change in Agreement Score and Predictions

	Past factions	Theory
House	0.094	0.114
(p-value)	(0.2467)	(0.2044)
Senate	−0.159	0.552
(p-value)	(0.7543)	(0.0047)

non-parametric Spearman's rank correlation test for variables w (change in distance in DW-Nominate scores) and x (prediction whether or not to join the same party).

A negative correlation is evidence that legislators predicted to join the same party converged more than pairs of legislators predicted to join different parties. I show the results in Table 5. The Past Factions predictions are worse than random in both chambers; the correlation according to the theory is negative as it should be in both chambers, but only in the Senate it is significantly different from zero.

I have presented three testable hypotheses, and two cases (House and Senate) per hypothesis. The Past Factions prediction performs better than random in only two of six results (House party labels and change in agreement scores), significantly better in only one (House labels) and significantly worse in another (Senate DW-Nominate distances). The theoretical predictions perform better than random in all six results, significantly better in all three in the Senate.

4.1 Robustness Tests

Robustness tests consisting in using the voting records from the First Congress only as input data, bootstrapping the results, or altering the order in which we apply the deviation classes yield either unchanged or slightly better results.

As a first check, I repeat all the analysis using as input data the roll call votes from the First Congress (1789–1791) alone, dropping the Second Congress. In the House, the prediction with this alternative dataset contains the three party configurations listed in the Appendix. All results have the right sign, but no statistical significance: the three partitions on average correctly classify 5.67 Representatives, for a 10% reduction in error and a Selten score of 0.01, a Spearman's rho of 0.12 with associated p-value 0.18 in the test of the change on agreement scores, and a Spearman's rho of -0.06 with associated p-value of 0.32 in the test of change in DW-Nominate distance.

In the Senate, the prediction becomes almost perfect once we use data from the First Congress only. The predicted party configurations are Π^1 and Π^2 listed on page 20 of the study. Π^1 is the observed outcome and Π^2 makes a single error. These two predicted partitions correctly classify 6.5 Senators, for an 85% reduction in error and a Selten score of 0.34 with p-value 0.00, a Spearman's rho of 0.64 with p-value 0.00 in the test of the change on agreement scores, and a Spearman's rho of -0.5892 with associated p-value 0.00 in the test of change in DW-Nominate distance.

This analysis shows that in the House, the predictions not only yield weak results (although always in the right direction), but they are fragile; whereas the strong results in the Senate are not only robust, but actually become better using the alternative data set.

As a second robustness check, I bootstrap the results that I obtain for the First and Second Congresses data, introducing a random perturbation to the matrix of roll calls,

Table 5 Rank Correlation Between Change in DW-Nominate Distance and Predictions

	Past factions	Theory
House	0.143	–0.019
(p-value)	(0.8507)	(0.4436)
Senate	0.541	–0.443
(p-value)	(0.9943)	(0.0221)

by changing each vote to blank with independent probability 1%. Then I apply the theory given the stochastically modified matrix of roll-call votes. I make 1,000 runs of this stochastic process, and check which partitions are predicted in a higher frequency of runs.

In the Senate, results are robust: the three stable party configurations with the true matrix of roll-call votes are the same three that are stable most frequently with the stochastic input data (they all survive more than two thirds of the runs). The fourth most frequently stable, which is stable in 35.5% of runs, makes only one classification error, separating Butler from the other six legislators (Landgon accompanies Butler in the observed data). In the House, bootstrapping the set of predictions, only one prediction survives more than half of the runs. This predicted partition is one of the five partitions predicted with the true roll-call matrix (it is Π^{H1} listed above). It correctly classifies eight Representatives for a 49.6 % reduction in error; it obtains a Selten score of 0.08 with a p-value of 0.10, and Spearman's rho of 0.12 with p-value of 0.18 in the test of the change on agreement scores, and a Spearman's rho of 0.03 with associated p-value 0.60 in the test of change in DW-Nominate distance. The partition that survives the second-most runs is also one of the five predicted with the original data (Π^{H2}), and it also correctly classifies eight representatives.

A different robustness test deals with variations on the theory, and in particular, on the order of the classes of deviations. Some classes are logically ordered: By definition, all deviations in one class are part of the larger class. In particular, $Dk \subset D(k+1)$ for $k \in \{2,6,8,10,12\}$, $D6 \subset D8 \cap D10 \subset D8 \cup D10 \subset D12 \subset D14$, and $D7 \subset D9 \cap D11 \subset D9 \cup D11 \subset D13$. For some other classes, deviations in one class are easier to execute than deviations in another class, and hence they should be considered first. Deviations from classes $D1$ to $D7$ all share in common that all the agents who deviate, and all the agents who after the deviation coordinate votes with deviators, all benefit (at least weakly) from the deviation. By contrast, all classes after $D7$ feature agents who oppose the deviation and nevertheless must accept the deviation and collude with the deviators, which is a greater obstacle for a deviation to be successfully executed. According to this argument, the first seven classes of deviations should precede all other classes, but this does not rule out variations in the order within the first seven classes, or within classes eight and higher.

As the predicted partitions survive deviations $D1$ through $D11$ and then fail at class $D12$, the results are the same – in this application – for any reordering of deviation classes up to $D11$ or after $D12$. Results can only differ if we run $D12$ before $D11$. As I have argued that $D1 - D7$ must precede the other deviations, and $D8$ and $D10$ logically precede $D12$, the greatest change to the order left to consider is to run $D9$ and $D11$ after $D12$. The robustness check is then to run deviations $D1 - D8$, $D10$ and $D12$, and only then $D9$ and $D11$.

The result with input data from the First and Second Congresses is once again that no partition survives $D12$. This means that with this data, survival to $D9$ and $D11$ is strictly weaker solution concepts than survival to $D12$, and thus it is more appropriate to apply $D9$ and $D11$ ahead of $D12$ to refine the set of solutions that survive $D8$ and $D10$, rather than applying $D12$ first, which eliminates all partitions.

The theory proposes a methodology to obtain a sharp prediction, by sequentially refining the set of solutions. This methodology is flexible: a vast number of alternative deviation classes, and in particular, recursive solution concepts could be added to the sequence of refinements. I leave such extensions for future research.

5. DISCUSSION

I have tested a formal theory of party formation based on the strategic incentives that legislators face to coordinate and form voting blocs, with data from the United States Congress over 1789 to 1797. Given the voting patterns in the First and Second Congresses (or just in the First), the theory is able to predict – with greater success in the Senate than in the House of Representatives – which legislators had joined the same party by the Fourth Congress. Furthermore, tests on the causal mechanism that drives the theoretical prediction are also successful: legislators who join the same party change their voting behavior to vote together more often (hypothesis 2a), as if their underlying ideological preferences as estimated by their DW-Nominate ideal points had converged (hypothesis 2b).

It is instructive to analyze the disparity between the results in the House and Senate. Institutional differences between the two chambers may help us understand why the formation of parties differed across chambers: House Representatives were directly elected by voters for a term of only 2 years. Senators were elected by their State legislatures for a 6-year term.[10] It is not surprising that the more senior politicians in the Senate, with a longer time horizon in office and with a closer bond to the political ruling class in their state, were better able to pursue the strategic incentives to coordinate their votes relative to House Representatives whose continuation in office was subject to the shifting winds of public opinion every 24 months.

One caveat in the analysis is that the results draw from the behavior of 18 legislators. This limitation cannot be overcome with the available data: we only possess reliable information on the preferences of these 18 legislators. It is a stretch to posit that the interaction between these legislators necessarily captures all the relevant insights about party among the hundred or so congressional members on 1789–1797. Furthermore, the ultimate goal of this research is not to revisit the historical evidence from the United States Congress, but rather to predict the future formation of parties or voting blocs in assemblies or recently created institutions in new democracies. It would be far-fetched to claim that the results obtained here directly apply to assemblies in other countries and other centuries.

I interpret the results more modestly as some evidence in support of theories of party formation that describe parties as voting blocs. The divergence of results between the House and the Senate suggests that the incentives to strategically coordinate votes are the driving factor in the origin of parties in some legislatures, and not in others, depending on the specific institutional rules of each assembly. A proper understanding of the mapping between institutional arrangements and the evolution of parties requires a replication of this study in a large number of different assemblies.

This and other theories on the origins of parties as voting blocs apply far beyond the United States Congress, both to State assemblies and internationally. In fact, Carey (2007) shows that the United States is an outlier with lower party unity than any other country in a sample of 19 major democratic countries. In all other countries, parties form more cohesive voting blocs. Although the exact case with no parties at the onset appears to be rare, a minimally extended version of the theory can be applied to assemblies that initially have many very small parties, which later coalesce into larger alli-

[10]Except one third of the first class of Senators, whose first term was only 2 years, and one third of that same first class, whose term was 4 years, so as to make one third of all senators' terms expire every 2 years into the future.

ances: treating each small party as an individual agent, we can apply the theory to predict the formation of coalitions of little parties into large voting blocs. Kaminski (2001) details how this happened in Poland after the first post communist election in 1991, in which 29 political parties gained representation in parliament and no party won more than 13% of votes or seats. Following an electoral reform that favored larger parties, a coalition of leftist parties governed after the 1993 election while the conservatives remained fragmented, until a complex series of mergers, splits, and alliances led to a large coalition of conservatives that took control of Parliament in 1997.

If future democratization processes lead to new legislative bodies that initially have no parties or have a large number of small parties (as in the case of the United States Congress in 1789 and the Polish Parliament in 1991), I predict that a process of consolidation will take place according to the incentives to coordinate votes, leading to the formation of a few large and disciplined voting blocs.

APPENDIX A

First, I describe how the theory holds without commitment, as noted in footnote 3.

Second, I formalize the definition of the deviation classes introduced in the theory section.

Third, I list the empirical predictions given by the theory in the House of Representatives, and given by the Past Factions alternative prediction in the House and the Senate.

A.1 Intuition for the Theory without Commitment

Summarized from Eguia (2011a), section 3.1.

Assume voting blocs cannot enforce any agreement to vote together. Then, the result of the caucus meeting in which party members vote internally does not determine how each party member votes in the assembly. The internal aggregation merely produces a recommendation of how the party wants its members to vote, and then in the assembly each member chooses whether or not to follow the recommendation.

If in the assembly an agent is pivotal, and if there are no punishments for ignoring the recommendation, then the agent will ignore it. In this regard, strict party discipline fails. However, parties can still coordinate in all other instances when the outcome is decided by more than one vote, so no agent has an individual incentive to deviate.

That is, parties can coordinate voting discipline in all cases where the outcome is decided by more than one vote so no individual agent is pivotal. This ability to coordinate in non-marginal cases suffices to provide an incentive to form voting blocs.

An example: Suppose there are seven agents and 10 proposals. Agents 1 and 2 are against all of them. On the other hand, for each pair of agents in {3,4,5,6,7}, there is exactly one proposal where only this pair opposes the proposal, and the other three agents favor it.

If agents vote sincerely, no proposal passes. Agents 3 through 7 obtain their desired outcome in four cases (the four proposals they oppose).

Suppose agents {3,4,5,6,7} form a voting bloc without commitment. At the caucus meeting, all proposals gain majority support, 3–2. So the bloc recommends that all of them be supported in the assembly. If agents follow the recommendation, all 10 proposals pass in the assembly 2–5. No member has an individual incentive to deviate from the recommendation, as the proposal would still pass anyway, 3–4. Hence it is an equilibrium to follow the bloc's recommendation. In this equilibrium, all 10 proposals pass, and each of the agents in the bloc obtains their desired outcome in six cases (the six proposals each agent supports). Hence every member is better off forming the bloc.

A.2 Theory. Deviation Classes

Let $\Pi = (\Pi_0, \Pi_1, \ldots, \Pi_K)$ be the partition before a deviation. Let Π' be the partition after the deviation. Then after a deviation of each class, Π' takes the following form:
$D1$: $\Pi' = (\Pi_0 \cup \Pi_J, \Pi_1, \ldots, \Pi_{J-1}, \Pi_{J+1}, \ldots, \Pi_K)$.

$D2 : \Pi' = (\Pi_0 \cup i, \Pi_1, \ldots, \Pi_J \backslash i, \ldots, \Pi_K)$.

$D3 : \Pi' = (\Pi_0 \cup S, \Pi_1, \ldots, \Pi_J \backslash S, \ldots, \Pi_K)$.

$D4 : \Pi' = (\Pi_0 \backslash S, \Pi_1, \ldots, \Pi_K, S)$.

$D5 : \Pi' = (\Pi_0, \Pi_1, \ldots, \Pi_J \backslash S, \ldots, \Pi_K, S)$.

$D6 : \Pi' = (\Pi_0, \Pi_k \backslash i, \ldots, \Pi_J \cup i, \ldots, \Pi_K)$ s.t. $u_h(\Pi') \geq u_h(\Pi) \forall h \in \Pi_J$, and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D7 : \Pi' = (\Pi_0, \Pi_k \backslash S, \ldots, \Pi_J \cup S, \ldots, \Pi_K)$ s.t. $u_h(\Pi') \geq u_h(\Pi) \forall h \in \Pi_J$, and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D8 : \Pi' = (\Pi_0, \Pi_k \backslash i, \ldots, \Pi_J \cup i, \ldots, \Pi_K)$ s.t. $\#\{h \in \Pi_J : u_h(\Pi') > u_h(\Pi)\} > \#\{h \in \Pi_J : u_h(\Pi') < u_h(\Pi)\}$, and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D9 : \Pi' = (\Pi_0, \Pi_k \backslash S, \ldots, \Pi_J \cup S, \ldots, \Pi_K)$ s.t. $\#\{h \in \Pi_J : u_h(\Pi') > u_h(\Pi)\} > \#\{h \in \Pi_J : u_h(\Pi') < u_h(\Pi)\}$, and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$

$D10 : \Pi' = (\Pi_0, \Pi_k \backslash i, \ldots, \Pi_J \cup i, \ldots, \Pi_K)$ s.t. $\sum_{h \in \Pi_J} u_h(\Pi') > \sum_{h \in \Pi_J} u_h(\Pi)\}$ and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D11 : \Pi' = (\Pi_0, \Pi_k \backslash S, \ldots, \Pi_J \cup S, \ldots, \Pi_K)$ s.t. $\sum_{h \in \Pi_J} u_h(\Pi') > \sum_{h \in \Pi_J} u_h(\Pi)\}$ and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D12 : \Pi' = (\Pi_0, \Pi_k \backslash i, \ldots, \Pi_J \cup i, \ldots, \Pi_K)$ s.t. $u_h(\Pi') > u_h(\Pi)\}$ for some $h \in \Pi_J$ and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D13 : \Pi' = (\Pi_0, \Pi_k \backslash S, \ldots, \Pi_J \cup S, \ldots, \Pi_K)$ s.t. $u_h(\Pi') > u_h(\Pi)$ for some $h \in \Pi_J$ and $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

$D14$: $\Pi' = (\Pi_0, \Pi_k \backslash i, \ldots, \Pi_J \cup i, \ldots, \Pi_K)$ for $k \in \{0,1,\ldots,J-1,J+1,\ldots,K\}$.

A.3 Empirics. Predictions

The five theoretical predictions for the House of Representatives using the input data from Congresses 1 and 2 are as follows:

$$\Pi_1^{H1} = \{Am., Gi., Ha., Hi., Ma., Mo., Pr., Sm., Th.\},\ \Pi_0^{H1} = \{Ba., Pg.\};$$
$$\Pi_1^{H2} = \{Am., Ba., Gi., Ha., Hi., Mo., Pr., Sm., Th.\},\ \Pi_0^{H2} = \{Ma., Pg.\};$$
$$\Pi_1^{H3} = \{Am., Ba., Ha., Hi., Mo., Th.\},\ \Pi_2^{H3} = \{Gi., Pg., Sm.\},\ \Pi_0^{H3} = \{Ma., Pr.\};$$
$$\Pi_1^{H4} = \{Gi., Ha., Hi., Mo., Pg., Sm.\},\ \Pi_2^{H3} = \{Am., Ma., Pr., Th.\},\ \Pi_0^{H3} = \{Ba.\};\text{ and}$$
$$\Pi_1^{H5} = \{Gi., Hi., Ma., Mo., Sm., Th.\},\ \Pi_2^{H5} = \{Am., Ha., Pg., Pr.,\},\ \Pi_0^{H5} = \{Ba.\}.$$

The three theoretical predictions for the House of Representatives using the input data from Congress 1 only are as follows:

$$\Pi_1^{1C1} = \{Am., Hi., Ma., Mo.\},\ \Pi_2^{1C1} = \{Gi., Pr., Sm.\},\ \Pi_3^{1C1} = \{Ha., Pg., Th.\};\ \Pi_0^{1C1} = \{Ba.\};$$
$$\Pi_1^{2C1} = \{Gi., Ha., Mo., Pg., Sm., Th.\},\ \Pi_2^{2C1} = \{Am., Hi., Ma., Pr.\},\ \Pi_0^{2C1} = \{Ba.\};\ \text{and}$$
$$\Pi_1^{1C1} = \{Am., Hi., Ma., Pg.\},\ \Pi_2^{1C1} = \{Gi., Mo., Sm.\},\ \Pi_3^{1C1} = \{Ba., Pr., Th.\};\ \Pi_0^{1C1} = \{Ha.\}.$$

The Past Factions predictions in the House and Senate using data from Congresses 1 and 2 are as follows:

$$\Pi_1^{HPF} = \{Ba.,\ Hi.,\ Ma.,\ Mo.,\ Pg.,\ Pr.\},\ \Pi_2^{HPF} = \{Am.,\ Gi.,\ Ha.,\ Th\};\ \text{and}$$
$$\Pi_1^{SPF} = \{Foster,\ King,\ Langdon,\ Strong\},\ \Pi_2^{SPF} = \{Butler, Gunn, Henry\}.$$

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REFERENCES

Aldrich, J. H., 1995, *Why Parties? The Origin and Transformation of Political Parties in America.*. (University of Chicago Press, Chicago).

——— and R. W. Grant, 1993, The antifederalists, the first congress, and the first parties. *Journal of Politics* 55, 295–326.

——— and D. W. Rohde, 2001, *Congress Reconsidered, Chapter the Logic of Conditional Party Government: Revisiting the Electoral Connection*, 7th edn. (CQ Press, Washington DC).

Ashworth, S. and E. Bueno de Mesquita, 2008, Informative party labels with institutional and electoral variation. *Journal of Theoretical Politics* 20, 251–273.

Baron, D. P. 1989, A noncooperative theory of legislative coalitions. *American Journal of Political Science*, 33, 1048–1084.

Caillaud, B. and J. Tirole, 1999, Party governance and ideological bias. *European Economic Review* 34, 779–789.

——— and ———, 2002, Parties as political intermediaries. *Quarterly Journal of Economics* 117, 1453–1489.

Carey, J. M., 2007, Competing principals, political institutions, and party unity in legislative voting. *American Journal of Political Science* 51, 92–107.

Carraro, C., 2003, *The Endogenous Formation of Economic Coalitions*. (Edward Elgar Publishing, Northampton, MA).

Carroll, R., J. B. Lewis, J. Lo, K. T. Poole and H. Rosenthal, 2009, Measuring bias and uncertainty in dw-nominate ideal point estimates via the parametric bootstrap. *Political Analysis*, 17, 261–275.

Chambers, W. N., 1963, *Political Parties in a New Nation*. (Oxford University Press, New York).

Cox, G. W., 2005, *The Efficient Secret: The Cabinet and the Development of Political Parties in Victorian England*. (Cambridge Univ. Press, New York).

——— and M. D. McCubbins, 2007, *Legislative Leviathan: Party Government in the House*. (Cambridge University Press, New York).

Cunningham, N. E., 1965, *The Making of the American Party System 1789 to 1809*. (Prentice-Hall).
Dewan, T. and A. Spirling, 2011, Strategic opposition and government cohesion in westminster democracies. *American Political Science Review* 105, 337–358.
Diermeier, D. and R. Vlaicu, 2011, Parties, coalitions and the internal organization of legislatures. *American Political Science Review* 105, 359–380.
Duverger, M., 1959, *Political Parties*. (Methuen, London).
Eguia, J. X., 2011, Endogenous parties in an assembly. *American Journal of Political Science* 55, 16–26.
———, 2011, Voting blocs, party discipline and party formation. *Games and Economic Behavior*, 73, 111–135.
Fox, J., 2006, Legislative cooperation among impatient legislators. *Journal of Theoretical Politics* 18, 68–97.
Harlow, R. V., 1917, *The History of Legislative Methods in the Period Before 1825*, (Yale Univ. Press, New Haven).
Hart, S. and M. Kurz, 1983, Endogenous formation of coalitions. *Econometrica* 51, 1047–1064.
Heckelman, J. C. and K. L. Dougherty, 2007, An economic interpretation of the constitutional convention of 1787 revisited. *Journal of Economic History* 67, 829–848.
Henderson, H. J., 1973, Quantitative approaches to party formation in the united states congress: a comment. *William and Mary Quarterly* 30, 307–324.
Hoadley, J. F., 1980, The emergence of political parties in congress, 1789–1803. *American Political Science Review* 74, 757–779.
———, 1986, *Origins of American Political Parties 1789–1803*. (University Press of Kentucky, Lexington).
Hofstadter, R., 1969, The Idea of a Party System: The Rise of Legitimate Opposition in the United States, 1780–1840. (University of California Press, Berkeley, CA).
Humphreys, M., 2008, Theory of coalitions and its applications. *Annual Review of Political Science*, 11, 351–386, June.
Jackson, M. and B. Moselle, 2002, Coalition and party formation in a legislative voting game. *Journal of Economic Theory*, 103, 49–87.
Jillson, C. C., 1981, Constitutional-Making: alignment and realignment in the federal convention of 1787. *American Political Science Review* 75), 598–612.
——— and R. K. Wilson, 1987, A social choice model of politics: insights into the demise of the U.S. continental congress. *Legislative Studies Quarterly* 12), 5–32.
Kaminski, M. M., 2001, Coalitional stability of multi-party systems: evidence from poland. *American Journal of Political Science* 45, 294–312.
Koford, K. J., 1982, Centralized vote-trading. *Public Choice* 39), 245–268.
Krehbiel, K., 1998, *Pivotal Politics: A Theory or U.S. Lawmaking*. (University of Chicago Press, Chicago).
Levy, G., 2004, A model of political parties. *Journal of Economic Theory* 115), 250–277.
Martis, K. C., R. A. Rowles and G. Pauer, 1989, *The Historical Atlas of Political Parties in the United States Congress, 1789–1989*. (Macmillan Pub. Co).
Morelli, M., 2004, Party formation and policy outcomes under different electoral systems. *The Review of Economic Studies* 71), 829–853.
Osborne, M. and R. Tourky, 2008, Party formation in single issue politics. *Journal of the European Economic Association* 6), 974–1005.
Patty, J. W., 2008, Equilibrium party government. *American Journal of Political Science* 52), 636–635.
Poole, K. T. and H. Rosenthal, 2007, *Ideology and Congress*. (Transaction Pub, New Brunswick, NJ).
Ray, D., 2007, *A Game-Theoretic Perspective on Coalition Formation*. (Oxford University Press, Oxford, UK).
Riker, W. H. and R.L., Calvert, 1996, *The Strategy of Rhetoric: Campaigning for the American Constitution*. (Yale University Press, New Haven, CT).
Rohde, D. W., 1991, *Parties and Leaders in the Postreform House*. (Unversity of Chicago Press, Chicago).

Schwartz, T., 1977, Collective choice, separation of issues and vote trading. *American Political Science Review* 71), 999–1010.

Selten, R., 1991, Properties of a measure of predictive success. *Mathematical Social Sciences* 21), 153–167.

Snyder, J. and M. Ting, 2002, An informational rationale for political parties. *American Journal of Political Science* 46, 90–110.

Stratmann, T., 1992, The effects of logrolling on congressional voting. *American Economic Review* 82), 1162–1176.

Inter university Consortium for Political and Social Research. 2009, United States Congressional Roll Call Voting Records, 1789–1998. Computer File ICPSR00004.

Weingast, B. R., 1979, A rational choice perspective on congressional norms. *American Journal of Political Science* 23, 245–262.

White, L. D., 1956, *The Federalists: A Study in Administrative History*. (Greenwood Press, Westport, CT).

Yi, S.-S., 1997, Stable coalition structures with externalities. *Games and Economic Behavior* 20), 201–237.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:
Appendix S1. Online Appendix.