Slicing and Bundling*

ODILON CÂMARA†
University of Southern California

JON X. EGUIA‡
Michigan State University

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Abstract

We develop a theory of agenda-setting in a legislature. A proposer supports a platform comprised of several policies. Policies are divisible and can be bundled — the proposer can slice each policy into parts, and she can aggregate the various policy parts into bills. The proposer chooses an agenda, which is a collection of bills. The legislature votes each bill up or down, and all the policy parts in each approved bill are implemented. We address the following questions: In equilibrium, which agenda is chosen? What are the consequences for voters? What are the implications for institutional design?

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†ocamara@marshall.usc.edu USC FBE Dept, 3670 Trousdale Parkway Ste. 308, BRI-308 MC-0804, Los Angeles, CA 90089-0804.

‡eguia@msu.edu 486 West Circle Rd. Dept. of Economics, 110 Marshall-Adams Hall, East Lansing, MI 48824. JE is also affiliated to the Dept. of Economics at the University of Bristol (United Kingdom).

We revisit a classic question in legislative studies: the power of an agenda setter to pass policies that are not favored by any majority of legislators.

If the policy-space is one-dimensional and preferences are single-peaked, the agenda setter attains an outcome in the interval from her ideal point to the median legislator's ideal point (Romer and Rosenthal 1978). With multiple dimensions, a strategic agenda setter attains her ideal outcome if other legislators are not sophisticated (McKelvey 1976), while the outcome is in the uncovered set if all legislators are sophisticated (Shepsle and Weingast 1984).

We propose an alternative model, which does not rely on a spatial interpretation. Consider a legislature with a proposer who controls the agenda and a set of legislators who vote on the proposals. The proposer supports a platform, which is a collection of policies. Policies are divisible: we regard each policy as an infinitely divisible unit mass of policy activity, and not as a point in space. The proposer can slice policies into parts, and she can bundle these parts into bills that she proposes to the legislature. Bills that gain a favorable vote from a majority of legislators pass, and the policy activity contained in any bill that passes is implemented.

The proposer's challenge is to pass policies that no majority of legislators wants. The standard tool to achieve this is to bundle unpopular policies with popular ones into an omnibus bill that can pass — see Krutz (2001) for evidence that bundling is increasingly important in the US Congress. We note that the proposer has a second degree of freedom: to *slice* a policy, proposing only a fraction of the total activity that constitutes the policy.[1] We call each fraction of a policy a "slice." We assume that preferences are separable across policies, and that policy preferences scale down to partial policies: if passing a policy in full

[1]See Rundquist and Strom (1987) for an empirical account of how some parts of an original policy proposal are dropped while others are kept in the process of crafting a bill in Congress.

gives a legislator a utility $\bar{u}$, then the utility of passing a slice of this policy of size $\lambda \in [0,1]$ is only $\lambda\bar{u}$. For example, suppose the policy is to advance NASA's space exploration program. This policy can be sliced into parts, such as missions to Mars, Jupiter and the Moon. If a mission to Mars is twice as important as a mission to the Moon, then a Mars mission is a slice twice as big as a Moon mission. Similarly, missions can be sliced into larger or smaller pieces — e.g., sending astronauts instead of rovers.

Slicing the policy first, and only then bundling the slices into bills makes it easier for the proposer to construct bills that can pass. The following example illustrates our theory.

Example 1 *Consider a legislature with a non-voting proposer, three voters, and simple majority rule. Assume that the proposer wants to pass a platform with three policies: education, gun control, and taxes. Table 1 describes the payoff for each voter per unit of policy passed.*

		Policies		
		Education	Gun Control	Taxes
voters	1	**+3**	-2	-2
	2	-2	**+3**	-2
	3	-2	-2	**+3**

Table 1: Payoffs from implementing each policy.

If the proposer introduces each of her policies in full one by one, all three policies fail by a 1-2 vote. By bundling policies, the proposer can get two of her policies to pass. For instance, if she bundles education and gun control into a single bill, this bill would pass with the votes of voters 1 and 2. But if two policies are bundled, then the third one does not pass alone, and there is nothing left to bundle it with. If all three policies are bundled into a single bill, then all voters reject the bill. Thus, the best the proposer can do by bundling is to pass two policies.

The proposer can do better by slicing policies before bundling them into bills. In our example, the proposer can get her entire platform to pass in three bills. A first bill, with half of the education policy and half of the gun control policy, yields a strictly positive payoff to voters 1 and 2, who vote to pass the bill. A second bill, with half of the education policy and half of the tax policy, passes with the votes of voters 1 and 3. Finally, a third bill, with the remaining half of the gun control and tax policies, passes with the votes of voters 2 and 3.

Policy bundling is a well-understood phenomenon in the literature on log-rolling (e.g., Schwartz 1977). Our contribution is to explain the strategic importance of both slicing and bundling policies and their consequences for the equilibrium payoff of voters. In our example, the proposer's ability to slice and bundle policies makes voters worse off: in equilibrium, the proposer's entire platform is approved, which yields a strictly negative payoff to all voters.

Our theory addresses the following questions: In equilibrium, which agenda is put to a vote? What is the outcome of the legislative process? What are the payoff consequences for voters? What are the implications for institutional design?

The Model

Overview: We model a game between a proposer and a group of n voters. The proposer wants to implement a set of policies, but she needs voter approval. The proposer strategically puts a list of bills to a vote. A bill is a collection of policy parts. Each voter chooses whether to approve or reject each bill. Bills that receive at least q approval votes pass, where $q \in \{1, ..., n\}$ is the established voting rule. Any legislation in a bill that passes is implemented.

Players: A proposer 0 and $n \in \mathbb{N}$ voters. Let $N \equiv \{0, 1, ..., n\}$.

Policies: We define a platform $J \equiv \{1, ..., m\}$ as a finite set with m policies, with arbitrary policy $j \in J$. Each policy j is composed of a unit mass of policy activity.[2]

Bills: A bill is a vector $b = (b(1), \ldots, b(m)) \in [0,1]^m$. Each $b(j)$ represents the mass of policy $j \in J$ contained in bill b.

Agendas: An agenda is a finite set of bills. Let B denote an arbitrary agenda, and let $b^t \in B$ denote an arbitrary bill in agenda B. An agenda B is feasible if and only if $\sum_{b^t \in B} b^t(j) \leq 1$ for each policy $j \in J$. Let $\mathcal{B}$ be the set of all feasible agendas.

Preferences: Let $v_i(j)$ denote the per unit utility for player $i \in N$ of policy j. For each player, normalize the utility of not passing anything to zero. We interpret J as the proposer's platform, so we assume that $v_0(j) > 0$ for each policy in the platform.

If an agenda B passes, it yields to player i a payoff

$$u(B, v_i) = \sum_{b^t \in B} \sum_{j \in J} b^t(j) v_i(j). \tag{1}$$

Timing: First, the proposer chooses an agenda $B \subset \mathcal{B}$. Let T be the number of bills in this agenda, $B = \{b^1, \ldots, b^T\}$. Bills are considered sequentially: for each $t \in \{1, \ldots, T\}$, all voters simultaneously vote on bill b^t, observe the vote outcome, and then, if $t < T$, they move on to bill b^{t+1}. Let agenda $\hat{B} \subseteq B$ denote the subset of bills that receive q or more votes. Agenda $\hat{B}$ passes and payoffs accrue.

Information: All information is common knowledge.

Rationality: All players are strategic and maximize their expected utility, and they do not use weakly dominated strategies. To simplify the exposition, we assume that if a legislator

[2] We consider policies with heterogeneous measures (mass) of activity in the online Appendix.

is indifferent between approving and rejecting a bill, then he votes for approval.

Solution concept: Subgame perfect Nash equilibrium.

Results

The proposer's agenda setting problem is to choose a feasible agenda that maximizes her expected utility, given the expected voting behavior of all other legislators. Fix any agenda $B \in \mathcal{B}$. For $t = T$, each legislator i votes for bill b^t if and only $\sum_{j \in J} b^t(j) v_i(j) \geq 0$, independently of the past history. By backward induction, the same holds for each $t < T$. For any bill b^t, define the indicator function $\mathbb{I}(b^t) = 1$ if at least q voters weakly prefer bill b to pass, and $\mathbb{I}(b^t) = 0$ otherwise. The proposer's problem then reduces to choosing an agenda in

$$\arg\max_{B \in \mathcal{B}} \sum_{b^t \in B} \mathbb{I}(b^t) \sum_{j \in J} b^t(j) v_0(j). \tag{2}$$

Problem (2) may appear difficult to solve. Fortunately, we can appeal to the literature to solve it for us. Alonso and Câmara (forthcoming) (AC) introduce a voting model of Bayesian Persuasion. As in the seminal theory by Kamenica and Gentzkow (2011), the main idea is that an information designer chooses an experiment that generates signals about the state of the world, and these signals shift the posterior beliefs of a receiver. The designer strategically chooses the experiment that is ex-ante most likely to generate posteriors desired by the designer. In AC, the receiver is a committee and the designer needs to generate favorable beliefs among at least q members of the committee.

While, substantively, our legislative agenda-setting model has nothing to do with experimentation or information design, it turns out that, mathematically, it is identical to AC.

Lemma 1 *The agenda choice problem* (2) *is isomorphic to the information designer's experiment choice problem in AC.*

Proof. See the online Appendix. ■

What we mean by "isomorphic" and "mathematically identical" is that the two models are the same, up to a reinterpretation of the variables and parameters: any result that is true in AC's is also true in ours, with the appropriate reinterpretation.[3] Once we prove this equivalence, we can import all of their results, suitably reinterpreted, without further proof. In particular, we obtain the following:

Proposition 1 *There exists an optimal policy agenda B^* that solves the agenda choice problem* (2) *and contains, at most,* $\min\left\{m, \frac{n!}{(n-q)!q!} + 1\right\}$ *bills.*

Proof. It follows from result **(R2)** in the online Appendix of AC. ■

Proposition 1 establishes that there exists an optimal agenda containing, at most, as many bills as there are policies (m), and, at most, one bill targeted to each of the $\frac{n!}{(n-q)!q!}$ possible minimum winning coalitions of voters plus one bill that will not pass.

Preferences such that the whole platform J can pass as a single bill or such that no bill can pass are trivial cases. The next restriction on voter preferences rules them out. It also assumes that the proposer's marginal utility is the same across all the policies in her platform,[4] and it assumes that voters have strict preferences over policies.

[3] Our model stands in the same relation to AC as Downs' (1957) model of electoral competition with a unidimensional policy space stands in relation to Hotelling's (1929) model of seller location in a linear market. Our agenda-setting model is also mathematically related to the cheap-talk models of Schnakenberg (2015 and forthcoming).

[4] This is merely a normalization on the measure (mass) of each policy. It is without loss of generality in the scope of admissible preferences. If the proposer values policy j twice as much as policy j', we can represent this by $v_0(j) = v_0(j')$ and then assign measure 2 to the activity on policy j. See the online Appendix.

Assumption 1 (A1) *Suppose that voters' preferences are such that at least* $n-q+1$ *voters strictly prefer the status quo over* J*, but there exists a feasible bill* $B \subset \mathcal{B}$ *such that at least* q *voters strictly prefer bill* B *over the status quo. Assume* $v_0(j) = 1$ *for each policy* $j \in J$ *and assume that* $v_i(j) \neq v_i(j')$ *for any two policies* $\{j, j'\} \subset J$ *and any voter* $i \in N \backslash \{0\}$.

Proposition 2 *Assume **(A1)**. If the voting rule is not unanimity* ($q < n$)*, then at least* $n-q+1$ *voters weakly prefer the status quo over the set of bills that pass. In particular, under a simple majority, the collection of bills that pass makes a majority of voters weakly worse off.*

Proof. It follows from Corollary 1 of AC. ■

Proposition 2 holds because the proposer wants to implement as much of her platform as possible. If at least q voters are strictly better off, then the proposer can include more of her policies on the bills that pass. Therefore, at least $n - q + 1$ voters must be weakly worse off.

To highlight the importance of controlling the agenda and the conflicts of interest between proposer and voters, we next consider an assembly in which all voters agree on their ordinal preferences over policies, and they all oppose certain policies favored by the proposer. Let policy 0 denote the status quo, interpreted as a policy that contains no actions.

Definition 1 *Voters have homogeneous ordinal policy preferences if, for any pair of policies* $j, j' \in \{0, ..., m\}$ *and any pair of voters* $i, i' \in N \backslash \{0\}$*, voter* i *prefers policy* j *to policy* j' *if and only if voter* i' *prefers policy* j *to* j' ($v_i(j) \geq v_i(j') \Longleftrightarrow v_{i'}(j) \geq v_{i'}(j')$).

We next present an example in which voters have homogeneous ordinal policy preferences, and yet policies that voters don't like pass, making voters strictly worse off. This is so because voters disagree on bills in spite of their homogeneous ordinal policy preferences. The proposer exploits this disagreement by properly slicing and bundling policies into different bills.

Example 2 *There are two voters, and the voting rule is $q = 1$. There are three policies: one policy (education) that both voters favor, and two policies (gun control and taxes) that voters oppose to differing degrees. Policy preferences are represented by the following utilities:*

Policy	v_0	v_1	v_2
Education	+1	+2	+2
Gun control	+1	-1	-3
Taxes	+1	-6	-5

The optimal agenda is $B^* = \left\{ \left(\frac{1}{2}, 1, 0\right), \left(\frac{1}{2}, 0, \frac{1}{5}\right), \left(0, 0, \frac{4}{5}\right) \right\}$.[5] The first bill passes with the vote of voter 1; the second bill passes with the vote of voter 2; and the third bill fails. The proposer slices the education and tax policies. She bundles a slice of the education policy with a slice of the gun control policy into bill b^1 to target voter 1, and she bundles a slice of education policy with a slice of tax policy into bill b^2 to target voter 2.

In Example 2, voters would like to collude to reject the proposals. However, in the subgame equilibrium, voters would be tempted to deviate from this deal. To create an enforceable commitment device, voters prefer to change the voting rule to unanimity, or to limit the proposer to include a single bill in the agenda. Both of these observations generalize. First:

Proposition 3 *Assume (**A1**) and homogeneous ordinal policy preferences. All voters weakly prefer unanimity over any other q-voting rule.*

Proof. It follows from Proposition 5 of AC. ■

[5] We provide a general algorithm to find the optimal agenda in the online Appendix.

In addition to importing AC's results, new results arise that have no substantive interpretation in AC's theory. Suppose that we introduce a constraint, in the form of a cap $\kappa \in \mathbb{N}$ on the number of bills. Say that a feasible agenda is admissible if it contains, at most, κ bills, and suppose that the proposer can propose only admissible agendas.

Proposition 4 *Assume (**A1**) and homogeneous ordinal policy preferences. Then, all voters are weakly better off if the number of bills in an admissible agenda is capped at $\kappa = 1$.*

Proof. See the online Appendix. ■

Voters are worse off with higher caps because they allow the proposer to design bills targeting different coalitions. This new result has no analogue in AC because it would mean a limit on the number of signal realizations of an experiment. Such a restriction makes no sense in their setting. In the context of a legislative body, a Constitution or a rules committee can impose any restrictions it wishes on the nature of admissible agendas. Proposition 4 highlights that, although our model and AC's are isomorphic, the two theories address different questions and provide distinct insights.

Conclusion

We present a theory of legislative policy making based on a new model of agenda formation. Our main insight is that the ability to slice a policy into its components is a powerful tool for an agenda setter. By slicing policies and bundling the slices into omnibus bills, an agenda setter can pass more legislation than had been previously understood. Other legislators prefer to curtail the agenda setter by choosing a more stringent voting rule, or by capping the maximum number of bills under consideration.

We consider a simple model, with assumptions that allow us to use existing mathematical tools to quickly characterize the equilibrium. Our main insights hold if we relax some of these assumptions, at the cost of a more burdensome equilibrium characterization — e.g., if we impose limits on the proposer's ability to slice policies. Our benchmark model can be extended to study other important questions, such as: what is the equilibrium if there are payoff externalities across policies? How do different legislative rules, such as an endogenously elected proposer, affect policy slicing and bundling?

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