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WHEN THE POWERFUL DRAG THEIR FEET

Paul Schure[+], Francesco Passarelli[++],

& David Scoones[+]

[+]University of Victoria

[++]Università degli Studi di Teramo and Università Bocconi

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JEL Classifications: D72, D78, H77

Author Contact:

Paul Schure, Dept. of Economics, University of Victoria, P.O. Box 1700, STN CSC, Victoria, B.C., Canada V8W 2Y2; e-mail: schure@uvic.ca; FAX: 1-250-721-8535

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When the Powerful Drag their Feet

1 Introduction

In this paper we address the *timing* of a group decision which is taken by weighted voting under a qualified majority rule. Decision-making in our model is in two stages. In the second stage, players vote on a *restriction* on behavior (to limit a negative externality). Before that, in the first stage, players vote to determine the timing of the second-stage vote: whether it should be "early", before the players' types are revealed, or "late", after types become common knowledge. Player types affect their cost of complying with the restriction. The restriction applies symmetrically to all players in the group and we do not (initially) allow for side payments between players.

The job of a social planner in this setting would be straightforward. Independently of the social welfare function, the planner would wait and pick the optimum restriction after player types are realized. However, in this paper we do not consider the social planner's problem and focus instead on *positive* issues. Under a late vote, then, players use their voting power to swing the second-stage group decision to serve their revealed interests. As a consequence voting on the restriction late may be inferior to the group than voting early.

A central feature of our model is its ability to distinguish the consequences of the *power* and the *size* of players. In the model power is measured by a player's voting power, and size by its impact on the group surplus. We show that, under a late vote the expected utility of a player increases in her voting power. By contrast, under an early vote players unanimously agree on the restriction and obtain the same expected utility. In stage 1, therefore, "powerful players" are inclined to choose to vote late on the restriction, while the less powerful tend to choose to vote early. By contrast, if players have equal power, large players have *lower* expected utility under a late vote than small players. The "spillovers" implied by adjustments of large players are high, which implies that if they end up in a losing coalition the winners will generally select a restriction which necessitates more adjustment than if the losing coalition has (more) players of smaller size. Therefore, players tend to drag their feet when their power is sufficient to outweight the effect of their possibly larger size.[1]

Under an early agreement the parameters for policy are chosen under uncertainty regarding how the policy will work out for the individual players. In empirical terms, this can take the form of a binding agreement or contract signed at the time of substantial uncertainty regarding its distributional consequences. By contrast, late agreements mean delay until players have learned where they stand. A different, but sometimes related, interpretation of early agreement is the choice to delegate powers to an independent executive body. For example, in the European Union (EU) the Council of Ministers (the EU's most important legislator) could decide early by delegating powers to the European Commission (the executive) at the time the distributional consequences of doing so are unclear. According to this interpretation one prediction of this paper is that the powerful tend to be less interested in delegation than the weak: although the mandate of the executive may not always be what the weak bargain for, delegation guarantees symmetric enforcement at the moment the information regarding types has come in.[2,3]

The result that the powerful procrastinate, whereas the less powerful do not, may

[1]The value of the qualified majority threshold matters for the early-versus-late trade-off as well: high values pose a problem in terms of weak agreements under a late vote. This makes early commitment more attractive.

[2]There are two underlying assumptions here, namely (1) the delegation decision must be difficult to turn around, and, related, (2) the executive must be sufficiently independent; if individual players – particularly powerful players – have too much leverage over the decisions of the executive, the weak can be wary of delegating powers. Magnette and Nicolaïdis (2005) argue that at the inception of the European Economic Community its three small member states had doubt about the independence of the Commission and insisted on establishing a Council in which all six member states retained a veto in most policy areas.

[3]While in our model the information regarding types is not used under early decisions, the discussion in Section 5.2 clarifies further this is not a crucial assumption. Thus, even if delegation involves discretionary power it counts as an early decision provided the executive is immune from political pressure of the players.

explain the stylized fact that influential countries are generally more reluctant to sign multilateral agreements than "small states".[4] In Section 5.1 we review evidence from the literature on International Relations which is consistent with our results, as well as evidence from literatures on corporate governance, EU governance, and the economics of oil extraction.

The above-mentioned results are obtained in a context of voting with a given qualified majority threshold (QMT). But how is the QMT determined if players have a veto at the outset? We study two alternative ways to address this question. In the first we add a stage prior to the two legislative stages. In this prior stage players decide whether to give up their veto in exchange for a given QMT. This decision resembles the situation of EU member states when they decide to surrender national competence in a certain "new" policy area. In the second extension we modify the first of the two legislative stages of our main model. In the modified stage 1 players take the early-late decision jointly with the decision on QMT. This decision resembles what Hammons (1999) called the decision between a "lengthy, statute-oriented constitution" (decide early) and a "short, framework-oriented constitution" (decide late plus choose its QMT) and also resembles the choice between a "complete social contract" and an "incomplete social contract" (Aghion and Bolton (2003) and Roland (2005)). To briefly preview the results, the first extension fails to explain why players ever jointly give up their vetoes if their powers differ substantially, while the second can explain this (although there are multiple equilibria). The second extension also sheds light on some of the intrinsic difficulties of constitutional negotiations if players anticipate power differences under "reasonable" constitutional templates (as in

[4]Much energy in the International Relations literature is devoted to defining the concept of a "small state", with suggested classifications ranging from those based on population, area, economic output to those based on "psychological" conditions, such as the feeling of powerlessness (see Neumann and Gstöhl (2004) and the citations therein). Some of this literature distinguishes between small states and weak states, much as we here distinguish between power and size.

the recent Iraqi constitutional negotiations).

There is a sizable literature that uses concepts of coalitional game theory to derive and apply measures for the power of individual players in the context of weighted voting (see Owen (1995), Felsenthal and Machover (1998), or Benoit and Korhauser (2002) for excellent reviews). In a recent paper Snyder, Ting, and Ansolabehere (2005) compute the voting power of voters that play a non-cooperative bargaining game.[5] Our paper is not concerned with computing the voting power of individual players, but it focuses on the *implications* of a setting in which players have different voting power. Persson and Tabellini (2003) also study the policy implications of given constitutional regimes, however, they do not draw a link between constitutions and the preference of players regarding the timing of decisions, which we address in this paper. Harstad (2005) studies the implications of the constitutional regime – particularly the qualified majority threshold – for the incentive of players to invest prior to the decision moment.

In some circumstances the model exhibits inefficient delay: on average parties would benefit from deciding early, which the powerful refuse to permit. Private information is the source of delay in Alesina and Drazen (1991) (in a war-of-attrition context), Bolton and Farrell (1990) (in a grab-the-dollar game), and Admati and Perry (1987) and Harstad (2007) (in signalling games). In our model information is symmetric and costly delay occurs because the distribution of benefits from an agreement changes over time (with the revelation of types).[6] The inefficiency arises not because of delay per se, as there is no discounting, but from the parties unequal ability to protect their interests in the ex post weighted vote.

[5] Another branch of the literature on weighted voting has focused on rationalizing the use of differential voting weights (e.g. Penrose (1946), Nitzan and Paroush (1982), Shapley and Grofman (1984) and, more recently, Felsenthal and Machover (1999) and Barberà and Jackson (2006)).

[6] Side payments (to the powerful) at the early-late decision would prevent possible costly delay. (Side payments at the time the restriction is chosen would not.) The role of side payments is clarified in Section 5.5.

The next section presents the model. In Sections 3 and 4 we derive the expected payoffs of players under an early and a late vote on the restriction. In Section 5 we discuss our core assumptions, state the model predictions, and discuss their evidence. Section 6 presents the two alternative extensions to endogenize the qualified majority threshold and embeds the analysis into the relevant literature afterwards. Section 7 concludes. The Appendix contains the proofs of Propositions 2-4.

2 The model

Consider a set of n players $N = \{1, ...n\}$ who take a joint decision to fix a *restriction* $r \in [0, 1]$ which caps the players' *behavior* $\widetilde{\delta}_i, i \in N$. Such a restriction is relevant if high realizations of individual behavior result in a negative externalities on the other players. This is the case here. We consider a "common pool problem" in which lower individual behavior has a positive effect on the *group benefits* V, but generally increases the player's privately carried *adjustment costs* C_i as well. We assume for simplicity that players receive certain (exogenous and known) shares τ_i of V, and that the adjustment costs of players are proportional to the shares τ_i as well, and depend on the distance between their chosen behavior and their *types* δ_i, $i \in N$. Specifically, each player i has the following utility function

$$U_i(\widetilde{\delta}_1, ..., \widetilde{\delta}_n) = \tau_i V(\widetilde{\delta}_1, ..., \widetilde{\delta}_n) - C_i(\widetilde{\delta}_i, \delta_i) = \tau_i \left[V(\widetilde{\delta}_1, ..., \widetilde{\delta}_n) - c(\left|\widetilde{\delta}_i - \delta_i\right|) \right] \quad (1)$$

In this equation the function c is the common factor of the adjustment costs of players. Observe that the assumption that adjustment costs are proportional to τ_i simplifies the model because it ensures that τ_i becomes irrelevant to the choice of a player. This assumption would apply, for instance, if the players each represent groups of agents, say the citizens of nations, which share equally in the benefits V and carry equal amounts of the adjustment costs.

We assume the partial derivatives of V are all negative, reflecting that higher individual behavior implies a negative externality. Adjustment costs are assumed continuously differentiable, increasing, and convex: $c' > 0$ and $c'' \geq 0$. We assume types are generated by independent draws from a uniform distribution on the unit interval: $\delta_i \overset{\text{i.i.d.}}{\sim} Uniform\,[0,1]$ for all $i \in N$. After types are revealed they are common knowledge. Finally, we assume that it is not in the interest of any individual player to unilaterally provide the group benefit by choosing her behavior below her realized type

Assumption 1 *(No private provision of public good) For all players* i *and all* $\widetilde{\delta} = (\widetilde{\delta}_1, ..., \widetilde{\delta}_n)$ *satisfying* $\widetilde{\delta}_i < \delta_i$ *we have*

$$V(\widetilde{\delta}_1, ..., \widetilde{\delta}_n) - c(\delta_i - \widetilde{\delta}_i) < V(\widetilde{\delta}_1, ..., \widetilde{\delta}_{i-1}, \delta_i, \widetilde{\delta}_{i+1}, ..., \widetilde{\delta}_n) - c(0)$$

Since choosing behavior higher than type also lowers utility (it lowers V plus leads to adjustment costs), Assumption 1 implies that the preferred behavior of a player of type δ_i is $\widetilde{\delta}_i = \delta_i$. In other words, a player's type δ_i represents her preferred behavior if unrestricted by r. A similar argument shows that under a policy restriction r players choose individual behavior as follows

$$\widetilde{\delta}_i = \widetilde{\delta}_i(r, \delta_i) = \min\{r, \delta_i\} \quad i \in N \tag{2}$$

Players choose $\widetilde{\delta}_i = \delta_i$ unless $\delta_i > r$, in which case players satisfy the restriction in the cheapest possible way (by choosing $\widetilde{\delta}_i = r$).

We now turn to decision-making. Players make two collective choices prior to choosing individual behavior. In Stage 2, the players choose the restriction r. Before that, in Stage 1, the players choose the *timing* of the second-stage decision: whether it should be "early", i.e. before the players' types are revealed, or "late", i.e. afterwards. Both early and late decisions on the restriction are nonrenegotiable, thus we will speak of *early commitment* and *late commitment.* A good interpretation of early commitment is that it represents the decision to delegate powers to an executive body. To be sure, the delegation decision must be difficult to reverse and the executive body be relatively immune to ex post pressure of the players. This is often the case, and, in fact, we know from the literature on central banks that one rationale for delegation is precisely to commit to the policy decision. Figure 1 displays the timing of the game.

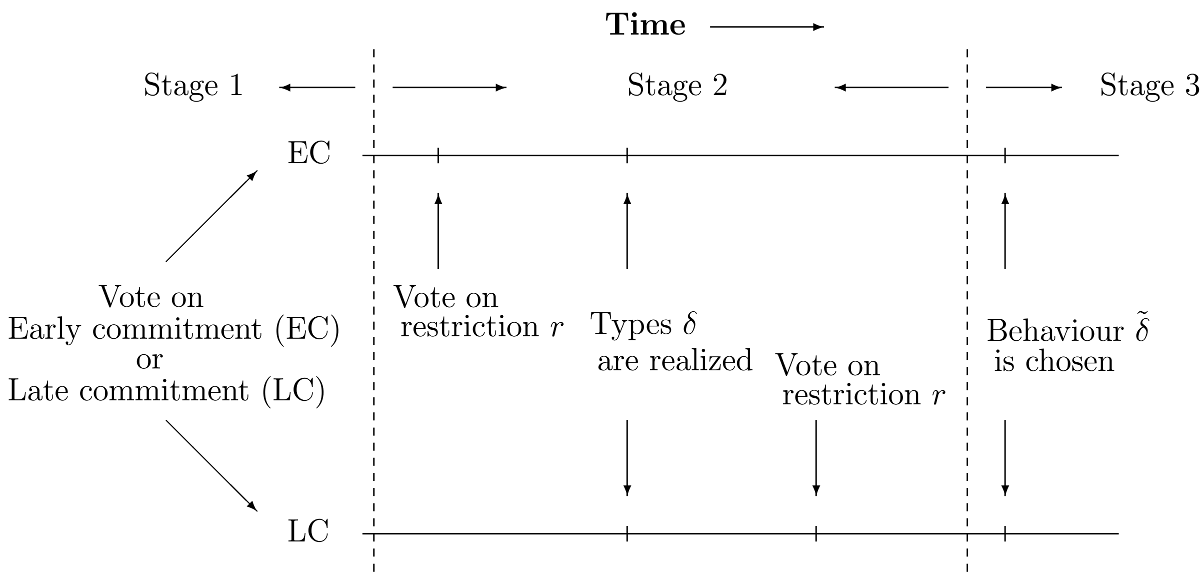

Figure 1: Timing of decisions

Group decisions are reached through weighted voting. The voting game is $\gamma = (q; w_1, ..., w_n)$, in which w_i represents the voting weight of player $i \in N$, and q the qualified majority threshold.[7] We assume that $q > 1/2 \sum_{i \in N} w_i$ to ensure that the voting outcome is well

[7]As in von Neumann and Morgenstern (1944) the voting game $\gamma = (q; w_1, ..., w_n)$ is defined by the simple coalitional game (N, v_γ) where the value function v_γ, defined on the set of subsets S of N, is such that $v_\gamma(S) = 1$ if $\sum_{i \in S} w_i \geq q$ (the decision is "accept") and $v_\gamma(S) = 0$ otherwise ("reject"). Some results in the paper refer to *voting power*, which we define as in Shapley and Shubik (1954):

$$\phi_i(\gamma) = \sum_{S \subseteq N \setminus i} \frac{s!(n-s-1)!}{n!} \left[v_\gamma(S \cup i) - v_\gamma(S) \right]$$

Here $s = |S|$ is the cardinality of S (the number of players in S). In words, the Shapley-Shubik index of a player i is given by the fraction of coalitions that are losing coalitions without i, but become winning coalitions if i joins (such that $v_\gamma(S \cup i) - v_\gamma(S) = 1$). A greater voting weight is a necessary, but not sufficient, condition for a player to have more voting power than another player.

defined. In Stage 1 players simultaneously cast a vote on the proposal "early commitment". Early commitment applies if the aggregate voting weight of the yes-voters meets or exceeds q, while late commitment prevails otherwise.

The stage-2 game is as follows. The default policy restriction before Stage 2 is $r^d = 1$, i.e. there is no binding agreement. Players sequentially propose alternative policy restrictions and each player gets the chance to propose a policy restriction at least once. If a player decides to make a proposal r during her turn, it must be more "drastic" than the current default, i.e. the proposals must satisfy $r \in [0, r^d]$. Each proposal r is put to a vote and if it gets accepted it becomes the new default policy restriction. The chosen policy restriction is the prevailing default policy restriction after the last player's turn.

3 The early commitment case

Assume temporarily that the group has chosen "early commitment" in Stage 1 and focus on the Stage 2 choice of the restriction r. Recall from Figure 1 that under early commitment the restriction is chosen before types $\delta = (\delta_1, ..., \delta_n)$ are picked by Nature. Thus in Stage 2 players choose r so as to maximize their *expected* utility. Specifically, since the shares τ_i do not affect choice they have the following indirect utility functions over r:

$$W_i^{EC}(r) = v(r) - \int_r^1 c(\delta_i - r) d\delta_i \quad \text{for all } i \in N \tag{3}$$

Here $v(r) \equiv E_\delta \left(V(\widetilde{\delta}(r, \delta)) \right)$ denotes the expected benefits induced by the restriction r.

Equation 3 shows that players have *identical* preferences over r. The Stage 2 voting game has therefore a trivial outcome under early commitment. The player that gets to make the proposal first advances the restriction that maximizes $W_i^{EC}(r)$, call it r^{EC}. All players vote in favor of the proposal r^{EC} and no stricter r is proposed in the other voting rounds, so that the outcome of the stage-2 voting game is $r = r^{EC}$.[8]

Under early commitment each player receives the same expected utility up to a scale factor τ_i, that is they receive the same (scaled) *payoff* $\pi^{EC} \equiv W_i^{EC}(r^{EC})$. We have obtained

Proposition 1 *Under early commitment the policy restriction r^{EC} is chosen, where r^{EC} solves $v'(r) + c(1-r) = 0$. All players receive the same expected utility up to a scale factor τ_i, that is, they obtain the same (scaled) payoff $\pi^{EC} = W_i^{EC}(r^{EC})$.*

The result in Proposition 1 suggests that agreement is "easy" if negotiations take place ex ante. This result finds support in evidence by Libecap and Wiggins (1985) on oil field unitization agreements, i.e. decisions to exploit oil fields as single units to curb over-exploitation as the consequence of a common-pool problem[9]. Libecap and Wiggins show that in Wyoming, where regulation encouraged unitization agreements at the initial stages of exploration, unitization agreements governed between 50 and 85 percent of the state's annual oil production in the period 1948-1975. This was considerably more than on oil fields in Oklamoma and Texas, where unitization negotiations took place after the exploration and development stage of oil fields. In Oklahoma unitization agreements governed between 9 and 38 percent, and in Texas between 0 and 20 percent, of the annual oil production in the period 1948-1975.

4 The late commitment case

In the late commitment case, players know the vector of types $\delta = (\delta_1, ..., \delta_n)$ during the Stage 2 game. The chosen restriction r under late commitment is therefore in general a

[8]An optimum policy restriction r^{EC} exists because $W_i^{EC}(r)$ is continuous in r. However, the first-order condition for an optimum, i.e. $v'(r) + \int_r^1 c'(\delta_i - r)d\delta_i = 0 \Rightarrow v'(r) + c(1-r) = 0$, may have multiple solutions, and, indeed, there may be more than one optimal policy restrictions. Since our interest is in the timing of the choice of the restriction, and not with the magnitude of the restriction *per se*, let us assume that $r^{EC} = \min\{r^* \in \arg\max_r \pi^{EC}(r)\}$. With this refinement r^{EC} is uniquely defined.

[9]For geophysical reasons, the more wells drilled into a single oil field, the lower is the total recovery.

function of the realized types. Below we first solve the Stage 2 game under late commitment. As we shall see, the chosen restriction corresponds to the restriction favoured by the "pivotal player". After solving the Stage 2 game under late commitment we will compute each player's expected payoff under late commitment.

4.1 The chosen policy restriction under late commitment

Recall that the default restriction before the Stage 2 voting game is $r^d = 1$ ("no binding agreement") and that players propose alternative restrictions in some predetermined order. Under late commitment the players' indirect utility functions over the restrictions are given by:

$$W_i^{LC}(r;\delta) = V(\min\{r,\delta_1\},...,\min\{r,\delta_n\}) - c(\delta_i - \min\{r,\delta_i\}) \quad \text{for all } i \in N \tag{4}$$

Unlike in the early commitment case, players have different indirect utility functions under late commitment because their realized types δ_i are different. In particular, the restrictions favored by the players differ.

Although $W_i^{LC}(r;\delta)$ may not have a derivative in the points $r = \delta_i$, $i = 1,...,n$, the *left-hand* derivative exists on the entire interval $r \in (0,1]$. Since players are only ever interested in lowering r, we can meaningfully speak of first-order conditions. We assume for simplicity[10] that for each player i and each realization δ the function $W_i^{LC}(r;\delta)$ has a single peak which is given by the first-order conditions following from equation 4.[11] Denote this peak or *bliss point* by $r = r_i^*(\delta)$.

[10]The proofs of our propositions, and their intuition sketched in the text, exploit single-peakness, but we can prove each result without this assumption.

[11]Multiple peaks in preferences could arise in theory for certain V when r is below a player's type. This would happen for particular δ if lowering r would lead to adjustment of a sufficiently large mass of players that have an impact on V that dominates the cost increase locally.

It is straightforward to show that the bliss points are situated to the left of the player's type, that is, we have

$$r_i^*(\delta) \leq \delta_i \text{ for all } i \tag{5}$$

Bliss points are never located to the right of a player's type δ_i because a laxer policy would increase the behavior of the players with types located to the right of δ_i. This would lower the gross surplus V, hence lower the payoff of the pivotal player, because adjustment costs play no role if $r_i^*(\delta) > \delta_i$. A player's bliss point may be located to the left of a player's type ($r_i^*(\delta) < \delta_i$) despite the fact that such a restriction would imply adjustment costs incurred by the player. This is because tightening the policy restriction decreases the negative externalities from players located to the right of the player. These externalities plus the contribution to V of the player itself may locally exceed the player's adjustment costs.

It is also straightforward to show that the ordering of the bliss points of players is identical to the ordering of the players' types. In other words, players of lower types have lower bliss points for all realizations of types $\delta = (\delta_1, ..., \delta_n)$:

$$\delta_i < \delta_j \Leftrightarrow r_i^*(\delta) < r_j^*(\delta) \text{ for any players } i \text{ and } j$$

We solve the game under the assumption that players make *sincere proposals*, that is, players propose their bliss points $r_i^*(\delta)$ whenever these lie to the left of the current default restriction. This assumption makes sense given that players know each others' types and bliss points when deciding late. With this assumption a result resembling the Median Voter Theorem applies: the chosen policy restriction corresponds to one favoured by the *pivotal player*. In this context, the pivotal player is the player of the lowest type among the players for which their voting weight plus the voting weight of players with types to their left, adds up to, or exceeds the qualified majority threshold q.[12]

[12]Formally, let S_r be the set of players with types lower than r, i.e. $S_r = \{i \in N : \delta_i \leq r\}$ and W_{S_r} the sum of the voting weights of the players in S_r, i.e. $W_{S_r} = \sum_{i \in S_r} w_i$. The pivotal player is the player, say p, defined by $W_{S_r} \geq q$ for $r = \delta_p$ but $W_{S_r} < q$ for all $r < \delta_p$.

Lemma 1 *The chosen policy restriction under late commitment corresponds to the preferred policy restriction of the pivotal player, that is, if player p is the pivotal player for a given realization of types $\delta = (\delta_1, ..., \delta_n)$, then the chosen policy restriction under late commitment is $r = r_p^*(\delta) = \arg\max_r W_p^{LC}(r, \delta)$.*

Proof. An equilibrium voting strategy for all players is to vote *against* all proposals located to the left of their own bliss point, and *for* proposals that are either equal to, or to the right of their bliss point. This constitutes the proof because if players adopt this strategy the chosen policy restriction indeed becomes $r = r_p^*(\delta)$. ■

In general the parameters of the voting game γ and the functional forms of V and c determine the bliss point of the pivotal voter and therefore the chosen restriction under late commitment. In particular, higher values of the qualified majority threshold q imply higher values of the chosen restriction. In the extreme case that $q = \sum_{i \in N} w_i$, all players have a veto and no binding agreement is reached ex post. In this case the player of the highest type is pivotal and will set the restriction equal to her type (or any level higher than her type) such that no player faces adjustment costs. In reality this situation may take the form of a weak agreement (e.g. mere lip service, a joint declaration of fidelity) that does not bind any party to a costly action, or "contractual breakdown" between players. Weak agreements for high q arise because of our assumption that adjustment costs are privately carried. This assumption rules out side payments between players that would be needed to convince players of high types to agree to a binding late agreement. Examples where partial or full contractual breakdown happened in standard common pool problems are Karpoff (1987) in the case of fishery regulation and Libecap and Wiggens (1985) for oil field unitization decisions in the period 1948-1975 in Texas where unitization decisions required unanimous agreement among the oil firms.

4.2 The expected utility under late commitment

At Stage 1 players do not know the realization of types δ (see Figure 1). Each player thus assesses the merits of late commitment in terms of its payoff (scaled expected utility). Equations 4 and Lemma 1 show that the payoff of late commitment is given by

$$\pi_i^{LC} = E_\delta V(\min\{r_p^*(\delta), \delta_1\}, ..., \min\{r_p^*(\delta), \delta_n\}) - E_\delta[c(\delta_i - \min\{r_p^*(\delta), \delta_i\})] \quad (6)$$

A player's payoff equals the expected group benefits minus the expected adjustment cost. Observe that the expected group benefit is equal for all players, while, as we will show below, the expected adjustment cost generally differs across players.

The remainder of this section is devoted to establishing three results regarding the payoffs of players under late commitment. The first states that if players are of *equal size* (in terms of their contributions to V — we will define this below), then the players' expected payoff is strictly increasing in their *voting power* (Shapley-Shubik index – see footnote 7). The second and the third results apply if players are not of equal size. The second result states that the expected payoff of a player is again strictly increasing with her voting power if the impact on V of the set of players in the potential losing coalitions is small relative to the adjustment costs of the potential pivots (such that their bliss points correspond to their type: $r_p^* = \delta_p$). The final result states that if two players that differ in size have *equal voting power* then the largest player of the two has the lowest payoff (unless, for all potential pivots p we have $r_p^* = \delta_p$, in which case the payoffs are equal). We discuss the empirical predictions that follow from these three results in the next section.

Before presenting the results, let us define some useful terminology. Define for any realization δ its *permutation* δ' as follows: $\delta' = (\delta'_1, ..., \delta'_j, ..., \delta'_i, ..., \delta'_n)$ where $\delta'_j = \delta_i$ and $\delta'_i = \delta_j$ and $\delta'_k = \delta_k$ for all $k \neq i, j$. That is, in δ' the location of the types of i and j are permuted and the location of all other types is identical. Define for any vector of behavior $\widetilde{\delta}$ its permutation in the same way. Next define what it means for two players to be of "equal size" and what it means if one is "larger" than the other.

Definition 1 *(Equal Size) Two players i and j are of equal size if $V(\widetilde{\delta}) = V(\widetilde{\delta}^{'})$ for any chosen vector of behavior $\widetilde{\delta}$ and its permutation $\widetilde{\delta}^{'}$.*

Definition 2 *(Larger / Smaller) For any two players i and j we will say that i is larger than j (j is smaller than i) if*

(a) $\dfrac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_i} < \dfrac{\partial V(\widetilde{\delta}^{'})}{\partial \widetilde{\delta}_j}$ for any $\widetilde{\delta}$ and its permutation $\widetilde{\delta}^{'}$, and

(b) $\dfrac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_k} \leq \dfrac{\partial V(\widetilde{\delta}^{'})}{\partial \widetilde{\delta}_k}$ any player k and $\widetilde{\delta}$ such that $\widetilde{\delta}_i > \widetilde{\delta}_j$

Definition 2 expresses that i is larger than j if she (a) has a stronger (i.e. more negative — recall that the partials of V are negative) marginal impact on V than j would have had, had j been in i's position, and (b) higher positions of i weakly increase the marginal effect of reductions in behaviour of others. Observe that if two players are not of equal size then it is not necessarily so that one is larger than the other.

The first proposition applies if players are of equal size but differ in their voting weight.

Proposition 2 *Consider two equally-sized players i and j and assume i has a greater voting weight ($w_i > w_j$). (a) The payoff of player i is weakly higher than that of player j, that is: $\pi_i^{LC} \geq \pi_j^{LC}$. (b) If player i has more voting power than player j, then the payoff of player i is strictly higher than that of player j, that is: $\pi_i^{LC} > \pi_j^{LC}$.*

Keeping size constant, the expected payoff of a player increases with its voting power because more voting power implies that the chosen restriction is generally located closer to the player's type. Even if a player is not pivotal herself, a yes-vote with more voting power generally has a stronger tightening effect on the chosen restriction, while a no-vote with more voting power generally has a stronger relaxing effect on the chosen restriction.

When players are not of equal size, larger players face potentially larger adjustment costs because of their greater influence on group benefits. This is because the restriction chosen by the pivotal player generally depends on the size of the players above her. Recall from equation 5 that the bliss points of players are either located to the left of their types, i.e. $r_i^*(\delta) < \delta_i$, or identical to their types, i.e. $r_i^*(\delta) = \delta_i$. Tightening the policy restriction slightly from δ_i leads to a marginal increase in V stemming from an adjustment of behavior of player i plus adjustments of the players with higher types. If this marginal increase in V initially exceeds i's privately carried adjustment cost we have $r_i^*(\delta) < \delta_i$ and the distance between $r_i^*(\delta)$ and δ_i increases with the sizes of the players above her. The larger the combined effect of the players of higher type on group benefits, the greater is the level of adjustment costs a pivotal player is willing to incur itself to reduce the behavior of those above it.

When considering players of equal size, as in Proposition 2, this effect is absent by definition. However, there are are other circumstances in which it plays no role, for instance if the potential bliss points of pivotal players coincides with their types independently of the composition of the losing coalition. Such corner solutions $r_p^*(\delta) = \delta_p$ happen if the pivotal player has players to its right whose adjustments merely have a "small" impact on V while adjustment costs are "substantial". The qualified majority threshold q is important here since higher q generally means there are fewer players in any losing coalition. In fact, it is always true that $r_i^*(\delta) = \delta_i$ for *some* set of players. For the player of the highest type, m say, tightening the restriction from δ_m does not lead to any adjustment of others, so $r_m^*(\delta) = \delta_m$ (see assumption 1). We have $r_p^*(\delta) = \delta_p$ for all potential pivots p (and hence no impact of larger size on expected adjustment costs) under the following condition:

Assumption 2 *(Externalities Dominated by Costs) The functions V and c and the qualified majority threshold q are such that for any potential realization δ, and its correspond-*

ing pivotal player p, losing coalition S,[13] *and equilibrium behavior if* $r = \delta_p$ *(namely,* $\widetilde{\delta}_i = \min\{\delta_p, \delta_i\}$ *for all* i*), we have:*

$$-\frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_p} - \sum_{k \in S} \frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_k} - c'(0) < 0$$

The next proposition invokes Assumption 2 to argue that more powerful players obtain a higher payoff than less powerful players, even if players are *not* of equal size. The intuition behind this is again that a potential "no-vote" of a powerful player i generally leads to a greater shift to the right of the chosen restriction than a no-vote of a less powerful player j. This implies that the expected adjustment cost of a powerful player is lower than for a less powerful player. Size now does not matter because $r_p^*(\delta) = \delta_p$, such that the adjustment costs of a player in a losing coalition just depend on her type, and not her size.

The crucial step for computing the expected adjustment costs term if $r_p^*(\delta) = \delta_p$ is the observation that a player i *only* incurs an adjustment cost if her type δ_i is located to the right of the player that would be pivotal in a voting game with all players but i, but in which it takes the *same number* of votes – namely q – to pass a proposal as in the game γ. In other words, denoting the "game without i" by γ_{-i}, and the location of the corresponding pivot by $\delta_p^{\gamma_{-i}}$, we have that player i incurs an adjustment cost only if $\delta_i > \delta_p^{\gamma_{-i}}$. If we had $\delta_i < \delta_p^{\gamma_{-i}}$ then either player i or a player to her right would be pivotal in the game γ, so that player i would satisfy the policy restriction without having to incur any adjustment cost.

This reasoning shows that *if* the pivot in the game without player i were *given*, the expected adjustment cost would be $\int_{\delta_p^{\gamma_{-i}}}^{1} c(\delta_i - \delta_p^{\gamma_{-i}}) d\delta_i$. However, from an ex ante perspective the pivot in the game without player i is *random* and follows a certain distribution, call it

[13] *That is* $\delta_k > \delta_p \Leftrightarrow k \in S$.

$F_{\delta_p^{\gamma_{-i}}}$. Therefore, the expected adjustment cost of a player is given by

$$E_\delta[c(\delta_i - \min\{\delta_p(\delta), \delta_i\})] = \int_0^1 \left[\int_r^1 c(\delta_i - r) d\delta_i \right] dF_{\delta_p^{\gamma_{-i}}}(r) \tag{7}$$

We show in the proof of the next proposition (Appendix B) that $F_{\delta_p^{\gamma_{-i}}}(r) < F_{\delta_p^{\gamma_{-j}}}(r)$ for all $r \in (0,1)$ if player i has more voting power than j.[14] This shows that $\pi_i^{LC} > \pi_j^{LC}$ because the term $E_\delta V$ in equation 6 is identical across players.

Proposition 3 *Consider any two players i and j and assume i has a greater voting weight ($w_i > w_j$). Assume externalities are dominated by costs (Assumption 2). (a) The payoff of player i is weakly higher than that of player j, that is: $\pi_i^{LC} \geq \pi_j^{LC}$. (b) If player i has more voting power than player j, then the payoff of player i is strictly higher than that of player j, that is: $\pi_i^{LC} > \pi_j^{LC}$.*

Our final result shows that if two players have *equal* voting power, then the expected payoff under late commitment is generally the lowest for the largest player. This is a direct implication of the phenomenon that pivotal players expose larger players to tighter restrictions; that is, it requires that Assumption 2 is violated. For this logic to apply it must be true that both players can end up in a losing coalition, i.e. neither has a veto.

Proposition 4 *Consider two players i and j and assume that i is larger than j. If i and j have equal voting power, and if there exists a potential realization δ and corresponding pivotal player and losing coalition S such that (1) $i \in S$ and (2) $-\frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_p} - \sum_{k \in S} \frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_k} - c'(0) > 0$ if $\widetilde{\delta}_i = \min\{\delta_p, \delta_i\}$ for all i (i.e. Assumption 2 is violated, the impact of some losing coalition with i is* not *"small"), then $\pi_i^{LC} < \pi_j^{LC}$, that is, the payoff of the largest player is the lowest.*

[14] That is, the distribution of $\delta_p^{\gamma_{-i}}$ stochastically dominates the distribution of $\delta_p^{\gamma_{-j}}$.

5 Discussion

5.1 Empirical predictions

Proposition 1 above shows that the payoff of early commitment is identical across players, while Propositions 2-4 show that the payoff of late commitment generally depends positively on the relative power of a player and negatively on the size of the player. In reality the preference as to early or late commitment of players depends on the specifics of the functions V and c, as well as on the qualified majority threshold q and any ex ante available information regarding (ex post) preferences (including any knowledge on anticipated cross-correlations among players – see Section 5.4). If variations in V, c and any potential information regarding preferences can be treated as "random noise" in the context of this paper, our model yields the following empirical predictions.

Prediction 1 *Assume the group has no veto players, i.e. for all players i we have $q < \sum_{j\in N\setminus\{i\}} w_j$. (a) Keeping their size fixed, players are more (less) likely to favor late commitment the greater (smaller) is their power. (b) Keeping their power fixed, players are more (less) likely to favor late commitment the smaller (greater) is their size.*

Depending on the balance between asymmetries in voting weights and their impacts on group benefits, individual players may prefer either early or late commitment. When voting weights differ significantly powerful players tend to want to delay policy choices because of their greater leverage over the ex post decision, while less powerful players prefer the symmetric treatment of early commitment. The prediction that large (high-impact-on-V) players are more prone to commit early stems from Proposition 4, which shows that if large players are in a losing coalition they tend to be exposed to strong actions on the part of the winning coalition, while small players in a losing coalition are not.

We next review some evidence that is consistent with these predictions.

Corporate governance. A recent literature studies the voluntary adoption of corporate governance provisions by firms. In this context voluntary adoption of certain types of corporate governance provisions can be viewed as early commitment by the firm. The decision to adopt such provisions is formally taken by the shareholders but is generally influenced by the firm's executives as well. While a firm's executives can be expected to oppose the adoption of clear corporate governance rules since it limits their discretion, the incentives of shareholders are less clear-cut and may depend on their power in the shareholder meetings according to Prediction 1a. In a sample of 748 decisions of Canadian firms regarding voluntary adoption of corporate governance provisions, Anand, Milne, and Purda (2006) show that firms are less likely to adopt the Canadian corporate governance guidelines if a member on the executive board of a firm holds more than 10 percent of the shares, or if the firm has a majority shareholder. Klapper, Laeven, and Love (2005) analyze a sample of 224 Eastern European firms and focus on the decision of these firms to include in their corporate charter two particular corporate governance provisions on shareholder voting. They find that firms with a majority shareholder are less likely to adopt these provisions than firms without a majority shareholder. However, the presence of block shareholders that are not majority shareholders makes it more likely that these provisions are adopted.

International Relations. There is a long-standing interest in the study of "small states" in international relations.[15] In this context "small" is usually defined in terms of power. Our model points out that although ex post the interests of small states may well diverge greatly, they may nevertheless pursue similar interests from an ex ante point of view. For example, our model supports the observation that small states are generally in support

[15]See e.g. Keohane (1969), Amstrup (1976), Katzenstein (1985), or Ingebritsen, Neumann, Gstohl, and Beyer (2006).

of furthering *legalization* of international organizations[16], i.e. precise codification and impartial third-party adjudication of rules: early commitment. The prediction that small states favor early commitment is also supported by a statement of Kofi Annan that small states "... are the very glue of progressive international cooperation for the common good." (Annan (1998)).

During the American constitutional convention in 1787 multiple coalitions formed, dissolved and reformed as the issues under consideration evolved. Subsequent scholarship has debated the source of the framers' differing viewpoints. Some argue that the positions taken were based on differing conceptions of what constitutes a "good republic," while others point to the personal interests (largely financial) of the founders themselves. Jillson and Eubanks (1984) argue that both these motives played a role, and that the dominant motive depended on the issue under consideration. They classify issues as either "high level", involving "constitutional design issues" such as the term of appointment of judges or whether the executive should be an individual or a council; and "low level" operational decisions, such as how the seats in the legislature will be apportioned. Though Jillson and Eubanks demonstrate that coalitions among states shifted in the course of the convention, it seems less clear that these issues can be classified so easily as principled or operational. After all, legislative apportionment can also be taken as a principled decision, with various rationales offered for equality of states or proportional representation. Our model suggests a classification of issues based on *information*. What Jillson and Eubank's termed "low level" issues were ones for which individual state interests have already been revealed, i.e. involving late commitment. Here, with all states maintaining a veto, negotiations were difficult (as Jillson and Eubanks clearly show). By contrast, "high level" decisions dealt with issues where adjustment costs remained unknown, thus early commitment. Jillson and

[16]See e.g. Goldstein, Kahler, Keohane, and Slaughter (2000)

Eubanks show these issues were the first broached because those in charge of the agenda recognized that agreement would be more easily reached.

European Union governance. Prediction 1a is also consistent with the observation in the European Union (EU) that the member states with high voting weight (e.g. France, Germany, Italy, and the UK) generally prefer to place responsibility for decisions with the Council of Ministers, where decisions are reached through weighted voting, while low-weight member states typically prefer policy to be delegated to the Commission, the EU's executive.[17] Schure and Verdun (2006) show that the three member states in the Euro-zone with the highest voting weight, namely France, Germany and Italy, were in favor of including open-ended statements during the recent reform of the Stability and Growth Pact, while several "small" member states were explicitly opposed, and pushed for a set of "clear rules". They argue that by including open-ended statements the high-weight member states sought to enhance the discretionary role for the Council in "enforcing" the Pact, while "small" member states tried to curb the discretionary role for the Council.

The unitization of oil fields. Prediction 1b is supported by the studies of Wiggins and Libecap (1985) and Libecap and Wiggins (1985) on oil field exploitation who found that small oil firms preferred to delay or permanently frustrate oil field unitization agreements. They also found that their power as a group explained how successful they were in achieving delay.[18]

[17]See, for example, Moravcsik and Nicolaïdis (1999) or Magnette and Nicolaïdis (2005). Although the Council formally decides by weighted voting, decisions are typically reached by "consensus". This fact does not contradict that the voting weights matter for the consensus decision that emerges (Golub, 1999).

[18]The failure of unitization negotiations in Texas represent the cleanest example of Prediction 1b because unitization agreements were taken by unanimity there, such that the oil firms *differed in size* but had *identical power*. On the other hand, it could also be argued that oil firms are not quite behind a veil of ignorance when they choose whether to unitize early or late. Wiggins and Libecap argue that small firms knew ex ante that their ex post incentives to cut back drilling intensity to the socially desirable level are generally less strong, that is, their types tended to be higher. This effect would reinforce the desire of small firms to unitize late despite the vast loss in revenue from the oil field.

Wiggins and Libecap (1985) suggest that asymmetries of information (e.g. regarding bottom hole pressure and remaining oil reserves) across firms bargaining for unitization agreements were the cause of contractual breakdown in oil field unitization agreements. However, Libecap and Wiggens (1985) explain that "... during exploration there is little asymmetric information across bargaining parties ... (p.692)" which makes early unitization agreements "easy". Since, as they also argue, early unitization is a far more efficient arrangement than late unitization, they leave unanswered the question as to why unitization agreements fail in an unregulated environment (see Libecap and Wiggens, 1984). Our model points to the incentive of some firms (and land owners) to drag their feet (and their political power as a group) as a possible cause of the breakdown of unitization agreements. While all parties were aware of the benefits of unitization for the group, firms may have disagreed about the timing of unitization negotiations because the *distribution* of the expected benefits of an agreement varied with time. Of course, as in all political economy models, side payments between players could have undone this effect. Thus, our answer is incomplete and leaves unexplained the transaction costs between the negotiating parties.

5.2 Delegation and the value of information

A disadvantage of early commitment in our model is that the information regarding types is not considered when setting the restriction. This is problematic if the costs of neglecting this information are substantial. In the model this happens for instance if the cost function c has a relatively high curvature. In this case the chosen restriction under early commitment would be "high", and inefficiencies arise, for instance, if most or all players have low type realizations.

In realistic settings there is the possibility to delegate a policy to an agency, and to grant the agency *discretionary power*. This avoids the costs of not using the information, but at the potential costs that the agency is not fully independent and can be manipulated by the players, particularly the powerful ones. If the agency is immune to political pressure of the players, then delegation with discretion is to be viewed as early commitment. If independence of the agency is not feasible then delegation with discretion resembles late commitment.

The International Criminal Court is a case of delegation with discretion, however its degree of independence is unclear as yet. It is a *court*, thus an actor immune to political pressure in its intent. However, its effectiveness depends crucially on the effort of parties to prosecute others and abide by its decisions. According to each of these two viewpoints, the reluctance of the US to join in is understandable in light of our model. As a powerful state the US is not prone to give up its power and commit early by abiding by the decisions of an independent court. However, the reluctance of the US is also understandable even if setting general standards of behavior does not imply equal treatment. While *ex post* voting rights mean little in a court, prosecution efforts are crucial. As a large player, the US fears it would be unduly exposed to asymmetric treatment and vindictive prosecution as Prediction 1b makes clear.

5.3 The role of the qualified majority threshold

An implication of Lemma 1 is that the value of q matters to the players' proposals in the late commitment game and for the winning restriction in particular. For high q the pivotal player has little incentive to tighten the restriction below its type, as the spillovers from reductions in behavior by the players of higher type are small. For lower values of q these spillovers can be significant, and the pivotal player may choose to incur substantial costs herself to further curtail the behavior of higher types.

In the extreme, when $q = \sum_{k \in N} w_k$ the procedure requires unanimity. Late commitment is then not threatening because each player can veto policy choices and protect their revealed interests. On the other hand, such opportunism poses a problem in terms of weak agreements that do not bind any party to a costly action. In anticipation of this sterility, or even failure, any hope for mutual gain will come from early commitment, i.e. agreements before self-interest is fully revealed. Thus, when we see any agreement at all, we expect to see early commitment.[19]

The fear of breakdown can be a strong incentive to continue bargaining. The US Constitutional Convention of 1787 serves as an illustration. At various times, stalemates were averted only because the delegates worried about the consequences of failure. Madison (1787) puts the problem of ex post disagreement in clear relief in the opening line of the Federalist Number 10: "Among the numerous advantages promised by a well-constructed Union, none deserves to be more accurately developed than its tendency to break and control the violence of faction." This argument worked to convince even the most wary delegates of the need for a vigorous effective government, and raised a specter useful at several later times in the convention to negotiate compromises (for example, the Connecticut Compromise that ensured the power of state delegates would be proportional to the state's population in one house and equal in a second house, and when states were permitted to maintain slavery).

5.4 Correlations in types

In the proofs above, the assumption that players' types are drawn independently plays an important role. In reality it is possible that certain subsets of players can anticipate that their types will correlate, so that these players form a natural coalition. Moving away

[19]Note however that in our model the group benefit function does not value standardization *per se*. If coordination on a single level of the policy variable desirable, such as may be the case for a (horizontal) product standard, it is possible that bargaining in a forum with veto players yields benefits.

from independence of type realizations would complicate the proofs, and also make it more difficult to identify "weak players". For example, on some issues it is reasonable to assume that Canada forms a natural coalition partner with the US. Thus, looking ahead to a late commitment vote, Canada would not consider itself in as much jeopardy as it would were types uncorrelated.

This suggests that were we to relax the independence assumption the principal loss would be empirical content. The theorems would go through, once the power measure was corrected to account for the expected natural coalitions. Canada might show up as a large player on several issues, only because in expectation it will form a coalition with others with sufficient power. In general, however, there is not always a simple way for an investigator to identify a set of natural correlations.

5.5 Side payments

So far we have assumed that utility is not transferable. Side payments could play a role both at the early-late decision as well as when the restriction is chosen. In the latter case, if the restriction is chosen early, symmetry amongst the players makes side payments irrelevant. However, if players choose the restriction late, side payments are another route for the powerful to extract surplus from the weak. During the early-late decision, therefore, the powerful already anticipate receiving more side payments than the less powerful, so that the prediction that the powerful drag their feet still holds. One difference when allowing for side payments when the restriction is picked is that the late decision on the restriction will be efficient (the Coase Theorem applies).

If side payments are allowed at the early-late decision as well, the Coase Theorem applies once more. The efficient decision is to choose "late commitment", since late decisions on the restriction are efficient. The voting outcome itself will now no longer reveal preferences as to early and late commitment, but the direction of the side payments will. In general the powerful will pay the weak.

6 Extensions

6.1 From veto to voting

In our model the voting weights w and the qualified majority threshold q are exogenous. One justification for this assumption is that the commitment decision is taken against a backdrop of an *existing constitutional template*, i.e. institutionalized values of q and w. For example, at the subnational level various interest groups (e.g. states or provinces within a federation, or political parties with predetermined legislative voting weights) may be faced with a constitutional template in which all decisions must be made. The model identifies characteristics that predict the players' stances on adoption of laws under subtantial uncertainty regarding its distributional consequences, or delegation to an administrative board versus maintaining legislative control. Another example would be decisions of the shareholders of a corporation subject to regulation and possibly the firm's statutes.

An alternative justification for treating the constitutional template as exogenous is that q and w do not represent explicit constitutional parameters, but rather the "informal power" of the players. Some players may be dominant as the result of economic or military power. Differences in the informal power of players may persist even when, nominally, everyone holds a veto, or players have equal (formal) voting weights. Sometimes, these explicit requirements are not capable of constraining the influence of dominant players and power relationships may change over time, even if the formal weights do not. As in the previous interpretation, the *template* is thus fixed. However it is less apparent in this case how the power of players might be measured, or how to draw the distinction between size and power, so that the model may lose empirical content.

These apologies for our exogeneity assumption are more persuasive in the case of the voting weights w than the threshold q, because even if voting weights represent differences in informal power, it is unclear how q is determined. For the rest of this section, we discuss how players might have arrived at a q. We proceed in two steps. In the current subsection we discuss when players are willing to give up their veto in exchange for a given q. In the next subsection we analyze a situation in which players have yet to determine the qualified majority threshold should they decide to commit to a policy late.

Assume the weights of players are given and that $q = q_0 = \sum_{k \in N} w_k$, i.e. each player currently has a veto. Consider the decision to adopt a given template $q_1 < \sum_{k \in N} w_k$. This situation may for example describe the choice of firms considering a merger, or the choice of sovereign states whether to address a "new" issue at the national level, or at the international level through an existing constitutional venue such as the United Nations or the WTO. This choice is also recurrently made by member states of the European Union (EU). Does the matter fall under EU jurisdiction or not? Or, does the Council of Ministers formally decide by unanimity or qualified majority voting. Both these cases involve a change to an existing Treaty, which requires unanimous approval of all 27 member states.

Assume for simplicity that there are just two weights, low and high, and that late commitment with $q = q_0$, i.e. contractual breakdown, is inferior to early commitment for all players. Finally, assume that the power difference between low-weight and high-weight players is substantial enough that low-weight players prefer early commitment under q_1, while high-weight players prefer late commitment.

There are two general cases to consider depending on the combined weight of the low-weight players. If the combined weight of the low-weight players exceeds q_1 then players are indifferent between retaining their veto power and relinquishing it. Under $q = q_0$ early commitment prevails because (by assumption) all players have an interest in avoiding late negotiations and contractual breakdown. However, once players agree to $q = q_1$ low-weight players will also impose early commitment on the group. In the case that low-weight players are collectively too weak to force early commitment under q_1, they are not willing agree to give up the unanimity rule q_0. Under q_1 high-weight players would successfully drag their feet, while under q_0 the threat of chaos after types are known induces all players, large and small, to opt for early commitment.

In summary, we began by studying the choice between the unanimity rule and qualified majority voting, which takes place before the decision to commit early or late. We found that this choice is irrelevant if low-weight players dominate under qualified majority voting, and that unanimity persists if they do not. Either way, in the end the policy choice becomes early commitment. Our main model has shown that the less powerful players have a tendency to favor early commitment in the context of a *given* constitutional template. This first extension suggests that when it comes to giving up sovereignty in exchange for a "reasonable" constitutional template it is less clear that small players are the frontrunners. Amstrup's (1976) report that small German states were the main hurdle to German unification in the 19th century are in support of this outcome. However, the result is of course tentative and calls for further investigation.

6.2 Endogenizing the qualified majority threshold

In this section we endogenize the qualified majority threshold q by changing stage 1 of the game described in Figure 1. Specifically, we consider the situation that in stage 1 players take the early-late decision *jointly* with the decision on q. This decision resembles what Hammons (1999) called the decision between a "lengthy, statute-oriented constitution" (early commitment) and a "short, framework-oriented constitution" (late commitment with a q). The setting also has a close resemblance with the choice between a "complete social contract" and an "incomplete social contract" as in Aghion and Bolton (2003) and Roland (2005), because a complete social contract would not involve voting, while voting or authority is essential under an incomplete social contract.[20]

As in the previous subsection, assume players are either high-weight or low-weight. Denote a generic high-weight player by the index i and a low-weight player by j. Assume again that policy decisions require unanimous consent by the players prior to negotiations: $q = q_0 = \sum_{k \in N} w_k$. Players either choose $r = r^{EC}$, i.e. the optimal restriction under early commitment, or they pick the qualified majority threshold $q < \sum_{k \in N} w_k$ which will govern a future (late) decision on r. For simplicity, consider just three values for q, namely: q_0 (the current default); $q^{\text{veto } i} < q_0$ (which is such that i retains its veto, but j not); and $q_1 < q^{\text{veto } i}$ (which is such that no individual player retains its veto). An outcome $q = q_0$ means constitutional negotiations fail; $q = q^{\text{veto } i}$ that the voting rules of, for example, the UN Security Council apply; and $q = q_1$ that all players voluntarily surrender their sovereignty over the policy decision.

Observe that, in a sense, the lower q is the more "drastic" is the constitution, since lower q means individual players give up more control over the policy choice. Early commitment $r = r^{EC}$ is the most drastic in this respect because players give up their leverage over the implemented policy completely. We will assume that players each propose a constitutional template simultaneously and non-cooperatively, and that the adopted constitution is the least drastic among them.[21] We will also concentrate on the non-trivial case in which (1) early commitment dominates failure for all players, i.e. $\pi^{EC} > \pi_i^{q_0} = \pi_j^{q_0}$, and (2) the power

[20]The resemblance is not perfect. Observe that the restriction r in our model is by construction also incomplete contract because it is not contingent on the state of nature and subjects all players to the same arrangement.

[21]This assumption ensures that disagreement among players does not necessarily imply failure of the constitutional negotiations, while, at the same time, each player has the chance to retain her veto. In reality, sovereign parties involved in constitutional negotiations often disagree on the preferred constitution, yet agree on certain aspects at the same time.

difference between low-weight and high-weight players is substantial enough to make low-weight players prefer early commitment and high-weight players late commitment under q_1, i.e. $\pi^{EC} > \pi_j^{q_1}$ and $\pi^{EC} < \pi_i^{q_1}$. We restrict the analysis to equilibria in pure strategies, and assume that players of identical voting weight choose identical strategies.

Let us first point out that the game has a trivial Nash equilibrium, namely one in which both types of players choose to keep their veto, i.e. (q_0, q_0). We will omit any further discussion of this equilibrium because it is unlikely that constitutional negotiations fail due to a coordination problem. Observe also that powerful players have a dominant strategy, namely either to propose q_1 (if $\pi_i^{q_1} > \pi_i^{q^{\text{veto } i}}$) or $q^{\text{veto } i}$ (if $\pi_i^{q_1} < \pi_i^{q^{\text{veto } i}}$). The presence of a dominant strategy for high-weight players rules out early commitment, even if low-weight players dominate the high-weight players under q_1. Notice the sharp contrast of this result with the outcome of the game of the previous subsection that predicted early commitment.

Since powerful players have a dominant strategy the constitutional game has an equilibrium. However, the equilibrium may be "failure". This result is perhaps surprising given our assumption that early commitment dominates failure. It highlights the intrinsic difficulties of constitutional negotiations if power is asymmetrically distributed across players under "reasonable" constitutional templates. If the dominant strategy of high-weight players is q_1, failure of the constitutional negotiations happens if $\pi_j^{q_1} < \pi_j^{q_0}$. Low-weight players anticipate being tyrannized by the majority too often under q_1 such that failure, however painful, is a more attractive option. The existence of this equilibrium may explain several difficulties in the US constitutional negotiations. One important divide between the states was based on power. "Small states" feared to be pushed aside too often in future legislative decisions (see e.g. Farrand, 1958). The Connecticut Compromise resolved the deadlock by the creation of a bicameral system with each state obtaining 2 seats in one house irrespective of size. Thus, in terms of our model, the resolution was to change the voting *weights* of states, diminishing the power difference between states. For "large states" relinquishing some power was a more attractive option than failure.

If the dominant strategy of high-weight players is $q^{\text{veto } i}$ failure can also happen. If $\pi_j^{q^{\text{veto } i}} < \pi_j^{q_0}$ the low-weight players block the powerful's favorite constitution $q^{\text{veto } i}$, because with their vetoes too little would remain on the table for the low-weight players. It is intuitive that $q^{\text{veto } i}$ is more likely to be rejected by the low-weight players if there are many high-weight players, because this implies the high-weight player of the highest-type is usually pivotal. Effectively, then, low-weight players have no voting power. On the other hand, a high-weight player's payoff under $q^{\text{veto } i}$ also tends to be small if they are many. Thus, with many high-weight players it is likely that $\pi_i^{q_1} > \pi_i^{q^{\text{veto } i}}$, that is, surrendering sovereignty is likely the dominant strategy for them.

In summary, if this model of the decision between a "lengthy, statute-oriented constitution" and a "short, framework-oriented constitution" adequately describes constitutional negotiations, early commitment cannot prevail even in the presence of many low-weight players. With just a few high-weight players the high-weight players are unlikely to be keen on surrendering their vetoes. For low-weight players $q^{\text{veto } i}$ may or may not be productive enough compared to the alternative, i.e. failure. With many high-weight players surrendering sovereignty is likely the dominant strategy for powerful players. Low-weight players essentially now choose to take or leave q_1.[22] The possibility of failure in a model with a Pareto-improving constitution, namely r^{EC}, sheds light on the intrinsic difficulties of constitutional negotiations in the face of anticipated power differences under "reasonable" constitutional templates. The recent Iraqi constitutional negotiations form an example of this situation.

By 1987 all EU member states had ratified the so-called Single European Act (1985-87). By ratifying the Act all EU member states had given up their vetoes regarding all

[22]The theoretical option that $q^{\text{veto } i}$ suits them best is unlikely because with many large players the payoff of $q^{\text{veto } i}$ is likely close to the payoff of failure.

decisions pertaining to the formation of the Single Market. Thus, member states committed to an open-ended process of market reforms to be decided upon by weighted voting in the Council that goes on to date. The model in the previous subsection could not explain why EU member states, particularly small member states, could ever agree to signing the Single European Act. While simplistic, the model of this subsection is rich enough to explain this major step in the European integration process.

6.3 Endogenizing the qualified majority threshold: the literature

Endogenizing the qualified majority threshold has a long history in the literature. A standard result is that a higher qualified majority threshold reduces the risk of "cycles" when voting on the policy decision. Caplin and Nalebuff (1988) prove that a qualified majority threshold of 64 percent ensures that the equilibrium voting outcome corresponds with the preferred voting outcome of the median-voter for a large class of voter preferences and a large number of voters. By construction we do not face the problem of cycles in our model.

In Harsanyi (1953, 1955) a risk-neutral "impartial observer" prefers a system with equal voting weights and the simple majority rule. An increase in the degree of risk aversion to become part of the losing minority increases the qualified majority threshold. Aghion and Bolton (2003) show that the optimal qualified majority threshold increases with the expected cost of compensating the losing minority ex post. In their model a group of players chooses the qualified majority threshold "behind a veil of ignorance" (Rawls (1971)). Under a veil of ignorance the group's problem corresponds to the "planner's problem" considered in Harsanyi.

In this paper we lifted the veil of ignorance in one specific dimension: ex ante players know their ex post power and size. We show that as a consequence players generally prefer different choices for the qualified majority threshold. This is one explanation why bargaining on the voting rules (constitutional bargaining) is often fraught with political economy considerations.[23]

Finally, in Aghion, Alesina, and Trebbi (2004) the choice for q represents the optimal degree of delegation of discretionary power to politicians, and in Dal Bo (2006) the optimal degree of commitment to a policy, respectively. Messner and Polborn (2004) explain why identical citizens may favor a higher qualified majority threshold with respect to decisions to change the voting rules than with respect to legislative decisions. In Barstad (2005) the choice of q induces the optimum level of investment that players make prior to the legislative choice. Maggi and Morelli (2006) point to the importance of the interaction between the choice of q and the difficulty of enforcement of the choices it governs. Barberà and Jackson (2004) investigate which constitutions, and q's in particular, survive over time given that decisions to alter them are governed by the prevailing constitutions itself.

7 Conclusion

In this paper we have studied collective decisions in which the aim is to agree on a policy that restricts the behavior of all individual group members. Such a setting is relevant in case the behavior of individual players involves externalities on the other players.

We show that if players have different voting weights, the powerful players have a greater incentive to vote on the restriction after they learn their type. Late decisions expose all players to the possibility to be tyrannized by the majority, however this happens less frequently to powerful players who therefore have a higher expected payoff from dragging their feet than less powerful players. Less powerful players will more likely prefer to vote on

[23]Another is that players have signals of their ex post preferences during constitutional decisions, as in Aghion, Alesina, and Trebbi (2004), Messner and Polborn (2004), or Barberà and Jackson (2004, 2006).

the restriction upfront as this serves as an insurance policy against ex post opportunistic behavior of the powerful. We found that greater size tends to reduce the payoff of a late decision because it generally makes for tighter restrictions if the player ends up being in a losing coalition. Players tend to drag their feet when their power is sufficient to outweight the effect of their possibly larger size.

The result that the powerful drag their feet is consistent with observations from a variety of areas and we have discussed examples from corporate governance, international relations, and European Union governance. The result that greater size of a player reduces her incentives to vote to delay is consistent with several papers on the exploitation of oil fields. A full-scale empirical investigation of our model awaits future research.

The existing literature on collective decision-making assumes the decision moment is fixed while our paper relates weighted voting to the preference of players regarding the *timing* of decisions. As we have shown the timing of decisions becomes relevant if players learn about the distributional consequences of decisions over time. In reality group decisions only take place when somebody has set the agenda. Seen from this angle our theory predicts that a player with a small voting weight is more active in advancing agenda items that force the group to vote. This can explain for example why the "small" EU member states were so adamant that the EU keep its rotating presidency in the European Convention which produced the Draft Treaty establishing a Constitution for Europe in July 2003 (Magnette and Nicolaïdis (2005)).

A caveat of our study is that we have maintained the assumption that the restriction is identical for each player. In multilateral negotiations this assumption is often satisfied, but there are also exceptions and sometimes "some animals are more equal than others". The Non-proliferation Treaty is a striking example of an asymmetric restriction, recognizing five states as the official nuclear powers as of 1 January 1967, and imposing on all other signatories restrictions that aim at preventing them from developing a nuclear weapon arsenal.

We have also assumed full commitment to the restriction in our model. In a context of limited commitment it can be expected in the logic of our model that powerful players more often agree ex ante to a given restriction than our model predicts, to challenge the agreement ex post.

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A Proof Proposition 2

Proof of statement (b). Any difference between the payoffs of players must come in through a difference in their expected adjustment costs, because $E_\delta V$ is common to all players. Hence, we must show that $E_\delta c(\delta_j - \min\{r_p^*(\delta), \delta_j\}) > E_\delta c(\delta_i - \min\{r_p^*(\delta), \delta_i\})$. We show this below by proving that $r_{p'}^*(\delta') \leq r_p^*(\delta)$ and $r_{p'}^*(\delta') < r_p^*(\delta)$ with positive probability.

Consider an arbitrary realization δ and its permutation δ'. Observe that the choice of δ is arbitrary, and that both δ and δ' have the same probability density. Let p be the index of the pivotal player for the realization δ and p' the index of the pivotal player for δ'. The chosen restriction associated with δ (namely $r_p^*(\delta)$) and δ' (namely $r_{p'}^*(\delta')$) are identical unless possibly if (1) $i = p$, (2) $\delta_j < \delta_p < \delta_i$, or (3) $\delta_i < \delta_p < \delta_j$. This also means that, unless in one of these cases, the adjustment costs of i under δ are identical to the adjustment costs of j under δ'.

If $\delta_j < \delta_p \leq \delta_i$ (i.e. if $\delta_j < \delta_p = \delta_i$ or case (2) applies) then switching the positions of i and j increases the voting weight *below* player p. This implies $\delta'_i \leq \delta_{p'} \leq \delta_p$ and $\delta'_i \leq \delta_{p'} < \delta_p$ with positive probability, hence $r_{p'}^*(\delta') \leq r_p^*(\delta)$ and $r_{p'}^*(\delta') < r_p^*(\delta)$ with positive probability.

If $\delta_i \leq \delta_p < \delta_j$ (i.e. $\delta_i = \delta_p < \delta_j$ or case (3)) then switching the positions of i and j increases the voting weight *above* player p. This implies $\delta'_j \leq \delta_p \leq \delta_{p'}$ and $\delta'_j \leq \delta_p < \delta_{p'}$ with positive probability, hence $r_p^*(\delta) \leq r_{p'}^*(\delta')$ and $r_p^*(\delta) < r_{p'}^*(\delta')$ with positive probability.

Statement (a) is implied by (b) because voting weight and voting power are related as follows: (i) if player i has more voting weight than player j, then i has as least as much voting power as j, that is: $w_i > w_j \Rightarrow \phi_i \geq \phi_j$; and (ii) if player i has more voting power than player j, then i must the largest voting weight, that is: $\phi_i > \phi_j \Rightarrow w_i > w_j$.

B Proof of Proposition 3

As in the proof to Proposition 2 we only need to prove statement (b) because it implies statement (a). Equations 6 and 7 show that any difference between π_i^{LC} and π_j^{LC} must come in through a difference in the distributions $F_{\delta_p^{\gamma_{-i}}}(r)$ and $F_{\delta_p^{\gamma_{-j}}}(r)$. We prove this below by showing that $F_{\delta_p^{\gamma_{-i}}}(r) < F_{\delta_p^{\gamma_{-j}}}(r)$ for all $r \in (0,1)$, that is, the distribution of $\delta_p^{\gamma_{-i}}$ stochastically dominates the distribution of $\delta_p^{\gamma_{-j}}$.

Let $F_{\delta_p^{\gamma_{-i}}}(r)$ be the distribution function of the type of the pivot in the "game without i" (i.e. the game $\gamma_{-i} = (q; w_1, ..., w_{i-1}, w_{i+1}, ..., w_n)$) and $F_{\delta_p^{\gamma_{-j}}}(r)$ the distribution function of the type of the pivot in the "game without j". The formulas of these distributions are given by equation 18 in the next appendix. We would like to prove that $F_{\delta_p^{\gamma_{-i}}}(r) < F_{\delta_p^{\gamma_{-j}}}(r)$ for all $r \in (0,1)$. The proof is based on the observation that among the set of all coalitions without players i and j (i.e. $T \subseteq N \setminus i \setminus j$) there are some losing coalitions that could become a winning coalition with the support of the w_i votes of a powerful player i, but remain a losing coalition with the support of the w_j votes of a less powerful player j. Below we will first rearrange the equations for the Shapley-Shubik power index of players i and j, and the formulas for the distributions of $F_{\delta_p^{\gamma_{-i}}}(r)$ and $F_{\delta_p^{\gamma_{-j}}}(r)$. We use these equations to next prove $F_{\delta_p^{\gamma_{-i}}}(r) < F_{\delta_p^{\gamma_{-j}}}(r) \Rightarrow \phi_i(\gamma) > \phi_j(\gamma)$ and after that the reverse.

The Shapley-Shubik power index, defined in footnote 7, can be rewritten as

$$\phi_i(\gamma) = \int_0^1 \sum_{S \subseteq N \setminus i} r^s (1-r)^{n-s-1} \left[v_\gamma(S \cup i) - v_\gamma(S) \right] dr \tag{8}$$

where $s = |S|$ is the cardinality of coalition S. Define $G_i(r)$ as the integrand of 8, and use equation 18 to get

$$G_i(r) = \sum_{S \subseteq N \setminus i} r^s (1-r)^{n-s-1} \left[v_\gamma(S \cup i) - v_\gamma(S) \right] = \sum_{S \subseteq N \setminus i} r^s (1-r)^{n-s-1} v_\gamma(S \cup i) - F_{\delta_p^{\gamma_{-i}}}(r) \tag{9}$$

Now rewrite the summation to get

$$G_i(r) = \sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup i\cup j) + \sum_{T\subseteq N\backslash i\backslash j} r^t(1-r)^{n-t-1} v_\gamma(T\cup i) - F_{\delta_p^{\gamma-i}}(r) \quad (10)$$

Here $t = |T|$, the cardinality of the coalition T. For player j we have a similar formula, namely:

$$G_j(r) = \sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup i\cup j) + \sum_{T\subseteq N\backslash i\backslash j} r^t(1-r)^{n-t-1} v_\gamma(T\cup j) - F_{\delta_p^{\gamma-j}}(r) \quad (11)$$

Subtracting these the last two equations yields

$$G_i(r) - G_j(r) = \sum_{T\subseteq N\backslash i\backslash j} r^t(1-r)^{n-t-1}\left[v_\gamma(T\cup i) - v_\gamma(T\cup j)\right] - \left[F_{\delta_p^{\gamma-i}}(r) - F_{\delta_p^{\gamma-j}}(r)\right] \quad (12)$$

Next, rewrite the formulas for the pivots without player i and player j by changing the summation index:

$$\begin{aligned} F_{\delta_p^{\gamma-i}}(r) &= \sum_{S\subseteq N\setminus i} r^s(1-r)^{n-s-1} v_\gamma(S) = \\ & \sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup j) + \sum_{T\subseteq N\backslash i\backslash j} r^t(1-r)^{n-t-1} v_\gamma(T) \end{aligned} \quad (13)$$

$$\begin{aligned} F_{\delta_p^{\gamma-j}}(r) &= \sum_{S\subseteq N\setminus j} r^s(1-r)^{n-s-1} v_\gamma(S) = \\ & \sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup i) + \sum_{T\subseteq N\backslash i\backslash j} r^t(1-r)^{n-t-1} v_\gamma(T) \end{aligned} \quad (14)$$

We now turn to the actual proof. We first prove that $F_{\delta_p^{\gamma-i}}(r) < F_{\delta_p^{\gamma-j}}(r) \Rightarrow \phi_i(\gamma) > \phi_j(\gamma)$. Since $F_{\delta_p^{\gamma-i}}(r) < F_{\delta_p^{\gamma-j}}(r)$ we know from equations 13 and 14 that

$$\sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup j) < \sum_{T\subseteq N\backslash i\backslash j} r^{t+1}(1-r)^{n-t} v_\gamma(T\cup i) \quad (15)$$

This inequality shows that, among the set of all coalitions T without players i and j, there are some losing coalitions, that continue to be losing if j enters the coalition (i.e.

$v_\gamma(T \cup j) = 0$), however become winning coalitions in case i enters ($v_\gamma(T \cup i) = 1$). Dividing both sides of inequality 15 by r, and rearranging, we get

$$\sum_{T \subseteq N \backslash i \backslash j} r^t (1-r)^{n-t-1} \left[v_\gamma(T \cup i) - v_\gamma(T \cup j) \right] > 0 \tag{16}$$

The inequalities 16 and $F_{\delta_p^{\gamma-i}}(r) < F_{\delta_p^{\gamma-j}}(r)$ show that $G_i(r) > G_j(r)$ for all r (see expression 12) Since $\int_0^1 G_i(r)dr = \phi_i(\gamma)$ and $\int_0^1 G_j(r)dr = \phi_j(\gamma)$ we must therefore have $\phi_i(\gamma) > \phi_j(\gamma)$.

We next prove $\phi_i(\gamma) > \phi_j(\gamma) \Rightarrow F_{\delta_p^{\gamma-i}}(r) < F_{\delta_p^{\gamma-j}}(r)$. First, define $G_i(r)$ and $G_j(r)$ as above. Since $\phi_i(\gamma) > \phi_j(\gamma)$ we have $\int_0^1 \left[G_i(r) - G_j(r) \right] dr > 0$. Substituting equations 13 and 14 into equation 12 and rearranging the result we obtain

$$\int_0^1 \sum_{T \subseteq N \backslash i \backslash j} r^t (1-r)^{n-t-1} (1+r) \left[v_\gamma(T \cup i) - v_\gamma(T \cup j) \right] dr = \int_0^1 \left[G_i(r) - G_j(r) \right] dr$$

Next, since $\int_0^1 \left[G_i(r) - G_j(r) \right] dr > 0$ and $r^t(1-r)^{n-t-1}(1+r) > 0$ for $0 < r < 1$ the equation above implies $v_\gamma(T \cup i) - v_\gamma(T \cup j) > 0$, i.e. there are some losing coalitions, that continue to be losing if j enters the coalition, however become winning coalitions in case i enters. Finally, from equations 13 and 14 we obtain that

$$F_{\delta_p^{\gamma-i}}(r) - F_{\delta_p^{\gamma-j}}(r) = r \sum_{T \subseteq N \backslash i \backslash j} r^t (1-r)^{n-t-1} \left(v_\gamma(T \cup j) - v_\gamma(T \cup i) \right) \tag{17}$$

Since $v_\gamma(T \cup i) - v_\gamma(T \cup j) > 0$ and $r^{t+1}(1-r)^{n-t-1} > 0$ for $0 < r < 1$ we conclude that $F_{\delta_p^{\gamma-i}}(r) - F_{\delta_p^{\gamma-j}}(r) > 0$ for $0 < r < 1$.

C The distribution of the type of the pivot

By assumption the types of players δ_j, $j \in N$ are independent and uniformly distributed on $[0, 1]$. Therefore, if r were exogenous, $\Pr\{\delta_j \leq r\} = r$ would be the probability that a player's type is to the left of r. Similarly, the probability of obtaining a coalition S with players that vote "yes" to an exogenously picked r, and players outside S all vote "no", is given by:

$$\Pr\{S\} = \prod_{j \in S} \Pr\{\delta_j \leq r\} \prod_{j \notin S} \Pr\{\delta_j > r\} = r^s (1-r)^{n-s}$$

Here $s = |S|$, the cardinality of the coalition S. The sum of votes cast in by a coalition S is $\sum\limits_{j \in S} w_j$. If $\sum\limits_{j \in S} w_j \geq q$ then S is a winning coalition, i.e. $v_\gamma(S) = 1$; otherwise S is a losing coalition.

Now define n independently distributed random variables w_j^r, $j = 1, ...n$ as follows:

$$w_j^r = \begin{cases} w_j & \text{with probability } r \\ 0 & \text{with probability } 1-r \end{cases}$$

The probability to reach a majority on a certain proposal r is given by $\Pr\left\{\sum_1^n w_j^r \geq q\right\}$. This probability depends on r, q, and w. The event $\sum_1^n w_j^r \geq q$, $j \in S$ is identical to the event $v_\gamma(S) = 1$ and identical to the event "The type of the pivot is located to the left of r". The distribution function $F_{\delta_p}(r)$ (which represents the probability that the type of the pivot is to the left of r) is hence given by:

$$F_{\delta_p}(r) = \sum_{S \subseteq N} r^s (1-r)^{n-s} \cdot v_\gamma(S)$$

Observe that $F_{\delta_p}(r) = 0$, $F_{\delta_p}(1) = 1$ and that $F_{\delta_p}(r)$ is continuously increasing in $r \in [0, 1)$.

Deriving the distribution function of the pivot in the game γ_{-i} in the same way gives:

$$F_{\delta_p^{\gamma_{-i}}}(r) = \sum_{S \subseteq N \setminus i} r^s (1-r)^{n-s-1} \cdot v_\gamma(S) \tag{18}$$

Note that $F_{\delta_p^{\gamma_{-i}}}(r)$ is also the conditional probability that the pivot in the game γ is located before r *given that* player i votes against r.

D Proof of Proposition 4

We need to show that the expected adjustment cost of i is larger than that of j, because $E_\delta V$ is common to all players. Consider an arbitrary realization δ and its permutation δ'. Assume without loss of generality that $\delta_j = \delta'_i < \delta_i = \delta'_j$. Observe that the location of the type of the pivotal voter, say δ_p, is identical for δ and δ', because i and j have equal voting power. (The *index* of the pivot is also the same, unless either i or j is the pivot, in which case the index of the pivot switches).

Focus on the functions of r that express the group benefits given the realization δ and its permutation δ', say $V_\delta(r) \equiv V(\min\{r, \delta_1\}, ..., \min\{r, \delta_n\})$ and $V_{\delta'}(r) \equiv V(\min\{r, \delta'_1\}, ..., \min\{r, \delta'_n\})$. The (left-hand) derivatives of these two functions are identical for $r \leq \delta_j = \delta'_i$. But for $\delta_j = \delta'_i < r \leq \delta_i = \delta'_j$ we have $V'_\delta(r) < V'_{\delta'}(r)$ that is, the derivative $V'_\delta(r)$ is more negative (the effect of a decrease in r is stronger under δ because it reflects a change in behavior of the larger player – see Definition 2, equation a), and for $r > \delta_i = \delta'_j$ we have $V'_\delta(r) \leq V'_{\delta'}(r)$ (see Definition 2, equation b)

Because we have $V'_\delta(r) < V'_{\delta'}(r)$ for $\delta_j = \delta'_i < r \leq \delta_i = \delta'_j$ we obtain from equation 4 that if $\delta_j = \delta'_i < r^*_p(\delta) < \delta_i = \delta'_j$ and $-\frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_p} - \sum_{k \in S} \frac{\partial V(\widetilde{\delta})}{\partial \widetilde{\delta}_k} - c'(0) > 0$ then $r^*_p(\delta) < r^*_p(\delta')$. Since, by assumption, these conditions are jointly satisfied with positive probability, we have also in any case $r^*_p(\delta) < r^*_p(\delta')$ with positive probability, and $r^*_p(\delta) = r^*_p(\delta')$ otherwise, so that $E_\delta c(\delta_j - \min\{r^*_p(\delta), \delta_j\}) < E_\delta c(\delta_i - \min\{r^*_p(\delta), \delta_i\})$.