Abstract

We study a model where a Parliamentary majority strategically aggregates information, after collectively assigning decision-making authority over policies. We allow communication to take two forms: Private conversations, or public meetings. The former is typical of ‘ministerial government’, whereas the latter arises in ‘cabinet governments’. We first suppose that politicians’ private information is relevant for all policies (the ‘common-state’ case). We show that public meetings Pareto dominate private conversations. Full authority centralization is optimal with private conversations. Power sharing agreements may be superior when meetings are public, but the leader should be assigned a large share of decisions — at least 80% in our numerical simulations. The leader’s optimal features consist in ideological moderation, and in the ability to elicit information from ideologically close ‘party allies’. Second, we consider the case where each politician is informed only on a specific policy issue. Surprisingly, we find that the optimal Executive structure is no more decentralized than in the common-state case. Indeed, all policy decisions are assigned to the most moderate politician, unless the policy expert has ‘intermediate’ ideology. Our results provide fresh impetus to the study of cabinet governments and centralized authority in Parliamentary democracies. A detailed description of the implications of our study for Victorian England is presented.
The cornerstone of democratic legitimacy is the consent given to those who exercise decision-making authority. An empirical regularity in all representative polities, observed most clearly in its parliamentary form, is the emergence of the cabinet government, with centralized Executive authority. In the United Kingdom, for example, during the nineteenth century legislative and executive powers were fused in a cabinet often lead by a dominant Prime Minister. Hume (1752) brought attention to the relationship between centralized power, on the one hand, and factional structure on the other: he noted that “the filling of the position of elective magistrate is a point to great and too general interest, not to divide the whole people into factions.” Why should a polity that consists of a diverse range of opinions give rise to centralized authority? What effect does the assignment of decision-making rights have on the factional structure of an assembly? How might different structures of the Executive and allocations of decision-making power be justified?

We answer these questions from an information aggregation perspective with a formal model of a single-party government that determines policy on a range of issues. The bare-bones of our model are a set of ideologically-differentiated politicians (a Parliamentary majority) and a set of policy decisions to be implemented (the government programme). The Parliamentary majority faces a collective choice problem on the assignment of decision-making authority over items on its programme: each policy can be assigned to at most one politician, though a politician may exercise authority on more than one policy. Information relevant to policy is dispersed amongst the set of politicians. Conditional on the assignment of authority, each politician chooses whether to communicate her information to decision-makers before they implement their policies. We determine how the Executive structure facilitates the effective aggregation of information.

Our information-aggregation perspective provides an evaluation of efficiency in different executive forms: cabinet, ministerial, and prime ministerial government. The focus on information aggregation and communication in a parliamentary setting is natural. Although Iceland boasts the oldest parliament, the Althingi, the word ”parliament” is a late 13th century word from the Old French parlement the name of which is derived from parler- to speak. The etymological origins of the word thus indicate the role that parliament plays in communication and information exchange. Bagehot (1867) wrote that the “modern” British parliament that emerged in the nineteenth century maintained an “informative” function analogous to the role played by the “medieval” parliament which advised the monarch. This function, Bagehot highlighted, sits alongside its “elective” function:
the executive must maintain the confidence of the assembly. Whilst the role that parliament plays in providing consent for the executive has been explored from a distributive angle (Cox, 1987; Diermeier and Feddersen, 1998), our formal model is the first, we believe, that, in addition, takes account of the advisory role of the Parliament and that evaluates the optimal executive structure from an information aggregation perspective.

One element of the Executive structure, and an important primitive in our model, is the form taken by communication. Under private communication, an assembly member can separately convey her message to each decision maker; under public communication any such communication is publicly known to all members of the Executive. We propose that this conceptual distinction captures, in a concise way, an important element in the difference between “ministerial” and “cabinet” government: the former exists when communication to decision-makers is private; the latter arises when there exists a cabinet - a meeting at a designated time and place- during which policy relevant information conveyed to one minister is available to all who exercise executive authority.

Given the communication form, and the assignment of decision-making authority, an equilibrium of our communication game consists of a (directed) network between members who transmit their information truthfully–we refer to this as the “factional structure” of the ruling party, together with a set of policy outcomes. Our focus is on the equilibria that most effectively aggregates information ex-ante. With this in mind, we calculate the optimal assignment of authority: the one which best incorporates the diversity of viewpoints held within the party, and leads to the equilibria which aggregates most information. We analyze the optimal structure of the executive with reference to several critical elements: size, composition, and balance. The first refers to the number of politicians granted authority: the range of possible allocations runs from full decentralization–so that all share in the exercise of executive power–to complete centralization in which all authority is granted to a unique individual. The second distinguishes those who exercise authority from those who do not. Finally, the third refers to the number of policies assigned to different ministers.

In our analysis we consider different assumptions on the relationship between a politicians’ information and the policies implemented. We first suppose that politicians’ private information is relevant for all policies (the ‘common-state’ model). For this case policy decisions taken by different ministers depend on a single unknown state, such as the state of the economy. This formulation leads
to a stark and surprising result. In the absence of a cabinet, so that politicians can only communicate information to executive holders in private, the optimal assignment grants all decision-making authority to a unique individual. Intuitively, the result follows from the stipulation that every politicians’ information is relevant for all policies. As a result, politicians and policies are “interchangeable”: whoever is the optimal politician to make one policy decision will also be the optimal politician to make all of them.

The full centralization result under private communication may revert when allowing for public meetings. Then it may prove optimal for decision-making authority to be shared between ministers. This is because a politician may be unable to communicate truthfully when a leader to whom all decisions are allocated is ideologically distant; and yet she may be truthful when power is shared with another whose ideology is intermediate. This possibility is absent with private communication: then the politician may misrepresent her views to an ideologically distant minister whilst communicating truthfully with one more aligned with her own views. This apparently innocuous observation leads to a powerful normative result: public meetings, typical of cabinet governance, dominate private conversations with policy makers. We view this result as laying formal normative foundations for cabinet government.

To what extent should decision-making authority be centralized under public communication? We explore this issue with numerical simulations, to establish the features of optimal cabinet structure. Specifically, we randomly draw ideology profiles, and calculate the optimal policy assignment. We find that, even with public communication in a cabinet environment, fully centralized authority is fairly frequent. Further, even when it is optimal for authority to be shared, a single minister (perhaps a Prime Minister) should be assigned a large share – on average at least 80 % – of decisions. Thus the normative underpinnings for centralized authority established for the case of private conversations continue to hold when communication is public.

Having established the relative size of the decision-making body and, more precisely, the fact that a unique individual will in an optimally designed executive enjoy the lions-share of authority, we then ask what are characteristics of such executive “leaders”. We uncover two important forces: The need for moderation on the one hand, and for effective aggregation of information on the other. The first force is intuitive and, indeed, is a key implication of many models of collective choice. Put simply, decision-making authority should be assigned to those less extreme in their views as the
policies they implement will reflect the wider views of the assembly. The second, more novel and less obvious, force highlights the strategic incentives for politicians to share information. These are stronger for politicians who share more similar ideology. Simply put, we find that an important element in granting decision-making authority to an individual is the number of ideologically close-minded allies she has.\(^1\)

We conclude by asking whether our results hinge upon the assumption that all politicians’ information is relevant to all policies. We consider the opposite polar case, where each politician has a different expertise, and is therefore informed only about one particular policy. Although one might think that, in this case, delegation of authority to such experts would be optimal, our results do not change fundamentally in such settings. Surprisingly, we find that the optimal executive structure is no more decentralized than in the common-state case. This is because all policy decisions are assigned to the most moderate politician, unless the policy expert has ‘intermediate’ ideology. For reasonable functional forms of the ideology distribution, the proportion of such intermediate ideology politicians is relatively small, thus granting most decision power to the most moderate politician.

Before providing details of our model and main results we discuss a main application of our analysis, and then comment on the broader literature on which we build.

1. **The Emergence of Cabinet Government in the United Kingdom**

Our model provides novel insights into a central puzzle in parliamentary democracies: the coexistence of parliamentary parties and factions that represent the diversity of preferences over policy and a system of centralized executive authority with few checks and balances. In the United Kingdom this has its origins in monarchical government which gradually, over the course of the 18th and 19th centuries, gave way to cabinet government. The standard view of this process is that parliamentary factions were kept in check by the Prime Minister who effectively exercised the patronage of the Crown. In his authoritative study Cox (1987) points to the fusion of legislative and executive powers under centralized cabinet control, in the mid to late 19th century, as a key

\(^1\)An illustrative example that describes these forces in a strikingly simple form is as follows. We suppose that politicians are clustered into like-minded factions containing a given number of politicians each. Politicians are ideologically differentiated across factions, but not within. Suppose that communication is private, for simplicity. The optimal assignment then involves all decision-making authority being granted to a single faction that is broadly representative of assembly wide opinion (reflecting its moderation) and contains a large number of close ideology politicians (reflecting its ability to aggregate information).
causal factor in the development of party organizations and structured party competition in the United Kingdom. He documents the transformation of the British system from its golden age, where legislative initiative rested with individual members, into a centralized system whereby the cabinet exercised a monopoly over executive power and legislative initiative.

To explain why an assembly of individuals with diverse preferences came to provide support for centralized authority, Cox adopts a normative framework based upon the tragedy of the commons. He argues that centralization of the legislative initiative represented a Pareto improvement over the status quo:

"Each MP wished to exercise the extraordinary parliamentary rights available to ventilate his or his constituents, grievances and opinions; but when too many did exercise their rights the cumulative effect was distressing to MPs......In order to extricate themselves from the dilemma in which they were entangled, the Commons repeatedly took the most obvious way out and abolished the rights that were being abused."

Like Cox, we seek to understand the legitimacy of centralized authority and to explore the relationship between the assignment of decision-making power and party structure. In contrast to that analysis, our focus is on information aggregation and so offers a new perspective on the tendency toward centralized decision-making authority in a divided Parliament. Our focus on single party government can be justified in order to abstract from the competitive party tensions that are important in Cox’s work. The question we then ask is whether centralization of decision-making authority is desirable vis-a-vis other forms of assignment without need for consideration of electoral competition. Our set up allows us to consider a wide range of allocations of decision-making authority including the case of decentralized authority (akin to the golden age of parliament described above) and centralized authority either to a unique individual (a Prime Minister), a Ministry, or a Cabinet of ministers.

Our framework also allows us to address an important puzzle raised by Cox: why did the Cabinet gain from the need to centralize the legislative initiative? (Cox (1987), page 61). Providing an answer to this question is difficult, not least because the conceptual distinction between cabinet and other forms of governance is not clear. The cabinet system is defined by constitutional conventions Jennings (1959), and our understanding of its workings is built largely on personal accounts (Castle,
Contemporary historians highlight the limitations of cabinet governance in light of the vast range of policy initiatives and responsibilities that modern governments face (Hennessy, 2001, 2005). And yet, nevertheless, there are two core features of the British cabinet that were distinct in Victorian England, that continue in some form today, and that distinguishes cabinet governance from other forms of centralized authority.

Firstly, cabinet ministers with portfolios were and remain individually responsible for the initiation, development, and implementation of policy. It is the minister who has the sole right of legislative initiative and who bears the brunt of the responsibility for the effective exercise of authority. This core feature of cabinet government is defined by the convention of individual ministerial responsibility, elucidated by Earl Grey in 1858:

“It is a distinguishing characteristic of Parliamentary Government that it requires the powers belonging to the Crown to be exercised through Ministers, who are held responsible for the manner in which they are used ... and who are considered entitled to hold their office only while they possess the confidence of Parliament, and more especially the House of Commons.” Grey (1969) (cited in Woodhouse (2003) p.281).)

Thus the doctrine makes clear that exercise of authority by ministers rests upon the consent of Parliament. This is a critical element of our model: our perspective is on the \textit{ex-ante} optimal assignment of decision-making authority when taking account of the collective views of parliament.

Secondly, the minister must obtain the consent of Cabinet for his policy – though the exact details of which circumstances are covered by the need for Cabinet agreement, and what that agreement entails is unclear (see, for example, Jennings (1959), p.123-25)– and once that consent is gained then any minister who is unable to support the policy must resign their post. Ministers therefore have considerable discretion – they are not bound by majority rule, and there is no evidence that cabinet votes are taken (King, page 45))–though the requirement of collective agreement, implicit in the absence of a ministerial resignation, acts as an important constraint. The convention that government ministers support government policy or resign appears as early as 1792 and was generally followed during the early part of the nineteenth century Cox (1994). An implication, namely that anything a minister proposed to parliament was government policy, was established practice by the time of Peel’s cabinet in 1841. The doctrine of collective ministerial responsibility
follows: each minister takes responsibility for the policies of the government as a whole and is expected to defend the policies of their colleagues. The classic expression of the doctrine is found in a speech made to parliament by Lord Salisbury in 1878:

“For all that passes in Cabinet every member of it who does not resign is absolutely and irretrievably responsible and has no right to say afterwards that he agreed in one case to a compromise, while in another he was persuaded by his colleagues. It is only on the principle that absolute responsibility is undertaken by every member of the Cabinet, who, after a decision is arrived at, remains a member of it, that the joint responsibility of Ministers to Parliament can be upheld and one of the most essential principles of Parliamentary responsibility is established.” (Ellis (1980), 387)

This notion of collective responsibility is the defining feature of cabinet government. In particular it is this feature that allows us to draw (a perhaps subtle) conceptual distinction between a Ministry and a Cabinet, a distinction that arose in political discourse during the 18th century. The former is a collection of individual ministers who hold office at the pleasure of the Crown. The Cabinet, by contrast is defined as a physical entity: it is the place provided by the Prime Minister to enable his colleagues to informally develop the collective responsibility of the government that is required by convention. What collective responsibility means in practice is that no minister can abrogate himself from responsibility for government policy by claiming that he was unaware of the policy, even if he was not present at the cabinet meeting in which the policy decision was discussed by the minister responsible and the collective cabinet. The Cabinet thus provides the necessary setting for collective responsibility to be exercised. Whilst it would be untrue to say that there exists no notion of collective responsibility in practice in congressional systems – Fiorina (1980), for example offers the perspective that American parties exercise limited collective responsibility– it does not exist in a constitutional sense as in the United Kingdom and other parliamentary democracies.

We capture this subtle distinction between ministerial and cabinet government by invoking different communication protocols. Under ministerial government communication between party backbenchers and cabinet ministers is private: the backbencher conveys his views on a particular policy to the minister responsible before policy is then implemented. Under cabinet government all communication between a backbencher and a minister is publicly available to other ministers. Our
model is the first to adopt the distinction between communication protocols in a formal setting, and to apply this analysis to parliamentary governance.

We have then defined the core features of cabinet government as a system whereby individual ministers are responsible for the development and initiation of policy but where all ministers are bound by collective responsibility. As we have argued, it is the second feature that distinguishes cabinet government from other collective forms of governance. Why then did this particular form arise in Victorian England? And can we provide normative justification for its emergence?

Cox’s explanation (Cox (1987), chapter 6) builds on historical precedent: from its inception as the Privy Council of which it remains a part today, the Cabinet was already the locus of government expertise; thus even if the UK had centralized the legislative initiative in a committee system, where individual decisions were made by majority rule, existing ministers would likely have headed the most important committees. This suggests that cabinet government can be justified as a particular form of delegation of authority to experts. Whist this view suggests that expertise is exogenous, and is not affected by the structure of Parliament and the assignment of decision-making authority, an important contribution of our model is in exploring the endogenous emergence of expertise via communication between politicians: in our model a politician can become an expert in a given situation because others choose to share their information with him and we show how this, in turn, hinges on the assignment of decision-making authority.

However, although the idea of cabinet governance as a form of delegation to experts is intuitive, it can not explain the emergence of this particular form in Victorian England. Delegation to experts can take various guises: in one, we might observe a collection of ministers each with autonomy over the policies they implement; in another ministers are, in addition, bound by collective responsibility. A further variation of the latter emerges when all policies are delegated to a unique individual, as when, for example, a Prime Minister emerges as the dominant decision-maker. As noted above, an important primitive in our model is the communication protocol that helps us distinguish between ministerial and cabinet government. The adoption of this distinction allows us to contrast these systems using a welfare criterion to evaluate their performance. Foreshadowing our results, we show that cabinet government always represents a Pareto improvement over ministerial government and decentralized authority. However, as we will show, it is often the case that delegation of all decisions to a unique individual is optimal.
A final, but important question, concerns whether the emergence of centralized authority depends upon the dispersion of expertise. A common justification for centralization of authority is that some are better able to make decisions than others because of the information they hold: centralized authority is justified by centralized information. This view is related to Michels (1915/1958) famous “iron law of oligarchy”. His claim was that delegation to experts arises due to the complexity of decision-making and the inability of the mass to deal with such complexity. This, Michels believed, explained the centralization of decision-making authority in mass parties such as the German Socialists, the main workers party in Imperial Germany: although, ostensibly, decision-making authority rested with the party base, actual policy decisions were taken by an elite in the party fraktion. The problem with making inference from such select empirical examples is that we do not observance the counterfactual: would (and should) decision-making authority be centralized if expertise were more widely dispersed? Our formal framework allows us to engage in a specific thought experiment that addresses this question. We suppose that expertise were widely dispersed among assembly members, so that each member of the assembly were an expert on a particular policy. Somewhat surprisingly, we show that even when expertise is distributed across assembly members then decentralization of authority is never optimal and indeed we use simulations to show that outcomes are qualitatively similar to those discussed above.

In sum, our model of information aggregation can breathe new life on a set of questions concerning the centralization of decision-making authority in Parliamentary government. Cox’s seminal work uses Victorian England as a laboratory for exploring his notion of centralization. Our theory offers several contributions to the understanding of this period. In explaining the centralization of decision-making authority, our model of single-party government asks whether centralization of authority can emerge even in the absence of party competition. In drawing a distinction between cabinet government and other forms of collective governance, we can provide normative justifications for the emergence of the former. And we will show that the emergence of centralized cabinets would have been likely even if expertise on elements of the government programme were widely dispersed. Finally, as well as being able to provide insights into the optimal executive structure, our model will provide insights into the characteristics of those who wield decision-making power.

Before building our model we discuss briefly the further related literature on which we build.
2. Related Literature

Our model relates to a broader literature on the effect of collective decision-making bodies on information aggregation. For the most part this literature, building on the seminal contribution by Austen-Smith and Banks (1996), Feddersen and Pesendorfer (1996), Feddersen and Pesendorfer (1997), Feddersen and Pesendorfer (1998), has not focused on the key institutions of parliamentary democracy, but instead the role that committees with qualified majority voting play in the aggregation of information.² Our emphasis on a cabinet, in which policy decisions are implemented by individual ministers, rather than voted on in committee, brings into sharp focus the assignment of decision-making authority. The assignment of decision-making authority is, shared with other models of cabinet governance— in particular the portfolio-assignment models of Laver and Shepsle (1996) and Austen-Smith and Banks (1990)—although their concern however is with distributional and ideological effects of different portfolio allocations rather than their information aggregation properties. Our focus on the assignment of decision-making authority from an information aggregation perspective is related to Dewan and Myatt (2007) who analyze the emergence of centralized leadership of a party congress in a common-value setting.

Our model is circumscribed by the cheap talk literature that builds on the seminal contribution of Crawford and Sobel (1982), applied in a political science setting by Gilligan and Krehbiel (1987) and Battaglini (2002). That literature has focussed primarily on congressional systems and on the stylized relationship between a unitary parent body (represented by the median floor member in the House) and a single committee which holds expertise. A related model of parliamentary democracy from an information aggregation perspective is by Dewan and Hortalla-Valve (2010) who analyze strategic communication between a collection of ministers and a Prime Minister. The latter appoints ministers, allocates portfolios, and assigns different tasks to each portfolio. Building on results in Battaglini (2002), they show that when the Prime Minister has some control over assignment then there is a truthful and fully revealing equilibrium that allows the Prime Minister to implement her preferred policy.

Our model of parliamentary democracy, by contrast, analyzes a richer situation in which multiple members of a Parliament communicate strategically with each other. Strategic communication in

²More recent models allow for information aggregation through cheap talk followed before voting takes place in committees, see Austen-Smith and Feddersen (2006), Visser and Swank (2008), and Gerardi and Yariv (2007).
a multiple-sender, multiple-receiver world is analyzed by Galeotti, Ghiglino, and Squintani (2009), who build their framework on the many-to-one communication model by Morgan and Stocken (2008) and on the one-to-many communication model by Farrell and Gibbons (1989). We use this modeling technology to explore how politicians’ actions are conditioned on the assignment of decision-making authority and procedural rules. Our analysis of many-to-many communication provides insight into a tradeoff between moderation and information in the optimal leader selection. The former is also relevant in the single-sender world of Gilligan and Krehbiel. In their model the adoption of restrictive procedural rules, that do not allow the parent body to amend legislation, can provide incentives for costly information acquisition. Such rules are optimal when experts’ ideal policies are not too distant from the floor median. Our focus on ideological divergence in a parliament gives rise to an effect that balances the moderation requirement: when a ruling party member considers whether to communicate with another he considers not only distance between their relative ideologies, but also how many others are communicating with that individual.

A key insight of our analysis is that the assignment of decision-making authority shapes the equilibrium truthful communication within the Parliament majority. Our information aggregation perspective offers a new notion of party factions to the formal literature on parties. Although there is a large political science literature on party factions, there are few studies that incorporate party factions in a formal analysis. Exceptions include Caillaud and Tirole (2002) and Castanheira, Crutzen, and Sahuguet (2010), however in these models the factional structure of the party is taken as exogenous. Building on Galeotti, Ghiglino, and Squintani (2009), we provide a novel conception of party factions as alignments between politicians who share information. In essence a party faction in our model is akin to the common term clique: social interaction between members of a faction affects the beliefs of individual members; such interaction is more likely between like-minded individuals; and communication reinforces the views of the group. This conceptualization of factions draws on network theory and offers a novel and natural way of thinking about affiliations forged amongst an assembly of politicians.

Our model allows for a rich variety of factional structures including some in which politicians are segregated into distinct factions whose memberships do not overlap, and others in which the factional alliances overlap. In developing our analysis we contribute to a small literature that addresses the endogenous nature of a parties internal organization. In particular, Persico, Rodriguez-Pueblita,
and Silverman (2008) analyze a model of party competition where candidates belong to intra-party factions that accounts for high levels of spending in party strongholds. Relatedly, Eguia (2008) looks at the endogenous emergence of factional and party alliances in a legislative setting where parties coordinate voting behavior. Both their modeling apparatus - they do not focus on information-and their definition of faction differ substantially from ours. Whilst their focus is on factions who compete for local public goods, our focus is on ideological factions. The distinction refers to the difference between factions of interest and those of principle (see Bettcher (2005)).

3. Model

We consider the following information aggregation and collective decision problem. Suppose that a set of \( I = \{1, ..., I\} \) of politicians form a single-party Parliamentary majority. Their role is to provide consent for its governing executive. It is faced with the collective task of choosing an assignment \( a : K \rightarrow I \) of policy decisions. This assignment grants decision-making authority over a set of policies \( K \). For each \( k \in K = \{1, ..., K\} \), the decision \( y_k \) is a policy on the left-right spectrum \( \mathbb{R} \). For simplicity we think of the assignment as granting complete jurisdiction over policy \( k \), though of course other interpretations, such as, for example, the assignment of agenda-setting rights could also be incorporated. The important element is that decision-making authority over each policy is granted by the collective body of politicians to a unique individual.

In a fully-decentralized executive, each policy decision is assigned to a different politician, so that \( a(k) \neq a(k') \) for all \( k, k' \) in \( K \). At the opposite end of the spectrum, all decisions are centralized to a single leader, so that \( a(k) = a(k') \) for all \( k, k' \) in \( K \). We let the range of \( a \) be denoted by \( a(K) \subseteq I \), which we term as the set of politicians with decision-making authority. We sometimes refer to such politicians collectively as active, othertimes we refer to them individually as ministers.

For any active politician \( j \), we let \( a_j \) denote the number of policies she takes under assignment \( a \). Our specification thus allows us to capture important elements of the executive body. In particular its size– beyond the extremes of full decentralization and the leadership of one, there are a range of possibilities; and its balance–amongst the set of active politicians some may have more authority than others.

Politicians are ideologically differentiated, and care about all policy choices made. For any policy decision \( \hat{y}_k \), their preferences also depend on unknown states of the world \( \theta_k \), uniformly distributed
on $[0,1]$. Specifically, were she to know the vector of states $\theta = (\theta_k)_{k \in K}$, we specify each politician $i$’s payoff as:

$$u_i(\hat{y}, \theta) = - \sum_{k=1}^{K} (\hat{y}_k - \theta_k - b_i)^2.$$  

Hence, each politician $i$’s ideal policy is $\theta_k + b_i$, where the bias $b_i$ captures ideological differentiation, and we assume without loss of generality, that $b_1 \leq b_2 \leq ... \leq b_I$. The vector of ideologies $b = \{b_1, ..., b_I\}$ is common knowledge.

Each politician $i$ has some private information on the vector $\theta$. Specifically, we make two opposite assumptions on politicians’ information. Firstly, for some of our analysis we assume that uncertainty over all policies is captured by a single common state that represents the underlying economic and social fundamentals. For example, an underlying economic recession will influence policy choices of all ministries, from the Home office immigration policy, to the fiscal policy of the Chancellor of the Exchequerer. We represent these fundamentals by a single uniformly distributed state of the world $\theta$, so that $\theta_k = \theta$ for all $k$, and each politician $i$’s signal $s_i$ is informative about $\theta$. Conditional on $\theta$, $s_i$ takes the value equal to one with probability $\theta$ and to zero with probability $1 - \theta$. Secondly, and in an alternative specification we say that the politician’s information is policy specific. Each policy has its own underlying set of circumstances over which politicians may be informed. Thus the random variables $\theta_k$ are identical and independently distributed across $k \in K$, and each politician $k$ receives a signal $s_k \in \{0, 1\}$ about $\theta_k$ only, with $\Pr(s_k = 1|\theta_k) = \theta_k$. In the case of policy specific information, for simplicity, we take $K = I$ so that each politician is informed on a single issue. This specification allows us to explore a situation where expertise on policies varies and is widely dispersed amongst the set of politicians.

In addition to providing consent for the executive, the Parliament acts as a forum via which information can be aggregated and transmitted to policy makers. In order to aggregate information, politicians may communicate their signals to each other before policies are executed. We allow for communication to either take the form of private conversations, or public meetings. We might think of private communication as taking place over dinner, or via a secure communication network, with no leakage of information transmitted. Hence, each politician $i$ may send a different message $\hat{m}_{ij} \in \{0, 1\}$ to any politician $j$. Under public communication, by contrast, a politician is unable to communicate privately with a decision-maker as all communication is publicly available to those
who exercise authority. Hence, each politician $i$ sends the same message $\hat{m}_i$ to all decision makers. A pure communication strategy of player $i$ is a function $m_i(s_i)$.

As already noted, the distinction we draw between these different modes of communication captures a subtle but key difference in the type of executive body that forms. Under private communication, once decision-making authority is assigned, a politician can communicate privately with a decision-maker. Under public communication, this is no longer possible and information must be shared with all decision-makers. The latter is an important element of the collective responsibility that binds all ministers to the government’s decision on policy that is implemented by the minister responsible. Fixing the size of the executive body, the difference in the communication mode then allows us to distinguish between what we term a “Ministry” and a Cabinet: the former is a collective of politicians with executive authority; the latter is a physical entity where a collective of politicians with executive authority share information before decisions are made. Note however, that under our notion of cabinet government, decisions are still taken by individual ministers who have discretion up to the point where they make all information available. Ministers are not bound by a collective decision-making rule when implementing policy.

In our model, alliances are formed via truthful communication of information. Such alliances arise endogenously between politicians whose ideological biases are similar. The resulting notion of faction encompasses a common definition of alliances that consist of like-minded politicians and is akin to a clique: a group in which membership involves the exchanges of information which, in turn, affects beliefs. To capture our abstract notion of faction we first note that, up to relabeling of messages, each communication strategy from $i$ to $j$ may either be truthful, in that a politician reveals her signal to $j$, so that $m_{ij}(s_i) = s_i$ for $s_i \in \{0, 1\}$, or “babbling”, and in this case $m_{ij}(s_i)$ does not depend on $s_i$. Hence, the communication strategy profile $\mathbf{m}$ define the truthful communication network $\mathbf{c}(\mathbf{m})$ according to the rule: $c_{ij}(\mathbf{m}) = 1$ if and only if $m_{ij}(s_i) = s_i$ for every $s_i \in \{0, 1\}$. This definition provides us with the factional structure of the party.

The second strategic element of our model involves the final policies implemented. Conditional on her information, the assigned decision-maker implements her preferred policy. We denote a policy strategy by $i$ as $y_k : \{0, 1\}^2 \rightarrow \mathbb{R}$ for all $k = a^{-1}(i)$. Given the received messages $\hat{\mathbf{m}}_{-i,j}$, by sequential rationality, politician $i$ chooses $\hat{y}_k$ to maximize expected utility, for all $k$ such that
\( i = a(k) \). So,

\[
(1) \quad y_k(s_i, \hat{m}_{i,-i}) = b_i + E[\theta_k|s_i, \hat{m}_{i,-i}],
\]

and this is due to the quadratic loss specification of players payoffs expressed in 3.

Given the assignment \( a \) an equilibrium then consists of \((m, y)\) and a set of beliefs that are consistent with equilibrium play. We use the further restriction that an equilibrium must be consistent with some beliefs held by politicians off the equilibrium path of play. Thus our equilibrium concept is pure-strategy Perfect Bayesian Equilibrium. Fixing policy assignment \( a \), then, regardless of whether communication is private or public, there may be multiple equilibria \((m, y)\). For example, the strategy profile where all players “babble” is always an equilibrium.

In distinguishing between equilibria our approach is normative. We seek to define the optimal assignment of decision-making authority given the endogenous formation of party factions. In doing so we rank the welfare of different assignments and the associated factional structures that emerge and assume that politicians are always able to coordinate on the equilibria \((m, y)\) that maximize equilibrium welfare. Our notion of welfare is ex-ante Utilitarian. Hence equilibrium welfare solves

\[
W(m, y) = -\sum_{i \in I} \sum_{k \in K} E[(\hat{y}_k - \theta_k - b_i)^2].
\]

However, for some of our results, however, we can invoke the weaker principle of Pareto optimality.

4. **Two Forces behind Authority Assignment: Moderation and Information**

We begin the analysis of the optimal assignment of policy decision power with a following fundamental result which holds irrespective of whether information is policy specific or about a common state, and of whether information is transmitted publicly or privately among party factions. We show that the assignment of policy choices involves trading off politicians’ moderation and equilibrium information.

The idea that the optimal assignment will involve the assignment of authority to leaders in the party with moderate ideology is not novel. Indeed we might think this as a reasonable expectation of any model of the assignment of decision-making authority. However, to our knowledge, ours is the first formal study of information transmission and assignment of executive authority for a party government that makes this point. Going beyond this point, our focus on information transmission
allows us to identify two main forces that determine the optimal assignment of executive authority: (i) ideological moderation of those who exercise authority, and (ii) their ability to elicit information from other party politicians.

In order to formalize this insight, we first say that a politician \( j \)'s moderation is \( |b_j - \sum_{i \in I} b_i / I| \), the distance between \( b_j \) and the average ideology \( \sum_{i \in I} b_i / I \). We note that politicians’ moderation does not depend on the assignment \( a \), nor on the equilibrium \((m, y)\). Second, we let \( d_{j,k}(m) \) denote politician \( j \)'s information on the state \( \theta_k \) given the equilibrium \((m, y)\). Specifically, \( d_{j,k}(m) \) consists in the number of signals on \( \theta_k \) held by \( j \), including her own, at the moment she makes her choice.

Evidently, in the model specification with policy specific knowledge, each politician \( j \) may hold at most one signal on each \( \theta_k \), either because \( s_k \) is her own signal \((j = k)\), or because \( s_k \) was communicated by \( k \) to \( j \) given the party’s factional structure \( c(m) \) that emerges in equilibrium. In a specification with common value information, instead, each politician’s information coincides with the number of politicians who, given the factions that form, communicating truthfully with her given by \( c(m) \), plus one (her own signal).

Armed with these definitions, we now decompose the equilibrium welfare into its ideological and informational parts.\(^3\)

**Lemma 1.** Given the assignment \( a \) and the equilibrium \((m, y)\), the equilibrium ex-ante welfare \( \mathcal{W}(m, y) \) can be rewritten as:

\[
\mathcal{W}(m, y) = - \sum_{k \in K} \sum_{i \in I} (b_i - b_{a(k)})^2 - \sum_{k \in K} \frac{I}{6[d_{a(k),k}(m) + 2]}. 
\]

The first term in the square parenthesis of the above expression denotes the aggregate ideological loss, the second term is the aggregate residual variance of the politicians’ decisions. Note that, statistically, the residual variance may be interpreted as the inverse of the precision of the politicians’ decisions. Due to the above decomposition, we see that determining which assignment \( a \) maximizes welfare taking into account each politicians’ moderation and information. In fact, assigning any task \( k \) to moderate politicians reduces the ideological loss \( \sum_{i \in I} (b_{a(k)} - b_i)^2 / I \), as their bias \( b_{a(k)} \) is closer to the average bias \( \sum_{i=1}^I b_i / I \). But at the same time, choosing an assignment \( a \) where the

\(^3\)Lemmas 1, 2 and 4 build on earlier analysis in Galeotti, Ghiglino and Squintani (2009).
active players are well informed in the welfare-maximizing equilibria \((m, y)\) reduces the aggregate residual variance 
\[
\sum_{k \in \mathcal{K}} [6(d_{a(k), k}(m) + 2)]^{-1}.
\]
We have proved the following fundamental result.

**Proposition 1.** The optimal assignment of decision-making authority \(a\) is determined by the politicians’ moderation, and by the information that they hold in equilibrium.

The result in proposition 1 will prove central in what is to follow. In the next section, we shall consider the case of private conversations of common state information. We will determine the optimal size, composition, and balance of the decision-making authority assignment.

5. Private Conversations, Common State Model

We begin our study of the optimal assignment of decision making tasks in a governing body by studying the case where underlying fundamentals are common to all policies so that a politicians’ information is relevant to all decisions. Initially we explore the situation where politicians may communicate only in private with decision-makers. Since such audiences are private—no forum exists for executive members to formally exchange information— for now, we explicitly rule out cabinet governance. Other forms of government—ranging from full centralization to full decentralization, and including a ministry of decision-making politicians, responsible for different ranges of policy—are all possible.

Our first result fully characterizes the internal alliances—the party’s factional structure—given any policy assignment \(a\). For notational simplicity, we denote by \(d_j(m)\) the information held by politician \(j\) in equilibrium. For future reference, for any assignment \(a\), we write \(d_j^*(a)\) as the information \(d_j(m)\) associated with any welfare-maximizing equilibrium \((m, y)\).

**Lemma 2.** Suppose that the state \(\theta\) is common across policies, and that communication is private. The profile \(m\) is an equilibrium if and only if, whenever \(i\) is truthful to \(j\),

\[
|b_i - b_j| \leq \frac{1}{2d_j(m) + 2}.
\]

The possibility for truthful communication from politician \(i\) to \(j\) becomes less likely with (i) an increase in the bias difference \(|b_i - b_j|\) and (ii) an increase in the information held by \(j\) in equilibrium.
Figure 1. Truthful communication decreases with many informants

We first note that the possibility that a politician \(i\) communicates truthfully with an active politician \(j\) in equilibrium is independent of the specific policy decisions assigned to \(j\), and of the possibility of communicating with any other politician \(j'\). Furthermore, the possibility that a politician \(i\) truthfully communicates with \(j\) becomes less likely with any increase in the difference between their ideological positions.

More surprising, perhaps, is the additional effect (ii) noted in proposition 1. The possibility for \(i\) to communicate truthfully with \(j\) decreases with the information held by \(j\) in equilibrium. To see why communication from \(i\) to \(j\) is less likely to be truthful when \(j\) is well informed in equilibrium, suppose that \(b_i > b_j\), so that \(i\)'s ideology is to the right of \(j\)'s bliss point. Suppose \(j\) is well informed and that politician \(i\) deviates from the truthful communication strategy—it reports \(\hat{m}_{ij} = 1\) when \(s_i = 0\),—then she will induce a small shift of \(j\)'s action to the right. Such a small shift in \(j\)'s action is always beneficial in expectation to \(i\), as it brings \(j\)'s action closer to \(i\)'s (expected) bliss point. Hence, politician \(i\) will not be able to truthfully communicate the signal \(s_i = 0\).

By contrast, when \(j\) has a small number of players communicating with her, then \(i\)'s report \(\hat{m}_{ij} = 1\) moves \(j\)'s action to the right significantly, possibly beyond \(i\)'s bliss point. In this case, biasing rightwards \(j\)'s action may result in a loss for politician \(i\) and so she would prefer to report truthfully—that is, she will not deviate from the truthful communication strategy. The effect is illustrated in Figure 1 where \(y'\) is the policy implemented when a politician for whom \(b_i > b_j\) truthfully communicates a signal \(s_i = 0\) to policy maker \(j\) and \(y''\) the policy implemented when she deviates.
The characterization of the party structure in Lemma 2 implies a striking result for our study of information aggregation and assignment of authority in single-party government.

**Proposition 2.** Suppose that the state $\theta$ is common across policies, and that communication is private. For generic ideologies $b$, any Pareto optimal assignment involves decision-making authority being centralized to a single leader $j$: that is $a(k) = j$ for all $k$.

The fact that the possibility for any politician $i$ to truthfully communicate with an active politician $j$ in equilibrium is independent of the specific policy decisions assigned to $j$, or to any other politician $j'$, leads generically to a stark finding: all $k$ decisions should be assigned to a single leader and, hence, the executive authority should be fully centralized. Remarkably, this result holds with our Utilitarian welfare condition and under the weak welfare concept of Pareto optimality. We have shown then that under common values and with the restriction to private conversation between a politician and a minister, then the optimal size of the executive is one: if politicians can coordinate on the optimal equilibrium, then leadership by a dominant Prime Minister emerges.

A critical factor in deriving the result in Proposition 1 is that $d^*_j(a)$ does not depend on $a$ (as long as $j$ is active under $a$). This aspect of our model allows us to micro-found the equilibrium information $d^*_j(a)$. In particular, we can think of $j$’s information as a consequence of her ideological position relative to that of the other politicians in her party. We define $n_j$ as the ideological “neighbourhood” of $j$, that is the number of politicians whose ideology is within distance $b$ of her own:

$$n_j(b) = \# \{i : |b_i - b_j| \leq b\}$$

Using this definition, combined with Lemmas 1 and 2 allows us to calculate $d^*_j(a)$.

**Lemma 3.** Suppose that the state $\theta$ is common across policies, and that communication is private. For any assignment $a$, and any active player $j \in a(K)$, the information $d^*_j(a)$ solves the equation

$$n_j \left( \frac{1}{2(d+2)} \right) = d$$

We can use this result to determine the composition of the executive. If a single leader should emerge then what distinguishes her from other politicians? The significance of the result in lemma 3 lies in the fact that, given any bias level $b$, the magnitude of the ideological neighborhood $n_j$...
can be taken as an expression of how large is the set of politicians ideologically close to \( j \). Ideologically close politicians translate into informants of \( j \), in equilibrium, according to the expression in equation 3. Thus, politicians who have many ideologically like-minded allies in the party, collect more information in equilibrium. Bringing together these thoughts we conclude that the optimal executive consists of a single leader who is selected taking into account the need for ideological moderation, on the one hand, with that for informed policy, on the other.

**Corollary 1.** Suppose that the state \( \theta \) is common across policies, that communication is private, and that ideologies \( b \) are generic. Any optimal assignment selects a single leader \( j \). Optimal leadership requires global ideological moderation, and local ideological concentration as defined by the function \( n_j \).

The identification of these two forces leading to optimal leader selection is, to our knowledge, completely novel both in the political science literature on leadership and executive politics, and in the game-theoretic literature on information transmission. The application in this setting is very natural and takes a particularly interesting form in a specific parametrization of our general model.

Suppose that the \( I \) politicians are clustered in \( N \) factions \( I_n \), of \( I_n \) politicians each. Politicians are ideologically differentiated across factions, but not within factions: We let \( b_i = \beta_n \), for all \( i \in I_n \), and assume without loss of generality, that \( \beta_n \) increases in \( n \). Because of Lemma 2, for any ideologies \( \beta \), there exists a welfare-maximizing equilibrium \((m, y)\) such that all players communicates to each other within each faction. Further, we are interested in the specification where, for any \( n = 1, \ldots, N - 1 \), \( \beta_{n+1} - \beta_n \) is sufficiently large that there is no equilibrium where players truthfully communicates across factions.

In this specialized set up, for generic ideology vectors, the optimal assignment involves all decision-making authority being granted to a single faction. Following Proposition 1, the selection of this faction trades off moderation, (the proximity of \( b_n \) to the average party ideology \( \sum_{i=1}^{I} b_i/I \)), with the information \( d^*_j(a) \) held by each politician \( j \) in faction \( n \). Because, we have engineered the set up so that there is complete communication within factions, and no communication across factions, here, the information \( d^*_j(a) \) of an active politician \( j \) in faction \( n \) consists simply of the number of signals he receives. This, in turn, is simply the number of politicians \( I_n \) in his faction.
In concluding our study of politicians who communicate privately and have information common to all policies, we note that complete centralization of authority Pareto dominates other forms of governance. Thus we have moved toward a novel explanation of centralized authority in a diverse factionalized Parliamentary majority, based on information aggregation. Our information aggregation perspective shows that centralized authority can arise in the absence of competitive party tensions. In the next section, we consider communication via public meetings. We will show that public meetings Pareto dominate private conversations, thereby laying foundations for cabinet government. Further, we will establish that, although full authority centralization is not always optimal, the optimal authority assignment nevertheless displays a high concentration of authority to the leader.

6. Cabinet meetings, Common State Model

This section studies optimal assignment of decision making authority in a single-party government where, as in the previous section, the politicians’ information is relevant to all executive decisions, but, unlike the previous section, information may be aggregated in public meetings. In particular, we now allow for the existence of a cabinet which provides a forum where information between the set of active politicians is exchanged. It is important to note that this alters the strategic calculus of information transmission. Given the assignment of decision-making authority, a politician must now ask whether he wishes to make his information available to all members of the Cabinet.

As in the previous section, we first fully characterize the equilibrium communication structure in the party that determines which factions will form, given any policy assignment $a$, and the public transmission of all policy relevant information to the full Cabinet.

Lemma 4. Suppose that the state $\theta$ is common across policies $k$, and that communication is public. The strategy profile $m$ is an equilibrium if and only if, whenever $i$ is truthful,

$$
|b_i - \sum_{j \neq i} b_j \gamma_j(m)| \leq \sum_{j \neq i} \frac{\gamma_j(m)}{2[d_j(m)] + 2},
$$

where for every $j \neq i$,

$$
\gamma_j(m) = \frac{a_j/[d_j(m)] + 2}{\sum_{j' \neq i} a_j'/[d_j'(m)] + 2}.
$$
When communication is public, the set of active politicians is equivalent to the Cabinet. Intuitively, each politician $i$’s willingness to communicate with a member of the Cabinet, depends on a weighted average of cabinet members’ ideologies. The specific weights are inversely related to the equilibrium information of each politician.

The characterization of the party factions that emerge in equilibrium given by Lemma 4 imply that our result that private conversation lead to fully centralized authority, Proposition 2, can be reverted when allowing for public meetings: Power sharing agreements may be optimal. We illustrate this possibility by means of a simple example, with four politicians, and “essentially” generic biases: $b_1 = -\beta$, $b_2 = \epsilon$, $b_3 = \beta$ and $b_4 = 2\beta$, where $\epsilon$ is a positive quantity, infinitely smaller than $\beta$. We compare four assignments, full decentralization, leadership by politician 2 (the most moderate politician), and two forms of power sharing agreements between politicians 2 and 3: in the symmetric power-sharing agreement, politicians 2 and 3 make two decisions each; in the asymmetric power-sharing agreement, politician 2 makes 3 choices, and 3 makes one choice.

The analysis requires calculating the welfare maximizing equilibria for each one of the four assignments, and then comparing welfare across assignments. Its details are relegated to the Appendix. It suffices here to say that, taking the limit for vanishing $\epsilon > 0$, we have the following results. First, full decentralization is never optimal. Then, for $\beta < 1/24$, all players are fully informed under any of the four considered assignments. At the same time, for $\beta > 1/12$, there is no truthful communication regardless of the assignment. In both cases the optimal assignment entails selecting politician 2 as the unique leader as she is the most moderate politician. Interestingly, however, for $\beta \in (1/24, 1/21)$, politician 1 and 4 are willing to communicate to 2 and 3 if they are under any power sharing agreement, but politician 4 is not willing to speak to 2 if she is the single leader. Further for $\beta \in (1/21, 1/18)$, players 1 and 4 are both willing to talk to 2 and 3 publicly if and only if they are under a symmetric power sharing agreement. Finally, for $\beta \in (1/24, 1/18)$, there is no advantage from assigning any choice to player 3 instead of player 2.

We summarize by the following result.

**Result 1.** Suppose that $b_1 = -\beta$, $b_2 = \epsilon$, $b_3 = \beta$, and $b_4 = 2\beta$, and compare leadership by 2, full decentralization, and power sharing agreements between 2 and 3, under public communication of information of common value. For $\beta < 1/24$ or $\beta > 1/18$, it is optimal to select 2 as the leader. For $\beta \in (1/24, 1/21)$, the optimal assignment is the asymmetric power sharing agreement of 2 and
3. For $\beta \in (1/21, 1/18)$, the optimal assignment is the asymmetric power sharing agreement where 2 makes 3 choices, and 3 makes one choice.

The facts that full authority centralization is always optimal when conversations are private, but not necessarily when there are public meeting, together with the observation that private and public communication equilibria coincide when all authority is granted to a single leader, lead to a striking result: Public cabinet meetings Pareto dominate private conversations in a ministerial government. In fact, when the optimal assignment with public meetings fully centralizes authority, private conversations and public meetings yield the same outcome, but the latter do strictly better than the former, when power sharing agreements are optimal with public meetings. We provide a formal proof of this result in the appendix.

**Proposition 3.** Suppose that the state $\theta$ is common across policies $k$. For generic ideologies $b$, the optimal assignment of decision-making authority when communication is public Pareto dominates any assignments with private conversation. Cabinet government Pareto dominates ministerial government.

Proposition 3 bears important consequences for optimal executive structure. Recall the two features that describe cabinet governance: under individual ministerial responsibility decisions are taken by individual ministers; under collective responsibility the policies implemented by a minister are government policy. A requirement for collective ministerial responsibility is that information relevant to the decision is shared by Cabinet. Our result shows that if the Parliamentary majority can assign authority optimally (politicians coordinate on the most efficient equilibria), then imposing a cabinet structure to the executive– a public meeting at a designated time and place where ministers provide the information relevant to their decisions– induces a welfare improvement over other forms of executive governance: in particular Cabinet government Pareto dominates what we term ministerial government; a system of government where individual ministers implement policy but are not bound by collective responsibility.

Having established that public cabinet meetings Pareto dominates private conversations in ministerial government, we now turn to explore the characteristics of optimal decision-making authority assignments in cabinet governments. We run simulations for a 9 member government in which players biases are independent and identically distributed according to $b_i = \alpha e^{X} + (1 - \alpha)X$ where
Table 1. The average number of decisions made by a leader

<table>
<thead>
<tr>
<th></th>
<th>σ = 1</th>
<th>σ = 1/2</th>
<th>σ = 1/4</th>
<th>σ = 1/8</th>
<th>σ = 1/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>α</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>8.3667</td>
<td>8.3667</td>
<td>7.2667</td>
<td>7.1333</td>
<td>6.9333</td>
</tr>
<tr>
<td>1/4</td>
<td>8.5333</td>
<td>7.7667</td>
<td>7.2667</td>
<td>6.9667</td>
<td>7.9333</td>
</tr>
<tr>
<td>1/2</td>
<td>8.4000</td>
<td>6.8000</td>
<td>6.7333</td>
<td>6.8333</td>
<td>7.8667</td>
</tr>
<tr>
<td>3/4</td>
<td>8.4000</td>
<td>6.1333</td>
<td>6.0667</td>
<td>6.3667</td>
<td>8.2</td>
</tr>
<tr>
<td>1</td>
<td>8.4333</td>
<td>6.7667</td>
<td>4.6333</td>
<td>6.3333</td>
<td>7.8333</td>
</tr>
</tbody>
</table>

X is normally distributed with mean zero, and standard deviation σ. The parameter α controls the asymmetry of the sampled distributions of ideology draws, whereas σ determines the concentration of such sampled distributions draws.

We calculate different statistics: Specifically, the leader’s average number of decision, the frequency of the draws for which a single leader makes all decisions, the frequency of the draws where the leader is the most moderate politician, and, finally, the frequency of the draws where the leader is the politician with the highest concentration of ideologically close politicians.

Table 1 reports the leader’s average number of assigned decisions. The first numerical result is that the leader’s average number of decisions is usually large; ranging from half to 96 % of decisions. Hence the tendency towards authority centralization found in the previous section extends also when considering public cabinet meetings. This numerical result corroborates our normative foundations of centralized authority.

This centralized authority finding naturally begs the question of how significantly different are assignments between cabinet and ministerial government. Recalling that with private conversations, a single leader always makes all decisions, Table 2 reports the frequency of the draws for which a single leader makes all decisions with public meetings. Allocating all actions to the leader is often suboptimal. We find that the maximal frequency with which a single leader is chosen to implement all policy decisions is just above 80% of the time. An implication is that at least 20% of the time Cabinet government is Pareto superior to ministerial governance. Further, for some parameters specifications, it is never the case that allocating all actions to the leader is optimal, and hence cabinet government is always superior to ministerial government.

We now turn to establish whether the result derived for private communication, that leadership selection is based on global relative ideology (moderation), and local ideological concentration
Table 2. Number of draws for which a single leader makes all decisions

<table>
<thead>
<tr>
<th></th>
<th>( \sigma = 1 )</th>
<th>( \sigma = 1/2 )</th>
<th>( \sigma = 1/4 )</th>
<th>( \sigma = 1/8 )</th>
<th>( \sigma = 1/16 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha = 0 )</td>
<td>0.8000</td>
<td>0.6333</td>
<td>0.4333</td>
<td>0.4000</td>
<td>0.3333</td>
</tr>
<tr>
<td>( \alpha = 1/4 )</td>
<td>0.8333</td>
<td>0.5333</td>
<td>0.5000</td>
<td>0.2333</td>
<td>0.4333</td>
</tr>
<tr>
<td>( \alpha = 1/2 )</td>
<td>0.8333</td>
<td>0.3667</td>
<td>0.2333</td>
<td>0.1000</td>
<td>0.2667</td>
</tr>
<tr>
<td>( \alpha = 3/4 )</td>
<td>0.8000</td>
<td>0.2667</td>
<td>0.1667</td>
<td>0</td>
<td>0.5667</td>
</tr>
<tr>
<td>( \alpha = 1 )</td>
<td>0.8333</td>
<td>0.3667</td>
<td>0</td>
<td>0.1000</td>
<td>0.4333</td>
</tr>
</tbody>
</table>

Table 3. Frequency of the draws where the leader is the most moderate politician

<table>
<thead>
<tr>
<th></th>
<th>( \sigma = 1 )</th>
<th>( \sigma = 1/2 )</th>
<th>( \sigma = 1/4 )</th>
<th>( \sigma = 1/8 )</th>
<th>( \sigma = 1/16 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha = 0 )</td>
<td>0.6333</td>
<td>0.8333</td>
<td>0.7667</td>
<td>0.6667</td>
<td>0.5667</td>
</tr>
<tr>
<td>( \alpha = 1/4 )</td>
<td>0.6333</td>
<td>0.9667</td>
<td>0.7333</td>
<td>0.5333</td>
<td>0.7</td>
</tr>
<tr>
<td>( \alpha = 1/2 )</td>
<td>0.3667</td>
<td>0.6667</td>
<td>0.8333</td>
<td>0.7333</td>
<td>0.6333</td>
</tr>
<tr>
<td>( \alpha = 3/4 )</td>
<td>0.4333</td>
<td>0.7667</td>
<td>0.7667</td>
<td>0.7667</td>
<td>0.7667</td>
</tr>
<tr>
<td>( \alpha = 1 )</td>
<td>0.3000</td>
<td>0.7000</td>
<td>0.5000</td>
<td>0.6000</td>
<td>0.5667</td>
</tr>
</tbody>
</table>

(information aggregation), extends to a world with public communication. Table 3 reports our findings on the frequency of the draws where the leader is the most moderate politician. Whereas, finally, Table 4 reports the frequency of the draws where the leader is the politician with the highest concentration of ideologically close politicians. For these results each politician \( i \)’s ideological concentration is defined as \(-\sum_{j \in I} \left| b_j - b_i \right|\).

Our numerical results corroborate the finding that, as with private conversations, leadership selection depends on global relative ideology (moderation), and local ideological concentration (information aggregation). Both the frequency of draws in which the leader is the most moderate politician, and the frequency of draws in which the leader is the politician with the highest concentration of ideologically close politicians, are higher than if it were the case that the leader were selected at random with equal probabilities.

This finding concludes our study of the common state model. The next section turns to consider the opposite case of policy specific information. In particular we check whether our central finding that the optimal structure of the Executive is characterized by strong concentration of powers to the leader, is robust to politicians having specific policy expertise.
Table 4. Frequency of the draws where the leader is the most well connected politician

<table>
<thead>
<tr>
<th></th>
<th>(\sigma = 1)</th>
<th>(\sigma = 1/2)</th>
<th>(\sigma = 1/4)</th>
<th>(\sigma = 1/8)</th>
<th>(\sigma = 1/16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha = 0)</td>
<td>0.3000</td>
<td>0.5333</td>
<td>0.5333</td>
<td>0.6000</td>
<td>0.4333</td>
</tr>
<tr>
<td>(\alpha = 1/4)</td>
<td>0.4333</td>
<td>0.6000</td>
<td>0.4333</td>
<td>0.5333</td>
<td>0.5667</td>
</tr>
<tr>
<td>(\alpha = 1/2)</td>
<td>0.2667</td>
<td>0.4667</td>
<td>0.5667</td>
<td>0.5333</td>
<td>0.5667</td>
</tr>
<tr>
<td>(\alpha = 3/4)</td>
<td>0.1333</td>
<td>0.4000</td>
<td>0.5000</td>
<td>0.4333</td>
<td></td>
</tr>
<tr>
<td>(\alpha = 1)</td>
<td>0.1667</td>
<td>0.4000</td>
<td>0.5667</td>
<td>0.4667</td>
<td>0.3333</td>
</tr>
</tbody>
</table>

7. Policy Specific Information

This section studies optimal assignment of decision making in a scenario where, unlike in the previous sections, each politician’s information is policy specific. In this world, policies no longer depend on a common state. Instead each policy has its own fundamentals that are relevant to the policy outcome. We assume that there for each of the \(k\) policies there is, prior to any transmission of information, one expert politician \(k\) who receives a signal \(\theta_k\). The interesting feature of this analysis is that we begin with a situation where expertise is widely dispersed in the Parliament. We begin as before by characterizing the equilibrium communication network that describes the alignments that form. The analysis is much simpler than in the common-state model.

Lemma 5. Suppose that information is policy specific. Under both private and public communication, the profile \((m, y)\) is an equilibrium if and only if, whenever politician \(k\) is truthful to \(a(k) \neq k\),

\[|b_k - b_{a(k)}| \leq 1/6.\]

The simplicity of the analysis is due to the fact there is only one signal that any politician may hold, and that signal is informative of only one policy decision. Hence, the amount of information held by politician \(a(k) \neq k\) depends only on whether \(k\) is truthful or not, and thus whether \(k\) is truthful or not does not depend on the communication strategy of any other politician. Further, because each politician is informed on one policy only, and this policy may be assigned to a single policy maker, private and public communication trivially coincide.

The remarkably simple characterization of information transmission bears a number of implications. The possibility that a politician \(k\) truthfully communicates her signal to the minister \(a(k)\) to whom \(k\) is assigned is independent of any other assignment \(a(i)\) for \(i \neq k\). Hence, for all choices \(k\), the
optimal assignment \( a(k) \) can be selected independently of all other assignments \( a(i) \). The optimal assignment is then the politician \( j \) who maximizes:

\[
- \sum_{i=1}^{I} \left( \frac{(b_j - b_i)^2}{I} \right) - \frac{1}{6(d_{j,k}(m) + 2)},
\]

where \( d_{j,k}(m) = 1 \) if \(|b_k - b_j| \leq 1/6\) and \( d_{j,k}(m) = 0 \), otherwise.

Simplifying the above expression, and using Lemma 5, we immediately see that our description of the two fundamental forces (information and moderation) determining the optimal selection of \( a(k) \) takes a very simple form when information is policy specific. The policy decision \( k \) should be assigned to either the most moderate politician \( m^* = \arg \min_m \left| b_m - \sum_{i=1}^{I} b_i / I \right| \), or to the most moderate politician \( m(k) \) informed of \( k \), i.e. to \( m(k) = \arg \min_{m: |b_m - b_k| \leq 1/6} \left| b_m - \sum_{i=1}^{I} b_i / I \right| \), depending on whether

\[
\sum_{i=1}^{I} \left( \frac{b_i - b_{m(k)}}{I} \right)^2 - \sum_{i=1}^{I} \left( \frac{b_i - b_{m^*}}{I} \right)^2 < (>) \frac{1}{36}.
\]

Because for any \( j \), the quantity \( \sum_{i=1}^{I} (b_i - b_j)^2 / I \) is the average ideological loss, whereas the information gain is 1/36, we may summarize our analysis as follows.

**Proposition 4.** When information is policy specific, each decision \( k \) is optimally assigned to either the most moderate informed politician \( m(k) \) or to the most moderate one \( m^* \), depending on whether the difference in average ideological loss is smaller or greater than the informational gain.

This complete characterization allows us to derive an important substantive result. Whilst policy specific information might lead one to believe that a fully decentralized cabinet may be optimal, we now show that this is never the case.

**Proposition 5.** Despite policy specific information, full decentralization is never optimal for generic ideologies \( b \).

A full proof of this proposition is provided in the appendix, here we convey the main mathematical intuition behind the result. First, note that when there are politicians \( i, j \) such that \(|b_i - b_j| < 1/6\), then \( i \) truthfully communicates to \( j \) and vice-versa. Hence for generic ideologies \( b \), either \( i \) or \( j \) is closest to the average ideology \( \sum_{i=1}^{I} b_i / I \), and hence either \( i \) improves welfare by making \( j \)'s decision, or vice-versa. So, suppose that \( b_i - b_{i-1} \geq 1/6 \), for all \( i \), and no communication takes
place. Because of risk aversion, spreading biases makes extremism less favorable to the pool of politicians. Hence, we conclude by taking $b_i - b_{i-1} = 1/6$ for all $i$, and by showing that assigning choice 1 to politician 1 yields lower welfare than assigning it to a moderate politician.

We extend this section by refining the implications of the characterization in Proposition 4 in a simplified set up that reveals an interesting non-monotonicity in the assignment of policy decisions according to politicians’ moderation. Suppose that there exists a politician $m^*$ whose bias coincides with the average bias $\sum_{i=1}^{I} b_i / I$, as it would be usually the case when the number of politicians $I$ is large. Then, Proposition 4 takes the following simple form: Each decision $k$ is optimally assigned to either the most moderate informed politician $m(k)$, if $(b_{m(k)} - b_{m^*})^2 < (>) 1/36$, or to politician $m^*$. Hence, we obtain a simple and interesting characterization of the optimal assignment of decisions. Any decision $k$ associated to a moderate-bias politician, i.e. $|b_k - b_{m^*}| \leq 1/6$, and any decision $k$ associated to an extreme-bias politician, i.e. $|b_k - b_{m^*}| > 1/3$, should be assigned to politician $m^*$. But all decisions $k$ associated to an intermediate-bias politician, i.e. $1/6 < |b_j - b_{m^*}| \leq 1/3$, should be assigned to the most moderate informed politician $m(k)$, who is different from $m^*$.

The above analysis shows a set up where all policies are assigned to the most moderate politician, unless the associated policy expert has intermediate bias. When the proportion of intermediate bias politicians is small, we therefore conclude that a large fraction of decisions is assigned to the most moderate politician. As a result, despite policy specific information, we obtain an decision-making authority assignment which is highly concentrated on a single leader. To verify this supposition, we return to our simulations, 9 member government in which players biases are independent and identically distributed according to $b_i = \alpha e^X + (1 - \alpha) X$ where $X$ is normally distributed with mean zero, and standard deviation $\sigma$.

Table 5 reports the leader’s average number of assigned decisions, when information is policy specific, and it shows that it is not smaller (in fact, usually, larger) than in the common-state case, for given parameter values, $\alpha$ and $\sigma$.

These results then conclude the analysis for the case in which each politician’s information is specific to a single policy decision. Whilst we have uncovered a rich equilibrium behavior that allows for both single leadership and power sharing agreements in the form of a cabinet, surprisingly, we have found that the optimal decision-making authority assignment is no more decentralized.
Table 5. Average number of decisions assigned to the leader with policy-specific information

<table>
<thead>
<tr>
<th>$\sigma$</th>
<th>$\alpha = 0$</th>
<th>$\alpha = 1/4$</th>
<th>$\alpha = 1/2$</th>
<th>$\alpha = 3/4$</th>
<th>$\alpha = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma = 1$</td>
<td>8.6300</td>
<td>8.6600</td>
<td>8.6400</td>
<td>8.8400</td>
<td>8.7700</td>
</tr>
<tr>
<td>$\sigma = 1/2$</td>
<td>8.0200</td>
<td>7.8800</td>
<td>7.9000</td>
<td>8.1000</td>
<td>7.9700</td>
</tr>
<tr>
<td>$\sigma = 1/4$</td>
<td>7.2600</td>
<td>7.0900</td>
<td>7.0800</td>
<td>6.9400</td>
<td>7.0100</td>
</tr>
<tr>
<td>$\sigma = 1/8$</td>
<td>7.7200</td>
<td>7.9300</td>
<td>7.7100</td>
<td>7.6900</td>
<td>7.7500</td>
</tr>
<tr>
<td>$\sigma = 1/16$</td>
<td>8.89</td>
<td>8.95</td>
<td>8.99</td>
<td>8.97</td>
<td>8.96</td>
</tr>
</tbody>
</table>

than in the common-state case. Recall that, according to Cox (1987), centralization of authority in Victorian England can be explained as due to the asymmetric distribution of expertise in the Parliament. Our information aggregation perspective reveals that the optimal assignment of decision-making authority involves centralization, sometimes to a Cabinet, other times to a unique individual minister, even when expertise is widely dispersed in the Parliament.

8. Concluding Discussion

Democratic legitimacy rests upon the consent given to those who exercise decision-making authority. A key empirical regularity is the centralization of such authority; in parliamentary government, in particular, such centralization takes the form of cabinet government often dominated by a Prime Minister. We have analyzed a novel model of collective assignment of decision-making authority within a Parliamentary majority. Politicians are privately informed about policies, and are ideologically differentiated. Before policies are decided, but after the allocation of decision-making authority, politicians may strategically communicate their information. We allow communication to take the form of private conversations or public meetings. In focusing on the assignment of decision-making we characterize key elements of the optimal executive structure and capture the important twin roles of the parliamentary body: the advise it gives to the governing executive and the consent it provides to the exercise of executive authority. Furthermore in contrasting communication protocols, in particular the private advise given to ministers and the public forum of cabinet governance, we can distinguish between ministerial and cabinet government.

When politicians’ private information is relevant for all policy choices (the ‘common-state’ model) and communication takes place through private meetings, we find that it is optimal to assign all decision-making authority to a unique individual. Because this result may revert when allowing for
public meetings, we derive the powerful conclusion that communication through public meetings Pareto dominates private conversations. This stark result provides novel normative foundations for the emergence of cabinet government. Returning to the question of centralized authority, we then established with numerical simulations that fully centralized authority is frequently optimal also when meetings are public. And even when power sharing is optimal, the leader should be assigned a large share of decisions – at least 80% of decisions in our simulations. Within the context of the ‘common-state’ model, we have found a strong force leading towards concentration of decision making power in the Executive. Turning to the characteristic features of optimal leaders, we uncover two fundamental forces: the need for moderation, and the ability to effectively aggregate information. We then establish that the latter increases as the concentration of ideologically close party allies rises. We conclude by establishing whether our results hinge upon the assumption that all politicians’ information is relevant to all policies. We consider the opposite polar case, where each politician is informed only about one particular policy. Surprisingly, we find that the optimal Executive structure is no more decentralized than in the common-state case. This is because all policy decisions are assigned to the most moderate politician, unless the policy expert has ‘intermediate’ ideology.

Our information setting provides a new framework toward understanding the existence of assemblies in which diverse preferences and strong factional alliances sit alongside centralized executive authority. Indeed, our paper provides an alternative normative framework for understanding important historical episodes such as the establishment of an all-powerful executive that fused legislative and executive powers in Victorian England. An important, and till now, unanswered part of that historical puzzle is why the need for centralization, as highlighted by Bagehot (1867), and later by Cox (1987) gave rise to Cabinet government. Our paper provides normative foundations for the emergence of such centralized control. Further analysis will consider the positive aspects of the assignment of decision-making authority.

9. Appendix

Equilibrium beliefs. The politicians’ equilibrium updating is based on the standard Beta-binomial model. Suppose that a politician $i$ holds $n$ bits of information, i.e. she holds the private signal $s_i$ and $n - 1$ politicians truthfully reveal their signal to her. The probability that $l$ out of
such $n$ signals equal one, conditional on $\theta$ is

$$f (l|\theta, n) = \frac{n!}{l! (n-l)!} \theta^l (1-\theta)^{(n-l)}.$$ 

Hence, politician $i$’s posterior is

$$f (\theta|l, n) = \frac{(n+1)!}{l! (n-l)!} \theta^l (1-\theta)^{(n-l)},$$

the expected value is

$$E (\theta|l, n) = \frac{l+1}{n+2},$$

and the variance is

$$V(\theta|l, n) = \frac{(l+1)(n-l+1)}{(n+2)^2 (n+3)}.$$

**Proof of Lemma 1.** Assume $(m, y)$ is an equilibrium. The ex-ante expected utility of each player $i$ is:

$$Eu_i(m, y) = -E \left[ \sum_{k=1}^{K} (y_k - \theta - b_i)^2; (m, y) \right]$$

$$= - \sum_{k=1}^{K} E \left[ (y^{a(k)} - \theta - b_i)^2; (m, y) \right]$$

$$= - \sum_{k=1}^{K} E \left[ (b_{a(k)} + E[\theta|\Omega_{a(k)}] - \theta - b_i)^2; m \right]$$

where $\Omega_{a(k)}$ denotes the equilibrium information of player $a(k)$. Hence

$$Eu_i(m, y) = - \sum_{k=1}^{K} E \left[ (b_{a(k)} - b_i)^2 + (E[\theta|\Omega_{a(k)}] - \theta)^2 - 2(b_{a(k)} - b_i) (E[\theta|\Omega_{a(k)}] - \theta); m \right]$$

$$= - \sum_{k=1}^{K} \left[ (b_{a(k)} - b_i)^2 + E \left[ (E[\theta|\Omega_{a(k)}] - \theta)^2; m \right] \right. \right.$$

$$-2(b_{a(k)} - b_i) \left[ E[E[\theta|\Omega_{a(k)}]; m] - E[\theta; m] \right],$$

by the law of iterated expectations, $E[E[\theta|\Omega_{a(k)}]; m] = E[\theta; m]$, and by definition $E \left[ (E[\theta|\Omega_{a(k)}] - \theta)^2; m \right] = \sigma_k^2(m)$. 32
Further, note that the equilibrium information \( \Omega_{a(k)} \) of player \( a(k) \) may be represented as any vector in \( \{0, 1\}^{d_j(c)+1} \). Letting \( l \) be the number of digits equal to one in any such vector, we obtain

\[
E \left[ (E [\theta | \Omega_{a(k)}] - \theta)^2 ; m \right] = \int_0^1 \sum_{l=0}^{d_a(k)(c)+1} \left( E [\theta | l, d_a(k)(c) + 1] - \theta \right)^2 f(l|d_a(k)(c) + 1, \theta) d\theta
\]

where the second equality follows from

\[
f(l|d_a(k)(c) + 1, \theta) = f(\theta|l, d_a(k)(c) + 1) / (d_a(k)(c) + 1 + 1).
\]

Because the variance of a beta distribution of parameters \( l \) and \( d + 1 \), is

\[
V(\theta|l, d + 1) = \frac{(l + 1)(d + 1 - l + 1)}{(d + 1 + 2)^2 (d + 1 + 3)},
\]

we obtain:

\[
E \left[ (E [\theta | \Omega_{a(k)}] - \theta)^2 ; m \right] = \frac{1}{d_a(k)(c) + 2} \left[ \sum_{l=0}^{d_a(k)(c)+1} V(\theta|l, d_a(k)(c) + 1) \right]
\]

\[
= \sum_{l=0}^{d_a(k)(c)+1} \frac{(l + 1)(d_a(k)(c) - l + 2)}{(d_a(k)(c) + 2)(d_a(k)(c) + 3)^2 (d_a(k)(c) + 4)}
\]

\[
= \frac{1}{6(d_a(k)(c) + 3)}.
\]

This completes the proof of Lemma 1. \(\blacksquare\)

**Proof of Proposition 2.** Fix any assignment \( a \). Any Pareto optimal equilibrium \((m, y)\) maximizes the welfare

\[
W(m, y; \gamma) = -\sum_{i \in I} \sum_{k \in K} \gamma_i \sum_{j} E[(y_k - \theta_k - b_i)^2 | s_i, m_{N_i,i}],
\]

for some Pareto weights \( \gamma \). An obvious extension of Lemma 1 implies that

\[
W(m, y; \gamma) = -\sum_{k \in K} \sum_{i \in I} \gamma_i (b_i - a(k))^2 - \sum_{k \in K} \frac{1}{6[d_a(k), k(m) + 2]}.
\]

This decomposition, together with Lemma 2 imply that, as long as \( j \) is active under \( a \), the equilibrium information \( d_j^a(a) \) associated to any Pareto optimal equilibrium \((m, y)\) is independent of the set of policy choices \( a^{-1}(i) \) assigned to any player \( i \), including \( j \). Hence, choosing the Pareto-optimal
Assignment is equivalent to finding the index \( j \) that maximizes

\[
- \sum_{i=1}^{I} \gamma_i (b_j - b_i)^2 - \frac{1}{6(d_j(m) + 2)}
\]

and to assigning all policy choices \( k \) to such optimal \( j \). For generic vectors of biases \( b \), the expression (6) has a unique maximizer.

**Proof of Lemma 3.** Because \( n_j(b) \) is step function, increasing in \( b \), and \( 1/[2(d + 2)] \) strictly decreases in \( b \), whereas the identity is strictly increasing in \( d \), there is a unique solution to equation (3). From Lemma 1, we see that maximization of \( W(m, y) \) is equivalent to maximization of the equilibrium in-degree \( d_j(m) \) of each active player \( j \in a(K) \). The characterization in Lemma 2 shows that the maximal in-degree of each active player \( j \in a(K) \) can be calculated independently of the other active players’ in-degrees, according to equation (3).

**Proofs of Lemmata 2 and 4.** We first prove Lemma 4 and then derive Lemma 2 as a corollary.

Consider any \( j \in a(K) \), and suppose let \( C_j(c) \) be the set of players truthfully communicating with \( j \) in equilibrium, i.e. the equilibrium network neighbors of \( j \). The equilibrium in-degree of \( j \) is thus \( d_j = |C_j(c)| + 1 \), the cardinality of \( C_j(c) \) plus \( j \)'s signal. Consider any player \( i \in C_j(c) \). Let \( s_R \) be the vector containing \( s_j \) and the (truthful) messages of all players in \( C_j(c) \) except \( i \). Let also \( y_{s_R,s}^j \) be the action that \( j \) would take if he has information \( s_R \) and player \( i \) has sent signal \( s \); analogously, \( y_{s_R,1-s}^j \) is the action that \( j \) would take if he has information \( s_R \) and player \( i \) has sent signal \( 1 - s \).

Agent \( i \) reports truthfully signal \( s \) to a collection of agents \( J \) if and only if

\[
- \sum_{j \in J} \sum_{k : a(k) = j} \int_0^1 \sum_{s_R \in \{0, 1\}^{d_j}} \left[ (y_{s_R,s}^j - \theta - b_i)^2 - (y_{s_R,1-s}^j - \theta - b_i)^2 \right] f(\theta, s_R|s)d\theta \geq 0.
\]

Using the identity \( a^2 - b^2 = (a - b)(a + b) \) and simplifying, we obtain:

\[
- \sum_{j \in J} \int_0^1 a_j \sum_{s_R \in \{0, 1\}^{d_j}} \left[ (y_{s_R,s}^j - y_{s_R,1-s}^j) \left( \frac{y_{s_R,s}^j + y_{s_R,1-s}^j}{2} - (\theta + b_i) \right) \right] f(\theta, s_R|s)d\theta \geq 0.
\]

Next, observing that

\[
y_{s_R,s}^j = b_j + E[\theta|s_R, s],
\]

\[
y_{s_R,1-s}^j = b_j - E[\theta|s_R, 1-s],
\]

we can write:

\[
- \sum_{j \in J} \int_0^1 a_j \sum_{s_R \in \{0, 1\}^{d_j}} \left[ (y_{s_R,s}^j - y_{s_R,1-s}^j) \left( \frac{y_{s_R,s}^j + y_{s_R,1-s}^j}{2} - (\theta + b_i) \right) \right] f(\theta, s_R|s)d\theta \geq 0.
\]
we obtain

\[- \sum_{j \in J} \int_0^1 a_j \sum_{s_R \in \{0, 1\}^{d_j}} \left[ (E[\theta + b_j|s_R, s] - E[\theta + b_j|s_R, 1 - s]) \right.

\left. \cdot \left( \frac{E[\theta + b_j|s_R, s] + E[\theta + b_j|s_R, 1 - s]}{2} - (\theta + b_i) \right) \right] f(\theta, s_R|s)d\theta \geq 0.\]

Denote

\[\Delta (s_R, s) = E[\theta|s_R, s] - E[\theta|s_R, 1 - s].\]

Observing that:

\[f(\theta, s_R|s) = f(\theta|s_R, s)P(s_R|s),\]

and simplifying, we get:

\[- \sum_{j \in J} a_j \sum_{s_R \in \{0, 1\}^{d_j}} \int_0^1 \left[ \Delta (s_R, s) \left( \frac{E[\theta|s_R, s] + E[\theta|s_R, 1 - s]}{2} + b_j - b_i - \theta \right) \right.

\left. \cdot f(\theta|s_R, s)P(s_R|s)d\theta \geq 0.\]

Furthermore,

\[\int_0^1 \theta f(\theta|s_R, s)d\theta = E[\theta|s_R, s],\]

and

\[\int_0^1 P(\theta|s_R, s)E[\theta|s_R, s]d\theta = E[\theta|s_R, s],\]

because \(E[\theta|s_R, s]\) does not depend on \(\theta\). Therefore, we obtain:

\[- \sum_{j \in J} a_j \sum_{s_R \in \{0, 1\}^{d_j}} \left[ \Delta (s_R, s) \left( \frac{E[\theta|s_R, s] + E[\theta|s_R, 1 - s]}{2} + b_j - b_i - E[\theta|s_R, s] \right) \right.

\left. \cdot P(s_R|s) \right] \geq 0.\]
Now, note that:

\[
\Delta(s_R, s) = E[\theta|s_R, s] - E[\theta|s_R, 1 - s]
\]

\[
= E[\theta|l + s, d_j + 1] - E[\theta|l + 1 - s, d_j + 1]
\]

\[
= (l + 1 + s) / (d_j + 3) - (l + 2 - s) / (d_j + 3)
\]

\[
= \begin{cases} 
-1 / (d_j + 3) & \text{if } s = 0 \\
1 / (d_j + 3) & \text{if } s = 1.
\end{cases}
\]

where \(l\) is the number of digits equal to one in \(s_R\). Hence, we obtain that agent \(i\) is willing to communicate to agent \(j\) the signal \(s = 0\) if and only if:

\[-\sum_{j \in J} a_j \left( \frac{-1}{d_j + 3} \right) \left( -\frac{-1}{2(d_j + 3)} + b_j - b_i \right) \geq 0,
\]

or

\[
\sum_{j \in J} a_j \frac{b_j - b_i}{d_j + 3} \geq -\sum_{j \in J} a_j \frac{1}{2(d_j + 3)^2}
\]

Note that this condition is redundant if \(\sum_{j \in J} a_j (b_j - b_i) > 0\). On the other hand, she is willing to communicate to agent \(j\) the signal \(s = 1\) if and only if:

\[-\sum_{j \in J} a_j \left( \frac{1}{d_j + 3} \right) \left( -\frac{1}{2(d_j + 3)} + b_j - b_i \right) \geq 0,
\]

or

\[
\sum_{j \in J} a_j \frac{b_j - b_i}{d_j + 3} \leq \sum_{j \in J} a_j \frac{1}{2(d_j + 3)^2}.
\]

Note that this condition is redundant if \(\sum_{j \in J} a_j (b_j - b_i) < 0\). Collecting the two conditions yields:

\[
(7) \quad \left| \sum_{j \in J} a_j \frac{b_j - b_i}{d_j + 3} \right| \leq \sum_{j \in J} a_j \frac{1}{2(d_j + 3)^2}.
\]

Rearranging condition 7 yields condition ?? and completes the proof of Lemma 4.

Proving Lemma 2, then, only entails noticing that, when \(J = \{j\}\), condition 7 simplifies to yield condition 2.

\[\blacksquare\]

Proof of Result 1. Consider a cabinet of 4 politicians, with biases \(b_1 = -\beta, b_2 = \varepsilon, b_3 = \beta,\) and \(b_4 = 2\beta\). We suppose that \(\varepsilon > 0\) is small, so that politician 2 is the most moderate. We compare four
assignments, full decentralization, leadership by politician 2, a symmetric power-sharing agreement
where politicians 2 and 3 make two decisions each, and an asymmetric power-sharing agreement
where politician 2 makes 3 choices, and 3 makes one choice.

Consider leadership by politician 2, first. Using Lemma 2, we obtain that $d_2 = 4$ if $2\beta - \varepsilon \leq 1/12$, i.e., $\beta \leq \varepsilon/2 + 1/24$, whereas $d_2 = 3$ if $\beta + \varepsilon \leq 1/10$, i.e. $\beta \leq 1/10 - \varepsilon$, as well as $d_2 = 2$ if
$\beta - \varepsilon \leq 1/8$, i.e., $\beta \leq 1/8 + \varepsilon$, and $d_2 = 1$ if $\beta > 1/8 + \varepsilon$.

Consider the symmetric power sharing rule. First note that, if 1 is willing to talk, then so are all
other players. Hence, for $2(\beta + \varepsilon) + 2 \cdot 2\beta \leq \frac{4}{2(3+3)}$, i.e., $\beta \leq 1/18 - \varepsilon/3$, then both $d_2 = 4$ and
$d_3 = 4$. Further, for $2(2\beta - \varepsilon) + 2\beta \leq \frac{4}{2(2+3)}$, i.e., $\beta \leq 1/15 + \varepsilon/3$, then 1 does not talk, but 4 does,
and so, $d_2 = 3$ and $d_3 = 3$. Finally, for $\beta - \varepsilon \leq 1/8$, i.e., $\beta \leq 1/8 + \varepsilon$, then both 2 and 3 talk to
each other: $d_2 = 2$ and $d_3 = 2$. Of course, $d_2 = 1$ and $d_3 = 1$, if $\beta > 1/8 + \varepsilon$.

Hence, the symmetric power sharing rule dominates the single leader 2 on $(\varepsilon/2 + 1/24, 1/18 - \varepsilon/3]$ in
terms of information transmission. It will dominate on a subset, because of the moderation effect,
but as $\varepsilon \to 0$, the subset converges to $(1/24, 1/18)$.

Consider now the asymmetric power sharing rule. In this case the condition for 1 to talk (if 4
is talking) becomes: $rac{3}{4} (\beta + \varepsilon) + \frac{1}{4} 2\beta \leq \frac{1}{2(3+3)}$, i.e., $\beta \leq 1/15 - 3\varepsilon/5$. The condition for 4 to
talk if 1 is talking becomes, $\frac{3}{4} (2\beta - \varepsilon) + \frac{1}{4} \beta \leq \frac{1}{2(3+3)}$, i.e., $\beta \leq 1/21 + 3\varepsilon/7$. Hence, for $\beta \leq 1/21 + 3\varepsilon/7$, then both $d_2 = 4$ and $d_3 = 4$. Instead, the condition for 1 to talk if 4 does not talk is
$\frac{3}{4} (\beta + \varepsilon) + \frac{1}{4} 2\beta \leq \frac{1}{2(2+3)}$, i.e., $\beta \leq 2/25 - 3\varepsilon/5$. And the condition for 4 to talk if 1 does not talk
is $\frac{3}{4} (2\beta - \varepsilon) + \frac{1}{4} \beta \leq \frac{1}{2(2+3)}$, i.e. $\beta \leq \frac{3}{8} \varepsilon + \frac{2}{35}$. Hence, for $\beta \leq 2/25 - 3\varepsilon/5$, then both $d_2 = 3$ and
$d_3 = 3$. The condition for 2 and 3 to each other other talk is $\beta \leq 1/8 + \varepsilon$; in this case $d_2 = 2$ and $d_3 = 2$. Again, $d_2 = 1$ and $d_3 = 1$, if $\beta > 1/8 + \varepsilon$.

Hence, the asymmetric power sharing agreement dominates the single leader 2 informationally on
$(\varepsilon/2 + 1/24, 1/21 - 3\varepsilon/7]$. Due to the moderation effect, it also dominates the symmetric power
sharing agreement. For $\varepsilon \to 0$, asymmetric power sharing agreement dominates on $(1/24, 1/21)$.

Finally, consider full decentralization. The player who is least likely to speak publicly is 1. Given
that all other players speak, he speaks if and only if $(\beta + \varepsilon) + 2\beta + 3\beta \leq \frac{3}{2(3+3)}$ or $\beta \leq \frac{1}{21} - \varepsilon/6$.
In this case, all players receive 3 signals, $\frac{1}{21} = 0.04166 7$. Then, if 1 does not speak, the least likely
to speak is 4. This occurs if and only if $\frac{3\beta}{3+3} + \frac{2\beta - \varepsilon + \beta}{2+3} \leq \frac{1}{2(3+3)^2} + \frac{2}{2(2+3)^2}$, i.e. if $\beta \leq \frac{2}{11}\varepsilon + \frac{97}{1980}$
for $\varepsilon \to 0$, this is close to $\frac{97}{1980} \approx 0.04899$. When 1 does not speak publicly, whereas 4 does, the
$d$-distribution is: 3, 2, 2, 2; which is informationally better than the private communication to 2. But, of course, it is worse in terms of moderation... Further, decentralization is dominated by the symmetric power sharing agreement, for the range $\beta \leq 1/18 - \varepsilon/3$, as $1/18 \approx 0.055556$; because in this range $d_2 = 3$ and $d_3 = 3$ for the asymmetric power sharing agreement. Then, if 1 and 4 do not speak, the least likely to speak is 3 —because 2 is more central. This occurs if and only if 

\[ \frac{2\beta}{2+\varepsilon} + \frac{\beta}{2+\varepsilon} \leq \frac{1}{2(1+3)^2} + \frac{2}{2(2+3)^2} \], i.e., $\beta \leq \frac{5\varepsilon}{17} + \frac{57}{680} \approx 0.083824$, with the distribution 2, 1, 1, 2. This is dominated by the asymmetric power sharing agreement, because for $\beta \leq 1/10 - 3\varepsilon/5$, i.e., essentially, $\beta \leq 1/10$, we have $d_2 = 2$ and $d_3 = 2$. Finally, 2’s condition to speak if nobody else speaks under decentralization is: $2\beta - \varepsilon + \beta - \varepsilon + \beta + \varepsilon \leq \frac{3}{2(1+3)}$, i.e. $\beta \leq \frac{1}{4}\varepsilon + \frac{3}{32} \approx 0.09375$. Because this yields the distribution 1, 0, 1, 1, we obtain that it is dominated by the asymmetric power sharing agreement.

**Proof of Proposition 4.** From Proposition 2, we know that all Pareto optimal assignments $a$ under private communication of common value information entails a single leader, i.e., there is $j$ such that $a(k) = j$ for all $k$. Suppose now that communication is public, and suppose that an assignment $a$ with a unique leader $j$ is selected. Then, because $\gamma_j(m) = 1$ and $\gamma_j'(m) = 0$ for all $j' \neq j$, condition (4) in Lemma 4 reduces to condition (??) in Lemma 2. Hence, the set of equilibria under private and public communication coincide under $a$. But because the optimal assignment under public communication $a^*$ need not entail a single leader, the statement of the result immediately follows.

**Proof of Proposition 5.** First note that if there is $i > 1$ such that $b_i - b_{i-1} \leq 1/6$, then $i$ is informed of $i-1$’s message or viceversa. For generic allocations of $b$, it cannot be the case that $\sum_{j=1}^{I} \gamma_j b_j - b_i = \sum_{j=1}^{I} \gamma_j b_j - b_{i-1}$. Supposing without loss of generality that $\sum_{j=1}^{I} \gamma_j b_j - b_i < \sum_{j=1}^{I} \gamma_j b_j - b_{i-1}$, it is therefore welfare superior to assign $a(i-1) = i$ rather than $a(i-1) = i-1$.

So suppose that $b_i - b_{i-1} > 1/6$ for all $i$, so that for all $j \neq i$, $d_{i,j}(m) = 0$ in any equilibrium $(m, y)$. Hence, assigning $a(1) = \lceil (I + 1)/2 \rceil \equiv m^*$ yields higher welfare than $a(1) = 1$ if and only if:

\[ \sum_{i=1}^{I} \frac{(b_i - b_1)^2}{I} - \sum_{i=1}^{I} \frac{(b_i - b_m)^2}{I} > \frac{1}{36}. \]
The left-hand side can be rewritten as:

$$D(\Delta) = \sum_{i=2}^{I} \left[ (i-1) \frac{1}{6} + \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) \right]^2 - \sum_{i=m+1}^{I} \left[ (i-m) \frac{1}{6} + \sum_{j=m+1}^{i} \left( \Delta_j - \frac{1}{6} \right) \right]^2 - \sum_{i=1}^{m-1} \left[ (m-i) \frac{1}{6} + \sum_{j=i+1}^{m} \left( \Delta_j - \frac{1}{6} \right) \right]^2,$$

where $\Delta_2 = b_2 - b_1, ..., \Delta_I = b_I - b_{I-1}$.

We now show that $D(\Delta)$ increases in all its terms $\Delta_k$.

When $k > m$, we obtain:

$$\frac{\partial}{\partial \Delta_k} D(\Delta) = 2 \sum_{i=k}^{I} \left[ (i-1) \frac{1}{6} + \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) \right] - 2 \sum_{i=k}^{I} \left[ (i-m) \frac{1}{6} + \sum_{j=m+1}^{i} \left( \Delta_j - \frac{1}{6} \right) \right]$$

which is clearly positive because $m > 1$ and $m + 1 \geq 2$.

When $k = m$, we have

$$\frac{\partial}{\partial \Delta_k} D(\Delta) = 2 \sum_{i=k}^{I} \left[ (i-1) \frac{1}{6} + \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) \right] > 0$$

Suppose finally that $k < m$,

$$\frac{\partial}{\partial \Delta_k} D(\Delta) = 2 \sum_{i=k}^{I} \left[ (i-1) \frac{1}{6} + \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) \right] - 2 \sum_{i=m+1}^{I} \left[ (m-i) \frac{1}{6} + \sum_{j=i+1}^{m} \left( \Delta_j - \frac{1}{6} \right) \right]$$

$$+ 2 \sum_{i=k}^{I} \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) - 2 \sum_{i=1}^{k-1} \sum_{j=i+1}^{m} \left( \Delta_j - \frac{1}{6} \right),$$

(8)

(9)

Because, $k < m$, evidently,

$$\sum_{i=k}^{I} (i-1) \frac{1}{6} > \sum_{i=m+1}^{I} (i-1) \frac{1}{6} > \sum_{i=m+1}^{I} (i-m) \frac{1}{6},$$

and $2 \sum_{i=1}^{k-1} (m-i) \frac{1}{6} < 2 \sum_{i=1}^{m-1} (m-i) \frac{1}{6}$.

and hence expression (8) is strictly positive.
Further
\[
2 \sum_{i=k}^{I} \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) > 2 \sum_{i=k}^{m} \sum_{j=2}^{i} \left( \Delta_j - \frac{1}{6} \right) = \sum_{i=2}^{k} \sum_{j=1}^{m} \left( \Delta_j - \frac{1}{6} \right) = \sum_{i=1}^{k-1} \sum_{j=i+1}^{m} \left( \Delta_j - \frac{1}{6} \right)
\]
and hence expression (9) is strictly positive, concluding that \( \partial D(\Delta) / \partial \Delta_k \) is strictly positive.

Hence, we may take \( \Delta = 1/6 \), so that
\[
D\left(\frac{1}{6}\right) = \sum_{i=2}^{I} \left( i-1 \right) \frac{1}{6}^2 - 2 \sum_{i=m+1}^{I} \left( i-m \right) \frac{1}{6}^2 = \frac{1}{4} I (I-1)^2 \frac{1}{36} \geq \frac{1}{4} \cdot 3 \cdot \frac{1}{36} > \frac{1}{36},
\]
Noting that for \( I \) odd,
\[
D\left(\frac{1}{6}\right) = \sum_{i=2}^{I} \left( i-1 \right) \frac{1}{6}^2 - 2 \sum_{i=m+1}^{I+1} \left( i-m \right) \frac{1}{6}^2 = \frac{1}{4} I (I-1)^2 \frac{1}{36} \geq \frac{1}{4} \cdot 3 \cdot \frac{1}{36} > \frac{1}{36},
\]
and for \( I \) even,
\[
D\left(\frac{1}{6}\right) = \sum_{i=2}^{I} \left( i-1 \right)^2 - \sum_{i=I/2+1}^{I} \left( i-I/2 \right)^2 - \sum_{i=1}^{I/2} \left( I/2-i \right)^2 = \frac{1}{4} I^2 (I-2) \frac{1}{36} \geq \frac{1}{4} \cdot 16 \cdot \frac{1}{36} > \frac{1}{36},
\]
we conclude that \( a(1) = \lfloor (I+1)/2 \rfloor \equiv m^* \) yields higher welfare than \( a(1) = 1 \).

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