The Advantage of Second Chambers in Republican Legislatures: An Informational Theory

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Abstract: Bicameralism initially arose in systems of “mixed government” in which the two legislative chambers were controlled by different social estates with differing substantive interests. The rise of republicanism in the modern era raises a theoretical problem for bicameralism: whether second legislative chambers are necessary when both chambers are congruent, representing the same set of electors and interests. A game theoretic model of bicameral decision-making is developed that identifies an informational welfare advantage for congruent bicameralism: Two-chamber legislatures are more apt to adopt the best statutory means relative to a given end than are one-chamber legislatures. In short, bicameralism produces better legislation than unicameralism. Importantly, this advantage is demonstrated when the two chambers have congruent preferences. The theory thus identifies a justification for republican bicameralism.

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Since the period of the earliest U.S. state constitutions, the justification for second legislative chambers in the republican governments of the states has proven problematical. To be sure, the colonial governments had a form of bicameralism and in the shift from colony to state each of the U.S. states maintained or soon adopted bicameral institutions.¹ The outward uniformity of the new state legislatures with the old colonial legislatures, however, masks the fundamental shift in constitutional theory that needed to occur during this era to justify the continued existence of second chambers. The old colonial governments had attempted to mirror, however dimly, the “mixed government” of the British constitution in which the three social estates of the realm – the king, the nobility, and the people – provided checks and balances on the power of each other. This was reflected in parliamentary bicameralism with one chamber devoted to the people and the other to the nobility. This was also reflected in American colonial government with a popular assembly for the people and a counsel which was supposed to represent the king’s interests and to be peopled by nascent American aristocrats. With the Revolution, however, American political institutions became thoroughly republicanized. Why then continue to have two chambers when both simply represent the same set of electors and, hence, were expected to experience a high degree of congruence over legislative outcomes? If bicameralism was to continue, it needed a new justification. While this need for a distinctly republican justification for two legislative chambers has been much studied and documented by modern historians of the Revolutionary era (Wood 1969, 197-255, Kruman 1997, 131-154, cf., Greene 1994), it has been all but ignored in modern attempts by political scientists to account for the value of second legislative chambers. Instead, modern bicameral studies identify continued justification for second chambers only when the substantive policy preferences of the two chambers diverge. While this argument justifies bicameralism in mixed regimes, it is largely irrelevant to republican bicameralism and to the legal and political evolution of highly congruent legislative chambers in U.S. states.

This paper seeks to fill this gap in bicameral theory by identifying a rationale for bicameralism in republican political systems – that is, to provide a justification for second chambers that does not rely on

¹ Georgia, Pennsylvania, and Vermont (until 1836) initially had unicameral legislatures (Barnett 1915, Morey 1893, Senning 1937).
there being any substantial divergence between the two chambers in primitive policy preferences. The paper is divided into four sections. Part I discusses the rise of the bicameral problematic in republican governments with a focus on the experience of U.S. states. Part II then sets out a simple common value/information model of bicameral decision-making. Part III examines the behavior between bicameral chambers that the model implies. Part IV derives the welfare implications of congruent bicameralism from the equilibrium behavior identified in Part III. Part V concludes the paper.

Part I. Political and Scholarly Interest in Bicameralism

Bicameralism evolved historically as an institutional reflection of fundamental political and class cleavages (Lijphart 1984, 95, Longley and Oleszek 1989, 14, Tsebelis and Money 1997, 32-33). In its most celebrated historical form – the “mixed government” of Great Britain – nobles were allocated one chamber and commoners were allocated the other. Because the two chambers represented different estates, each needed the protection of a legislative veto against measures that would advance one estate’s interests at the expense of the other. In extolling the British example Montesquieu thus wrote that nobles must “form a body that has a right to check the licentiousness of the people” but that the people must also have a chamber to “oppose any encroachment” by the aristocracy (1748/1949, 155).

The theory of mixed government had come to American shores at the hands of the British colonists (Greene 1994, cf., Wood 1969 and Kruman 1997). Upon separation from Britain, however, the traditional, mixed government rationale for bicameralism faced a major theoretical problem in application to the new U.S. states: the underlying social estates necessary for a mixed regime did not exist. The new states did not have two social estates, let alone three. Rather, the “homogeneity of orders” in the United States (Wood 1969, 237) implied “two homogenous branches” in state bicameral legislatures should both chambers share the same set of electors (ibid., 214-244). Wood concludes, “The people in the new states seemed to be electing the same kinds of persons to both houses of the legislatures, thus creating a homogeneity of interest between the two branches and destroying the purpose for instituting a mixed polity” (ibid., p. 216). Jefferson (1784/1987), for example, had objected to the structure Virginia senate because, “being chose by the same electors” it was “too homogenous with the house of delegates” when
the whole purpose of bicameralism was “to introduce the influence of different interests or different principles” (365). Historian Marc W. Kruman similarly concludes:

Many revolutionaries dispensed altogether with the idea of mixed government and envisioned a senate simply as an institutional restraint on the power of the representatives. These men based their views on the assumption that, in a republic, there could be only one interest – that of the people. To organize government around conflicting estates would encourage and even bless political disagreement. . . .

Those bicameralists, as well as men who supported a single assembly, envisioned an undivided, harmonious polity. “Having no rank about that of freemen,” the essayist “Salus Populi” declared, “she has but one interest to consult, and that interest . . . is the true and only interest of men as members of society.” (1997, 145)

Three arguments for the continuation of bicameralism subsequently developed among American constitutionalists. First, that two chambers, even if sharing the same set of electors, serve as a check upon the other and thus reduce the probability of legislative tyranny (Wood 1998, 244-255). Secondly, in the context of the U.S. national government, a “dissimilarity in . . . genius” between House and Senate, as Madison commended, would promote stable policy outcomes (The Federalist No. 62, 379). Finally, almost alone in commending the value of congruent chambers, James Wilson argued that bicameral decision-making produced an informational advantage for the legislative process relative to unicameral decision-making. We briefly consider rationale in turn.

First, while legislative tyranny was an undoubted fear for early Americans, the modern case for bicameralism cannot really turn on it. U.S. states now have a long tradition of republican politics and enjoy a number of institutional safeguards that mitigate modern fears of legislative tyranny: the Fourteenth Amendment provides the Federal judiciary a negative on “unreasonable” state legislation, executives wield the veto in greater proportion than originally anticipated, and the national government retains the commission to guarantee to each state a “Republican Form of Government” (U.S. Const. art IV, sec 4). Further, as an empirical matter, Nebraska has had over sixty years of experience with unicameralism and has yet to manifest any unique penchant for legislative tyranny relative to the 49 bicameral U.S. states. Thus, it does not appear that the fear of legislative tyranny is a compelling reason to maintain bicameral legislative systems in modern republican regimes.

That bicameralism promotes “stability” is the justification most often advanced in the modern

There are several weaknesses, however, with this justification for bicameralism. First, and most importantly, stability does not have unambiguous welfare implications. The literature itself often recognizes this. For example, Tsebelis and Money observe:

> [G]reater stability (in the sense of preserving the status quo) and focus of conflict along one dimension are the main features (both advantages and disadvantages) of bicameralism. If an institutional designer desires policy stability . . . bicameralism delivers. . . . On the other hand, if rapid change is desired, a constitutional designer would be better off avoiding bicameral . . . institutions (217).

In these models, preferences over cameral choice are simply proxies for preferences over status quo policies. “Conservatives” prefer bicameral processes because it increases the difficulty of adopting new legislation; “liberals” prefer unicameral processes because it increases the ease of adopting new legislation. Hammond and Miller note the same problem (1987, 1170), as does Madison (The Federalist No. 62, 378). Indeed, in the ratification debates surrounding the U.S. Constitution, bicameral opponents agreed that bicameralism promoted stability, but argued that was a reason to oppose the institution.2 The stability-inducing quality of bicameralism was also a main argument Progressive-era unicameralists asserted to indict the institution.3 A second problem with the social choice case for bicameralism is that the analyses have largely ignored the implications of reconciliation mechanisms for the stability

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2 For example, the pseudonymous “Republicus” argued in 1788: “Are [second chambers] not as likely to check a good bill as a bid one? and has it not in fact often happened?” (1788/1987, 373).

3 Orfield (1938) argued that “the present system results in too much check and balance. For every poor measure that may be defeated under the bicameral system, it is likely that two or more good measures fail. In times of depression, this may result in lack of action at critical moments with something approaching anarchy ensuing” (32-33). Populist U.S. Senator George Norris argued that “special interests, corporations, and monopolies” use bicameralism to “prevent legislation” (Norris 1935a, 54, ibid. 1935b, 1635). In the 19th century, Jeremy Bentham argued similarly that bicameral stability was one of the institution’s disadvantages (Rockow 1928).
Representatives from both chambers gather in the “unicameral” body of the conference committee; an agenda setter in one chamber can dictate the agenda in the other chamber through motioning. Thus it is not clear just how much bicameralism reduces the size of the domain over which majority cycling may occur (Levmore 1992, 148-49, cf., Tsebelis and Money 1997, 216).

One common conclusion in these attempts to identify “stability” as the modern rationale for bicameralism is that the institution generates a legislative advantage only if the chambers differ significantly from one another. Hammond and Miller find that “The stability-inducing properties of bicameralism are . . . dependent on the existence of distinctly different viewpoints in the two chambers” (1989, 92, cf., ibid. 1987, 1160). Buchanan and Tullock conclude similarly that, “unless the bases for representation are significantly different in the two houses, there would seem to be little excuse for the two-house system” (1962, 236). Differences in chamber preferences are critical to generating Tsebelis and Money’s stability results (1997, 89, cf., 39, 69, 74-76). Because two “congruent” chambers would ostensibly not significantly affect policy outcomes, Lijphart described bicameral systems with congruent chambers as “weak” forms of bicameralism (1984, 98-99). And Declercq (1977) summarized the conventional wisdom when he wrote: “The case for unicameralism becomes substantially stronger if one can find little empirical distinction between the two houses. If, in fact, little inter-house variation exists, why maintain two houses that merely delay policy making? If substantial differences are found, a necessary (albeit not a sufficient) condition for maintaining bicameral legislatures is met” (775). Of course, modern scholars are not alone in making this conclusion. As noted earlier, both Madison and Jefferson explicitly regarded “dissimilar” chambers as a necessary condition for realizing a bicameral advantage.

James Wilson, however, articulated a decidedly minority position among early constitutional commentators in identifying an informational welfare rationale for the congruent chambers of republican

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4 While Tsebelis and Money devote a substantial amount of their analysis to reconciliation mechanisms, their social choice model of bicameral action in a multi-dimensional setting abstracts away from the reconciliation mechanisms that they later analyze, as well as the conditions under which bicameral chambers will choose to employ a specific reconciliation mechanism or choose not to reconcile at all.

5 Declercq (1977) summarized the conventional wisdom when he wrote: “The case for unicameralism becomes substantially stronger if one can find little empirical distinction between the two houses. If, in fact, little inter-house variation exists, why maintain two houses that
bicameralism. He argued in his Lectures on Law:

[Many] reasons . . . may be assigned, why all the advantages, to be expected from two branches of a legislature, may be gained and preserved, though those two branches derive their authority from precisely the same source. . . . [These include a] double source of information, precision, and sagacity in planning, digesting, composing, comparing, and finishing the laws, both in form and substance (1791/1987, 378, emphasis added; cf., Story 1833/1987, 380).

The analysis below picks up on this minority insight and demonstrates that both the old and new literature on bicameralism has erred in concluding that divergent chambers are a “necessary condition” for a bicameral advantage. It shows this under the condition that both traditional and modern scholars have considered to be the weakest form of bicameralism: when both chambers are congruent.

The argument over the existence of a benefit to a second chamber in republican political systems is more than of academic interest both in the U.S. and world-wide. While Nebraska is the only U.S. state currently with a unicameral legislature, the 1990s have witnessed a level of interest in the reform rarely seen since the 1930s. At least fourteen states have officially considered unicameral proposals in recent years. In 1997 legislative sessions, state legislators sponsored unicameral proposals in Alaska, Connecticut, Hawaii, Iowa, Minnesota, New York, South Dakota, and Wisconsin. Florida’s constitutional revision commission narrowly defeated a 1997 measure to eliminate one legislative chamber. During 1995 sessions, legislators introduced measures proposing unicameralism in Maine, Massachusetts, Pennsylvania, and Vermont, and legislation proposing the reform was introduced in merely delay policy making? If substantial differences are found, a necessary (albeit not a sufficient) condition for maintaining bicameral legislatures is met” (775). Georgia, Pennsylvania, and Vermont (until 1836) initially had unicameral legislatures (Barnett 1915, Morey 1893, Senning 1937). Nebraska’s unicameral legislature held its first session in 1936, after adopting the reform in a 1934 initiative measure. Twenty-one state legislatures subsequently considered unicameral proposals in their 1937 legislative sessions (Johnson 1938, 95).

10 S.B. 3160, 19th State Leg. (HI 1997).
the California legislature in 1993. California’s Constitution Revision Commission initially adopted a unicameral recommendation in 1995 (Stall 1995), but failed to send it to the legislature after several commissioners changed their votes (San Francisco Chronicle 1996).

Interests extends beyond the borders of the U.S. as well. While the bicameral form predominates among U.S. legislatures, the opposite is the case world-wide, with 126 unicameral and 56 bicameral national legislatures (Tsebelis and Money 1997, 45). There was a modest national trend toward unicameralism after WWII, with New Zealand adopting the reform in 1950, Denmark in 1953, Kenya in 1966, and Sweden in 1970 (Longley and Olson 1991). This trend reversed around the time of the Soviet collapse. Poland (AP 1989), Kyrgyzzstan (Nash 1994), Belarus (in 1997), and the breakaway Dnestr Moldovan Republic (in 1995) replaced communist-era unicameralism with bicameral institutions. Albania’s ruling Socialist Party also announced on July 30, 1998 that both unicameralism and bicameralism would be considered for the parliament’s new structure (BBC 1998). Beyond the former Soviet alliance, Haitian voters chose bicameralism over unicameralism in a 1987 referendum, as did Moroccan and Algerian voters in 1997. Chinese officials have also considered adding a second legislative chamber, and Canada is considering reinvigorating its torpid upper chamber (Longley and Olson 1991, 222). Thus, accounting for the existence and nature of a bicameral advantage is a matter of practical as well as scholarly interest.

Part II. Description of the Model

Austin-Smith and Banks (1996) recently argued that information theoretic models potentially imply misleading results unless modeled within a game theoretic context. The information theoretic model of bicameralism developed below thus sets the informational choices of the actors in a game theoretic model. Thus, while the information theoretic aspects of the model developed below are conceptually very simple, given the number of possible decision periods and the number of possible decisions in each period, the game theoretic model is unfortunately notation dense. We now turn to the model.

There are three possible actors in the model: chamber 1, chamber 2 (which always act), and a conference committee (cc), which may or may not be called. \( I = \{1, 2, cc\} \) is the set of institutional actors. The chambers consider two versions of a bill on the same subject matter, \( l \in L = \{A, B\} \). Each bill is best in one of two states (s) of the world without confusion named A and B, \( s \in S = \{A, B\} \). For simplicity, either state of the world occurs \textit{a priori} with equal probability, \( \text{pr}(s = A) = \text{pr}(s = B) = 0.5 \).\(^{22}\) The chambers and the conference committee share common preferences over the outcomes, described by

\[
P = u(l = A|s = A) = u(l = B|s = B) > u(\varnothing | \bullet) = 0 > u(l = A|s = B) = u(l = B|s = A) = -P
\]

where \( P \in R_+ \). Adopting law A in state A is better than adopting no bill, which is better than adopting law A in state B. The payoff structure noted in relationship (2.1) explicitly assumes a common value held between the chambers. While this makes the analysis easier to develop relative to the alternatives, it is important to stress that the common values assumption is substantively motivated \textit{precisely} because it captures the key problematic of republican bicameralism – that of homogenous preferences across the chambers. The theoretical problem posed by republicanism for bicameral institutions is precisely that of whether a second chamber is useful when chamber preferences are congruent.

The chambers may use different reconciliation mechanisms, such as motioning and conferencing. There is a cost to employing a reconciliation mechanism. Motioning (\( \mu \)) a bill back to the originating chamber costs each chamber \( c_\mu \in R_+ \) and conferencing a disagreement costs \( c_c \in R_+ \), with \( c_\mu < c_c \) (Longley and Oleszek 1989, 168). These are opportunity and transaction costs and may vary depending on the point the chambers are at in the legislative session (ibid.). The cost of each reconciliation mechanism could be assumed to differ between the chambers, but no substantive result depends critically on assuming equal costs across the chambers and it does provide some economy in deriving results.

The chambers and the conference (if held) observe a signal that is private to the institution and a public signal communicated by the actions of institutions in previous periods. Beliefs about the true state of the world are derived from these signals. The nature of the private signals received by each chamber

\(^{22}\) This assumption can be relaxed without significantly altering the results derived below, but it provides a great deal of economy.
and the conference (if held) is discussed first. Derivation of the equilibrium implications of the model
draws on several different probability measures (cf., Hirshleifer and Riley 1992, 170-208). Begin with:

\[(2.2) \quad q_{m|s}^{i,t} = \Pr(m \mid s), \quad m^i \in M = \{a,b\}, \quad s \in \{A,B\}, \quad i \in \{1, 2, cc\}, \quad t \in \{1, 2, 3, 4\}.\]

This expresses the conditional probability that institution \(i\) receives private message \(m\) given state \(s\) in
period \(t\). Each institution that holds a session observes a private signal, \(m^i \in \{a,b\}, i \in \{1,2,cc\}\), that is
correlated with the true state of the world, \(q_{A|A}^{i,t} = q_{B|B}^{i,t} > 0.5\). Similar results to those proven below could
be derived without requiring that \(q_{A|A}^{i,t} = q_{B|B}^{i,t}\), but the equality does permit more economical proofs and
permits the conditional probabilities to be abbreviated by \(q^i = q_{A|A}^{i,t} = q_{B|B}^{i,t}\). In general, \(q^i \neq q^j\) for \(i \neq j, i, j \in \{1, 2, cc\}\). The value of \(q^i\) for \(i \in \{1, 2, cc\}\) is assigned in period zero. While the content of the
message is private knowledge, the correlation value of each institution’s signal with the true state of the
world is common knowledge. Other useful probability measures are:

\[(2.3) \quad q_m^{i,t} = \text{the unconditional probability of } i \in \{1,cc\} \text{ receiving message } m \text{ in period } t.\]

\[(2.4) \quad \pi_s^{i,t} = \text{the unconditional (prior) probability of state } s \text{ for institution } i \text{ in period } t.\]

\[(2.5) \quad j_{m,s}^{i,t} = \text{the joint probability of state } s \text{ and message } m \text{ for institution } i \text{ in period } t.\]

\[(2.6) \quad \pi_{s|m}^{i,t} = \text{the conditional (posterior) probability of state } s, \text{ given message } m \text{ in period } t \text{ for institution } i.\]

As noted, chambers receive signals from the other chamber (in the form of a bill) or from the
conference committee (in the form of a bill recommendation). Institutions acting in periods 2, 3 and 4
observe both their private signal and the actions taken by institutions in earlier periods. The combination
of private and public signals the institutions receive is represented by \(\psi^{i,t} \in \Psi^{i,t}\). These signals are
detailed below for each stage of the game. The expansion of the message set implies a straightforward
translation of relationships (2.2) through (2.6). For example, \(q_{\psi|\psi}^{i,t}\) would be the unconditional probability
of \(i \in \{1, 2, cc\}\) receiving message \(\psi^{i,t}\) in period \(t\); \(\pi_{s|\psi}^{i,t}\) would be the conditional probability of state \(s\),
given message $\psi^{i,t}$ in period $t$ for institution $i$, etc. Because the indexing superscripts on $\psi^{i,t}$ only repeat the indexing superscripts on the probabilities, they are suppressed. Thus, for example,

$$q_{i,t}^{i,t} = q_{i,t}^{i,t} \cdot \pi^{i,t}_{s_{w},s_{m}} \equiv \pi^{i,t}_{s_{w},s_{m}}, \text{ etc.}$$

Let $v_{i,t}$ be the policy action (or vote decision) chosen by institution $i$ in period $t$, with $V^{i,t} = \{A, B\}$ denoting the set of feasible policy decisions for $i \in \{1, 2, cc\}$ in period $t \in \{1, 2, 3, 4\}$. In addition to voting in period 2, chamber 2 also selects a reconciliation option, $\gamma \in \mathcal{R} = \{cc, \mu, \emptyset\}$, from a set including a conference committee (cc), motioning ($\mu$), or voting on the proposal without a reconciliation option ($\emptyset$). (It would be technically more correct to permit chamber 1 to invite a conference in period 3 upon receiving chamber 2’s amended bill. Doing so, however, only adds an additional step in the analysis without providing any additional insights. So chamber 2 is permitted to call the conference.)

Let $h_{i}$ be the commonly observed history of the game through period $t$. The set of possible histories at the end of period $t$ is denoted $H_{i}$. The chambers and conference have private information and beliefs. These are captured by the chambers’ and conference’s posterior distribution over $S$, which are dependent on the history of the game. These are described in greater detail below for each period of the game. A strategy for institution $i$ in period $t$ is denoted $\sigma^{i,t}$. A strategy for the entire game is denoted

$$\sigma^{i} = \{ \sigma^{i,1}, \sigma^{i,2}, \sigma^{i,3}, \sigma^{i,4} \}, \text{ with } \sigma^{i,t} = \emptyset \text{ if institution } i \text{ does not have a feasible action in period } t.$$ 

The sequence of the game is as follows (see Figure 1).

Period 0. The value of $q_{i}^{i}$ for $i \in \{1, 2, cc\}$ is assigned.

Period 1. Chamber 1’s action set in period 1 is $V^{1,1} = \{A, B\}$. The message received in period 1 (the period with no preceding actions) by chamber 1 is $\psi^{1,1} \in \mathcal{Y}^{1,1} = M = \{a, b\}$. The prior distribution on $S$ is $\pi_{s}^{1,1} = 0.5$. After observing its signal, chamber 1’s posterior distribution over $S$ in period 1 is just

$$\pi^{1,1}_{s_{w}} = \pi^{1,1}_{s_{m}} = q_{1}^{1}$$. A strategy for chamber 1 in period 1 is a function that takes its posterior into the set of
actions, \(\sigma^{11}(q^1) \in V^{1,1}\). The set of histories at the end of period 1 is given by \(H^1 = V^{1,1}\).

**Period 2.** Chamber 2’s action set is comprised of a decision to vote for A or B, \(V^{2,2} = \{A, B\}\), and a reconciliation choice \(s \in \mathcal{R} = \{cc, \mu, \emptyset\}\). Chamber 2’s action set is represented by \(D^{2,2} = V^{2,2} \times \mathcal{R}\), with an action in period being the duple \(d^{2,2} \in D^{2,2}\). The message received by chamber 2 in period 2 is \(\psi^{2,2} \in \Psi^{2,2} = V^{1,1} \times M = \{A, B\} \times \{a, b\}\). For chamber 2 in period 2 the prior distribution on \(S\) is a function of \(q^1\) and conjectures about chamber 1’s equilibrium action. The posterior probability for chamber 2 in period 2 is \(\pi_{s^*}^{2,2} = \pi_{s^*}^{2,2}(V^{1,1}, m^2)\). A strategy for chamber 2 in period 2 is a function \(\sigma^{2,2}(\pi_{s^*}^{2,2}(V^{1,1}, m^2), h^1) \in D^{2,2}\) for all \(h^1 \in H^1\). The commonly known history at the end of period 2 is \(H^2 = H^1 \times D^{2,2}\).

**Period 3.** Chamber 1’s posterior probability on \(S\) in period 3 given \(h^2 \in H^2\) is \(\pi_{s^*}^{1,3} = \pi_{s^*}^{1,3}(m^1, d^{2,2})\). If a conference is called, its posterior probability over \(S\) given \(h^2 \in H^2\) is \(\pi_{s^*}^{c,3} = \pi_{s^*}^{c,3}(V^{1,1}, m^2, m^c)\). Depending on the period 2 action of chamber 2, chamber 1 or the conference committee might have feasible actions or neither may have feasible actions. Thus, the action sets for chamber 1 and the conference committee in period 3 must be restricted to depend on chamber 2’s period 2 action. In period 3, the conference committee’s action set is

\[
V^{c,3} = \begin{cases} 
\{A, B\} & \text{if } d^{2,2} \in \{(A, cc), (B, cc)\} \\
\emptyset & \text{otherwise} 
\end{cases}
\]

The message received by the conference committee in period 3 is \(\psi^{c,3} \in \Psi^{c,3} = [V^{1,1} \times D^{2,2} \times M] \cup \{\emptyset\}\). A strategy for the conference committee is \(\sigma^{c,3}(\pi_{s^*}^{c,3}(V^{1,1}, d^{2,2}, m^c), h^2) \in V^{c,3}\).

The period 3 action set for chamber 1 is

\[
V^{1,3} = \begin{cases} 
\{A, B\} & \text{if } d^{2,2} \in \{(A, \mu), (B, \mu)\} \\
\emptyset & \text{otherwise} 
\end{cases}
\]
Figure 1. Outline of the Bicameral Decision-Making Process

**Period 0**

Chamber 1 updates beliefs given private signal

**Correlation values assigned to chambers and conference**

**Period 1**

Chamber 1 adopts version A or B of bill

**Period 2**

Chamber 2 updates beliefs given private signal and chamber 1’s bill

Chamber 2 accepts Chamber 1’s bill without amendment  
*Game ends*

Chamber 2 amends chamber 1’s bill and proposes conference reconciliation

Chamber 2 amends chamber 1’s bill and motions it back for reconsideration

Chamber 2 rejects chamber 1’s bill without proposing reconciliation  
*Game ends*

**Period 3**

Chamber 1 updates belief given chamber 2’s action; or conference observes private signal and earlier actions

Conference Committee recommends version A or B under a closed rule

Chamber 1 concurs in or rejects chamber 2’s amendment  
*Game ends*

**Period 4**

Chambers 1 and 2 update beliefs given conference recommendation

Chambers 1 and 2 accept or reject conference recommendation  
*Game ends*
The message received by chamber 1 in period 3 is \( \psi^{1,3} \in \Psi^{1,3} = [M \times D^{2,2}] \cup \{\emptyset\} \). A strategy for chamber 1 in period 3 is \( \sigma^{1,3}(\pi^{1,3}_{s(m^1,d^{2,2})}, h^2) \in V^{1,3} \). The commonly known history at the end of period 3 is \( H^3 = H^2 \times V^{c,3} \times V^{1,3} \).

**Period 4.** In this period, the chambers consider the conference proposal under a closed rule, so chamber 1’s action set, \( i \in \{1,2\} \), is given by

\[
V^{i,4} = \begin{cases} \{\text{Accept, Reject}\} & \text{if } \psi^{c,3} \in \{A,B\} \\ \emptyset & \text{if } \psi^{c,3} = \emptyset \end{cases}.
\]

The message received by chamber 1 in period 4 is \( \psi^{1,4} \in \Psi^{1,4} = [M \times D^{2,2} \times V^{c,3}] \cup \{\emptyset\} \). The message received by chamber 2 in period 4 is \( \psi^{2,4} \in \Psi^{2,4} = [V^{1,1} \times M \times V^{c,3}] \cup \{\emptyset\} \). A strategy for chamber 1 in period 4 is a function \( \sigma^{1,4}(\pi^{1,4}_{s(m^1,d^{2,2},v^{c,3})}, h^3) \in V^{1,4} \). A strategy for chamber 2 in period 4 is a function \( \sigma^{2,4}(\pi^{2,4}_{s(v^{1,1},m^2,v^{c,3})}, h^3) \in V^{2,4} \).

The legislature selects a policy with the chambers voting in periods 1, 2, 3 and/or 4, depending on the history of the game. The legislative selection rule is therefore defined by:

\[
\Lambda(v^{1,*}, v^{2,*}) = \begin{cases} A & \text{if } v^{1,t} = v^{1,2} = A \text{ for } t \in \{1,3\} \text{ or if } v^{1,3} = A \text{ and } v^{1,4} = v^{2,4} = \text{accept} \\ B & \text{if } v^{1,t} = v^{2,2} = B \text{ for } t \in \{1,3\} \text{ or if } v^{1,3} = B \text{ and } v^{1,4} = v^{2,4} = \text{accept} \\ \emptyset & \text{if } v^{1,t} \neq v^{2,2} \text{ for } t \in \{1,3\} \text{ and } \exists i \in \{1,2\} \text{ such that } v^{i,t} = \text{reject}. \end{cases}
\]

The solution concept is perfect Bayesian equilibrium. Actors do not play weakly dominated strategies (which produces a unique equilibrium for each condition). Informational voting occurs when \( v^{i,t} = A \) (respectively, B) if the private message received by the actor is \( m^t = a \) (b).

Several aspects of the model merit some discussion. First, the conference committee is modeled here as an endogenously chosen message service. Chambers may vote again on a proposal after receiving an additional signal regarding the state of the world. The conference literature recognizes that conferences perform this function in the legislative process. For example, Longely and Oleszek write:
Another [conference committee] negotiating strategy includes conferees’ efforts to obtain information – both policy and political. . . . Providers are typically other congressmen, the president, executive branch officials, representatives of interest groups, committee and personal staff, and the media. At times, these ‘third parties’ and their information can be instrumental in the resolution of conference disputes.

. . .

[C]onferences are subject to agency reestimates, the availability of new information, and a host of other factors . . . that may move conferences . . . toward one chamber’s figures because they reflect changing realities and understandings better (1989, 205, 211, cf., ibid., at 150, 207, 284).

Similarly, Krehbiel finds some empirical support for the hypothesis that conference committees serve an informational role in the legislative process. He concludes that “Bills that go to conference will tend to be those about whose consequences legislators are uncertain and thus in need of the services of expert agents from whom the parent chamber stands to benefit” (1991, 213).

Secondly, note that an exogenous voting sequence is imposed on the chambers in that chamber 1 votes first, even if chamber 2 has better information (i.e., \( q^2 > q^1 \)). Given that the chambers are always at least as well off if the best informed chamber originates legislation, the assumption might initially appear implausible. There are two reasons that this is an inoffensive assumption, one technical and one methodological. First, there is a straight-forward technical fix for this: instead of a “point” correlation level being assigned in period 0 and being common knowledge, the chambers can be assigned a distribution of correlation levels with a known mean and variance. Nature would not assign a particular value to an institution until the beginning of the period in which it acts. The chamber with the “best” distribution (in the sense of stochastic dominance) would then vote first and the chamber with the second best distribution would vote second. But given that each chamber’s probabilistic assessment of the world is drawn from a distribution, the originating chamber will sometimes be less informed than the second voting chamber. That outcome is all that is necessary to derive results similar to those below.

There is also a substantive reason to permit the less informed chamber to originate legislation. Endogenous timing models in economics (Daugherty and Reinganum 1994) and political science (Rogers 1998) in which actors are asymmetrically informed and choose the sequence in which they order their decisions consistently derive multiple perfect Bayesian equilibria. One equilibrium is the anticipated
equilibrium in which the more informed actor moves first and the less informed actor moves second. But these studies also consistently derive a second perfect Bayesian equilibrium in which the less informed actor moves first and the most informed actor moves second. As above, that this equilibrium outcome occurs sometimes is all that is necessary to derive results similar to those discussed below.

There is, however, a more general facial challenge to the need for bicameralism to help legislatures aggregate information. Given the large population results of the Condorcet jury theorem (Feddersen and Pesendorfer 1998), a unicameral legislature of, say, 50 members could choose correct decisions with a high aggregate probability. Thus, even if bicameralism increases the probability of a correct decision relative to unicameralism, the marginal increase in that probability might be so low that it would be facially implausible that the benefit of a second chamber would be worth the cost. There are at least two reasons that bicameral decision-making might nonetheless be beneficial. First, the Condorcet theorem depends on the absence of correlated information that might arise, say, from legislative deliberation (cf., Austen-Smith and Banks 1996, Lahda 1992). But one hallmark of bicameralism is that deliberation in the two chambers is acoustically separated. This separation can be understood precisely as a mechanism to induce uncorrelated deliberation and, hence, to create superior outcomes relative to those available should the same set of legislators deliberate in a unicameral body. Secondly, chamber decisions are often products of information gathered by a handful of informed committee members (Gilligan and Krehbiel 1987, Krehbiel 1991). Aggregating two acoustically separated, small-population committee decisions across chambers would permit significant increases in the probability of selecting a right policy relative to a unicameral legislature deferring to one small population committee decision. We now turn to the results of the model.

Part III. Equilibrium Reconciliation Behavior

This part accounts for the equilibrium behavior predicted in the interaction between congruent bicameral chambers. This justifies the behavior assumed in deriving the welfare results in the next Part.

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23 Montesquieu identified acoustic separation as a necessary aspect of bicameralism. He argued that legislative power should be divided between two groups of legislators, “each having their assemblies and deliberations apart” (1748/1949, 155).
Part 1.A of the lemma states the equilibrium conditions under which a bill will *die* without reconciliation.

Part 1.B states the conditions under which a bill is *adopted without amendment*. Part 1.C states the conditions under which a bill will be *amended* by the second chamber and *motioned* back to the originating chamber. Part 1.D states the conditions under which a *conference committee* will be called.

The relevant behavior occurs when chamber messages are different, so that is the focus of the lemma.

**Lemma.** Let \((m', m^\ast) = (a, b)\) (or \((m', m^\ast) = (b, a)\)), then there is a unique equilibrium in each of the following partitions:

[A] If \(q^i < q^2\), \(P(2\pi^{2,2}_{B(a,b)} - 1) - c_\mu < 0\), and \(P(2q^e - 1) - c_c < 0\), then both chambers vote informatively in periods 1 and 2. Chamber 1’s bill dies in chamber 2 without reconciliation.

[B] If \(q^i > q^2\) and \(2P(q^e - \pi_A^{c,3}) - c_c < 0\), then chamber 1 proposes informatively and chamber 2 votes un informatively for chamber 1’s bill in period 2. The bill is adopted by chamber 2 without amendment.

[C] If \(q^i < q^2\), \(P(2\pi^{2,2}_{B(a,b)} - 1) - c_\mu > 0\) and \(2P(q^e - \pi_A^{c,3}) + c_\mu (q^e - \pi_A^{c,3} (2q^e - 1)) - c_c < 0\), then chamber 2 will amend chamber 1’s bill and motion it back to chamber 1 for reconsideration. Chamber 1 will concur in chamber 2’s amendment. In equilibrium, both chambers vote informatively in their period 1 and period 2 votes. Chamber 1 votes un informatively for the amended bill in period 3.

[D] [i] If \(q^i > q^2\) and \(2P(q^e - \pi_A^{c,3}) - c_c > 0\), then chamber 2 will propose a conference committee in period 2 and the conference recommendation will be adopted in period 4. In periods 1, 2, and 3, chamber 1, chamber 2, and the conference committee, respectively, all vote informatively. In period 4, the chamber that agrees with the conference recommendation votes informatively, the chamber whose private message disagrees with the conference recommendation votes un informatively.

[ii] If \(q^i < q^2\), \(P(2\pi^{2,2}_{B(a,b)} - 1) - c_\mu < 0\) and \(P(2q^e - 1) - c_c > 0\) then chamber 2 will propose a conference committee in period 2 and its recommendation will be adopted in period 4. In periods 1, 2, and 3, chamber 1, chamber 2, and the conference committee, respectively, all vote informatively. In period 4, the chamber that agrees with the conference recommendation votes informatively, the chamber whose private message disagrees with the conference recommendation will vote un informatively.

[iii] If \(q^i < q^2\), \(P(2\pi^{2,2}_{B(a,b)} - 1) - c_\mu > 0\) but \(2P(q^e - \pi_B^{c,3}) + c_\mu (q^e - \pi_B^{c,3} (2q^e - 1)) - c_c > 0\), then chamber 2 will propose a conference committee in period 2 and its recommendation will be adopted in period 4. In periods 1, 2, and 3, chamber 1, chamber 2, and the conference committee, respectively, all vote informatively. In period 4, the chamber that agrees with the conference recommendation votes informatively, the chamber whose private message disagrees with the conference recommendation will vote un informatively.

Proof: See Appendix A.

The choices whether to disagree with a proposal from the other chamber, as well as choices to
reconcile the disagreement and of selecting a reconciliation mechanism, are unique in each partition stated in the lemma and are derived endogenously from the model. While the lemma may be visually dense, only three sets of variables with a total of six elements account for all of the results: the payoff of the bill \( P \); the expertise of the institutions \( q^1, q^2, \) and \( q^c \); and the cost of the reconciliation mechanisms \( c_\mu \) and \( c_c \). The period 3 prior probability \( \pi^{c,3}_B \), and the period 2 posterior probability \( \pi^{2,2}_{B\ast(a,b)} \) (recall that \( \pi^{2,2}_{B\ast(a,b)} = \pi^{c,3}_B \)), are computed from \( q^1, q^2, \) and \( q^c \). As noted above, the equilibrium result is that chamber 1 always votes informatively in period 1. Therefore, for heuristic purposes, the message that chamber 2 observes, \( \psi^{2,2} \), is stated in terms of the private messages that each chamber receives (e.g., \( (m^1, m^2) = (a, b) \)) instead of \( (V^1, m^2) = (A, b) \)). We now turn to the welfare implications of congruent bicameralism.

**Part IV: The Bicameral Advantage**

In his speech opening the 1934 Nebraska unicameral initiative campaign, Progressive U.S. Senator George Norris summarized the basic argument against bicameralism this way:

> The qualifications of members of both branches of our State legislature are exactly the same. They represent exactly the same idea. The official duties they are to perform are of exactly the same nature. Why should we then have two bodies instead of one, and burden our taxpayers with the necessarily increased expense, to attain the object that can be fully attained by one house instead of two? (3277)

For Norris, second chambers in republican systems were congruent chambers and, thus, were wasteful redundancies. (Recall that Progressives regarded bicameral stability as a disadvantage of the institution.) This part develops the argument that bicameral decision-making – even when the chambers are congruent – produces better legislative outcomes than obtain with unicameral decision-making.

The analytical argument is similar to the one developed for the conference committee in Part III, except here we move back one step in the legislative process and account for the value of the information provided by the second chamber (and by the concomitant reconciliation mechanisms). The relevant constitutional choice then weighs the expected value of the information that a second chamber provides to the legislative process against the cost of that chamber.

First, the expected social gain of unicameral legislation is computed. Redefine the payoff \("P"\)
from above to identify social gain rather than (only) legislative payoffs. Let \( m^u \) be the signal observed by a unicameral chamber and let \( m^u = a \). Then the expected payoff if the unicameral legislature were to adopt bill A is:

\[
q^u P - (1 - q^u)P = (2q^u - 1)P > 0 \text{ for } q^u > 0.5.
\]

Next, we want to “add” one chamber to the unicameral legislature and compute the gain that would be acquired if the bicameral legislature were to consider the same bill. To do so, chamber “1” is arbitrarily designated to be the existing unicameral chamber. The other chamber is arbitrarily designated chamber 2. These are “arbitrary” designations now because they no longer designate voting sequence.

Either chamber may vote first or second on a bill. As before, either chamber may be the more or the less informed chamber, sometimes \( q^u > q^2 \) and sometimes \( q^2 > q^u \). Consider the following theorem.

**Theorem:** Given \((m^u, m^2) = (a, b)\) (resp. \((b, a)\)) and the equilibrium behavior identified in the lemma, the social value *added* by a second chamber in the consideration of one bill relative to its consideration by a unicameral body is:

[A] for \( q^u < q^2 \) and,

[i] the bill does *not* go to a conference committee, \( 2P(q^2 - q^u) > 0 \); or

[ii] the bill goes to a conference committee, \( 2P\left(q^2 - q^u(2q^c q^2 + 1 - q^2 - q^c)\right) > 0 \);

[B] for \( q^u > q^2 \) and,

[i] the bill goes to a conference committee, \( 2P\left(q^2 - q^u(2q^c q^2 + 1 - q^2 - q^c)\right) > 0 \);

[ii] the bill does *not* go to a conference, the value added by a second chamber is zero.

Proof: See Appendix B.

Importantly, note that the theorem identifies a positive informational gain from a second chamber *both* when the second chamber is more informed than the first/unicameral chamber, \( q^2 > q^u \), and when the first/unicameral chamber is the most informed chamber, \( q^u > q^2 \). The existence of a conference committee is crucial for the bicameral advantage in the latter case. Nonetheless, to the extent that a second chamber will *sometimes* have higher quality information than the “first” chamber, then bicameral systems will be informationally advantageous even if they do not employ conference committees as reconciliation mechanisms (and many bicameral systems do not, Tsebelis and Money 1991, 54–69).

Three numerical examples are provided to give a sense of the different outcomes identified in the

\[24\text{Recall from the lemma that a conference is called only if } q^c > q^u;^3\text{, which guarantees that } 2P\left(q^2 - q^u(2q^c q^2 + 1 - q^2 - q^c)\right) > 0.\]
As noted, the theorem expresses the value of a second chamber for one bill. The total social product of bicameralism would be the value of the second chamber summed across all legislation that it affects. Call this total social product of a second chamber \( \theta \). The informational service provided by a second chamber is always weakly productive: decisions are always at least as good, and sometimes better, with two chambers than with one chamber. Therefore \( \theta > 0 \). But simply because \( \theta > 0 \) does not mean that second chambers always represent net social gains. The social product of bicameralism must be reduced by the cost of a second chamber, \( c_2 \). Therefore the constitutional decision regarding a second chamber depends on whether the expectation is that \( \theta - c_2 > 0 \) or \( \theta - c_2 < 0 \).\(^{25}\)

Consider several things about \( \theta \). First, there is a public goods aspect to legislative output. On the benefits side, everyone within a political jurisdiction lives under the same set of laws. As with any public good, then, the value of legislative output is summed across the population while the cost of legislation remains constant (it costs no more to legislate for 5 million people than for 50 million). This permits an intuitive prediction regarding when bicameralism might and might not be cost effective. It is more likely

\(^{25}\) The internal legislative costs of conferencing or motioning a bill are negligible relative to any gain summed over an entire polity, so they are now ignored.
that $\theta - c_2 > 0$ for larger jurisdictions and it is more likely that $\theta - c_2 < 0$ for smaller jurisdictions. Thus, large countries and large states would receive the largest benefit from bicameral institutions. For smaller jurisdictions it becomes increasingly likely that $\theta - c_2 < 0$. There seems to be some reflection of this in actual cameral choices. Lijphart (1984), for example, notes a general relationship between the size of a country’s population and the presence of bicameral legislatures. All of the large countries he studied had bicameral legislatures and most of the smaller countries had unicameral legislatures (93-94). It further accounts for the predominance of bicameralism among U.S. state governments and unicameralism among U.S. local governments. (Interestingly, the New York City Charter Revision Commission considered recommending a bicameral legislature for the city in 1989, Purdum 1989).

But what about the reverse of the question: If two chambers are good, might not three or more be better? The question is not as farfetched as it might sound. Yugoslavia had a tricameral system under its communist regime (Courier-Journal 1992) and South Africa, too, briefly had a tricameral legislature (Longley and Olson 1991, 34). Estate-based tricameral systems were well known during the Middle Ages (Tsebelis and Money 1997, 29) and Sweden even had a form of quacmationalism (Sydow 1991). Further, as modeled above, conference committees can be viewed as attempts to derive the benefits of tricameralism on the cheap by forming “third” chambers only when it is cost effective to do so. (The literature often identifies conference committees with third legislative chambers, Vogler 1971, Norris 1935b). But why not three or more permanent chambers? While a fully fleshed out answer to this mechanism design question would take us too far afield, a couple of thoughts are offered. Multiple private signals are useful only when there is some likelihood that they will differ. This is why legislation adopted by two chambers is better fitted for its purpose than legislation adopted by only one chamber. But the information implied by these signals is averaged or aggregated by Bayes’ rule, accounting for the quality of the signal as well as the information implied by the message. Each additional signal, being aggregated with the previous signals, is thus less likely to be informationally pivotal. Under reasonable assumptions about informational productivity, it becomes increasingly unlikely that three or more permanent chambers
would be cost effective relative to two chambers that have the option of forming a third body only when
they deem it cost effective to do so.

Finally, it should be noted that the bicameral advantage identified in the theorem is not derived
from the prevention or delay of legislation. Rather, the advantage the theorem identifies is that
bicameralism produces better laws relative to unicameralism in the sense that it promotes a better fit
between the purposes of legislation and the means adopted to achieve those purposes. In fact, whether the
total number of bills increases or decreases under bicameralism with congruent chambers is
indeterminate. Note that this claim about the total number of laws produced by a bicameral legislature
should not be confused with the fact that one chamber will often kill legislation passed by the other
chamber. To be sure, with internal reconciliation costs, bicameral consideration results in the loss of some
bills that would have been adopted by a unicameral legislature. Yet bicameralism also offers two
chambers of legislators who may introduce legislation. If, for example, the two chambers of a bicameral
legislature were each to send to the other chamber as many bills as a unicameral chamber would adopt,
but each chamber kills less than half of the other chamber’s bills, then the bicameral legislature would in
fact enact more laws than a unicameral legislature composed of just one of those two chambers.
Nebraska’s experience may illustrate the argument. Nebraska’s last bicameral session held in 1935 saw
1,056 bills introduced and 192 bills adopted. The first unicameral session held in 1937 saw 581 bills
introduced and 210 bills adopted (Johnson 1938, 142). While half as many bills were proposed, the final
number of bills adopted in 1937 was only slightly greater than in 1935. This outcome is consistent with
the informational theory proposed here. It is inconsistent with the stability theory of bicameralism that
identifies its primary effect to be the delay or prevention of legislation.

Part V. Conclusion

The model also has practical implications for states and nations considering cameral reform. The
analysis developed a heretofore neglected informational rationale for second chambers. This rationale
does not require that the two chambers have divergent preferences over policy outcomes. It thus provides
a justification for bicameralism even when chambers preferences are congruent, which is the limiting case
for bicameral chambers in modern republican systems. The informational advantage of bicameralism does not stem from the institution delaying or preventing the adoption of legislation. Rather, bicameral process is advantageous because it produces better legislation relative to a unicameral process. Further, unlike previous studies that sought to account for a bicameral advantage with models that abstracted away from the availability of interchamber reconciliation mechanisms, the analysis developed here explicitly included reconciliation options in its model of the bicameral process.
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Appendix A: Proof of Lemma


Proof of Lemma [D][i]

Consider the chambers’ choices in period 4, given the conjectured voting in periods 1–3, with \( m^c = b \) and \( v^{c,3} = B \). The chambers’ payoffs if the conference recommendation is adopted is

\[
U^{i,A}(v^{i,A} = B|m^c = b; \pi_{A\bullet(a,b)}^2) = P(2\pi_{B\bullet(a,b)}^3 - 1) \text{ for } i \in \{1, 2\}.
\]

[A.1] > 0 when \( \pi_{B\bullet(a,b)}^3 > 0.5 \) and \( \pi_{B\bullet(a,b)}^3 > 0.5 \), when \( q^c > \frac{q^1(1-q^2)}{q^1 + q^2 - 2q^1q^2} = \pi_{A\bullet(a,b)}^{2.2} \). Proof:

\[
\pi_{B\bullet(a,b)}^3 = \frac{\pi_B^3 q^c}{\pi_A^3 + q^c (\pi_B^3 - \pi_A^3)}.
\]

Substituting for \( \pi_A^3 \) and \( \pi_B^3 \) and simplifying produces

\[
\pi_{B\bullet(a,b)}^3 = \frac{(1-q^1)q^2 q^c}{q^1(1-q^2) + q^c (q^2 - q^1)}.
\]

Requiring that this equation be greater than 0.5 and rearranging terms guarantees the inequality. Therefore \( P(2\pi_{B\bullet(a,b)}^3 - 1) > 0 \) for \( q^c > \pi_{A\bullet(a,b)}^{2.2} \).

Neither chamber will deviate from voting for the conference recommendation in period 4. If one chamber deviates and votes for A even though the conference has recommended B, then the payoff to both chambers is \( U^{j,A}(v^{j,A} = A|m^c = b, v^{j\neq i,A} = B; \pi_B^3) = 0 < P(2\pi_{B\bullet(a,b)}^3 - 1) \). A similar argument holds for \( m^c = a \) and \( v^{c,3} = A \).

Now consider the conference committee’s action in period 3, given the conjecture that the chambers adopt its recommendation in period 4 (and that \( q^c > \pi_{A\bullet(a,b)}^{2.2} \)). If it recommends informatively, then its payoff is \( U^{c,3}(v^{c,3} = B|m^c = b, v^{j,A} = v^{c,3}, i \in \{1, 2\}; \pi_{B\bullet(a,b)}^3) = P(2\pi_{B\bullet(a,b)}^3 - 1) > 0 \). If the conference committee deviates from informatively recommending a bill, given the chambers’ conjecture that the conference is informatively making its recommending, then the conferences payoff will be

\[
U^{c,3}(v^{c,3} = A|m^c = b, v^{j,A} = v^{c,3}, i \in \{1, 2\}; \pi_{B\bullet(a,b)}^3) = P(1-2\pi_{B\bullet(a,b)}^3) < 0.
\]

Thus the conference will
not deviate from an informative bill recommendation.

Now consider chamber 2’s period 2 action. Given the conjecture that both chambers accept the conference committee’s recommendation and that the conference committee recommends informatively, then in period 2 chamber 2 votes informatively for B and proposes a conference, \( d^{2,2} = (B, cc) \), when
\[
2P(q^c - \pi_A^3) - c_c > 0.
\]
The unconditional probability that the conference observes \( m^c = a \) is
\[
q^c \pi_A^3 + q^c \left( \pi_A^3 - \pi_B^3 \right).
\]
The unconditional probability that the conference observes \( m^c = b \) is
\[
q^c \left( \pi_A^3 - \pi_B^3 \right).
\]
The expected gain of voting for B is
\[
2P \left( \frac{2\pi_B^3 q^c}{\pi_A^3 + q^c \left( \pi_B^3 - \pi_A^3 \right)} - 1 \right).
\]
The expected gain if the conference is informationally pivotal, discounted by the probability that the message produced by the conference committee is actually \( m^c = b \) is:

\[
[A.2] \quad \left( \pi_B^3 + q^c \left( \pi_A^3 - \pi_B^3 \right) \right) \left( \pi_A^3 + q^c \left( \pi_A^3 - \pi_B^3 \right) \right) = 2P(q^c - \pi_A^3)
\]
Thus, chamber 2 will not deviate from voting informatively and proposing conference reconciliation when \( 2P(q^c - \pi_A^3) > c_c \). Similarly, chamber 2 will not deviate from voting un informatively for chamber 1’s proposal in period 2 when \( 2P(q^c - \pi_A^3) < c_c \). (The payoff to motioning bill B back to chamber 1, which would not concur in the amendment, is \(-c_{ip}\) so chamber 2 will not deviate to that alternative.)

Now consider chamber 1’s period 1 action. There are two cases to consider, when
\[
2P(q^c - \pi_A^{2,2}_{(a,a)}) - c_c < 0 \text{ and when } 2P(q^c - \pi_A^{2,2}_{(a,a)}) - c_c > 0.
\]
(Unlike the conference committee’s possible agreements.) First consider the case when \( 2P(q^c - \pi_A^{2,2}_{(a,a)}) - c_c < 0 \). The expected payoff to chamber 1 for voting informatively for A is:

\[
[A.3] \quad pr(m^2 = a|m^1 = a)P(2\pi_A^{2,2}_{(a,a)} - 1) +
pr(m^2 = b|m^1 = a)|pr(m^c = a|m^1,m^2) = (a,b)P(2\pi_A^{c,3}_{(a,b,a)} - 1) +
pr(m^c = b|m^1,m^2) = (a,b)P(2\pi_A^{c,3}_{(a,b,b)} - 1) - c_c |.
\]
If chamber 1 votes un informatively for B then its expected payoff is
Now consider the case when \( 2P(q^c - \pi_3^3) - c_c > 0 \). The conference is always informationally pivotal here, thus chamber 2 will always propose it. There is no incentive for chamber 1 to deviate from informative voting in period 1. (Uninformative voting by chamber 1 in this case is weakly dominated.)

**Proof of Lemma D[iii]**

The analysis of periods 1, 3, and 4 are similar to that discussed above, so here we consider chamber 2’s period 2 action. Because \( P(2\pi_2^2) - 1 - c_\mu > 0 \), chamber 2 receives a positive expected payoff if it amends chamber 1’s proposal to B and motions it back for concurrence. The gain of going to conference relative to motioning is \( q_u^c [2P(\pi_3^3) - 1] + (1 - q_u^c)(0) - c_c \). (By holding a conference, the chambers may change the bill they adopt relative to motioning, but also save the expense of motioning, which explains why \( c_\mu \) appears in the equation.) Substituting \( \pi_3^3 - \pi_B^3 \) for \( q_u^c \) and simplifying provides the following expression for the gain of going to conference relative to motioning:

\[
[A.5] \quad 2P(q^c - \pi_B^3) + c_\mu (q^c - \pi_B^3 q^c - 1 - c_c).
\]

If \([A.5] > 0 \) then chamber 2 will not deviate from proposing a conference to motioning the amended bill back to chamber 1. (And if \([A.6] < 0 \) but \( P(2\pi_2^2) - 1 - c_\mu > 0 \), then chamber 2 will motion the amended bill back to chamber 1 and will not seek conference reconciliation.) QED.\(^{27}\)

---

\(^{26}\) Note that \( \pi_{A(a,b,a)} > 1/2 \) for \( q^c > \frac{q^2(1-q^4)}{q^4 - 2q^4q^2} = \pi_B^3 \).

\(^{27}\) Uniqueness of the equilibrium behavior follows from the elimination of weakly dominated strategies.
Appendix B. Proof of Theorem

We will discuss two cases, when \( q^1 < q^2 \) and when \( q^1 > q^2 \).

**Case 1:** \( q^1 < q^2 \). Let \( m^u = a \). (The proof for \( m^u = b \) would be analogous.) Given only one signal, the posterior probability is just the prior probability, so \( q_{u|m^u} = q^u = \pi_{u|m}^u \). The unicameral chamber’s expected payoff of voting for A is: \( q^u P - (1 - q^u) P = (2q^u - 1)P > 0 \) for \( q^u > 0.5 \). If the unicameral chamber were to deviate and vote for B then its payoff would be \( (1 - q^u)P < 0 \) for \( q^u > 0.5 \).

Now consider the possible value of a second chamber. By assumption in Case 1, \( q^2 > q^u \). The prior probability for a second chamber in period 2 would just be the posterior probability of the first/unicameral chamber in period 1, or \( \pi_{2}^{2} = q^u \) and \( \pi_{2}^{2} = 1 - q^u \). As described in the lemma, there is always the possibility that the chambers will choose to purchase another message service in the form of a conference committee. The priors for the conference committee for \( (m^u, m^2) = (a,b) \) are

\[
\pi_{2(a,b)} = \pi_{A}^3 = \frac{q^u (1 - q^2)}{q^u + q^2 - 2q^u q^2} \quad \text{and} \quad \pi_{2(b,a)} = \pi_{A}^3 = \frac{q^2 (1 - q^u)}{q^u + q^2 - 2q^u q^2}.
\]

If \( m^2 = a \), then the second chamber is not informationally pivotal and the bicameral legislature makes the same decision as the unicameral legislature. If \( m^2 = b \), then the second chamber is informationally pivotal and the expected gain to a bicameral decision relative to a unicameral decision is:

\[
[A.6] \quad 2P \left( 2 \frac{q^2 - q^u q^2}{q^u + q^2 - 2q^u q^2} - 1 \right) > 0.
\]

Proof of [A.6]. \( q^2 > q^u \) by assumption. Adding \( q^2 \) and \( -2q^u q^2 \) to both sides and dividing through by 2 and \( q^u + q^2 - 2q^u q^2 \) implies that \( \frac{q^2 - q^u q^2}{q^u + q^2 - 2q^u q^2} > 0.5 \), which guarantees the inequality.

To compute the expected value of the second chamber, we must consider the case in which a conference committee is not held and the case in which one is held. If there is no conference, then the expected value of the second chamber is simply the expected payoff when \( m^2 = b \) discounted by the probability that \( m^2 = b \). The unconditional probability that chamber 2 observes \( m^2 = b \), \( pr(m^2 = b) \), is
$q_b^{2,2} = q^u + q^2 - 2q^u q^2$. So the expected value of the message service is

\[
[A.7] \quad (q^u + q^2 - 2q^u q^2) \cdot 2P \left( 2 - \frac{q^2 - q^u q^2}{q^u + q^2 - 2q^u q^2} - 1 \right) = 2P(q^2 - q^u) > 0.
\]

If a conference is held, there is a gain to a second chamber only if the signal the conference observes is the same as that observed by the second chamber. The probability that the conference observes message $m^c = b$, $\text{pr}(m^c = b)$, is $\frac{q^c q^2 + q^u (1- q^c - q^2)}{q^u + q^2 - 2q^u q^2}$. The expected gain from adopting B given that $m^c = b$ is:

\[
2P \left( \frac{q^c q^2 (1-q^u)}{q^c q^2 + q^u (1-q^c - q^2)} - 1 \right) > 0. \quad \text{Proof:} \quad \frac{q^c q^2 (1-q^u)}{q^c q^2 + q^u (1-q^c - q^2)} > 0.5 \quad \text{if} \quad q^c > \frac{q^u (1-q^2)}{q^u + q^2 - 2q^u q^2} \]

It is straightforward to show that $0.5 > \frac{q^u (1-q^2)}{q^u + q^2 - 2q^u q^2}$. But $q^c > 0.5$, which guarantees the inequality.

The expected value of bicameralism is the expected gain from adopting B given that $(m^u, m^2, m^c) = (a, b, b)$ discounted by the probability that the second chamber and the conference actually observe “b.”

\[
\text{pr}(m^2 = b) = q^u + q^2 - 2q^u q^2 \quad \text{and} \quad \text{pr}(m^c = b) = \frac{q^c q^2 + q^u (1-q^c - q^2)}{q^u + q^2 - 2q^u q^2}. \]

Therefore the expected value of bicameralism when a conference is held is:

\[
[A.8] \quad \left( q^u + q^2 - 2q^u q^2 \cdot \left( \frac{q^c q^2 + q^u (1-q^c - q^2)}{q^u + q^2 - 2q^u q^2} \right) \right) \cdot 2P \left( \frac{2q^c q^2 (1-q^u)}{q^c q^2 + q^u (1-q^c - q^2)} - 1 \right) = 2P \left( \frac{q^c q^2 (1-q^u)}{q^c q^2 + q^u (1-q^c - q^2)} \right) > 0.
\]

Case 2. $q^u > q^2$. The expected value of the second chamber is the same as above. Simply recall from the lemma that a conference is called only if $q^c > \pi^3 s^2$, which guarantees that the inequality stated in part 2[B] of the lemma holds for $q^u > q^2$. 