A Generalized Measure of Bargaining Power, with an Application to EU Law-Making

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Abstract

Despite recent advances, no general methods for computing bargaining power in non-cooperative games exist. We propose a measure of bargaining power that can be applied to virtually any such game. The principle underlying this measure is that the influence of a player can be assessed according to how much changes in this player's preferences affect outcomes. In the context of two-player games, we show that no other function satisfies a number of desirable properties. Considering specific classes of games, we demonstrate that our approach nests existing measures of power. As an application, we investigate the relative influence of institutions of the European Union on EU legislation. Based on a structurally estimated model of the legislative process, we find that the distribution of bargaining power is driven by veto rights. While the Treaty of Lisbon substantially increased the power of the European Parliament, the combined influence of the Commission and the Council of Ministers continues to exceed that of the Parliament.

Keywords: Bargaining Power, Non-Cooperative Games, Legislative Bargaining, European Union.

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1 Introduction

Bargaining power and its sources have long interested economists and social scientists more generally. Examples that have received particular attention include bargaining between buyers and sellers (Dunlop & Higgins 1942, Taylor 1995, Loertscher & Marx 2022), employers and labour unions (Hamermesh 1973, Svejnar 1986, Manning 1987), husband and wife (Basu 2006, Browning et al. 2013, Anderberg et al. 2016), the members of a political alliance (Diermeier et al. 2003, Francois et al. 2015), or legislators (Snyder et al. 2005, Kalandrakis 2006, Ali et al. 2019). In cooperative game theory, a vast literature deriving power indices exists with the Shapley-Shubik index (Shapley & Shubik 1954) or the Penrose-Banzhaf index (Penrose 1946, Banzhaf 1965, Dubey & Shapley 1979) being the most famous examples. Cooperative game theory, however, does not model the process through which players interact with one another and is thus not able to answer question such as how the bargaining power of a player depends on their ability to make a counter offer, delay agreement, or veto certain proposals. Understanding the role of such features is important for institutional design, for instance. In non-cooperative game theory, on the other hand, the structure of the interaction between players forms an explicit part of a game, but in this context much less effort has been invested in developing measures of power. A common approach is to assume transferable utility (henceforth TU) and self-interested players, in which case bargaining power can be measured by the expected share of the surplus that each participant receives. But if utility is non-transferable or at least one player feels some degree of altruism, the utility a player achieves in equilibrium need not be informative about this player's bargaining power. To see this, consider the following example: Three countries form a military alliance and need to decide how to respond to foreign aggression. Country A is hawkish, country B is dovish, and country C prefers a measured response. If the agreed policy coincides with that favoured by country C, it is not clear that this outcome is due to the dominance of Country C or represents a compromise between countries A and B. How can we put a number on the bargaining power of each country?

In this paper, we provide a measure of bargaining power that can be applied across a wide range of contexts. More specifically, we introduce a procedure for calculating each player's influence in any non-cooperative game of bargaining. We start by introducing a number of axioms that a measure of bargaining power should satisfy. The key idea underlying these axioms is that bargaining power should depend on the degree to which changes in a player's preferences translate into changes in the outcome of the game. For example, we call a player a dictator if only this player's preferences matter for the outcome and specify that such a player should be assigned a bargaining power of one. In the context of two-player games, we show that there exists a unique function satisfying all axioms. This function measures the bargaining power of player n as the degree to which changes in this player's preferences affect everyone's utility relative to the case where player n is a dictator. We then propose an extension of this measure to settings with more than two players and show that this function also satisfies all axioms.

We establish conditions under which, for games of transferable utility, our measure is equal to the expected share of the total surplus a player receives in equilibrium, and thus equivalent to the conventional approach to calculating bargaining power in this setting. Whereas the two approaches often coincide, they can also produce notably different results as illustrated by the following example: Suppose there are two players who need to divide a cake among themselves and each player's utility is given by the share of the cake they receive. With probability .9 the whole cake is given to player 1 and the game ends. With the remaining probability, player 2 is given the opportunity to propose a split. If player 1 accepts such an offer, the split proposed by player 2 is implemented. If player 1 rejects, both players receive nothing. In the unique subgame perfect equilibrium of this game, player 2 proposes to keep the whole cake and player 1 accepts. The share of the cake (and of the available surplus) that player 1 receives in expectation is therefore equal to .9. However, the preferences of player 1 do not matter for the outcome. For example, the outcome of the game would not change even if player 1 preferred to give all of the cake to player 2. Given that our measure is based on the degree to which changes in a player's preferences lead to changes in the outcome, it assigns player 1 a bargaining power of zero rather than 0.9. While arguments in favour of either approach to measuring bargaining power exist, the key advantage of our method is that it is not limited to TU settings and can be applied to any game of bargaining.

The bargaining power our measure assigns to a player is conditional on players' preferences. It can also be of interest to abstract from preferences and evaluate power as determined by the rules of the game only, for example when designing institutions before players' preferences are known. Such an ex ante measure of power can be constructed based on our ex post measure by specifying a distribution that players' preferences are drawn from and then calculating expected ex post power under said distribution. We apply this method to weighted voting games. Under suitable choices of the distribution of players' preferences, we show that the ex ante version of our measure reproduces the Shapley-Shubik index and the Penrose-Banzhaf index.

To demonstrate the usefulness of our measure of bargaining power, we apply it to the legislative process of the European Union. The EU has the power to introduce laws that immediately become binding in all member states. Passing such legislation is a shared responsibility of three institutions, namely the European Commission, the European Parliament, and the Council of Ministers. The relative influence of these institutions has been a source of controversy. In particular, a perceived weakness of the European Parliament as the only directly elected institution of the EU has led to claims of a "democratic deficit". Partly in response to this criticism, the Treaty of Lisbon sought to strengthen the role of the European Parliament. To evaluate the extent to which this goal was achieved, we formulate a model of the legislative process of the EU. This model is closely tailored to the formal rules that negotiations are subject to, known as the Ordinary Legislative Procedure (OLP). We estimate the structural parameters of our model based on data that contain information on the nature and timing of all decisions taken as part of the OLP during the seventh and eighth term of the European Parliament between 2009 and 2019.

Based on the estimated model, it is straightforward to apply our measure of bargaining power. The results show that individually the Parliament has the strongest influence on EU legislation under the OLP. We find that the outcomes of the legislative process are mostly driven by veto rights, since the interests of the Commission and the Council are often diametrically opposed to those of the Parliament. The relatively close alignment between the Commission and the Council has the consequence that the vetoes of these institutions are individually redundant, making them appear weak. We show, however, that collectively their influence far exceeds that of the Parliament. The reason is that the Commission and the Council are favoured by the status quo, making their vetoes more effective in preventing unwanted policy shifts. Additional results reveal that the rules of the OLP by themselves create a fairly level playing field among institutions and that the Treaty of Lisbon substantially strengthened the role of the Parliament by giving it the ability to veto legislation. The predominance of veto rights means that reforms of the legislative process that leave vote rights in place are largely inconsequential for the distribution of bargaining power.

The remainder of this paper is organised as follows: In Section 2, we place our study in the context of the literature, before introducing our measure of bargaining power ins Section 3. Section 4 presents the application to the legislative process of the European Union, while Section 5 concludes.

2 Related Literature

Our main contribution to the literature is to provide a method for calculating the bargaining power of a player that can be applied to any non-cooperative model of bargaining. In cooperative game theory, a vast literature exists that develops power indices for so-called simple games with a particular interest in voting games (see, for example, Penrose 1946, Shapley & Shubik 1954, Banzhaf 1965, Deegan & Packel 1978, Johnston 1978, Holler 1982, Owen & Shapley 1989). Since a non-cooperative game can generally not be expressed as an in some sense equivalent cooperative game,[1] there is no general way to apply power indices intended for cooperative games to non-cooperative games. In non-cooperative game theory, in contrast, the only approach to measuring power that is widely applied is to assume transferable utility and selfish players, in which case power can be measured by the share of the total surplus a player receives (Taylor 1995, Haller & Holden 1997, Kambe 1999, Fréchette et al. 2005, Snyder et al. 2005, Kalandrakis 2006, Ali et al. 2019). Yet, transferable utility is a strong assumption since it requires that players have access to a common currency with constant marginal utility (Myerson 1991, p. 384). When utility is non-transferable, it is in some cases possible to express the equilibrium of the bargaining game as a weighted mean of each player's most preferred outcome, either in terms of physical outcomes or in terms of utilities. In games with more than two players such weights are often not unique, however, as in the example of the military alliance we provide in the introduction or in our application to EU legislation. Larsen & Zhang (2021) follow this approach to derive a measure of bargaining power for two-player games. Their measure is outcome-based in the sense that it assigns a player a high bargaining power if their utility is close to their best-possible outcome. The same is not necessarily true for our measure, as illustrated by the example in the introduction where player 1 receives almost all of the surplus but is assigned a bargaining power of zero since their preferences have no influence on the allocation. Steunenberg et al. (1999) develop a power measure for games where players' utilities are a function of the distance between the outcome and their ideal point. They assume a

[1] Papers that connect cooperative and non-cooperative game theory typically seek to provide a non-cooperative justification for a cooperative solution concept by finding a specific non-cooperative game that generates the same distribution of payoffs as the cooperative solution. See, for example, Hart & Mas-Colell (1996), Krishna & Serrano (1996), Serrano & Vohra (1997) and Laruelle & Valenciano (2008).

distribution that players' preferences and the status quo are drawn from and that the power of a player is inversely proportional to the average distance between their ideal point and the outcome across all possible draws. This procedure is computationally intensive and cannot calculate power conditional on a specific constellation of preferences. Napel & Widgrén (2004) explore the idea of power as the sensitivity of the outcome of a game to changes in preferences and their approach is in this sense closest to ours. They propose a measure for games with a one-dimensional outcome space and suggests different ways in which their approach can potentially be generalised. The basis of their measure is the extent to which changes in a player's ideal outcome shift the outcome of the game, while our axiomatic approach produces a measure of bargaining power that depends on how much a player can affect both their own and the utility of all other players. Furthermore, their focus on marginal shifts in preferences can produce misleading results.[2] We thus go beyond the existing literature by providing a new measure of bargaining power, which is the first measure that can be applied to any non-cooperative game of bargaining. Furthermore, we provide the first axiomatization of a measure of bargaining power in the field of non-cooperative game theory.

We demonstrate the value of our approach in an empirical context by applying it to a structurally estimated model of legislative bargaining in the EU. Empirical approaches to estimating bargaining power broadly fall into three categories. A first class of papers implicitly or explicitly assumes transferable utility so that bargaining power can be equated with observed resource shares (Hamermesh 1973, Knight 2008). A second group of papers relies on data from surveys that elicit information on decision-making power directly from respondents (Allendorf 2007, Lépine & Strobl 2013). By far the most common approach to evaluating bargaining power empirically is based on a cooperative model, namely generalized Nash bargaining (Nash 1950, Roth 1979). Svejnar (1986) and Doiron (1992) estimate models of wage bargaining between employers and labour unions while Draganska et al. (2010) consider bargaining between manufacturers and retailers. Generalized Nash bargaining is also widely used in the search-and-matching literature (See for example Shimer 2005, Cahuc et al. 2006). The collective model of the

[2]Consider the following example: Two players need to agree on a point on the real line. Each players' utility is equal to minus the distance between the chosen point and their ideal point. The ideal point of player 1 is equal to 1 and that of player 2 equal to 2. There is a status quo given by 2.5. Player 1 makes a take-it-or-leave-it offer to player 2. Player 2 only accepts if the offer is weakly above 1.5 and player 1 thus offers 1.5. A marginal shift in the ideal point of player 1 leaves the outcome unchanged and the measure of Napel & Widgrén thus assigns player 1 a bargaining power of zero. However, player 1 clearly has an influence on the outcome of the game. Our measure assigns both players a bargaining power of .5.

household (Chiappori 1992) is a cooperative model with a close connection to Nash bargaining. Empirical implementations of this model yield insights into the factors influencing the bargaining between husband and wife, for instance (Chiappori et al. 2002, Browning et al. 2013). A possible drawback of relying on Nash bargaining is that it assumes efficient outcomes.[3] Furthermore, relying on a cooperative approach has the same caveat as in a theoretical setting, namely that the process of bargaining itself is not modelled. The role of any formal or informal features of this process in determining the influence of different players, such as the order of moves or veto rights, is therefore difficult or impossible to recover. Our approach makes it possible to explicitly model the process of bargaining and then calculate the bargaining power of each player based on the estimated model.

Our empirical application contributes to the literature evaluating the balance of power among the institutions of the EU. An extensive literature uses voting power indices to analyse the distribution of power *within* the Council of the European Union (Leech 2002, Felsenthal & Machover 2004, Barr & Passarelli 2009, to give just a few examples). Papers interested in the distribution of power *between* institutions often use formal models to generate insights into the distribution of influence without providing a quantification (Tsebelis & Garrett 1996, Crombez 1997, Tsebelis 2002). Steunenberg et al. (1999) and Napel & Widgrén (2006, 2011) apply their respective measures of power discussed above to theoretical models of EU politics. A prominent strand of empirical work in this context is based on data collected by the Decisionmaking in the European Union project (Thomson et al. 2006, 2012), which selected 125 legislative proposals and used expert interviews to elicit information on the positions of key actors as well as the final outcome within the context of each proposal. Thomson & Hosli (2006) and Costello & Thomson (2013) use these data to compute weights that yield the policy that legislators agree on as a weighted average of each of their positions. These studies find that the Council is the most powerful institution. Expert interviews are also used by König et al. (2007) to evaluate relative bargaining power in the Conciliation Committee, which represents a final attempt to achieve agreement on a legislative text. Our quantitative analysis instead uses the entirety of legislative proposals during two terms of the European Parliament as a basis for the calculation of bargaining power. By estimating a structural model, we can account for the strategic choice of proposals and amendments by each institution, and provide insights into the role of individual rules of the European Union's legislative procedure.

[3]Loertscher & Marx (2022) introduce a framework that, like Nash bargaining, relies on an exogenous vector of bargaining weights, but does not assume efficient outcomes.

3 A Measure of Bargaining Power

In this section we present our approach to measuring bargaining power. We start by formally defining the setting in which we develop our theory.

3.1 Theoretical Framework

Let Γ be a bargaining game. Play of a game Γ leads to a physical outcome o, such as a distribution of resources, a contract, or a law. The set of all possible outcomes is given by O and contains at least two elements, that is, $|O| \geq 2$. $\mathcal{N}$ denotes the set of players with $N = |\mathcal{N}|$ and $2 \leq N < \infty$. The preferences of player n over the set O are represented by a utility function u_n. We assume that u_n attains a maximum on O, that is, there exists an outcome $\bar{o} \in O$ such that $u_n(\bar{o}) \geq u_n(o)$ for any $o \in O$. Denote by $\mathcal{U}$ the set of all such utility functions.[4] For a given game, $\mathbf{u}$ is the vector of all players' utility functions, while $\mathbf{u}_{-n}$ denotes the utility functions of all players other than player n.

Due to possible moves of nature or mixed strategies, an equilibrium of Γ generates a probability distribution over the set of outcomes O. We assume there exists a function o^* that maps vectors of utility functions $\mathbf{u} \in \mathcal{U}^N$ into distributions over the set outcomes O. This assumption is satisfied if the equilibrium of Γ is always unique, possibly subject to some method of equilibrium selection.[5]

The indirect utility function of player n is defined as the expected utility of the player under the equilibrium distribution $o^*(\mathbf{u})$ over outcomes, that is,

$$v_n(u_n, \mathbf{u}) = \int_O u_n(o)\ do^*(\mathbf{u}) \ . \tag{1}$$

Let $\mathbf{v}$ denote the vector of all players' indirect utility functions. Note that the utility function of player n appears twice in the definition of the indirect utility function: once explicitly and once as part of the vector $\mathbf{u}$. Importantly, we do not require these utility functions to coincide. The indirect utility function can thus be used to evaluate "hypothetical" outcomes that would occur if the utility function of player n contained in $\mathbf{u}$ was different from the first argument u_n. To avoid

[4]All theoretical results below are unaffected if further restrictions are placed on the utility functions contained in $\mathcal{U}$. In particular, any redundant utility functions that represent the same preferences as some other element of $\mathcal{U}$ can be excluded without loss of generality.

[5]While it would be interesting to extend the results to games with multiple equilibria, it is clear that such an approach has limits. For example, in the Baron-Ferejohn model (Baron & Ferejohn 1989), any possible distribution of resources among players can be supported in a subgame perfect equilibrium unless the additional restriction of stationarity is imposed. It is not clear how such a large set of equilibria would permit any insights about bargaining power.

confusion, we henceforth follow the convention that (vectors of) utility functions such as u_n or $\mathbf{u}$ refer to the utility functions contained in the definition of the game Γ. We call these the "endowed" utility functions. In contrast, symbols such as u' or $\mathbf{u}'$ denote arbitrary (vectors of) utility functions. Since we never consider indirect utilities where the first argument is different from player n's endowed utility function, we simplify notation by suppressing dependence on the first argument and simply write $v_n(\mathbf{u})$.

We refer to the indirect utilities that arise if all players were to share the same preferences as agreement payoffs. To define these formally, let $\mathbf{1}_{u'}$ be an N-vector such that each element is equal to the same utility function $u' \in \mathcal{U}$.

Definition 1 (Agreement Payoffs)**.** *An agreement payoff of player n is an indirect utility of the form $v_n(\mathbf{1}_{u'})$ for some $u' \in \mathcal{U}$.*

Since utility functions are bounded from above on O, the same is true of agreement payoffs. We interpret the agreement payoff $v_n(\mathbf{1}_{u_n})$ as the best feasible payoff from player n's perspective.[6] For example, in a public goods game, agreement on player n's utility function would imply an equilibrium where all players apart from player n contribute.

All games we consider satisfy the following assumption:

Assumption 1 (Conflict of Interest)**.** *For any player n there exists a player m such that $v_n(\mathbf{1}_{u_n}) > v_n(\mathbf{1}_{u_m})$. Furthermore, for any two players, n and m, $v_n(\mathbf{1}_{u_n}) > v_n(\mathbf{1}_{u_m})$ implies $v_m(\mathbf{1}_{u_m}) > v_m(\mathbf{1}_{u_n})$.*

Assumption 1 states that every player can be paired with another player such that each strictly prefers agreement on their own utility function over agreement on the other player's utility function. This assumption requires not only that there are two players with distinct preferences, but also that players collectively have at least some influence on the outcome. Assumption 1 thus rules out any "game" where the outcome is independent of any players' choices. On the other hand, a game where all players have the same most-preferred alternative can satisfy Assumption 1 as long as players do not have the ability to implement the mutually preferred outcome with certainty and some players disagree in their ranking of

[6] The validity of the interpretation of $v_n(\mathbf{1}_{u_n})$ as the best-possible payoff for player n hinges on equilibrium selection. The question is not whether an equilibrium refinement selects the best equilibrium for player n among those that exist given that all players share the preferences of player n. Instead, what matters for our purpose is that the payoff $v_n(\mathbf{1}_{u_n})$ is at least as high as the payoff that player n achieves in the equilibrium selected under any other constellation of preferences.

other outcomes. Assumption 1 could thus be summarised as requiring that there is a conflict of interest between players across the outcomes that are actually achievable.

Given a suitable method of equilibrium selection, the above framework covers a very broad range of games in general and any game of bargaining that we are aware of in particular. For example, we define TU-games in our context as games that can be represented in the following form.

Definition 2 (TU-Games)**.** *A game Γ satisfies transferable utility if $O = \{o \in [0,1]^N | \sum_{n=1}^N o_n \leq 1\}$ and each player's utility function is given by $u_n(o) = o_n$.*

The outcome of a TU-game is a vector that assigns each player a share of the available surplus and each player's utility is equal to the share they receive. Any such game satisfies Assumption 1 as long as for any player n there exists another player m such that the share of the surplus that player n receives if all players agree that player n should receive the entire surplus is infinitesimally larger than the share that player n receives if all players agree that player m's should receive the entire surplus, while the opposite is true for player m.

3.2 Axioms

Our aim is to derive a real-valued function $\rho_n(\mathbf{v})$ that uses the information contained in the indirect utility functions $\mathbf{v}$ to assign a number to player n that can be interpreted as this player's bargaining power. Below we introduce axioms that this function should satisfy, which require the following definitions. First, a player n is a dictator if the outcome of the game is always equal to the outcome that would arise if all other players shared the preferences of player n, no matter what the utility function of player n actually is.

Definition 3 (Dictator)**.** *Player n in some game Γ is said to be a dictator if $o^*(\mathbf{u}') = o^*(\mathbf{1}_{u'_n})$ for any $\mathbf{u}' \in \mathcal{U}^N$.*

A null player, on the other hand, is a player who never has any impact on the outcome of the game. Let $\mathbf{u}_{u_n \leftarrow u'}$ represent the vector of utility functions created by taking the vector $\mathbf{u}$ and replacing the utility function of player n with some function $u' \in \mathcal{U}$.

Definition 4 (Null Player)**.** *Player n in some game Γ is said to be a null player if $o^*(\mathbf{u}') = o^*(\mathbf{u}'_{u'_n \leftarrow u''})$ for any $\mathbf{u}' \in \mathcal{U}^N$ and $u'' \in \mathcal{U}$.*

Assumption 1 rules out that a player could simultaneously be a dictator and a null player.[7]

Finally, a compound game is a game that starts with a random draw that determines which of a number of other games is played. Importantly, all players are aware of which game is selected and—given that equilibrium is assumed to be unique—the behaviour of players is thus identical to the case where each game is played in isolation. The constituent games of a compound game need to be compatible in the sense that they share the same sets of outcomes and players.

Definition 5 (Compound Game)**.** Γ *is said to be a compound game if*

i. there exists a finite set of games $\mathbf{\Gamma} = \{\Gamma_1, \Gamma_2, ..., \Gamma_G\}$ *possessing equal sets of outcomes* O *and players* $\mathcal{N}$*, and*

ii. the game Γ *begins with a commonly-observed move of nature that selects one game from* $\mathbf{\Gamma}$ *to be played subsequently, and each game* $\Gamma_g \in \mathbf{\Gamma}$ *is chosen with probability* λ_g*.*

We write

$$\Gamma = \sum_g \lambda_g \Gamma_g \ .$$

We can now state our axioms:

A1 (Dictators): Suppose player n is a dictator in a game with a vector of indirect utility functions $\mathbf{v}$. Then $\rho_n(\mathbf{v}) = 1$.

A2 (Null Players): Suppose player n is null player in a game with a vector of indirect utility functions $\mathbf{v}$. Then $\rho_n(\mathbf{v}) = 0$.

A3 (Compound Games): Let $\Gamma = \lambda\Gamma_1 + (1-\lambda)\Gamma_2$ and denote by $\mathbf{v}$, $\mathbf{v}_1$, and $\mathbf{v}_2$ the indirect utility functions corresponding to these games. If Γ_1 and Γ_2 share the same agreement payoffs, then for any player n

$$\rho_n(\mathbf{v}) = \lambda\rho_n(\mathbf{v}_1) + (1-\lambda)\rho_n(\mathbf{v}_2) \ .$$

[7] A player is both a dictator and a null player if and only if the outcome of the game is constant. The if-part is immediate. To see the only if-part, suppose there exist $\mathbf{u}', \mathbf{u}'' \in \mathcal{U}^N$ such that $o^*(\mathbf{u}') \neq o^*(\mathbf{u}'')$. If player 1 is a null player, it follows that $o^*(\mathbf{u}') \neq o^*(\mathbf{u}'') = o^*(\mathbf{u}''_{u_1'' \leftarrow u_1'})$. This contradicts that player 1 is a dictator since in that case it would have to hold that $o^*(\mathbf{u}') = o^*(\mathbf{u}''_{u_1'' \leftarrow u_1'})$. Assumption 1 is thus sufficient to ensure that a player cannot be a dictator and a null player at once since it implies that the outcome of a game is not constant.

A4 (Equal Gains): Suppose in a two-player game Γ with associated indirect utility functions $\mathbf{v}$ it holds that

$$\frac{v_1(\mathbf{u}) - v_1(\mathbf{1}_{u_2})}{v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})} = \frac{v_2(\mathbf{u}) - v_2(\mathbf{1}_{u_1})}{v_2(\mathbf{1}_{u_2}) - v_2(\mathbf{1}_{u_1})} \ . \tag{2}$$

Then $\rho_1(\mathbf{v}) = \rho_2(\mathbf{v}) = .5$.

In the presence of Axioms *A3* and *A4*, Axioms *A1* and *A2* merely amount to normalisations of the value of ρ_n. The Axiom of Compound Games states that the bargaining power assigned to a player in a compound game Γ should be equal to a weighted average of the bargaining power assigned to this player in each of the constituent games of Γ. This property is desirable since equilibrium uniqueness and the assumption that players are aware of which game is selected ensures that behaviour in each constituent game is the same as if this game were played on its own. The outcome of the game as a whole is thus a weighted average of the outcomes in each constituent game, as are the indirect utility functions. For example, let Γ_1 and Γ_2 be two two-player games with identical sets of outcomes and players such that in each game Γ_n player n is a dictator. The Axioms of Dictators and Null Players thus require that player 1 is assigned a bargaining power of 1 in Γ_1 and a bargaining power of 0 in Γ_2. In the compound game $\Gamma = .5\Gamma_1 + .5\Gamma_2$ either player is equally likely to be a dictator or a null player and it thus seems natural to require that both are assigned a bargaining power of .5.

Importantly, the Axiom of Compound Games applies only to compound games constructed from constituent games with identical agreement payoffs. This qualification is necessary since there would otherwise be no function that satisfies all of the axioms: Below we show that in the context of two-player games there is a unique function satisfying all axioms. However, this function violates the stronger version of Axiom *A3* without the restriction to games with equal agreement payoffs.

To understand the Axiom of Equal Gains, recall that $v_1(\mathbf{1}_{u_1})$ is the utility of player 1 if all players shared the same utility function as player 1. $v_1(\mathbf{1}_{u_2})$, on the other hand, is the utility of player 1, given player 1's endowed utility function, under the outcome that would arise if all players shared the same preferences as player 2. The expression $v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})$ is thus the maximal utility gain that player 1 can achieve relative to the best-possible outcome for player 2. The left-hand side of Equation (2) can therefore be interpreted as the utility gain that player 1 realizes in equilibrium relative to the situation where player 2 was a dictator, expressed as a share of the maximal gain possible. In the context of a

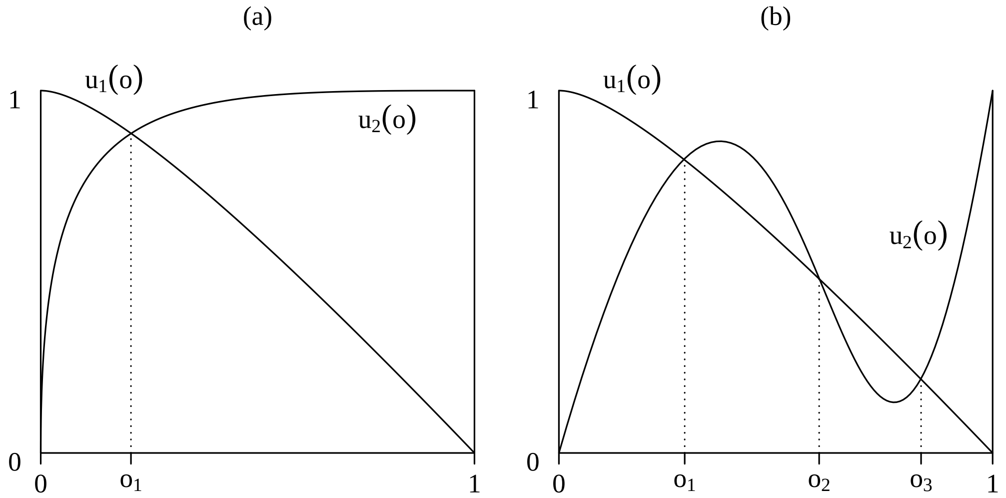

Figure 1: An Illustration of Equal Gains

two-player game, we refer to this value simply as the "gain" of a player. If both players achieve the same gain, then the Axiom of Equal Gains requires that both are assigned a bargaining power of .5. Such a situation is illustrated in Panel (a) of Figure 1, where the horizontal axis represents the outcome space O, which is in this case given by the interval $[0, 1]$. Player 1 prefers to shift the outcome as far to the left as possible, while the opposite is true for player 2. For the sake of the example, assume that players having the same utility functions would imply that they achieve their most preferred outcome with certainty. Note that it is always possible to rescale utility functions such that the level of utility associated with a player's own most preferred outcome is equal to one, while the utility in case the other player's ideal outcome is realized is equal to 0. It is therefore without loss of generality to draw the figure accordingly. Now suppose the equilibrium of the game produces the outcome o_1 with certainty. Since o_1 is close to the most preferred outcome of player 1, the impression may arise that player 1 has the upper hand over player 2. However, the utility function of player 2 is steep between 0 and o_1 and player 2 actually achieves most of the possible utility gain relative to 0 at o_1. In fact, both players experience the same gain at o_1 and this justifies assigning both the same bargaining power.

If the utility function of player 2 instead had the shape as represented in Panel (b) of Figure 1, the outcomes o_1, o_2, and o_3 would all satisfy equal gains. Since the outcome o_1 Pareto dominates both o_2 and o_3, one may wonder what game would produce the latter results. This is not of concern for our purpose here, however.

Axiom *A4* simply requires that if the equilibrium of a game satisfies equal gains, both players are assigned a bargaining power of one half. Axiom *A4* imposes no restrictions on the value of ρ_n if the equilibrium does not satisfy equal gains.

3.3 Two-Player Games

Based on Axioms *A1* to *A4*, we can derive the following result for two-player games.

Theorem 1. *Let Γ be a two-player game satisfying Assumption 1 with associated indirect utility functions $\mathbf{v}$.*

Then a function $\rho_n(\mathbf{v})$ satisfies Axioms A1, A2, A3, and A4 if and only if

$$\rho_n(\mathbf{v}) \;=\; \frac{1}{2}\left[\frac{v_n(\mathbf{u}) - v_n(\mathbf{1}_{u_{-n}})}{v_n(\mathbf{1}_{u_n}) - v_n(\mathbf{1}_{u_{-n}})} \;+\; \frac{v_{-n}(\mathbf{1}_{u_{-n}}) - v_{-n}(\mathbf{u})}{v_{-n}(\mathbf{1}_{u_{-n}}) - v_{-n}(\mathbf{1}_{u_n})}\right] \,. \tag{3}$$

Proof. See Appendix A □

The measure of bargaining power introduced in Theorem 1 is simply the average of the gain of player n and the forgone gain of the other player. If player n is a dictator, both these numbers are equal to one, while they are both equal to zero if player n is a null player. The bargaining power of a player thus depends on the degree to which they achieve a favourable outcome, but also on how much resistance from their opponent they are able to overcome. Equation (3) thus echoes Max Weber's definition of power as "a person's ability to impose his will upon others despite resistance" (this translation is taken from Blau 1963, p. 306). Note that in a two-player game $\mathbf{1}_{u_{-n}}$ equals $\mathbf{u}_{u_n \leftarrow u_{-n}}$. A possible interpretation of Equation (3) is therefore the following: the bargaining power of player n is the degree to which a shift in this player's preferences affects the utility of all players, measured as a share of the effect that would occur if player n was a dictator. According to this interpretation, the measure ρ_n is cardinal in nature and possesses a natural zero that corresponds to a player not having any impact on the outcome of the game. The power coefficients ρ_1 and ρ_2 always sum to one, which can be shown straightforwardly by writing down the sum of the two expressions and simplifying. The key to this result is that a player's gain and forgone gain always add up to one.

A crucial insight underlying the proof of Theorem 1 is that any game can be combined with a second game to create a compound game that satisfies equal gains. This principle is illustrated in Figure 2. Suppose that under the given utility

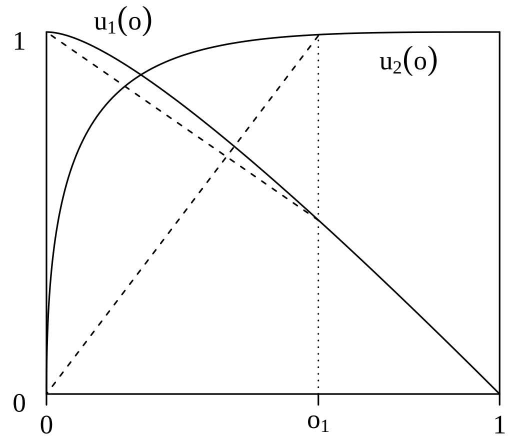

Figure 2: A Compound Game Satisfying Equal Gains

functions some bargaining game Γ with associated indirect utilities $\mathbf{v}$ generates the outcome o_1 with certainty. As is visible in Figure 2, the gain of player 2 in this equilibrium exceeds the gain of player 1. It is then possible to construct a second game, Γ', in which player 1 is a dictator and the outcome is equal to 0 with certainty. Let $\mathbf{v}'$ denote the vector of indirect utilities associated with Γ'. The expected utility of each player in the compound game $\Gamma^* = \lambda\Gamma + (1-\lambda)\Gamma'$ as a function of λ is indicated by the dashed lines in the figure. Since the lines intersect, there exists a value for λ such that Γ^* satisfies equal gains. This value of λ can be calculated and turns out to be a function of the same indirect utilities that appear in Equation (3).

Based on the preceding paragraph, ρ_1 can then be constructed as follows: The Axioms of Compound Games and Equal Gains together imply

$$\lambda\rho_1(\mathbf{v}) + (1-\lambda)\rho_1(\mathbf{v}') = .5 \ .$$

Since the Axiom of Dictators requires $\rho_1(\mathbf{v}') = 1$, the preceding equation can be solved for $\rho_1(\mathbf{v})$ and inserting the previously calculated value of λ yields Equation (3).

In the context of TU games, the conventional measure of bargaining power is the expected share of the total surplus that player n receives, that is, $v_n(\mathbf{u})$. When the equilibrium outcome of a TU game is inefficient, some of the surplus is wasted such that $v_1(\mathbf{u}) + v_2(\mathbf{u}) < 1$. Since ρ_1 and ρ_2 sum to one, it is then impossible that $\rho_n = v_n(\mathbf{u})$ holds for both players. In fact, the relationship between player n's expected utility and the bargaining power assigned to player n by Equation (3) hinges on the efficiency of the outcome function more generally.

Proposition 1. *In a TU game with two players, $\rho_n(\mathbf{v}) = v_n(\mathbf{u})$ if the equilibrium outcome $o^*(\mathbf{u})$ and the agreement outcomes $o^*(\mathbf{1}_{u_1})$ and $o^*(\mathbf{1}_{u_2})$ are Pareto efficient.*

Proof. The proposition follows from the more general result of Proposition 3 below. □

If all players agree that some player n should receive all of the available surplus, then the only outcome that is Pareto efficient is that player n does indeed receive the whole surplus. If the agreement outcome $o^*(\mathbf{1}_{u_n})$ is efficient, the corresponding payoffs are therefore given by $v_n(\mathbf{1}_{u_n}) = 1$ and $v_{-n}(\mathbf{1}_{u_n}) = 0$. Pareto efficiency of the equilibrium outcome $o^*(\mathbf{u})$ further implies $v_n(\mathbf{u}) + v_{-n}(\mathbf{u}) = 1$. Equation (3) then simplifies to $\rho_n(\mathbf{v}) = v_n(\mathbf{u})$. To understand the intuition behind this result, recall the example from the introduction where player 1 receives all of the surplus with probability .9 independently of any players' choices. In this game, the agreement outcome where both players prefer that player 2 receives everything is inefficient since players do not have he ability to give the whole surplus to player 2. In contrast, efficiency of the agreement payoffs implies that the players collectively have full control over the outcome of the game. In that case, the best-possible outcome for player n is that they receive all of the surplus, while the worst-possible outcome is that they get nothing. The gain of player n is accordingly equal to their share of the surplus. If the equilibrium outcome itself is also efficient, then the gain of player n is equal to the utility loss that they impose on the other player and the average of the two is simply equal to $v_n(\mathbf{u})$. Inefficiency of any of the outcomes listed in Proposition 1 implies that $\rho_n(\mathbf{v}) = v_n(\mathbf{u})$ does not hold in general, even though inefficiency of both agreement outcomes combined with efficiency of the equilibrium outcome can produce this result coincidentally.

3.4 N-Player Games

Extending the result of Theorem 1 to settings with more than two players is not straightforward. In a two-player game, one player being a null player implies that the other player is a dictator.[8] The gain of a player can thus be measured relative

[8] Suppose player 1 in a two-player game is a null player. The definition of a null player implies $o^*(\mathbf{u}') = o^*(\mathbf{u}'_{u'_1 \leftarrow u'_2}) = o^*(\mathbf{1}_{u'_2})$ for any $\mathbf{u}' \in \mathcal{U}^2$ and player 2 is therefore a dictator.

to the best-possible outcome of their opponent. With three or more players, a player may be a null player even though no dictator is present. As a consequence, the Axiom of Equal Gains has no equivalent in the N-player case since it may not be clear what the equilibrium would be in the counterfactual game where one player has no ability to influence the final agreement.[9] In addition, there are many functions that yield Equation (3) as a special case when applied to a two-player game. These functions often differ in minor aspects and produce comparable results. We are thus not able to provide a uniqueness result in the spirit of Theorem 1. We can, however, propose a measure of bargaining power for N-player games that satisfies Axioms *A1* to *A4* and possesses additional desirable properties.

Our aim is to construct a measure based on the logic revealed by Theorem 1, namely that the power of a player can be calculated as the effect that a shift in this player's preferences has on *all* players' utilities, expressed as a share of the effect that would occur if the player in question was a dictator. Doing so requires us to answer two questions: which shifts in a player's preferences should the measure be based on and how do we incorporate the resulting changes in all players' utilities? Regarding the former question, the answer suggested by Theorem 1 is that "large" changes in preferences are more revealing about a player's influence: in Equation (3), the preferences of player n are shifted all the way to equate them to those of player n's opponent. A small change in a player's preferences may fail to resolve deadlock between players, for example, which can make a player appear less influential than they in fact are (see Footnote 2 for an example illustrating this point). In the N-player context, we therefore consider shifts in player n's preferences that equate this player's utility function with those of the players most opposed to player n. To operationalise this idea, define

$$\mathcal{N}_{\rightleftarrows n} = \underset{m \in \mathcal{N}}{\arg\min}\, v_n(\mathbf{1}_{u_m}) \ ,$$

that is, $\mathcal{N}_{\rightleftarrows n}$ is the set of players such that agreement on any of their utility functions would generate the worst outcome from player n's perspective among all the possible agreement outcomes. $\mathcal{N}_{\rightleftarrows n}$ is non-empty since the number of players is finite, and it does not contain player n by Assumption 1.

[9]The problem is that this counterfactual game is not well-defined if the roles of players are inherently asymmetric. For example, the legislative process of the EU gives the Commission the sole right to initiate new legislation. In the game representing the counterfactual scenario where the Commission has no influence, should the right of initiative be passed on to the Parliament, to the Council, or to a neutral arbiter?

Now suppose we want to calculate the extent to which a shift in player n's utility function to that of some player $m \in \mathcal{N}_{\rightleftarrows n}$ affects the utilities of all players. In analogy to Equation (3), the expression $[v_k(\mathbf{u}) - v_k(\mathbf{u}_{u_n \leftarrow u_m})]/[v_k(\mathbf{1}_{u_n}) - v_k(\mathbf{1}_{u_m})]$ in principle measures how said shift affects some player k relative to the case where player n is a dictator. However, the value of the preceding expression may not be defined if k is not equal to n or m. In that case, player k may be indifferent between agreement on player n's or player m's utility function, leading to division by zero. To avoid such singularities, we calculate the effect of a shift in player n's preferences on sums of utilities instead of individual utilities. Grouping players according to their preference over the two agreement outcomes in question creates a measure that is guaranteed to be well-defined, as will become clear momentarily. Specifically, denote by $\mathcal{N}_{n \trianglerighteq m}$ the set of players who weakly prefer agreement on the utility function of player n over agreement on the utility function of player m, that is,

$$\mathcal{N}_{n \trianglerighteq m} = \{k \in \mathcal{N} | v_k(\mathbf{1}_{u_n}) \geq v_k(\mathbf{1}_{u_m})\} \ .$$

Similarly, let $\mathcal{N}_{n \triangleright m}$ be the set of players for whom the preference between the two agreement outcomes is strict. The sum of such players' utilities is then given by $V_{n \trianglerighteq m}(\mathbf{u}') = \sum_{k \in \mathcal{N}_{n \trianglerighteq m}} v_k(\mathbf{u}')$ with $V_{n \triangleright m}(\mathbf{u}')$ defined accordingly.

We thus propose to measure the bargaining power of player n in an N-player game as

$$\begin{aligned} \rho_n(\mathbf{v}) = \frac{1}{|\mathcal{N}_{\rightleftarrows n}|} \sum_{m \in \mathcal{N}_{\rightleftarrows n}} \frac{1}{2} \Bigg[& \frac{V_{n \triangleright m}(\mathbf{u}) - V_{n \triangleright m}(\mathbf{u}_{u_n \leftarrow u_m})}{V_{n \triangleright m}(\mathbf{1}_{u_n}) - V_{n \triangleright m}(\mathbf{1}_{u_m})} \\ & + \frac{V_{m \trianglerighteq n}(\mathbf{u}_{u_n \leftarrow u_m}) - V_{m \trianglerighteq n}(\mathbf{u})}{V_{m \trianglerighteq n}(\mathbf{1}_{u_m}) - V_{m \trianglerighteq n}(\mathbf{1}_{u_n})} \Bigg] \ . \end{aligned} \tag{4}$$

The expressions that appear in the denominators in Equation (4) are non-negative, since, for example, all players belonging to $\mathcal{N}_{m \trianglerighteq n}$ weakly prefer agreement on player m's utility function over agreement on that of player n. Furthermore, the preference is strict for player m by the definition of the set $\mathcal{N}_{\rightleftarrows n}$ in combination with Assumption 1, which ensures that the value of the expression is in fact positive. The value of Equation (4) is therefore well-defined and the interpretation of this measure is the same as in the two-player case: the bargaining power of player n is their ability to shift all players' utilities expressed relative to the case where player n is fully in control. What is more, this function satisfies all axioms.

Proposition 2. *Let Γ be a game satisfying Assumption 1 with associated indirect utility functions $\mathbf{v}$. Then the function $\rho_n(\mathbf{v})$ as defined by Equation (4) satisfies*

Axioms A1, A2, A3, and A4.

Proof. See Appendix A. $\square$

Given that the value of Equation (4) is well-defined under Assumption 1, ρ_n satisfies the Axioms of Dictators and Null Players in analogy to Equation (3). The Axiom of Compound Games, on the other hand, is fulfilled since ρ_n is an affine function of all included indirect utilities that are not agreement payoffs. Finally, Equation (4) simplifies to Equation (3) in case of a two-player game and therefore satisfies the Axiom of Equal Gains.

Another attractive feature of this measure of bargaining power is that it extends the result of Proposition 1 to N-player games: in a TU game, Equation (4) is equal to the expected share of the surplus that player n achieves if certain outcomes are Pareto efficient.

Proposition 3. *In a TU game, $\rho_n(\mathbf{v}) = v_n(\mathbf{u})$ if the outcomes $o^*(\mathbf{u})$, $o^*(\mathbf{u}_{u_n \leftarrow u_m})$, $o^*(\mathbf{1}_{u_n})$, and $o^*(\mathbf{1}_{u_m})$ are Pareto efficient for any $m \in \mathcal{N}_{\rightleftarrows n}$.*

Proof. See Appendix A. $\square$

The proof of Proposition 3 proceeds by using the definition of a TU-game and the assumption of Pareto efficient outcomes to determine the values of the indirect utilities entering ρ_n. First, Pareto efficiency implies that one player receives all resources if all players agree that this would be the ideal outcome. Under the endowed utility functions, however, the only player who strictly prefers the allocation where player n receives everything over the allocation where player m receives everything is player n herself. In the case of player m, the preference is reversed, while all other players are indifferent. It thus holds that $\mathcal{N}_{n \rhd m} = \{n\}$ and $\mathcal{N}_{m \unrhd n} = \mathcal{N} \setminus \{n\}$. Furthermore, Pareto efficiency implies that no resources are wasted and payoffs thus sum to one. It follows that $V_{m \unrhd n}(\mathbf{u}) = 1 - v_n(\mathbf{u})$. Substituting accordingly in Equation (4) yields the desired result.

3.5 Ex Ante Power and Relation to Voting Power Indices

Our measure of bargaining power calculates power based on the endowed utility functions and power may depend on preferences. In some sense this is natural: for example, it is generally held that more impatient negotiators are at a disadvantage. In some cases, and in particular for the purpose of institutional design, it nevertheless can be of interest what degree of influence the rules of the game assign to each player independently of preferences. Napel & Widgrén (2004) distinguish in this context between an ex ante and an ex post perspective, that is, assessments of power before or after players' preferences have been revealed. Following their approach, we can use our ex post measure to calculate power from an ex ante perspective. Doing so requires specifying a distribution F that players' preferences are drawn from and ex ante power is simply equal to expected ex post power under F. Depending on the chosen distribution, it may be possible to calculate this expectation exactly, such as when F has finite support. Otherwise, expected power can be calculated numerically by drawing preferences, calculating ex post power, and repeating this process until the mean across draws converges. Denote by $\bar{\rho}_n(F)$ the ex ante bargaining power of player n under the distribution F calculated based on the ex post measure ρ_n.

In practice, care needs to be taken with respect to preference profiles that violate Assumption 1, since the value of ρ_n is not defined in such cases. One option is to specify F such that such cases do not occur. Alternatively, it may be possible to resolve the problem by assigning a default value when ρ_n is not defined. For example, if players' preference orderings over outcomes are identical, it may be reasonable to assign each player a power of zero or of $1/N$. In other games, such as the example that follows, a natural extension of ρ_n exists.

We now use the ex post and ex ante measures ρ_n and $\bar{\rho}_n$ to investigate the relationship between our theory and the literature on voting power indices, which calculate the power of players in weighted voting games. In such games, a committee decides whether to accept or reject a proposal. The outcome space is equal to $\{0, 1\}$, where 1 corresponds to acceptance of the proposal, while 0 indicates rejection. It is typically assumed that players have strict preferences over the two outcomes and it is then without loss of generality to let all players' utility functions be given either by u^0 or by u^1, where $u^i(o) = 1$ if $o = i$ and $u^i(o) = 0$ otherwise. Beyond the set of players, a weighted voting game is characterised by a voting rule, which consists of a quota $q > 0$ and a vector of weights $w \in \mathbb{R}_+^N$, one for each member of the committee, such that $\sum_{n=1}^N w_n \geq q$. Players simply vote in favour of or against the proposal and the proposal is accepted if and only if the sum of all players' weights who vote in favour is at least equal to q. Assume players vote sincerely. Denote by $S \subset \mathcal{N}$ the set of players who prefer acceptance under the endowed utility functions $\mathbf{u}$. In the language of cooperative game theory, the players in S form a coalition and the value $\mathcal{V}$ of the game indicates whether a coalition wins: $\mathcal{V}(S) = 1$ if $\sum_{n \in S} w_n \geq q$ and $\mathcal{V}(S) = 0$ otherwise.

Under any given constellation of preferences $\mathbf{u}$ and the corresponding profile of votes, player n is pivotal if them changing their vote would change the outcome of the game. Since a pivotal player has the ability to achieve the "largest" possible shift in the outcome of the game, the measure ρ_n assigns them a power of 1. If a player is not pivotal, their preferences do not matter for the outcome and $\rho_n = 0$. Note, however, that agreement among the players implies that Assumption 1 is violated and the value of ρ_n is not defined. It seems natural to introduce the convention that in such unanimous games (that is, $S = \emptyset$ or $S = \mathcal{N}$), $\rho_n = 1$ if player n is pivotal and $\rho_n = 0$ otherwise. Under this convention, we have the following result.

Proposition 4. *Let $\mathbf{v}^S$ denote the vector of indirect utilities corresponding to a weighted voting game where the set of players S prefers acceptance. Assume $\rho_n(\mathbf{v}^{S=\emptyset}) = 1$ if $w_n \geq q$ and $\rho_n(\mathbf{v}^{S=\emptyset}) = 0$ otherwise. Also assume $\rho_n(\mathbf{v}^{S=\mathcal{N}}) = 1$ if $\sum_{m \in S \setminus \{n\}} w_m < q$ and $\rho_n(\mathbf{v}^{S=\mathcal{N}}) = 0$ otherwise.*

Then there exist distributions F_{PB} and F_{SS} such that $\bar{\rho}_n(F_{PB})$ is equal to the Penrose-Banzhaf index and $\bar{\rho}_n(F_{SS})$ is equal to the Shapley-Shubik index.

Proof. See Appendix A. □

Under suitable choices of the distribution of preferences F, $\bar{\rho}_n(F)$ is thus equal to the Shapley-Shubik index or the Penrose-Banzhaf index. These indices are based on cooperative game theory, and showing that they are equivalent to $\bar{\rho}_n(F)$ is possible since a weighted voting game is a rare case of a game that can naturally be expressed in a cooperative or a non-cooperative form. In general, however, voting power indices cannot be applied to non-cooperative games, for which our measure is intended.

3.6 Examples and Practical Considerations

Before applying our measure of bargaining power to the dynamics of EU legislation, we illustrate its use through some simpler examples and discuss issues that may arise in practice. Consider a game in which three players need to agree on a point in the set $[0, 1]$ and bargaining takes place with an infinite time horizon. In the first period, player 1 makes an offer to player 3. If player 3 accepts, this offer is implemented and the game ends. If player 3 rejects the initial offer, one of players 1 and 2 is chosen with equal probability to play Rubinstein bargaining with player 3 from the second period onwards. More specifically, player 3 and the chosen opponent alternate in making offers until an offer is accepted by the other player, with player 3 making the first offer. The utility of player $n \in \{1,2,3\}$ depends on the accepted offer o and the period of agreement T, and is given by

$$u(o,T) = \delta^T [1 - |o - i_n|] \ ,$$

where δ is a common discount factor and i_n is the ideal point of player n, with $i_1 = 0$, $i_2 = .5$ and $i_3 = 1$. In this setting, replacing one player's utility function with that of another player simply requires shifting the former player's ideal point to match that of the latter.

The unique subgame perfect equilibrium of the game in the limit as δ approaches 1 can be characterized as follows: In the subgame starting in period 2 where player $n \in \{1,2\}$ has been selected, player 3 offers the outcome $(i_3 + i_n)/2$ and player n accepts (Rubinstein 1982). Given that player 3 is risk neutral, in period 1 player 3 is willing to accept any offer they like at least as much as the mean of the two outcomes that may arise in period 2. Player 1 offers their preferred outcome among those that player 3 accepts and the game ends in period 1. Under the ideal points given above, the outcome of the game is equal to .625.

Note that the game described in the preceding paragraph is similar in terms of the constellation of ideal points to the example of the military alliance in the introduction. As in that example, the outcome of the game by itself allows only limited insights into the distribution of bargaining power. In the current example one can conclude that player 3 must have some influence, but the relative importance of players 1 and 2 remains unclear. After going through the calculations required to apply Equation (4),[10] the results are $\rho_1 = .19$, $\rho_2 = .19$, and $\rho_3 = .44$. Players 1 and 2 are equally powerful despite their asymmetric decision rights: Due to the patience of player 3, player 1 is not able to achieve any improvement in period 1 over the expected outcome of period 2. The expected outcome of period 2, in turn, is equally influenced by players 1 and 2. Player 3, in contrast, is guaranteed to have a say over the outcome at any point, giving this player the upper hand.

A notable aspect of the preceding example is that in games with more than two players the power coefficients need not sum to one. In fact, there are games where all players are assigned a bargaining power of zero, such as in the following

[10] Take the calculation of ρ_1 as an example. When players' ideal points coincide, the outcome of the game is equal to the common ideal point with certainty. Player 1 thus prefers agreement on Player 2's utility function over agreement on that of player 3 and $\mathcal{N}_{\rightleftarrows 1} = \{3\}$. Player 2 is indifferent between agreement on player 1's or player 3's ideal point, which implies $V_{1 \triangleright 3}(\mathbf{u}') = v_1(\mathbf{u}')$ and $V_{3 \trianglerighteq 1}(\mathbf{u}') = v_2(\mathbf{u}') + v_3(\mathbf{u}')$. The final piece of information required by Equation (4) is that the outcome of the game when player 1's ideal point is shifted to match that of player 3 is equal to 1 with certainty.

example: Assuming the same sets of outcomes and players as above, consider a game with a status quo equal to .5 where each player can veto agreements they like less than that outcome. Without fully specifying the rules of the game, it is clear that as long as player 2's ideal point remains at .5, player 2's veto prevents any shifts of the outcome away from the status quo. Even if player 2's preferences change, the opposing preferences of players 1 and 3 equally preclude any outcome other than .5. Shifting any single player's ideal point thus has no effect on the outcome of the game and each player is assigned a bargaining power of zero. This last example suggests that a sum of power coefficients smaller than one is the result of deadlock between players that no single player has the ability to resolve. For the purpose of comparing the relative bargaining power of players, especially across games that are similar but vary in the degree of deadlock, it can thus be useful to rescale the bargaining powers, for example such that they sum to one.

Finally, a question that can arise in applications is the specification of the set of outcomes O. One possibility is to choose the set O such that it reflects all aspects of the final agreement between players, but not other outcomes that are merely by-products of the bargaining process. In the example at the beginning of this section, O would then equal $[0, 1]$. The alternative to this "narrow" definition of the set of outcomes is to incorporate all aspects of the game affecting players' utilities. In the example this would entail also including the period of agreement $T \in \mathbb{N}$, letting $O = [0, 1] \times \mathbb{N}$. While the theoretical results presented above are true irrespective of this choice, the bargaining power assigned to each player can be affected. To see this, consider the following modification of the game above: After player 1 makes their offer, player 3 receives this offer with probability one-half, while the game moves directly to the second period with the remaining probability. Given that players are patient and player 1's initial offer does not differ from the expected outcome of period 2, bargaining powers are not affected by this change. Now suppose that player 1 has a discount factor δ_1 specific to period 1 that is lower than 1, while applying the common discount factor δ from period 2 onwards. This change in player 1's patience does not affect player 1's behaviour, nor that of any of the other players. The outcome of the game is thus independent of δ_1, whether O is specified as $[0, 1]$ or $[0, 1] \times \mathbb{N}$. Accordingly, it is hard to argue why the bargaining power of player 1 should depend on δ_1. Yet, if O is chosen to include the period of agreement, then ρ_1 does become a function of δ_1. We therefore favour the narrow specification of the outcome set: Bargaining power as the ability to achieve a favourable agreement should depend exclusively on said agreement.

4 Legislative Bargaining in the European Union

In this section we illustrate our generalized measure of bargaining power in an application to the legislative process of the European Union.

4.1 Institutional Setting and Data

Legislation in the EU involves three institutions: the European Parliament, the Council of Ministers, and the European Commission. The European Parliament is the only directly elected institution of the EU, with elections held every five years. The Council consists of ministers belonging to the national governments of member states and meets in different configurations depending on the subject of the law being debated. The members of the Commission, which forms the executive branch of the EU, are appointed by the governments of member states at the start of each term of the Parliament and have to be confirmed by a parliamentary vote.

In our empirical analysis, we focus on laws subject to the Ordinary Legislative Procedure (OLP), which applies to the vast majority of legislative proposals discussed and implemented. The process starts with the introduction of a new legislative proposal by the European Commission. This proposal is then debated and potentially amended by the Parliament and the Council through the course of up to three readings.

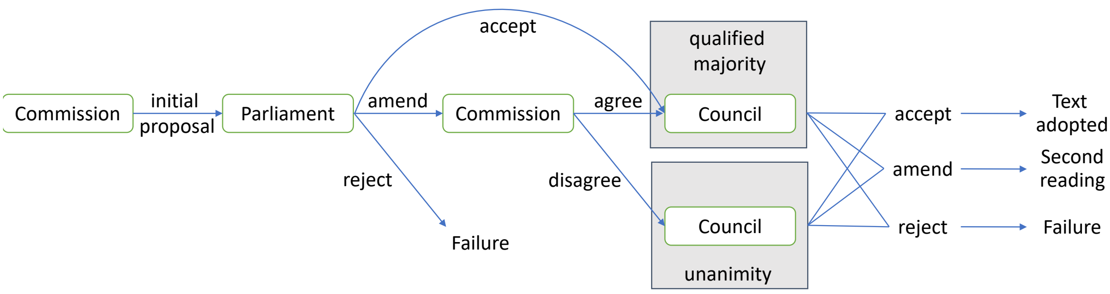

Figure 3: Timing of the Ordinary Legislative Procedure - First Reading

The timing of the OLP is illustrated in Figures 3 and 4. After a proposal by the Commission has initiated the first reading, the Parliament can either accept the legislative draft as it is, introduce amendments, or reject the proposal. In the former two cases, the proposal is then forwarded to the Council, while rejection implies failure of the process. If the Council accepts the proposal it receives from the Parliament, the process ends and the act is adopted. If the Council instead introduces amendments of its own, the process moves on to the second reading. Importantly, the majority requirements in the Council depend on the opinion of the Commission on the amendments introduced by the Parliament. If the Commission disagrees with any of the proposed changes, the Council can only accept these amendments by a unanimous vote. If the Commission agrees with all amendments, on the other hand, a qualified majority[11] in the Council usually[12] suffices to adopt the act. The Council can also reject a proposal.

The second reading is illustrated in Figure 4. The Parliament again has the options of accepting the proposal in its current state, proposing amendments, or rejecting. Unlike at first reading, acceptance of the proposal leads to the immediate adoption of the act. In the case of amendments, the Council holds a vote on whether it accepts the proposal. As in the first reading, the majority requirements in the Council depend on the opinion of the Commission. Acceptance leads to the adoption of the act, otherwise the process moves on to the third reading. The Council is not able to propose any amendments of its own during the second reading.

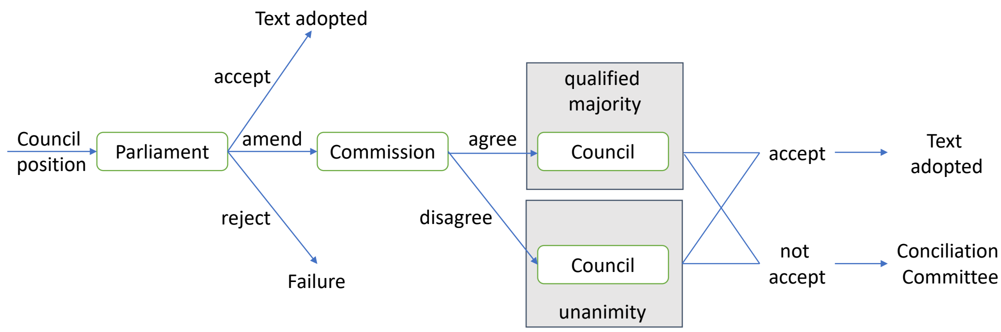

Figure 4: Timing of the Ordinary Legislative Procedure - Second Reading

If the third reading is reached, the so called Conciliation Committee convenes, which is made up of representatives of all three institutions. This step represents a final attempt to find a text that is acceptable to both the Parliament and the Council, with the Commission officially playing a mediating role. If no compromise can be found, the proposal fails. A proposal may also fail at earlier stages if it is rejected by the Parliament or the Council or withdrawn by the Commission, which may do so at any point during the first reading.

An important part of the practice of the OLP are meetings between representatives of the institutions called “trilogues”. During these meetings, the legislative

[11]The Council accepts a proposal if at least 55 percent of member states representing at least 65 percent of the EU population vote in favour.

[12]Proposals relating to certain areas such as taxation or defence always require unanimity.

draft is discussed with the aim of finding a compromise acceptable to all sides. The participants stay in touch with their home institutions and if an agreement is reached, this agreement is considered to be binding. Any subsequent votes in the Parliament or the Council required to pass the agreed text thus become formalities and usually take place within a few weeks. Trilogues may be initiated at any point after the publication of the initial proposal by the Commission.

Our data on the OLP is taken from the EUR-Lex database, which provides detailed information on all relevant decisions taken by the participating institutions. The focus of our analysis is on the seventh and eighth term of the Parliament, which lasted from 2009 to 2014 and from 2014 to 2019, respectively. Each of the 1,016 observations in our dataset is thus an independent legislative proposal subject to the OLP for which at least one decision was taken during the seventh or eighth term. Table 1 lists the decisions observed at different stages of the OLP, which form the basis of the structural estimation of the model presented below. Failure of a proposal usually manifests itself in the halt of any further activity, while a formal rejection is an extremely rare event.[13] Further details of the construction of the data set and the calculation of the numbers in Table 1 can be found in Appendix B.

In the seventh (eighth) term, the Parliament amends 89% (82%) of proposals during the first reading, but only 43% (11%) of proposals during the second reading. The Commission approves a high share of these amendments during both readings. The Council, on the other hand, accepts most proposals if there were no amendments introduced by the Parliament or if all amendments were accepted by the Commission, but rejects most proposals if the amendments of Parliament were at least partially rejected by the Commission. A notable feature of the numbers is that the approval of a proposal is more likely at any point of the process during the eighth term compared to the seventh term. As the final rows of Table 1 show, about one in seven proposals of the 7th term fail and never become law.[14]

[13]During the 10 years we consider, only 7 proposals were formally rejected. The probabilities of approval in Table 1 are calculated for all proposals that were not rejected at the stage in question.

[14]Since negotiations may continue beyond the end of a term, at the time of writing it was not possible to determine whether some proposals from the eighth term have failed or are simply facing long delays between decisions. We therefore target only the share of failed proposals from the 7th term in our structural estimation. The model of course also allows for failure of proposals during the eighth term.

	7th Term		8th Term	
Reading:	First	Second	First	Second
Approval by EP	0.1056 (464)	0.6667 (60)	0.1828 (372)	0.8919 (37)
Commission agreement on EP amendments	0.7398 (319)	0.8 (20)	0.8486 (317)	1 (5)
Approval by Council if				
No amendments by EP	0.9531 (64)		1 (65)	
EP amendments approved by Comm.	0.9783 (323)	0.8846 (26)	0.9954 (219)	1 (4)
EP amendments not approved by Comm.	0.1404 (57)	0 (3)	0.2444 (45)	NaN (0)
Number of proposals made	495		381	
Number of failed proposals	68		NA	

Table 1: Probabilities of Decisions on Legislative Proposals During the Seventh and Eighth Term of the European Parliament

4.2 The Model

This section sets out our model of the legislative process of the EU. The subject of bargaining is a new piece of legislation $p \in [-1, 1]$. The time horizon is infinite, so that the process of bargaining generates an infinite sequence $\mathbf{p}$ of policies that are effective during each period. There is a status quo $q \in [-1, 1]$ that remains in place until agreement is reached, which is not guaranteed. If agreement is achieved, policy takes the value specified by the agreed-upon proposal and then remains at that level during all subsequent periods.

Players: Throughout, the letter b will refer to the Commission (located in Brussels), c will refer to the Council, and s will refer to the European Parliament (located in Strasbourg). Each institution is represented by a single player who can be thought of as the pivotal member.[15] The preferences of the player representing

[15]The parametrization of our model accounts for the different majority requirements in the Council described in the previous section.

an institution $z \in \{b, c, s\}$ over sequences of policies are given by

$$u_z(\mathbf{p}, P_b) = -\sum_{t=0}^{\infty} \delta_z^t \, (p_t - i_z)^2 \; - \; P_b \cdot k \; ,$$

where i_z and δ_z are the ideal point and discount factor of institution z, respectively. The utility of the Commission in addition depends on their choice to initiate negotiations. Introducing a new proposal requires the Commission to carry out a lengthy consultation of experts and stakeholders, which we capture by assuming that an initial proposal is associated with a fixed cost k. The variable P_b is therefore equal to 1 if the utility function is that of the Commission and the Commission decides to initiate a proposal, while $P_b = 0$ otherwise.

Timing: The timing of the game is tailored closely to the protocol of the OLP. The key choices that players make are tabling a new proposal and responding to a proposal already on the table. If the Commission decides to introduce an initial proposal instead of leaving the status quo in place, it picks a point $p \in [-1, 1]$. When the Parliament or the Council have the opportunity to table a new proposal, on the other hand, they face two options: the first is to initiate a trilogue and negotiate directly with the other institutions, while the second is to introduce a new proposal without consulting the remaining players. We assume that trilogues produce a predictable result, referred to as a "safe proposal", that is immediately accepted by everyone. A proposal produced without engaging in trilogues, in contrast, may be amended or rejected by the other institutions and is referred to as a "risky proposal".

Making a safe proposal: In order to be accepted by all participants, the result of a trilogue has to belong to the set of points that each institution prefers over the status quo, known as the winset (Tsebelis 2002).[16] More specifically, we assume that a trilogue produces a policy given by a weighted average of each institution's most preferred element of the winset. The weight on the most preferred element of institution z is given by $\delta_z/(\delta_b + \delta_s + \delta_c)$. If the third reading is reached, the Conciliation Committee produces the same outcome as a trilogue.

Making a risky proposal: When an institution makes a risky proposal, it can choose any point on $[-1, 1]$. The response of the remaining institutions is uncertain, however. To model this uncertainty, we assume that the responding institution draws a random shock from an extreme value distribution F_z on each of the continuation values that the possible choices of the institution imply. The

[16]Institution z prefers a proposal p over the status quo q if and only if $-(p-i_z)^2 \geq -(q-i_z)^2$.

chosen alternative is then the one that maximises the sum of continuation value and random shock. The options an institution has when responding to a proposal are determined by the protocol of the OLP. The Parliament and the Council can accept, amend, or reject a proposal when it is their turn to move.[17] The Commission can generally agree or disagree with a proposal by the Parliament, and during the first reading additionally has the option to withdraw the proposal. The decision of the Commission to disagree with a proposal of the Parliament implies that the Council can only accept the proposal through a unanimous vote, while otherwise a qualified majority suffices. We capture this by assuming that the shock on the choice of accepting is drawn from a shifted distribution $F_{\tilde{c}}$ if the Commission announces disagreement, while all other shocks specific to the Council follow a distribution F_c.

We refer to the periods in which negotiations are ongoing as the active phase of the game. The active phase ends either if agreement is achieved or a proposal has been rejected or withdrawn. A period within the active phase ends whenever an institution decides to amend a proposal.

Equilibrium: The legislative bargaining game features uncertainty due to the shocks affecting the response to a proposal. However, the realisations of uncertain variables and all actions are observed by all players and preferences are common knowledge. The game is therefore one of multiple stages and observed actions, and the appropriate equilibrium concept is subgame perfection (Fudenberg & Tirole 1991, p. 70). In addition, although the time horizon is infinite, the active phase of the game has finite length, and the game can therefore be solved by backward induction. A subgame-perfect equilibrium consists of proposals tabled at the various stages, probability distributions over the possible responses by institutions as a function of the proposal on the table, as well as the initial decision of the Commission to initiate negotiations. Given that the shocks determining the responses to a proposal are assumed to follow extreme value distributions, the choice probabilities take the familiar logistic form.[18] Optimal proposals, on the other hand, can be computed numerically when solving the model for a given parameter vector.

[17] In the second reading the choice of the Council to "amend" implies that the Conciliation Committee convenes.

[18] Suppose that some institution z chooses between C options at some point of the game. Denote by $V_{z,c}$ the continuation value corresponding to option $c \in C$. Then the probability that institution z chooses c is given by $\frac{\exp(V_{z,c})}{\sum_{c' \in C} \exp(V_{z,c'})}$.

4.3 Empirical Implementation and Basic Results

We estimate the structural parameters of the model presented in the previous section using the observed decisions by each institution over the course of the legislative process. To do so, we calculate the choice probabilities predicted by our model, which can then be used to construct moment conditions that are informative about the model's parameters. Calculating the solution of the model requires us to specify the status quo. The dimension of conflict in models of EU politics is typically interpreted as the degree of EU integration. Along this dimension, existing legislation in the areas of agriculture and taxation, for example, differs strongly in the degree of policy harmonisation across member states that has already been achieved. Accounting for this variation is essential since the status quo plays a crucial role in the process of bargaining. We therefore assume that there is a distribution of status quos across all perceivable policy areas for which a proposal could be initiated, which we normalise to a uniform distribution on the policy space $[-1, 1]$.[19]

While the distribution of seats in the Parliament or the composition of the Council certainly matter for EU policy, the position of each institution on the question of EU integration is influenced by the nature of the institution itself. For example, the Council represents the governments of member states, for whom further EU integration implies a loss of direct decision-making power. For members of the European Parliament, on the other hand, more integration implies the ability to have a more tangible impact on citizens' lives and raise the Parliament's profile. We therefore assume that ideal points are an institutional feature and thus constant across the period we consider. Since the members of the Commission are proposed by the governments of member states, who are also represented in the Council, and subsequently approved by the Parliament, we restrict the ideal point of the Commission to lie in between the ideal points of the Parliament and the Council.

To capture differences in acceptance probabilities across terms, we allow the variance of the shock distributions that determine choice probabilities to differ between the eighth and the seventh term. The general increase in the probability of acceptance across stages of the OLP visible in the data plausibly reflects learning by the participating institutions, since the OLP was only introduced at the beginning of the seventh term.[20] Such learning would be reflected in a decrease in

[19]In practice, we need to discretise the support of the status quo distribution and choose an evenly spaced grid of 1001 points ranging from -1 to 1.

[20]The OLP is largely identical to what was known as Co-Decision prior to the Treaty of Lisbon,

the variance of shock distributions.

Given that the requirement of unanimity reduces the probability that the Council accepts a proposal, we allow the mean of the shock distribution $F_{\tilde{c}}$ to be smaller than that of the otherwise relevant distribution F_c and estimate the difference.[21]

The above choices leave us with nine parameters to estimate: three ideal points (i_b, i_s, and i_c), three discount factors (δ_b, δ_s, and δ_c), the standard deviation σ_8 of preference shocks during the eighth term of the European Parliament, the difference Δ_c between the means of the shock distributions F_c and $F_{\tilde{c}}$, and the cost k of introducing an initial proposal. Given values for these parameters, we can calculate the solution of the model.

Out of the probabilities listed in Table 1, we decided not to use any values that are equal to zero or one or that are based on less than ten observations. As an additional moment, we include the ratio between the numbers of proposals introduced by the Commission during the seventh and the eighth term, resulting in 15 moments and nine parameters to estimate. Despite all parameters being identified jointly under the model, many are associated closely with specific moments. The shift Δ_c in the mean of the shock distribution of the Council acting under unanimity is identified by the probabilities that the Council accepts proposals by the Parliament with which the Commission has formally disagreed. The standard deviation σ_8 determines the difference in the average probability of acceptance across terms. The share of proposals that fails identifies the cost k to the Commission of introducing an initial proposal: Failure implies that the status quo remains in place and there is no utility gain for the Commission. The higher the cost of making an initial proposal, the more the Commission refrains from making proposals in areas where failure is likely. What remains is to establish the separate identification of ideal points and discount factors. A lower discount factor implies that an institution is more willing to accept the proposal currently on the table. Similarly, an institution whose ideal point is far from the status quo finds delays in agreement more costly and therefore also has a higher willingness to accept. However, the discount factor affects choices equally across readings, while the average distance of the ideal point from the status quo changes across readings. The latter effect is due to selection: Under a status quo equally disliked by all institutions, agreement is likely to be achieved during the first reading.

but which applied to much fewer policy areas.

[21] With the exception of the distribution $F_{\tilde{c}}$, all shocks are assumed to have mean zero. Since we can only identify the change in variance across terms, we set the variance of shock distributions in the seventh term equal to one.

Proposals that reach the second reading tend to be more controversial. Discount factors are thus identified by the average probability that an institution accepts across readings, while identification of ideal points rests on the difference in the probability of acceptance across readings.

Appendix C provides further details on identification and estimation, including the model's fit to the observed moments. The same appendix also lists the estimated structural parameters of our model. Following the notion that the policy dimension reflects the degree of EU integration, we can interpret the estimates as indicating that the European Parliament favours further integration for most policy areas. The ideal points of the Council (representing member states) and the Commission (which is appointed by the governments of member states) are estimated to be relatively close to one another, with the Council being most in favour of shifting more responsibility back to member states. Our estimates for institutions' discount factors range between 0.88 and 0.98, with the Commission being most impatient. The degree of uncertainty about institutions' future choices, as measured by the standard deviation of random shocks to acceptance decisions, decreases by 32% between the 7th and the 8th parliamentary term. When acceptance of a proposal by the Council requires unanimous approval, the distribution of shocks on acceptance is shifted left by 0.29 of its standard deviation during the 7th term. While its absolute magnitude is difficult to interpret, the cost of initiating a legislative proposal is substantial enough to induce a rather selective choice of policy areas by the Commission, as we discuss in more detail below.

4.4 The Distribution of Bargaining Power

This section uses our estimation results to determine the relative bargaining power of the three co-legislators of the European Union. For the purpose of calculating the measure of bargaining power ρ_n as given by Equation (4), we define the outcome space O of the game as the interval $[-1, 1]$, which is the policy space of the model.[22] The utility of institution $z \in \{b, s, c\}$ under some outcome $p \in O$ is given by $-(p - i_z)^2$. Based on the estimated parameter values, we can calculate the distribution over O implied by the equilibrium for any constellation of ideal points and the status quo in a policy area. Given this equilibrium distribution, we can further compute the corresponding indirect utility of each institution as defined in Equation (1). The bargaining power of an institution is then calculated based

[22]Alternatively, we could specify the outcome space such that it also includes the timing of agreement. As we discuss in Section 3.6, excluding the timing of agreement is preferable.

	Baseline		Ideal Points		Right of Initiative		No Unanimity		Consult. Procedure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	7th	**8th**	**7th**	**8th**	**7th**	**8th**	**7th**	**8th**	**7th**	**8th**
Commission	.040	.039	.042	.040	.038	.038	.040	.039	.077	.077
Parliament	.362	.361	.065	.062	.363	.362	.362	.361	-.005	-.005
Council	.058	.058	.355	.357	.581	.570	.058	.058	.925	.928
Normalised:										
Commission	.087	.085	.091	.087	.039	.039	.087	.085	.077	.077
Parliament	.787	.788	.141	.135	.370	.373	.787	.788	-.005	-.005
Council	.126	.127	.768	.778	.592	.588	.126	.127	.928	.928

Table 2: Bargaining Power Under the Ordinary Legislative Procedure at Baseline and in Counterfactual Scenarios

Notes: The values in the lower panel of the table are normalized to sum to one across institutions. The counterfactuals considered are a. Ideal Points: The ideal points of the Parliament and the Council are exchanged; b. Right of Initiative: The Commission is forced to initiate legislation for every status quo and loses the ability to withdraw proposals; c. No Unanimity: The Council always votes subject to qualified majority; d. Consult. Procedure: A simulation of the Consultation Procedure.

on the indirect utilities integrated over all status quos.

The results are presented in the first two columns of Table 2. The upper panel reports bargaining powers when applying Equation (4), whereas the values in the lower panel are rescaled such that the numbers for each legislative term sum to one as suggested in Section 3.6. We find that the European Parliament has the strongest impact on EU legislation. The influence of the Council and the Commission is not negligible, albeit considerably smaller. The power coefficients are almost identical across legislative terms, indicating that the variance of shock distributions has little impact on the balance of power, which is also confirmed by the counterfactuals included in Table 2. We thus present all subsequent results focusing on the seventh term.

What explains the strength of the Parliament vis-à-vis the Commission and the Council? An important factor is the high degree of deadlock: for a majority of policy areas, the status quo falls between institutions' ideal points. In such cases, the legislators use their vetoes to prevent movements in policy away from the status quo that would be to their disadvantage. A shift in the position of the Parliament towards the Council reduces the degree of deadlock and therefore produces a substantial changes in the outcome of the game. Accordingly, the Parliament is assigned a relatively high bargaining power. The same logic does not apply to the Commission and the Council, since these institutions have very similar positions. A shift of either institution towards the Parliament does not lower the amount of deadlock, implying that their ability to affect outcomes individually is low. Overall, however, the vetoes of the Commission and the Council are important for the outcome, suggesting that the collective bargaining power of the Commission and the Council is larger than the sum of its parts. We confirm this through the following exercise: We first set the ideal point of the Commission equal to that of the Council and then calculate the indirect utilities as before. For the purpose of applying Equation (4), however, we treat the Commission and the Council as one player, whose indirect utility is given by the sum of the individual utilities. This implies that instead of shifting one player's ideal point at a time and observing the effect on players' utilities, we simultaneously shift the ideal points of the Commission and the Council. The corresponding power coefficient is equal to .631, compared to that of the Parliament of .362. Collectively, the influence of the Commission and the Council on EU legislation thus exceeds that of the Parliament. The reason is that the joint veto of the former institutions is more effective in preventing unwanted policy shifts than that of the Parliament, since they are located closer to the average status quo. Effectively, the Commission and the Council act as defenders of the status quo against the Parliament, which is pushing for more federalism.

The importance of vetoes is also visible in Figure 5, which plots bargaining powers across status quos. When the status quo is in the vicinity of the ideal point of the Parliament, the veto of the Parliament precludes any meaningful shifts in policy. The position of the Parliament is accordingly close to dictatorial. When the status quo falls next to the ideal points of the Commission or the Council, on the other hand, the individual influence of each institution is close to zero. Agreement between all institution on the need for new legislation is highest when the status quo falls close to -1. Outcomes are then less constrained by veto rights and all institutions are assigned a positive influence, with the Council coming out on top. A noteworthy feature of Figure 5 is that there is a small range of status quos where the power of the Council turns negative. In that range, the Commission initiates new legislation in equilibrium, but refuses to do so if the ideal point of the Council is equal to that of the Parliament. Shifting the ideal point of the Council towards

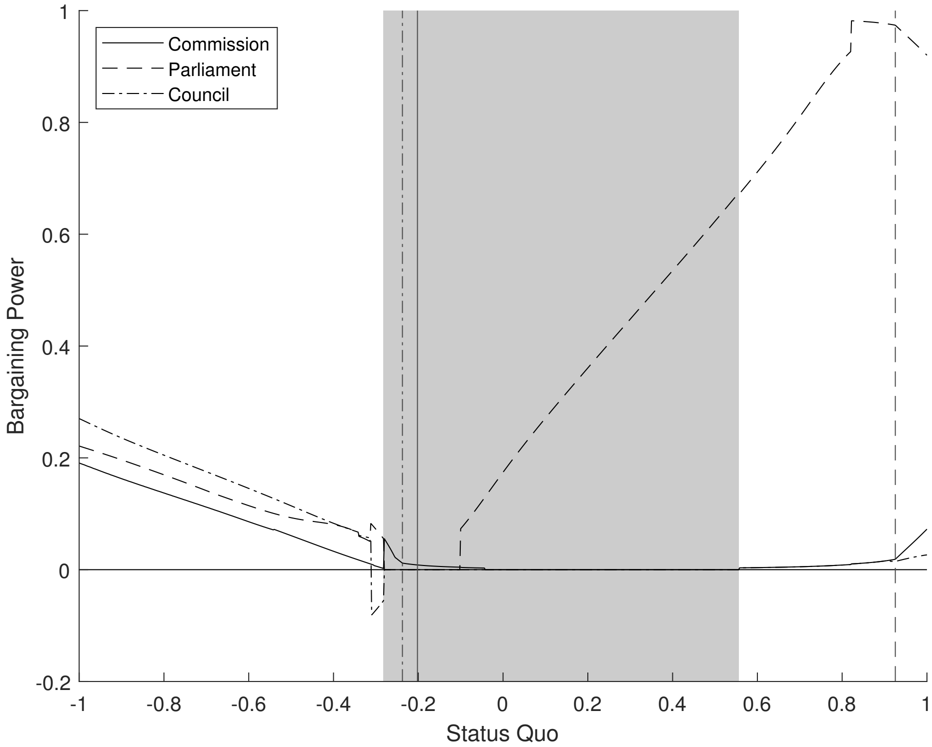

Figure 5: Bargaining Power Under the Ordinary Legislative Procedure Conditional on Status Quo.
Notes: Vertical straight lines represent the ideal points of institutions. Grey shading indicates that the Commission does not make an initial proposal for the given status quo in equilibrium.

that of the Parliament—as required to calculate Equation (4)—thus produces a small shift in policy in the opposite direction, which explains the negative influence of the Council.

Since we interpret ideal points as an institutional feature, the results presented in this section reflect not just the rules of the legislative process, but the institutional setup of the EU more broadly. We can also ask what the protocol of the OLP by itself implies for the distribution of bargaining power. We thus calculate the ex ante measure of bargaining power $\bar{\rho}_n$ introduced in Section 3.5, setting all discount factors equal to that of the Council and drawing ideal points and a status quo independently from a uniform distribution on $[-1, 1]$.[23] The results reveal a

[23]Under the chosen distribution of preference parameters, the set of parameter constellations that violate Assumption 1 has measure zero and is thus irrelevant for the final results. However, cases where at least one of the denominators in Equation (4) becomes very small occur with positive probability. Such instances can produce extreme values of ρ_n, not least due to numerical issues, which slows convergence. We therefore exclude cases where at least one of the relevant denominators is smaller than 10^{-3}. Convergence to three decimals occurs after about 80,000

fairly even distribution of power, with the bargaining power of the Commission equal to .204, that of the Parliament equal to .234, and .224 in case of the Council. Veto rights are again an important driver of these results: Given that the status quo often falls between ideal points and each institutions' veto is equally likely to be binding across draws, institutions are assigned a similar degree of influence. The roles assigned to the Parliament and the Council by the OLP are relatively symmetric in general, while the slightly weaker influence of the Commission reflects the more limited ability of the Commission to intervene in the legislative process after the introduction of the initial proposal.

4.5 Counterfactual Policy Environments

To gain further insights, we use the estimated model to evaluate a number of counterfactual scenarios. The results are included in Table 2.

Switching Ideal Points: The first counterfactual, presented in Columns 3 and 4, is a switch of the positions of the Parliament and the Council. The consequence is that the bargaining power of the Council becomes essentially equal to that previously assigned to the Parliament, and vice versa. This result once more confirms the point that under deadlock the institution with the most effective veto has most power.

Right of Initiative: A key privilege of the Commission is its right of initiative. Columns 5 and 6 consider the effects of abolishing this right of the Commission. Specifically, we assume that the Commission is forced to initiate legislation for every status quo. Furthermore, in its ruling of April 2015 on case C-409/13, the European Court of Justice stated that the right of the Commission to withdraw a proposal follows from its right of initiative. Conversely, we assume that without the right to initiate legislation, the Commission loses the ability to withdraw proposals. Not surprisingly, this change reduces the influence of the Commission relative to the other institutions (see the normalised coefficients in the lower panel of Table 2). At the same time, the power of the Council increases sharply, such that it exceeds that of the Parliament and comes close the level of the collective power of the Commission and the Council calculated above. This counterfactual thus effectively confers the power held jointly by the Commission and the Council at baseline onto the Council alone.

No Unanimity: Given the predominance of veto rights under the estimated constellation of ideal points, any change to the rules of the OLP that leaves vetoes

draws.

in place has little consequence for the distribution of bargaining power. We illustrate this through another simulation. The Commission has the ability to formally disagree with amendments introduced by the Parliament, with the consequence that the Council can then only accept these amendments through a unanimous vote. This rule is somewhat peculiar, given the fact that the Commission also states its opinion on amendments of the Council, but this opinion has no formal impact on subsequent proceedings. The special treatment of the amendments of the Parliament seems at odds with official EU publications that often describe the Council and the Parliament as equal co-legislators, while simultaneously assigning a very minor role to the Commission (see, for example, European Commission 2014, p. 10). We thus calculate bargaining powers for a counterfactual protocol under which the Council always votes subject to qualified majority. As Columns 7 and 8 of Table 2 show, this change to the OLP has essentially no impact on the distribution of bargaining power. Given that each institution retains its veto, this was also the expected result.

Consultation Procedure: The final question we address is the extent to which the Treaty of Lisbon, which came into force on the first of December 2009, affected the balance of power between the institutions of the EU. Prior to the Treaty of Lisbon, the OLP was referred to as Co-Decision and applied to a smaller set of legislative texts. During the sixth term of the European Parliament, about half of new proposals were instead subject to the Consultation Procedure. Under that procedure, the Commission has the right of initiative as in the case of the OLP. Once the Commission introduces a new proposal, Parliament can propose changes to the legislative text. The Council then has the ability to decide the final version of the text, without being bound by the opinion of the Parliament in any way. We model this process as follows: The introduction of an initial proposal by the Commission works as in our model of the OLP. The Parliament can then delay proceedings by one period. The Council subsequently accepts the proposal on the table, implements a proposal of its own at the cost of an additional period of delay, or rejects the proposal, leaving the status quo in place. We use our estimates of the structural parameters to calculate the bargaining power of the three institutions under this protocol. Not surprisingly, the power of the Council is above .9 under the Consultation Procedure, while that of the Parliament is essentially equal to zero. We thus find that the Treaty of Lisbon succeeded in strengthening the role of the European Parliament.

Our results regarding the bargaining power of the institutions of the EU can be summarised as follows: The crucial factor determining the outcomes of the Ordinary Legislative Procedure are veto rights. Since each institution has the ability to veto proposals, the OLP assigns a fairly equal degree of influence to all of them. In practice, however, the institutional nature of the European Parliament implies that the Parliament pushes for more federalism than is currently the case in most policy areas. The vetoes of the Commission and the Council prevent such outcomes in many cases, which makes these institutions collectively more influential than the Parliament. While we find that the Treaty of Lisbon succeeded in giving the Parliament a say over EU legislation, additional reforms of the legislative process that leave the collective veto of the remaining institutions intact would fail to further empower the Parliament.

5 Conclusion

This paper introduces a novel method for measuring the power of a player in any non-cooperative game of bargaining. The power of a player is calculated as the extent to which shifts in this player's preferences change the utility of all participating players, expressed relative to the changes that would occur if the player in question had full control over the outcome of the game. This measure satisfies a number of axioms and in the context of two-player games we show that no other function has these properties. For the special case of TU-games, we compare our measure to the more conventional approach of interpreting the expected surplus share of a player as their bargaining power. The two approaches coincide when the equilibria of the game are Pareto efficient, but generally yield different results when they are not. Intuitively, inefficiencies imply that players collectively do not have full control over the distribution of the surplus and our measure calculates bargaining power relative to the share of the surplus that players can freely allocate.

Given that non-cooperative games are explicit about the process of bargaining, our measure is particularly valuable when assessing features of this process and their role in determining the influence of a player. Such insights are important. For example, they are crucial when designing institutions that aim to achieve a specific distribution of power among its members. Our application in the context of the legislative process of the European Union illustrates this point well. The de-facto bargaining power of an EU institution is the product of a wide range of factors such as who has the right of initiative, veto rights, the order in which institutions move, or majority requirements in the Council. By structurally estimating a model of this process, we can apply our measure of bargaining power and determine through counterfactual simulations what drives the results.

The often-voiced criticism that the European Commission has a dominant influence on the laws passed by the European Union is not confirmed by our results. Instead, we find that, *individually*, the European Parliament is the most influential among the institutions of the EU. The Commission and the Council are not powerless though. In particular, our analysis reveals that *jointly* these two institutions dominate the bargaining power of the Parliament. We further show that the deadlock arising from institutions' veto power implies that many changes to the bargaining protocol, such as a removal of the right of the Commission to influence the majority requirements in the Council, would have little impact on the distribution of bargaining power across institutions.

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Appendix

A Proofs

Proof of Theorem 1. Let Γ be a two-player game with associated indirect utility functions $\mathbf{v}$. Assume without loss of generality that the gain of player 2 weakly exceeds the gain of player 1, that is,

$$\frac{v_1(\mathbf{u}) - v_1(\mathbf{1}_{u_2})}{v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})} \leq \frac{v_2(\mathbf{u}) - v_2(\mathbf{1}_{u_1})}{v_2(\mathbf{1}_{u_2}) - v_2(\mathbf{1}_{u_1})} \ .$$

Assumption 1 rules out that the denominators in the preceding expression could be equal to zero. Given that agreement payoffs are bounded from above, the gain of each player is therefore well-defined.

We proceed by constructing a compound game that satisfies equal gains. Let Γ' be a game with associated indirect utility functions $\mathbf{v}'$ that coincides with Γ in terms of outcome space, set of players, and agreement payoffs, but such that player 1 is a dictator while player 2 is a null player. The latter implies $v'_1(\mathbf{u}) = v'_1(\mathbf{1}_{u_1})$ and $v'_2(\mathbf{u}) = v'_2(\mathbf{1}_{u_1})$.

Now consider the compound game $\Gamma^* = \lambda\Gamma + (1-\lambda)\Gamma'$. Since each constituent game of Γ^* forms a subgame, behaviour in a subgame does not depend on previous moves of nature, and equilibrium is assumed to be unique, the indirect utility functions of Γ^* are given by $\mathbf{v}^* = \lambda\mathbf{v} + (1-\lambda)\mathbf{v}'$. Since player 1 (player 2) is a dictator (null player) in Γ' and all games under consideration have equal agreement payoffs,

$$\begin{aligned} v^*_n(\mathbf{u}) = \lambda v_n(\mathbf{u}) + (1-\lambda)v'_n(\mathbf{u}) &= \lambda v_n(\mathbf{u}) + (1-\lambda)v'_n(\mathbf{1}_{u_1}) \\ &= \lambda v_n(\mathbf{u}) + (1-\lambda)v_n(\mathbf{1}_{u_1}) \ . \end{aligned}$$

Γ^* thus satisfies equal gains if

$$\frac{\lambda v_1(\mathbf{u}) + (1-\lambda)v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})}{v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})} = \frac{\lambda v_2(\mathbf{u}) + (1-\lambda)v_2(\mathbf{1}_{u_1}) - v_2(\mathbf{1}_{u_1})}{v_2(\mathbf{1}_{u_2}) - v_2(\mathbf{1}_{u_1})} \ .$$

Solving for λ yields

$$\begin{aligned} \lambda &= 1/\left[\frac{v_2(\mathbf{u}) - v_2(\mathbf{1}_{u_1})}{v_2(\mathbf{1}_{u_2}) - v_2(\mathbf{1}_{u_1})} - \frac{v_1(\mathbf{u}) - v_1(\mathbf{1}_{u_1})}{v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})}\right] \\ &= 1/\left[1 + \frac{v_2(\mathbf{u}) - v_2(\mathbf{1}_{u_1})}{v_2(\mathbf{1}_{u_2}) - v_2(\mathbf{1}_{u_1})} - \frac{v_1(\mathbf{u}) - v_1(\mathbf{1}_{u_2})}{v_1(\mathbf{1}_{u_1}) - v_1(\mathbf{1}_{u_2})}\right] \ . \end{aligned}$$

Since the gain of player 2 in the game Γ weakly exceeds that of player 1, $\lambda \in (0, 1]$.

Now notice that the Axioms of Equal Gains and Compound Games imply

$$\rho_1(\mathbf{v}^*) = \lambda\rho_1(\mathbf{v}) + (1-\lambda)\rho_1(\mathbf{v}') = .5 \tag{5}$$

and

$$\rho_2(\mathbf{v}^*) = \lambda\rho_2(\mathbf{v}) + (1-\lambda)\rho_2(\mathbf{v}') = .5 \tag{6}$$

By the Axioms of Dictators and Null Players, $\rho_1(\mathbf{v}') = 1$ and $\rho_2(\mathbf{v}') = 0$. Using the value of λ derived above, Equations (5) and (6) can thus be solved for $\rho_1(\mathbf{v})$ and $\rho_2(\mathbf{v})$ to yield the desired result. $\square$

Proof of Proposition 2. As a first step, it will be shown that the value of $\rho_n(\mathbf{v})$ is well-defined if $\mathbf{v}$ corresponds to a game satisfying Assumption 1. Since $N < \infty$, the set $\mathcal{N}_{\rightleftarrows n}$ is non-empty. Since there exists at least one player m such that $v_n(\mathbf{1}_{u_n}) > v_n(\mathbf{1}_{u_m})$ by Assumption 1, the same condition must be satisfied for any $m \in \mathcal{N}_{\rightleftarrows n}$. Assumption 1 thus implies $v_m(\mathbf{1}_{u_m}) > v_m(\mathbf{1}_{u_n})$ for any $m \in \mathcal{N}_{\rightleftarrows n}$. Now fix some $m \in \mathcal{N}_{\rightleftarrows n}$. Then it holds by definition for any player $k \in \mathcal{N}_{n \rhd m}$ that $v_k(\mathbf{1}_{u_n}) \geq v_k(\mathbf{1}_{u_m})$. Furthermore, it was established above that $v_n(\mathbf{1}_{u_n}) > v_n(\mathbf{1}_{u_m})$ and since player n is a member of $\mathcal{N}_{n \rhd m}$ it follows that $V_{n \rhd m}(\mathbf{1}_{u_n}) - V_{n \rhd m}(\mathbf{1}_{u_m}) > 0$. An analogous argument shows that $V_{m \trianglerighteq n}(\mathbf{1}_{u_m}) - V_{m \trianglerighteq n}(\mathbf{1}_{u_n}) > 0$, which rules out that any denominator included in Expression (4) could be equal to zero.

Given that is has thus been established that the value of Equation (4) is well-defined, it can now be shown that ρ_n satisfies all axioms. If player n is a dictator, the numerator of any fraction contained in Equation (4) is equal to the denominator and the expression as a whole is equal to one as required by Axiom *A1*. Axiom *A2* is equally satisfied: if player n is a null player, the numerator of any fraction contained in Equation (4) equals zero, as does the expression as a whole. Axiom *A4* holds since Equation (4) simplifies to Equation (3) in case of a two-player game. Finally, all denominators in Equation (4) are constant across games possessing equal sets of players and agreement payoffs, as is the set $\mathcal{N}_{\rightleftarrows n}$. ρ_n is therefore an affine function of the indirect utilities that vary across such games and thus satisfies Axiom *A3*. $\square$

Proof of Proposition 3. Pareto efficiency implies that if all players agree that a unique outcome would be optimal, then the equilibrium of the game must produce this outcome with certainty. In a TU game, under the vector of utility functions $\mathbf{1}_{u_m}$ all players agree that player m should receive everything. Pareto efficiency of the outcomes $o^*(\mathbf{1}_{u_n})$ and $o^*(\mathbf{1}_{u_m})$ thus implies $v_k(\mathbf{1}_{u_n}) = 0 = v_k(\mathbf{1}_{u_m})$ for any

$k \in \mathcal{N} \setminus \{m, n\}$ while $v_n(\mathbf{1}_{u_n}) > v_n(\mathbf{1}_{u_m})$ and $v_m(\mathbf{1}_{u_m}) > v_m(\mathbf{1}_{u_n})$. Consequently, $\mathcal{N}_{n \rhd m} = \{n\}$ while $\mathcal{N}_{m \unrhd n} = \mathcal{N} \setminus \{n\}$. Furthermore, Pareto efficiency of some outcome $o^*(\mathbf{u}')$ implies that the utilities of players sum to one in this equilibrium and thus $V_{m \unrhd n}(\mathbf{u}') = 1 - v_n(\mathbf{u}')$. Based on all of the above, $v_n(\mathbf{1}_{u_m}) = V_{m \unrhd n}(\mathbf{1}_{u_n}) = 0$ and $v_n(\mathbf{1}_{u_n}) = V_{m \unrhd n}(\mathbf{1}_{u_m}) = 1$. Finally, Pareto efficiency implies $v_n(\mathbf{u}_{u_n \leftarrow u_m}) = 0$ since under the vector of utility functions $\mathbf{u}_{u_n \leftarrow u_m}$ all players other than n prefer more for themselves while player n prefers more for player m. Given Pareto efficiency, $v_n(\mathbf{u}_{u_n \leftarrow u_m}) = 0$ implies $V_{m \unrhd n}(\mathbf{u}_{u_n \leftarrow u_m}) = 1$. Using all of the above to substitute in Equation 4, it follows that

$$
\begin{aligned}
\rho_n(\mathbf{v}) &= \frac{1}{|\mathcal{N}_{\rightleftarrows n}|} \sum_{m \in \mathcal{N}_{\rightleftarrows n}} \frac{1}{2} \left[\frac{v_n(\mathbf{u}) - 0}{1 - 0} + \frac{1 - (1 - v_n(\mathbf{u}))}{1 - 0} \right] \\
&= v_n(\mathbf{u}) \ . \qquad \square
\end{aligned}
$$

Proof of Proposition 4. We start by calculating the value of ρ_n for a given vector $\mathbf{u} \notin \{\mathbf{1}_{u^0}, \mathbf{1}_{u^1}\}$. The set $\mathcal{N}_{\rightleftarrows n}$ contains all players who prefer a different outcome than player n does and it holds that $u_m \in \{u^0, u^1\} \setminus \{u_n\}$ for any $m \in \mathcal{N}_{\rightleftarrows n}$. All terms of the sum in Equation (4) are therefore identical. It is clear that the agreement outcome under the vector of preferences $\mathbf{1}_{u^0}$ ($\mathbf{1}_{u^1}$) is equal to 0 (1) with certainty. If player n is pivotal, the outcome coincides with that preferred by player n, which implies $V_{n \rhd m}(\mathbf{u}) = V_{n \rhd m}(\mathbf{1}_{u_n})$ and $V_{n \rhd m}(\mathbf{u}_{u_n \leftarrow u_m}) = V_{n \rhd m}(\mathbf{1}_{u_m})$. The first fraction in Equation (4) is therefore equal to 1 and the same is analogously true of the second fraction. It follows that $\rho_n = 1$ if player n is pivotal. If player n is not pivotal, switching the preference of player n has no consequence for the outcome and $\rho_n = 0$. It follows that $\rho_n(\mathbf{v}^S) = \mathcal{V}(S \cup \{n\}) - \mathcal{V}(S)$ if $n \notin S$ and $\rho_n(\mathbf{v}^S) = \mathcal{V}(S) - \mathcal{V}(S \setminus \{n\})$ if $n \in S$.

Define $F_{PB}(\mathbf{u}) = 1/2^N$ and $F_{SS}(\mathbf{u}) = [|S|! \cdot (N - |S|)!]/(N+1)!$. We can now establish that

$$\begin{aligned}
\bar{\rho}_n(F_{PB}) &= \sum_{S\subseteq\mathcal{N}} \frac{1}{2^N}\rho_n(\mathbf{v}^S) \\
&= \sum_{\substack{S\subseteq\mathcal{N}\\ n\notin S}} \frac{1}{2^N}\rho_n(\mathbf{v}^S) + \sum_{\substack{S\subseteq\mathcal{N}\\ n\in S}} \frac{1}{2^N}\rho_n(\mathbf{v}^S) \\
&= 2\sum_{\substack{S\subseteq\mathcal{N}\\ n\notin S}} \frac{1}{2^N}\rho_n(\mathbf{v}^S) \\
&= \sum_{\substack{S\subseteq\mathcal{N}\\ n\notin S}} \frac{1}{2^{N-1}}\left[\mathcal{V}(S\cup\{n\}) - \mathcal{V}(S)\right]\ ,
\end{aligned}$$

where the third equality follows from the fact that for every $S \subseteq \mathcal{N}$ such that $n \notin S$ there exists exactly one $S' \subseteq \mathcal{N}$ such that $n \in S'$ and $S = S' \setminus \{n\}$. Since pivotality of player n only depends on the other players' preferences, it thus holds that $\rho_n(\mathbf{v}^S) = \rho_n(\mathbf{v}^{S'})$. Furthermore,

$$\begin{aligned}
\bar{\rho}_n(F_{SS}) &= \sum_{S\in\mathcal{N}} \frac{|S|!\cdot(N-|S|)!}{(N+1)!}\rho_n(\mathbf{v}^S) \\
&= \sum_{\substack{S\subseteq\mathcal{N}\\ n\in S}} \Bigg[\frac{|S|!\cdot(N-|S|)!}{(N+1)!}\rho_n(\mathbf{v}^S) \\
&\qquad + \frac{(|S|-1)!\cdot(N-|S|+1)!}{(N+1)!}\rho_n(\mathbf{v}^{S\setminus n})\Bigg] \\
&= \sum_{\substack{S\subseteq\mathcal{N}\\ n\in S}} \Bigg[\frac{|S|!\cdot(N-|S|)!}{(N+1)!} \\
&\qquad + \frac{(|S|-1)!\cdot(N-|S|+1)!}{(N+1)!}\Bigg]\rho_n(\mathbf{v}^S) \\
&= \sum_{\substack{S\subseteq\mathcal{N}\\ n\in S}} \frac{(|S|-1)!\cdot(N-|S|)!}{N!}\left[\mathcal{V}(S) - \mathcal{V}(S\setminus\{n\})\right]\ ,
\end{aligned}$$

where the third equality holds since $\rho_n(\mathbf{v}^S) = \rho_n(\mathbf{v}^{S\setminus n})$, which follows as the value of ρ_n only depends on whether player n is pivotal, which in turn only depends on the preferences of other players. $\square$

B Data Appendix

The EUR-Lex database in principle provides all the information we require, but has some missing values. We fill these missing values by referring to the Legislative Observatory of the European Parliament. The raw dataset we construct in this manner contains 1,163 proposals with at least one relevant decision taken during the seventh or eighth term of the European Parliament. However, some of these proposals belong to "legislative packages", which are introduced jointly by the Commission and are then effectively treated as one proposal during the legislative process. To correct for this issues, we first search for groups of proposals where all major decisions were taken on the same day and with the same outcome. We classify such a group as a package if at least three decisions are observed for each proposal belonging to the group. If less than three decisions are observed, we verify manually if the proposals deal with the same subject matter. Treating each identified package as one proposal, we are left with 1,016 independent proposals.

Based on this dataset, we calculate decision probabilities for different stages of the OLP. First of all, we compute the share of proposals that are accepted by the Parliament during the first reading out of all proposals that are accepted or amended by the Parliament at that point. As explained in the main text, rejection of a proposal typically means that the institution in question simply refuses to take further steps. Rejection is therefore often not directly observable in our data. We proceed in the same way when calculating the likelihood that the Parliament accepts a proposal during the second reading, and when calculating the corresponding choice probabilities for the Council. Another decision of interest is whether or not the Commission agrees with amendments proposed by the Parliament. As was mentioned in the previous section, this determines the majority requirements if the Council subsequently wants to accept the amendments in question. The opinion of the Commission is recorded as "agreement","partial agreement", or "refusal". As even partial agreement means that at least one unanimous vote is required in the Council to accept the proposal of the Parliament, we treat both partial agreement and refusal as "disagreement". Finally, we compute the probability that a proposal fails. Since failure typically manifests itself as an indefinite period of inactivity, we treat any proposal as failed that has not seen any legislative activity for at least six years.[24] As only four years had passed since

[24]There is no completed first reading in the Parliament and only one completed first reading in the Council that lasted more than six years in our data. The latter case was proposal COM (2005) 507 on the portability of supplementary pension rights. The Council concluded its first reading on this proposal on February 17 2014, about six years and eight months after Parliament

the end of the eighth term at the time of writing, this creates an issue of censoring. We therefore compute the probability of failure based only on the seventh term.

C Estimation and Identification

We estimate the structural parameters of the model presented in Section 4.2 using a method of moments estimator. For the vector of included empirical moments $\mathbf{m_D}$ we calculate the theoretical counterpart $\mathbf{m_M}(\boldsymbol{\theta})$ predicted by the model under a parameter vector $\boldsymbol{\theta}$. Our estimates minimize the distance between empirical and theoretical moments calculated as

$$(\mathbf{m_D} - \mathbf{m_M}(\boldsymbol{\theta}))'\mathbf{W}(\mathbf{m_D} - \mathbf{m_M}(\boldsymbol{\theta})),$$

where $\mathbf{W}$ is a weighting matrix, for which we use the identity matrix.

A comparison of the empirical and theoretical moments in Table 3 shows that our model fits the data well. The most notable deviation is that we overestimate the probability that the Commission agrees with amendments introduced by the Parliament at first reading.

We list the estimated parameters in Table 4.[25] Figure 6 presents the gradient matrix of the theoretical moments with respect to model parameters.

concluded its first reading.

[25]Conceptually, the moments we target are population rather than sample moments. We thus do not calculate standard errors for our parameter estimates. Moreover, one of the moments—namely the ratio between terms of the number of proposals—is observed only once and thus has no standard error.

	Moment	Data	Model
	Seventh Term of the European Parliament		
	First Reading		
(1)	Approval by EP	0.1056	0.1168
(2)	Commission agreement on EP amendments	0.7398	0.9990
	Approval by Council conditional on		
(3)	No amendments by EP	0.9531	0.9476
(4)	EP amendments approved by Commission	0.9783	0.9995
(5)	EP amendments not approved by Commission	0.1404	0.1765
	Second Reading		
(6)	Approval by EP	0.6667	0.6242
(7)	Commission agreement on EP amendments	0.8000	0.8420
(8)	Approval by Council (cond. on Com. approval)	0.8846	0.8598
(9)	Share of Failed Proposals	0.1374	0.1738
	Eighth Term of the European Parliament		
	First Reading		
(10)	Approval by EP	0.1828	0.2439
(11)	Commission agreement on EP amendments	0.8486	0.9901
	Approval by Council conditional on		
(12)	EP amendments approved by Commission	0.9954	0.9933
(13)	EP amendments not approved by Commission	0.2444	0.2192
	Second Reading		
(14)	Approval by EP	0.8919	0.8796
(15)	Ratio of Proposals 8th to 7th Term	0.7697	0.8625

Table 3: Empirical and Predicted Moments

Parameter		Value	Parameter		Value
Ideal Points:	i_b	-.202	*Discount Factors:*	δ_b	.876
	i_c	-.237		δ_c	.980
	i_s	.925		δ_s	.982
Shock Distributions:	Δ_c	-.294	*Cost Initial Proposal:*	k	.043
	σ_8	.677			

Table 4: Structural Parameter Estimates

Notes: The table lists the estimates for the parameters of the model presented in Section 4.2, obtained by targeting the moments listed in Table 3.

	i_b	i_s	i_c	δ_b	δ_s	δ_c	σ_8	Δ_c	k
1	0.008626	0.001315	0.0154	0.09022	0.03736	0.008143	0	8.444e-06	0.02317
2	8.785e-06	3.681e-05	0.0002065	0.04794	0.0001685	0.04783	0	1.377e-06	0.04785
3	0.0421	0.01857	0.4285	0.3546	0.02192	0.07574	0	3.758e-05	0.003894
4	4.673e-06	1.225e-05	0.0003954	0.02469	0.0001065	0.02545	0	1.718e-06	0.02465
5	1.582e-07	0.007919	0.3855	0.03495	0.02812	1.064	0	0.04389	0.03495
6	0.09762	0.07761	0.8836	2.316	0.01509	2.342	0	0.0008794	2.903
7	0.1071	0.03831	1.134	2.999	0.1926	3.194	0	0.001465	3.883
8	0.1128	0.04035	1.16	3.009	0.2089	3.458	0	0.0008625	3.905
9	0.0004016	0.007117	0.1072	0.1045	0.04789	0.0602	0	1.458e-05	0.1123
10	0.01181	0.001132	0.2464	0.2142	0.02974	0.06278	0.2302	1.892e-05	0.0008333
11	0.0001859	0.0006421	0.001043	0.001796	0.001725	0.001159	0.003503	0.0004673	0.001252
12	0.0001075	0.0003321	0.0005022	0.001188	0.004072	0.001316	0.001607	0.00313	0.0008519
13	8.046e-06	0.06396	0.006686	0.2197	0.241	0.057	0.03416	0.1429	0
14	0.05659	0.01248	0.009202	0.03428	0.09507	0.003192	0.07519	0.006445	0.0008479
15	0	0.1718	0.02336	0.02336	0.02336	0	0.1718	0	0.02336

Figure 6: Gradient Matrix of Theoretical Moments with Respect to Parameters.

Notes: The matrix contains derivatives of theoretical moments with respect to parameters. The theoretical moments in rows are listed in the same order as in Table 3.