Power in Legislative Bargaining:
Theoretical conception and empirical application of power indices to legislative decision-making in the European Union

by

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Starting from the fundamental criticism of the application of power indices to analyze legislative decision-making the paper derives the classical power indices in a non-cooperative game-theoretical framework. Based on a simplified version of the Baron/Ferejohn model a political exchange mechanism organized as an abstract economy is derived to show: (i) a Walras equilibrium exists taking external effects of exchange into account. (ii) Under specific conditions political power of legislators correspond with the Shapley/Shubik or normalized Banzhaf-Power index, respectively. (iii) actors ability to determine the final policy outcome can be subdivided into constitutionally determined power and luck corresponding to the externalities of political exchange. (iv) the model is empirically supported by an application to the European Agricultural Policy.

Key words: formal modeling of legislative process, non-cooperative game theory, power indices, political exchange, abstract economy, European Union

JEL: C63, C72, D58, D 72, D78
1 Introduction

There is an on-going discussion on the application of power indices to the European Union (see special issue of *Journal of Theoretical Politics* 1995, 1999, 2001 or Tsebelis/Garrett 1996). In general our paper is addressed to this discussion, but we do not intend to refer to all details of this discussion. Rather we like to focus our analyses on more general aspects of power indices and formal modeling of legislative decision-making process raised by the dispute among the authors.

In particular, Garrett and Tsebelis (1999) argue against the application of voting power indices in the EU. Their main argument is twofold. First, classical concepts of voting power indices, i.e. Banzhaf and Shapley-Shubik indices, do not take into account important institutional rules of the legislative decision-making process within the EU-system, e.g. agenda setting power. Second, classical voting power indices ignore policy preferences of relevant political actors, e.g. national members in the council, the commission and parliamentary groups in the EP. Moreover, Garrett and Tsebelis criticize simple cooperative voting games as inappropriate models and suggest non-cooperative game theoretical models, i.e. an agenda setter model, to analyze legislative decision-making within the EU-system (Garett and Tsebelis 1999).

In contrast to Garett and Tsebelis, scholars supporting the application of classical power indices to the EU argue that the analyses of a priori voting power make important contribution especially to constitutional choice theory (Lane and Berg 1999, Holler and Widgrén 1999 and partially also Steuenberg et al. 1999 and Felsenthal and Moshé 2001). This argumentation goes back to Shapley and Shubik (1954) who emphasize the usefulness of power indices analyzing the “..[b]asic design in of legislative assemblies and policy-making boards”. Analogously Coleman (1971, reprinted in Coleman 1986: 192) stated that “[T]he distribution among the members of formal control over a collectivity’s actions is an important element of constitution. The exercise of such control is mediated by decision rules, which may be very complex, involving preliminary decisions by sub-collectivities within the larger collectivity. Framers of constitution pay very special attention to distribution of control and to the form of decision rules, for these determine in large part the power of various members of the collectivity...”.

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It is argued in the paper that both groups of authors might be partially right. On the one hand Garrett and Tsebelis are right in demanding generally that any analysis of legislative–decision-making should be based on a positive model of the legislative decision-making process. Moreover, results derived from a model can only deliver any insights into real decision-making if the model fits empirically observed legislative decision-making process. Therefore, as far as it can be demonstrated that legislative decision-making in the EU cannot be modeled within simple voting games, Garrett and Tsebelis are correct in criticizing these approaches. On the other hand, it is always possible to conceptualize power of individual actors engaged in social situations, in particular legislative decision-making. Moreover, analyzing political power of individual actors based on positive models of legislative decision-making is an interesting and important endeavor, especially in the framework of normative and positive constitutional choice theory (Shapley and Shubik 1954, Coleman 1971, Weingast et al. 1981, de Figueiredo and Weingast 1998, Shepsle and Weingast 1995).

Thus, to conjoin both lines of argumentation, in this paper a model of legislative decision-making will be defined that according to the premises of Garrett and Tsebelis is based on non-cooperative game theory and simultaneously allows for a derivation of political power indices. Moreover, we will demonstrate that this model can be applied to the EU predicting pars pro toto real policy outcome of the European Common Agricultural Policy (CAP), while for the agenda setter model only a poor empirical support can be observed.

The paper is structured as follows. We will first provide a general conceptualization and definition of individual political power and luck in section 2. In section 3 the theoretical model is derived in two steps. In a first step we conceptualize legislative decision making as a simple non-cooperative legislative bargaining game (NLG) corresponding to the non-cooperative bargaining game of Baron and Ferejohn (1989) to show the following results: (i) The equilibrium outcome of the NLG corresponds to a lottery over legislators’ ideal points and the status quo. (ii) The probability that the ideal point of a legislator i is the final outcome of the game is only determined by the constitutional rules and can be interpreted as her political power. (iii) On the basis of NLG, power can be systematically distinguished from luck, the latter defined on the basis of individual expected utility corresponding with the lottery of other legislators’
ideal points and the status quo. (iv) under specific conditions political power defined in the framework of the NLG corresponds to the classical Banzhaf and Shapley-Shubik voting power index, respectively.

In a second step we define a political exchange game (PEG) and demonstrate that under specific conditions the PEG dominates the NLG, i.e. leads for every legislator to a higher ex ante expected utility. According to the PEG, legislators informally agree ex ante on a common proposal procedure, where the common proposal corresponds with a weighted mean of agent’s ideal points and the status quo. It will be shown that political power defined in the framework of PEG generalized the power concept defined in the framework of the NLG. Moreover, in section 4 the political exchange model is applied to legislative decision-making within the European Common Agricultural Policy. In particular, empirical application results in a convincing support of the PEG compared to a poor performance of the agenda setter model generally supported in the literature (e.g. Garrett and Tsebelis 1999). Section 5 summarized the main findings.

2 On the concept of (political) power

Although power is a widely used concept in social sciences, there exists no unique definition of power. The most promising starting point is Weber who defined power of an individual actor in a specific social situation as the probability that this actor can determine the outcome of this specific social situation even against the will of other actors (Weber 1921). To formalize Weber’s conception of power we define a social situation as an abstract game (denoted SG hereafter) played by a set of actors $N$. Each actor $i \in N$ has a specific action set $A_i$ from which she can choose her individual action strategies $a_i \in A_i$. The outcome $\alpha$ is defined as a function of the individual action strategies: $\alpha = \alpha(a)$, where $a = \{a_1, \ldots, a_n\}$ denotes the vector of individual action strategies. Moreover, every actor has a pay-off function defined over the outcome $\alpha$, $U_i(\alpha)$. Further, we assume that a Nash equilibrium of the game exists and denote it $a^*$. Accordingly, we consider the outcome $\alpha^*(a^*)$ corresponding with this Nash equilibrium as the outcome of the game. Furthermore, we assume that for each actor exists an ideal point $y_i$ defined as the maximand of $U_i(\alpha(a))$ over
the total strategy space $A = \prod_{i \in N} A_i$. Given the final set of actors’ ideal points, $Y$, a zero point for every actor $z_i$ can be defined as the minimum of $U_i(\alpha)$ over $Y$.

To introduce Weber’s concept of power we assume that the outcome $\alpha^*$ is a lottery over actors’ ideal points. Let $P_i$ denote the probability that the ideal point of an actor $i$ will be the outcome. Then, the power of an actor $i$ corresponds to the probability $P_i$. Next we can define the individual value of the game $SG$ ($v_i^{SG}$) as actors’ expected utility for the equilibrium outcome $\alpha^*$:

$$v_i^{SG} = EU_i(\alpha^*) = \sum_{k \in N} P_k U_i(y_k) = P_i U_i(y_i) + (1 - P_i) \sum_{k \neq i} P_k U_i(y_k)$$

As the pay-off function is cardinal we always can transform this function in a way that $U_i(y_i) = 1$ and $U_i(z_i) = 0$. Hence, given this transformation of individual pay-off functions, we can define another set of games, which we call “games against the will of other” ($GAW^i$) for all $i \in N$. By definition, for any $i \in N$ $GAW^i$ corresponds exactly to $SG$ except the assumption that all actors $k \neq i$ have an ideal point $y_k = z_i$. Hence, $GAW^i$ can be interpreted as a formalization of what Weber describes as “against the will of other”.

Finally, we can systematically define luck as the difference between the value of the social game $v_i^{SG}$ and the value of the $GAW^i$ ($v_i^{GAW}$). Given the definition of the pay-off function this difference corresponds with the amount of power an actor $i$ would additionally need in a game “against the will of other”, so that the value of the (transformed) $GAW^i$ equals the value of the social game $SG$ actually played. We shall denote this difference by $L_i^{SG}$. Hence, in a game $SG$ individual power is measured by $P_i^{SG}$ and luck by $L_i^{SG}$.

Next we want to relate the concepts of power and luck, respectively, with the problem of constitutional choice. Therefore, let $\Gamma$ and $M^u$ denote a set of rules and a set of preference profiles, respectively. An element $\gamma \in \Gamma$ defines the rules of a game of type $SG$, while an element $u \in M^u$ is a vector of individual pay-off functions defined for the actors $i \in N$. Then, $SG(\gamma, u)$ denotes the game defined by the rules $\gamma$ and the
preferences. Now given that \( \Gamma \) has more than one element, a constitutional choice problem corresponds with the selection of a concrete element of \( \Gamma \).

How can we model a constitutional choice problem? A first starting point is Weingast (1979) interpreting constitutional choice as “legislators choosing the rules of the game to maximize their expected benefits”. Thus, applying Weingast’s approach actors’ individual constitutional choices depend on the value of the game \( \text{SG}(\gamma, u) \), analogously we denote this value \( v_i^{SG}(\gamma, u) \). Given the exposition above it holds for a given \( u \) and \( \gamma \):

\[
(b) \quad v_i^{SG}(\gamma, u) = L_i^{SG}(\gamma, u) + P_i^{SG}(\gamma)
\]

We do not want to define a complete constitutional game here, but obviously it holds that an equilibrium of such a game \( (\gamma^*) \) depends on the individual values actors relate with the different games \( \text{SG}(\gamma, u) \). Hence, according to eq.(2) these values directly depend on actors’ power and luck. Therefore, it follows quite plainly that any constitutional choice problem can be analyzed on the basis of power and luck related with the different games actors can play. Finally, it is a common assumption that constitutional choices are made under the veil of ignorance, that is actors do not know their specific preferences when they have to choose \( \gamma^* \). Hence, to take this specific assumption into account one can assume that after actors have chosen the rules of the game \( \gamma^* \), nature has a last move selecting randomly an element \( u^* \) out of the set \( M_u \) according to a probability distribution \( f(u) \). Assuming actors know the probability distribution \( f(u) \) when choosing the institutional rule implies that actors choices depend on the expected values of the games \( \text{SG}(\gamma, u^*) \). Denote these expected values by \( \text{Ev}^{SG}(\gamma, u^*) \) results in:

\[
(c) \quad \text{Ev}^{SG}_i(\gamma, u) = \int_0^1 \left[ L_i^{SG}(\gamma, u) + P_i^{SG}(\gamma) \right] f(u)du = EL_i^{SG}(\gamma) + P_i^{SG}(\gamma)
\]

with:

\[
EL_i^{SG}(\gamma) = \int_0^1 L_i^{SG}(\gamma, u) f(u)du
\]

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1 Alternatively, one could assume that the outcome corresponds with the weighted mean of ideal positions. Accordingly, individual power is then defined as the weight of actors’ ideal position. See also section 3 below.
A strong interpretation of the veil of ignorance would be that the term $EL^{SG}(\gamma)$ which can be interpreted as the expected luck in a game $SG(\gamma)$ is the same for all $\gamma \in \Gamma$. Then, it follows directly from eq. (3) that the constitutional game is completely determined by actors’ institutionally determined power.

Overall, the analyses provide a clear concept of power in social situations. Further, the concept of power is systematically distinguished from luck. Moreover, it has been demonstrated that constitutional choices can generally be analyzed in terms of power and luck. In particular, under a strong interpretation of the assumption of the veil of ignorance, constitutional choices can be analyzed exclusively in terms of power. Thus, as long as legislative decision-making corresponds to the type of social game $SG$ as defined above, our expositions directly justify an application of political power concepts in the framework of constitutional choice theory. What is left to show is how concepts of political power relate to positive analysis of legislative decision-making.

In the following section we first will derive a non-cooperative game of legislative decision-making (NLG) that corresponds c.p. to the structure of the social game described above. Therefore, the derived concepts of power and luck can be analogously applied. Next we will define a political exchange game (PEG) and show that under specific conditions the PEG dominates the NLG in the sense that ex ante expected pay-offs are higher for all legislators. Moreover, we argue that the PEG provides a positive model of legislative decision-making, in particular within the EU-system applied to the Common Agricultural Policy.

### 3 Power indices and modeling of legislative decision-making

Following Baron and Ferejohn (1989) we consider a legislature comprising of $n$ legislators $N=\{1,\ldots,n\}$ and a constitutionally fixed majority voting rule $\varphi$. The legislature has collectively to choose an alternative $\alpha$ out of a compact and convex subset $R^m$ of the $m$-dimensional cube $(0,1)^m$. Each legislator $i \in N$ has a complete,
transitive binary preference relation, \( >_i \), defined for all \( \alpha, \alpha' \in R^m \), that is represented by a concave utility function \( U_i(\alpha) \).

Formally, the rule \( \varphi \) corresponds to a binary choice procedure \( C(\alpha, \alpha') \) which determines that legislature chooses among two alternatives \( \alpha \) and \( \alpha' \) and a random recognition rule that determines which legislator can make a proposal. In general, the random recognition rule can be represented by a vector of individual probabilities \( q = q_1, \ldots, q_n \), where \( q_i \) denotes the probability that legislator \( i \) is chosen to make a proposal. For simplicity we assume in the following that \( q_i = 1/n \) for all \( i \in N \). The choice procedure \( C(\alpha, \alpha') \) can be represented by a set \( G \) of winning coalitions. A winning coalition \( g \in G \) is defined as an element of the superset \( 2^N \), for which the following holds: if all members of \( g \) prefer an alternative \( \alpha \) in comparison to an alternative \( \alpha' \), then legislature prefers the alternative \( \alpha \) to \( \alpha' \).

Let “s” denote the status-quo policy. A necessary condition for a change of the status-quo policy is the existence of a winning coalition \( g \) whose members uniquely prefer an alternative \( \alpha \) to the status quo \( s \). Let \( W(s) \subseteq R^m \) denote the subset of alternatives \( \alpha \), for which a winning coalition exists that prefers \( \alpha \) to \( s \). A general characteristic of legislative decision-making is that \( W(s) \) is generally a large subset of \( R^m \) and there exists a large number of different winning coalitions preferring different alternatives to the status quo. Moreover, constitutional rules do neither determine which winning coalition has to form nor which element of \( W(s) \) has to be proposed.

In this context Baron (1994) as well as Banks and Duggan (1998) assume that the final selection of an alternative \( \alpha \in W(s) \) is a non-cooperative bargaining procedure among legislators determined by the following rules. At a first stage an individual legislator \( i \in N \) is selected by a randomized recognition rule to propose a specific alternative and at a second stage the selected legislator has to form a stable winning coalition for his proposal. If a selected legislator succeeds in forming a winning coalition for his proposal, this proposal is the new policy, otherwise a new legislator is selected and the procedure starts from the beginning.

Assuming individual preferences are common knowledge, Banks and Duggan (1998) have shown that the non-cooperative bargaining game has a stationary solution even for multidimensional policies and multiple legislators, i.e. \( m, n > 1 \).
In contrast, many scholars of legislative decision-making assume that individual policy preferences are private information. For example, Blin and Satterthwaite (1977: 881) underline “[T]herefore, a realistic analysis of voting behavior must accept that a member’s true preferences are private”, and Wilson (1967) even stronger concludes that most of the legislative institutions would be superfluous if individual policy preferences were common knowledge.

Generally assuming private information implies that the process of forming a winning coalition for a given proposal is generally uncertain for an individual legislator. In particular, individual legislators trying to form a winning coalition do no more know with certainty if another legislator will vote negatively or positively on a specific proposal. Note that this uncertainty also remains even if it is assumed that legislators partly know the preferences of other legislators. For example it is often argued that in real legislative systems legislators have some information on the policy position preferred by other legislators. However, even if it is assumed that the preferred policy positions are common knowledge, uncertainty on legislators voting behavior still remains as long as preferences intensities for different policy dimensions are unknown.

In the following we apply a rather simple approach to introduce uncertainty derived from incomplete information on other legislators preferences. In essence, we assume that any legislator \( i \) suggesting a proposal only knows with a specific probability \( p_{ij} \) that another legislator \( j \) will vote positively for a given proposal. In detail, we assume that each legislator \( i \in N \) suggesting a proposal only knows a distribution \( f_i^\alpha \) of the probability \( p_{ij} \). Of course, the distribution \( f_i^\alpha \) generally will depend on the proposal \( \alpha_i \) made by a legislator \( i \), i.e. \( f_i^\alpha(\alpha_i) \). However, to simplify analyses we assume that for all proposals sufficiently close to the status-quo this distribution \( f_i^\alpha \) is uniform over the \([0,1]\)-interval, while for all other proposals the probability simply equals zero\(^3\).

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\(^3\) Assuming legislators can be positioned in an ideological space would imply that ideal positions of legislators are correlated according to their ideology. Hence, ideology would allow legislators to form individually specific expectations on the probabilities \( p_{ij} \). Note, that also the assumption of individually specific probabilities \( p_{ij} \) would not change substantially the results derived in the following (see below).
Formally, denote $H(s)$ as a sphere with a sufficiently small radius around the status-quo, than the expected probability $P_{ij}$ is defined as follows (see proof of proposition 1 in the appendix):

\[ P_{ij} = \begin{cases} 0.5 & \alpha \in H(s) \\ 0 & \alpha \not\in H(s) \end{cases} \forall i, j \in N \]

It is beyond the scope of this paper to provide a more sophisticated model of belief formation. Note that in essence the assumptions made above correspond to a rather simple elaboration of the fact that private information regarding legislators' policy preferences imply fundamental uncertainty on coalition formation. Basically, the following expositions rest on this specific implication of private information and will therefore not change in substance when a more sophisticated modeling strategy of legislators' belief formation will be applied.

Finally, we assume that in general the time to draw a legislative decision is limited. This implies that legislature will not infinitely consider proposals regarding a specific decision. Thus, ex post the number of proposals that have been made is always limited, while the number of proposals that will be considered is ex ante not known by individual legislators. Therefore, it is assumed that after each round there exists a fix probability $p_T$ that a next round will occur. Thus, after each round the legislative decision procedure stops with a probability $(1-p_T)$ and the status quo policy sustains.

We assume that the organization of legislature, including the voting rule $\varphi$ and the random recognition rule, the set $H(s)$, the probability $p_T$ and expected probabilities $P_{ij}(\alpha^i)$ are common knowledge to all legislators.

Under these assumptions the legislative process can be understood as a non-cooperative game of winning coalition formation corresponding to the game tree given in figure 1 below. To be clear: the non-cooperative legislative bargaining game in figure 1 describes legislative decision-making ex ante under the veil of ignorance. Therefore, it follows that individual legislators even do not know how they themselves vote on a specific proposal.
Given the infinite form of the game we cannot directly derive subgame-perfect Nash equilibrium using backwards induction. Therefore, following Baron and Ferejohn (1989) we could analyze stationary equilibria. As is shown in proposition 1 it follows directly from the simple structure of the game that a stationary subgame-perfect equilibrium of our legislative bargaining game is defined by the following pure strategy configuration: a recognized legislator proposes the maximand of the utility function \( U_i(\alpha) \) over \( H(s) \). Let \( x_i \) denote this maximand. Obviously, as long as \( x_i \) is unique for each legislator, the stationary subgame perfect Nash equilibrium is unique.

As is shown in proposition 1 we further can characterize the stationary subgame-perfect equilibrium of the winning coalition game in the following way. There exist fixed ex ante probabilities \( Q_s \) and \( Q_i \), respectively, that the status quo and the individual proposals \( x_i \) will be the outcome of the legislative decision. Hence, the ex ante outcome of the legislative bargaining game is a lottery over legislators’ proposal \( x_i \) and the status quo \( s \), where \( Q_s \) is the probability of the status quo and \( (1-Q_s) \) \( C_i \) is the probability of the proposal \( x_i \). \( C_i \) corresponds to the conditional probability that, if the status-quo is changed, the proposal of legislator \( i \) will be the final outcome. \( C_i \) is completely determined by constitutional voting rule \( \varphi \).

Accordingly, assuming for simplicity a discount factor of 1 for all legislators the value \( (v_i) \) of the legislative bargaining game is given for a legislator \( i \) by:

\[
(1) \quad v_i = (1 - Q_i) \sum_x C_x U_i(x_x) + Q_s U_i(s).
\]

**Proposition 1:** Assuming for all legislators a discount factor \( \delta = 1 \) a configuration of pure strategies is a stationary subgame-perfect Nash equilibrium of the infinite session legislative game if and only if it fulfills the following condition: (i) a recognized legislator proposed \( x_i \), the maximand of his utility function over \( H(s) \). (ii) The ex ante probability \( Q_i \) that the proposal \( x_i \) will be the final outcome of the legislative game is given by

\[\text{A more sophisticated modeling of belief formation could be derived in the framework of probabilistic utility function.}\]
(2) \[ Q_i = (1 - Q_s) \sum_k^{g_i} g_k, \]

where \( Q_s \) denotes the ex ante probability that the status quo will be the final outcome of the legislative decision and \( g_i \) denotes for every \( i \in N \) the number of winning coalitions, in which \( i \) is a member. (iii) In particular, it holds for \( Q_s \):

\[ Q_s = \frac{(1 - p_T) \left( 1 - \frac{0.5^n}{n} \sum_k g_k \right)}{1 - p_T + p_T \frac{0.5^n}{n} \sum_k g_k} \]

(iv) The ex ante values of the game \( v_i \) are determined by:

\[ v_i = (1 - Q_s) \sum_k C_k U_j(x_k) + Q_s U_j(s) \]

The proof of proposition 1 is given in the appendix.

**Definition and measurement of political power in the framework of the NLG**

Thus, according to proposition 1 the structure of the NLG corresponds with the structure of the SG defined in section 2 above. Therefore, we directly can apply the concepts of power and luck defined in section 2. Hence, political power of an individual legislator \( i \) corresponds to the ex ante probability \( Q_i \) that he succeeds in forming a winning coalition. Obviously, given this definition it follows that as long as \( Q_s > 0 \) the set of legislators does not completely control legislative decision-making. Thus, following Coleman (1986) \((1 - Q_s)\) can be interpreted as the power of the legislature to act as a collectivity. Note that legislature's power to act as a collectivity corresponds to the ability of legislature to change the status quo policy. According to eq. (3) this ability is completely determined by the constitutional rules. Further, one might consider the relative political power, i.e. the conditional probability that the outcome of the legislative decision-making is the ideal position of legislator \( i \) given the condition that legislature acts, i.e. actually changes the status quo policy. The relative political power is defined by the relative probability \( C_i \):

\[ \frac{Q_i}{\sum_k Q_k} = C_i = \frac{g_i}{\sum_{k \in N} g_k} \]
According to eq. (5) legislator’s relative power to act depends on the number of winning coalitions in which he is a member in relation to the total number of winning coalitions individual legislators are members in. Note that the measure of relative political power corresponds to the relative inclusiveness, where inclusiveness is a apriori voting power concept defined by Bräuninger (see Bräuninger 1996 as well as König and Bräuninger 1998).

Analogously, an index of individual voting luck \( L_i \) can be defined according to the exposition made in section 2:

\[
(6) \quad L_i = v_i - Q_i = \left(1 - Q_i\right) \sum_{h \neq i} C_{ih} U_j(x_h) + Q_i U_i(s)
\]

According to eq. (6) a legislator is the more lucky the closer c.p. his ideal position lies to the ideal position of relatively powerful legislators and to the status quo, respectively.

Finally, a further comment should be made regarding agenda setting power and political power. So far a random recognition rule has been assumed. In general, one could also assume asymmetric agenda setting power of legislators via assuming different individual values for \( q_i \). Then, eq. (3) results in:

\[
(7) \quad \frac{Q_i}{\sum_k Q_k} = C_i = \frac{q_i g_i}{\sum_{k \in N} q_k g_k}
\]

According to eq. (7), relative political power is generally determined by the structure of winning coalition and the probability that a legislator is determined to make a proposal. Thus, in general our power index takes asymmetric agenda setting power into account. Note that in the general case our relative political power index no more corresponds to the relative inclusiveness defined as a priori power indices in the literature\(^5\).

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\(^5\) Moreover, so far it has been assumed that \( x_i \) corresponds to legislators’ ideal position. In fact \( x_i \) is legislators’ ideal position defined over the set \( H(s) \). But, in general \( H(s) \) is a subset of \( R^m \). Now one could alternatively define \( y \) as the maximand of \( U_i \) over the set \( R^m \). Generally, \( y \) does not equal \( x_i \). Intuitively, the more \( x_i \) differs in comparison to \( y \), the more the agenda setting power of a legislator is restricted. Note that generally, this specific form of individual power restriction could also be
Further, so far we derived the conditional probability $P_i$ that a selected legislator succeeds in forming a winning coalition for his proposal assuming a uniform distribution for the probabilities $p_{ij}$ (see appendix). Note, that this assumption could also be easily relaxed without changing our main conclusions. In particular, assuming another probability distribution results that legislators’ expectations of $p_{ij}$ no more equal 0.5 for any pair $(i,j) \in N \times N$, but generally can take any value between 0 and 1. Hence, it follows for the conditional probability $P_i(\alpha)$:

$$P_i(\alpha) = \sum_{i \in g} \prod_{j \in g} P_{ij} \prod_{k \in g} (1 - P_{ik}) \quad \alpha \in H(s)$$

(8)

where: $0 \leq P_{ik} = \int_{0}^{1} f_{ik}(p_{ik}) p_{ik} \ dp_{ik} \leq 1$

The general expression in eq. (8) allows for different probabilities of legislators to vote positively or negatively, respectively. Moreover, it can take any a priori knowledge of legislators’ policy preferences into account, e.g. knowledge based on legislators’ position in an ideological space. Interestingly, the conceptualization in eq. (8) has already been suggested by Coleman (1971 reprinted in Coleman 1986: 223-224).

**Deriving classical voting power indices in the framework of the NLG**

**The normalized Banzhaf-index**

Note that relative inclusiveness comes already very close to the normalized Banzhaf index. In contrast to normalized inclusiveness the normalized Banzhaf-Index corresponds to the relative number of winning coalitions in which an individual legislator is a decisive member. A legislator is a decisive member of a winning coalition $i \in g \in G$ if the coalition $g\{i\}$ is a losing coalition.

Now, as long as we assume that within the legislative decision-making process the formation of winning coalitions actually takes place via voting, i.e. a randomly selected legislator formulates a proposal and all other legislators simultaneously introduced into our formal political power index, but as it is not the focus of the paper here, we will not go into further detail. Hence, in the following we simply assume that for all $i \in N$ it holds $y_i = x_i$.
decide to join the winning coalition via voting, decisiveness of the agenda setter does not play a rule.

Contrary, let us assume that the formation of a winning coalition does not occur via simultaneous voting, but instead in the following sequential procedure. In a first step, legislators announce their willingness to join a winning coalition. In a second step, the members who announced to join the winning coalition are publicly revealed to all legislators who announced to join the coalition. Given this information the latter legislators can finally decide whether to execute their positive announcement via voting for the made proposal or not. Given these settings we can define a new non-cooperative legislative bargaining game NLG1 corresponding to NGL. NGL1 equals NGL except that in NGL1 the formation of winning coalition follows the two-step procedure described above. Further, it is assumed that legislators generally follow the behavioral norm that they support only winning coalitions via voting if the initiator (agenda setter) is decisive.

We don't want to analyze the equilibrium conditions of the NLG1 in detail, but note that under specific conditions legislature might prefer to play NGL1 instead of NGL. For example, assume there exists a central subset of actors, $N^C$, for which it holds: for all winning coalitions $g \in G$ exists at least one member of the subset $N^c$ that is decisive for $g$, and all members of $N^C$ gain from sustaining the behavioral norm mentioned above, e.g. it holds: $v_i^{NLG1} \geq v_i^{NLG}$. Under these assumptions it follows that $N^C$ prefers playing NLG1 to playing NGL and that the member of $N^C$ can commonly enforce playing NLG1.

As is stated in proposition 2 the equilibrium outcome of NLG1 generally corresponds with the equilibrium outcome of NGL, except the fact that for NLG1 the probabilities $Q_i$ and $Q_s$, respectively, are functions of the normalized Banzhaf index corresponding to the constitutional majority voting rule $\varphi$ instead of the relative inclusiveness.

**Proposition 2:** The NLG1 corresponds to the following equilibrium outcome: (i) the outcome of NLG1 is a lottery over legislators’ ideal points ($x$) and the status quo. (ii) The ex ante probability $Q_i$ that the proposal $x_i$ will be the final outcome of the legislative game is given by
\[ Q_i = (1 - Q_s) \beta_i' = (1 - Q_s) \sum_{k \in N} \frac{g_i}{g_k}, \]

where \( \beta_i' \) is the normalized Banzhaf index of legislator \( i \) corresponding to a simple voting game defined on the basis of the constitutional choice rule \( \varphi \). Accordingly, \( g_i' \) denotes for every \( i \in N \) the number of winning coalitions, in which legislator \( i \) is a decisive member. (iii) In particular, it holds for \( Q_s \):

\[
Q_s = \frac{(1 - p_r) \left( 1 - \frac{1}{n} \sum_k \beta_k \right)}{1 - p_r + p_r \frac{1}{n} \sum_k \beta_k},
\]

where \( \beta_i \) denotes the non-normalized Banzhaf value corresponding to \( \beta_i' \).

(iv) The ex ante values of the game \( v_i \) are determined by:

\[
v_i = (1 - Q_s) \sum_k \beta_i' U_i(x_k) + Q_s U_i(s)
\]

The proof of proposition 2 is given in the appendix.

**The Shapley-Shubik index**

So far we have assumed that legislators selected to make a proposal from their beliefs assuming other legislators vote independently from each other. Formally, this assumption implies that the probabilities \( p_{ik} \) that other legislators \( k \) join a winning coalition proposed by a legislator \( i \) are independently drawn from uniform distributions \( f_{ik} \). Alternatively, one could assume that legislators’ decisions to join a winning coalition are related. For example, following Straffins’ homogeneity assumption (1988) we can alternatively assume that the probabilities \( p_{ik} \) are drawn from a common uniform probability distribution \( f \). As will be shown in proposition 3 under this homogeneity assumption it follows that the equilibrium outcome of a NLG1 still corresponds with the equilibrium outcome of an NLG, but now the probabilities \( Q_i \) and \( Q_s \) are functions of the Shapley-Shubik index \( (\varphi) \) corresponding to the constitutional majority voting rule \( \varphi \).

**Proposition 3**: Under the homogeneity assumption the NLG1 results the following equilibrium outcome: (i) the outcome of NLG1 is a lottery over legislators’ ideal
points \((x)\) and the status quo. (ii) The ex ante probability \(Q_i\) that the proposal \(x_i\) will be the final outcome of the legislative game is given by

\[ Q_i = (1 - Q_s) \Phi_i \]

where \(\Phi_i\) is the Shapley-Shubik index of legislator \(i\) corresponding to a simple voting game defined on the basis of the constitutional choice rule \(\varphi\). (iii) In particular, it holds for \(Q_s\):

\[ Q_s = \frac{(1 - p_T) \left( 1 - \frac{1}{n} \right)}{1 - p_T + p_T \frac{1}{n}} \]

(iv) The ex ante values of the game \(v_i\) are determined by:

\[ v_i = (1 - Q_s) \sum_k \Phi_k U_i(x_k) + Q_s U_i(s) \]

The proof of proposition 3 is given in the appendix.

Towards a positive model of real legislative decision-making

Overall, we could demonstrate that under specific assumptions regarding the belief formations of legislators a set of different power indices including the classical Shapley-Shubik and Banzhaf index can be derived in the framework of non-cooperative game theory. Note that so far derivations followed under the general assumption that legislative decisions are made under the veil of ignorance. To be able to test whether these analyses apply to a specific legislative system, e.g. the EU-system, one has to derive a corresponding positive model of legislative decision-making that can be tested empirically. Of course, the NLG corresponds straightforwardly with a positive model of legislative decision-making. A real legislative decision implies that legislators know exactly their own policy preferences. Therefore, legislators’ decision to vote positively or negatively on a given proposal will be modeled deterministically via utility maximization. Thus a legislator \(k\) will vote positively as long as it holds \(U_k(x) > v_k\). Note, that in contrast the Baron and Ferejohn model we still assume that legislators do not know policy preferences of other legislators. Therefore, the formulation of a proposal is still a decision under uncertainty as assumed in NLG. Hence, according to this assumption even the
outcome of a real legislative decision is uncertain. This uncertainty implies inefficiency which depending on the degree of uncertainty can be quite high (see Blin and Satterthwaite 1977). In essence, we argue that this anticipated inefficiency makes legislators commonly choose another informal decision-making procedure that reduces inefficiency and dominates the mechanism of non-cooperative bargaining.

In particular, following Henning (2000) we suggest that real legislative decision-making can be modeled empirically by a political exchange game (PEG). Theoretically, the PEG corresponds to an informal decision-making process that is informally derived in the shadow of formal constitutional rules. Further, under specific conditions the PEG dominates NLG, i.e. leads for all legislators to a higher ex ante expected utility.

**A political exchange approach to legislative decision-making**

Obviously, uncertainty of the outcome of the NLG implies inefficiency, that is there always exists at least one common proposal x which ex ante will be preferred by all legislators vis-à-vis the expected outcome of the legislative game, i.e. it holds: \( \exists x \in H(s): U_i(x) \geq v_i \quad \forall i \in N \).

**Definition 1:** Consider a legislature as defined above and assume that legislators have played a NLG as defined above. Thus, in particular the probabilities \( Q_s, Q_i, C_i \) and the ideal points \( x_i \) are common knowledge. Define the following mean voter decision-making procedure: First, a leader of the legislature \( L \in N \) is appointed by a random recognition rule. At a second stage every legislator \( i \in N \) submits her ideal point \( x_i \) to the leader. At the third stage the leader chooses the final policy \( x^M \) according to the following mean voter decision:

\[
(15) \quad x^M = (1 - Q_s) \left( \sum_{i, y \in H(s)} C_i x_i + x_L \sum_{i, y \in H(s)} C_i \right) + Q_s s.
\]

**Mean Voter Theorem:** Assuming legislators’ preferences can be represented by a concave utility function \( U_i(\alpha) \) and denoting by \( v_i^{NLG} \) and \( v_i^{MVD} \) the ex ante individually expected utility of the mean voter decision-making procedure and the non-cooperative legislative game, respectively. Then it holds: \( v_i^{MVD} \geq v_i^{NLG} \quad \forall i \in N \).

**Proof:** The proof follows directly from the concavity of legislators’ utility functions.
Further, applying the mean voter decision rule and assuming heterogeneous policy preferences generates gains from exchange among legislators (Weingast/Marshall 1988). In particular, political exchange corresponds to the desire of individual legislators to increase their individual weight \( c_i \) for dimensions \( j \in M \), in which they are highly interested, in exchange for a lower weight for policy dimensions, in which they are less interested. Therefore, the weight of a legislator \( i \) for a policy dimension \( j \) can be interpreted as his political control resources \( c_{ij} \) over this dimension. Formally,

substituting the mean voter \( x^M \) into legislators’ utility function results in a utility function \( V_i(c) \) over political control resources. Denoting the original distribution of individual political control resources by the vector \( c^a = \{c^1, \ldots, c^j, \ldots, c^m\} \), where \( c^j = C_1, \ldots, C_n \) for all \( j \in M \), gains of exchange exist if there exists another feasible distribution of political control resources \( c^* \) for which it holds:

\[
V_i(c_i, c_{-i}) \leq V_i(c_i^*, c_{-i}^*) \quad \forall i \in \mathbb{N}.
\]

Obviously, \( c^* = \{c_1^*, \ldots, c_j^*, \ldots, c_m^*\} \), is a feasible distribution of control resources if it holds for all \( j \):

\[
\sum_{i \in \mathbb{N}} c_{ij}^* \leq 1.
\]

Moreover, applying the mean voter decision rule political exchange results in the following final policy outcome \( x^{EM} \):

\[
(16) \quad x^{EM} = \{x^{EM}_j\}, \quad x^{EM}_j = \sum_{i \in \mathbb{N}} [C^*_j(X_i(1 - Q_j) + Q_jS)].
\]

Obviously, gains of exchange imply that the ex ante value of the mean voter decision-making procedure allowing for political exchange is for every individual legislator higher than for the simple mean voter decision-making procedure. Nevertheless, even if gains of exchange exists the core problem is the organization of political exchange. As has been extensively discussed in the literature (see for example Weingast/Marshall 1988), in contrast to economic exchange political exchange is plagued by high transaction costs mainly due to the enforcement problem of trades. Thus, the problem is to identify a specific organization of political exchange that beyond a market organization deals with these specific problems and allows political exchange given reasonable transaction costs. In this context Henning (2000, 2001, see also Pappi/Henning 1998) has suggested a specific organization of centralized political exchange as an abstract economy that overcomes most of the criticism of existing political exchange models (Coleman 1966, Wilson 1969, Tullock...
1970, Weingast/Marshall 1988). In particular, this approach overcomes the enforcement problems inherent in market organization of political exchange and explicitly takes external effects of exchange into account that so far have been neglected by all authors including Weingast and Marshall (1988).

As the focus of the paper is the analysis of power indices we do not derive the political exchange model in detail, but only describe the main points briefly (for a detailed derivation of the model see Henning 2000 or 2001).

**Centralized political exchange as an abstract economy**

Given the individual policy preferences and the mean voter decision rule, one can define individual preferences $V_i(c)$ over political control resources:

$$(17) \quad V_i(c) = U_i(\alpha), \text{ with: } \alpha = \sum_k C_k \bar{x}_k \text{ and } \bar{x}_k = (1 - Q_r) x_k + Q_r s$$

Further, we define the following political exchange game (PEG):

a. A leader $L \in N$ of the legislature is appointed by a random recognition rule.

b. The leader $L$ determines prices $p_1, \ldots, p_j, \ldots, p_m$ for the policy dimension $j=1,\ldots,m$.

c. Each individual legislator can demand political control resources $c^\ast_i$ and supplies his control endowment $c^{ia}$, where the value of demanded control resources cannot exceed the value of supplied control resources: $c^\ast_i p \leq c^{ia} p$.

d. Whenever an exchange equilibrium is reached, e.g. for a given price vector demand equals supply of control resources, the leader formulates the common mean voter proposal which then is considered as the final policy outcome.

Intuitively, given the prices of political control resources each individual legislator wants to allocate his given political control resources over the different policy dimension in such a manner that his utility is maximized. Hence, analogously to classical demand theory each legislator chooses a control vector $c^{ik}$ that maximizes his individual utility given the prices $p$ and his individual control endowment $c^{ia}$. But, in contrast to standard demand theory we observe external effects of consumption, i.e. according to the mean voter decision rule the individual utility of a legislator $i$ and
therefore the choice of \( c_i^* \) depends also on the choices \( c_i^* = \{c_1^*, \ldots, c_i^*, c_{i+1}^*, \ldots, c_n^* \} \) of other legislators \( k \neq i \). Intuitively, the higher the demand of control resources of other legislators for a specific policy dimension \( j \), who have ideal points \( (x_{kj}) \) that are similar to ideal point of legislator \( i \) \( (x_{ij}) \), the lower c.p. will be the demand of control resources of legislator \( i \) for this policy dimension \( j \).

Obviously, the individual demand of a legislator \( i \) depends on the behavior of other legislators as well as on the prices \( p \), that is on the behavior of the leader. This specific feature can be captured in so-called demand correspondences \( B_i(c, p) \) (see Ellickson 1993). Simply speaking, a demand correspondence gives the best reply of a legislator to a given environment, that is given prices and control demands of other legislators. Note that the demand correspondence has essentially the same interpretation as the best response of consumers in a simple Walrasian economy.

Next we define the preferences and best response correspondence of the leader \( L \).

By definition the main task of the leader \( L \) is to derive a political exchange equilibrium, that is to find a price vector \( p^* \) for which the best responses \( c_i^* \) of all legislators just clear the political market, that is to fulfill the following condition:

\[
\sum_i c_i - \sum_{a\neq i} c_{a} = Z(c, c^a) \leq 0
\]

Therefore, following Debreu’s concept of an abstract economy we assume that the leader analogously to the Walras auctioneer maximize the value of the excess demand function \( V_L(c, p) = p^*Z(c, p) \). Then the best response correspondence \( B_L \) of the leader is defined as:

\[
B_L(c, p) = \left\{ p' \in P | p'Z(c, c^a) = \sup_p V_L(c, p) \right\}
\]

Definition: An n-tuple \( (c^*, p^*) = (c_1^*, \ldots, c_i^*, \ldots, c_n^*, p^*) \) is called a political exchange equilibrium if it holds: \( c_i^* \in B_i(c^*, p^*) \) and \( p^* \in B_L(c^*, p^*) \).

Note, that the political exchange equilibrium extends the Nash equilibrium (see Ellickson 1993: 288), while it also corresponds to a Walrasian exchange equilibrium including external effects. The general proof of the existence of an equilibrium for an abstract economy including external effects is given by Ellickson (1993: 297pp).
Intuitively, the centralized exchange mechanism describes a centralized political discussion chaired by a committee leader in which legislators find the mean voter proposal via a tâtonnement process allowing for false trading. Further, it can be demonstrated that under specific assumption the centralized exchange mechanism overcomes the enforcement problem inherent in decentralized political exchange even if sequential exchange is assumed (see Henning 2000 and 2001).

To facilitate the characterization of the equilibrium outcome of the PEG we assume that legislators’ utility functions \( U(\alpha) \) correspond to the following two stage utility function:

\[
U_i(\alpha) = \prod_j \left( 1 - |\alpha_j - X_i^j| \right)^{\theta_{ij}}
\]

The two stage utility function is a specific nested spatial utility function that implies that on a lower stage legislators’ sub-utility derived for a single policy dimensions \( j \) corresponds to a single peaked utility function. On an upper stage sub-utility for single policy dimensions is aggregated to total utility via a Cobb-Douglas specification, where the coefficient \( \theta_{ij} \) indicates the relative salience of a legislator \( i \) for a policy dimension \( j \). It follows that the utility function \( U_i(\alpha) \) defined in eq. (20) implies the following two-stage Cobb-Douglas specification for the utility function \( V_i(c) \):

\[
V_i(c) = \prod_j \left( 1 - \mu_{ij} + \mu_{ij} C_{ij} \right)^{\theta_{ij}}, \quad \text{with} \quad \mu_{ij} = \sum_{k \neq i} \frac{C_{ij}}{\sum_{h \neq i} C_{ij}} |X_{ij} - X_y|
\]

**Proposition 4:** Assuming legislators’ preferences can be represented by a two-stage Cobb-Douglas specification for \( V_i(c) \) as defined in eq. (21). Then, the equilibrium outcome \((c^*, p^*)\) of the PEG can be characterized as follows:

For each individual legislator a shadow income \( m^*_i \) and a vector of shadow prices \( \lambda^*_i = \{\lambda^*_i1, \ldots, \lambda^*_im\} \) exist, such that it holds:

---

\(^{6}\) For simplicity in eq (21) as well as in the following expositions it is assumed that \( p_i = 1 \). Since under this assumption it directly follows from eq. (3) that \( Q_i = 0 \), it is implicitly assumed that the status-quo is no more considered as an acceptable policy outcome.
\[
\left(1 - \mu_{ij}^* + \mu_{ij}^* C_{ij}^*\right)\lambda_{ij}^* = 0\ y m_i^*
\]

\[
p_j^* \geq \mu_{ij}^* \lambda_{ij}^* = \frac{\partial V_i(c^*)}{\partial C_{ij}^*}
\]

\[
(22) \quad (p_{ij}^* - \mu_{ij}^* \lambda_{ij}^*) C_{ij}^* = 0
\]

\[
m_i^* = \sum_{j \in M} C_{ij}^* p_j^* + \sum_j (1 - \mu_{ij}) \lambda_{ij}^*
\]

\[
\mu_{ij}^* = \sum_{k \neq i} \sum_{h \neq i} \frac{C_{kj}^*}{C_{bh}^*} |X_{kj} - X_{ij}|
\]

Since the proof of proposition 4 follows straightforward from the equilibrium conditions, it is omitted here.

Now, assume for any legislator i that his ideal position equals 1, while the ideal position of all other legislator equal 0. Obviously, this setting corresponds to a political exchange game in which legislator i plays against the will of all other legislators. According to the mean voter decision rule the outcome \(\alpha^*\) reached under this assumption in equilibrium just equals \(c_i^*\) the vector of political control resources hold by the legislator i in equilibrium. Moreover, it follows from eq. (22) that the equilibrium income \(m_i^*\) of legislator i just equals \(\sum_j C_{ij}^* p_j\), since the second summand of \(m_i^*\) is zero. Note that as long as \(X_{ij}=1\) and \(X_{kj}=0\) for all \(k\) and \(j\). All \(\mu_{ij}\)'s equal 1 and thus \((1-\mu_{ij})\) equals zero for all \(j\). Accordingly, in the framework of the PEG political power can be defined as actors potential to determine the final mean voter position and hence measured by the first summand of the shadow income \(m_i^*\).

Recall that by definition legislators’ resource control \(c_i^a\) equals his conditional probability \(C_i\) that his proposal will be the final outcome of the NLG. Thus, political power defined in the framework of PEG perfectly corresponds to the political power defined in the framework of NLG.

Moreover, the second summand of the shadow income \(m_i^*\) in eq. (22) corresponds to the external effects of political control demand of other legislators. This component is c.p. the higher the closer a single legislators’ ideal point is to the ideal point to other legislators demanding a high amount of political control. Therefore,
this component directly corresponds to the luck component defined in the framework of the NLG and hence is considered as a measure of luck in the PEG.

Finally, consider the case that political exchange occurs over different policy issues decided under different constitutional rules. Under this assumption a PEG still can be defined on the basis of two or more different NLG corresponding to the different constitutional rules. In this case the political exchange equilibrium is still defined according to eq. (22) and obviously the corresponding power and luck measures of the PEG combine the single measures defined within the different NLG\(^7\).

### 4 Empirical evidence

Beyond the theoretical expositions above, the crucial question regarding the ongoing discussion on the application of power indices to the European Union is: to what extent does the PEG correspond to legislative decision-making within the EU. In general, we do not intend to investigate this specific question for all legislative decision-making in the EU. We only analyze this questions for the specific case of the European Agricultural Policy (CAP). Nevertheless, we consider the CAP as a good example for legislative decision-making within the EU, since the CAP is certainly the most integrated and also most important EU policy accounting approximately for 50% of total EU budget.

To this end, we first discuss whether or to what extent the assumptions of the political exchange model match the reality of legislative decision-making of the CAP. In detail, we have to check if legislative decision-making corresponds with (1) a randomized recognition rule implying for all relevant political actors an equal probability to be selected to form a winning coalition and (2) if no stable stylized policy preferences of relevant political actors exists for the CAP.

According to §43 of the EU-treaty the CAP is decided under the consultation procedure, e.g. the council decides on a proposal submitted according to the following decision rule: the council can accept the proposal of the commission

\(^7\) Interestingly, this kind of generalization was already suggested by Coleman (1971).
qualified majority\(^8\) or the council can unanimously accept any other proposal made by a member of the council. In contrast to a widely accepted interpretation of the consultation procedure, we do not interpret this procedure in the sense that the commission has the “[m]onopoly over introducing legislative proposals around which coalitions in the council form” (Garett and Tsebelis 1999: 301). In particular, this different interpretation is justified as follows. Generally, following Weingast et al. (1981) modeling legislative decision-making we take relevant sociological and political superstructures explicitly into account (see also Shapley/Shubik: 791). Furthermore, note that according to §208 EGV any national member can initiate the commission to make a proposal to any issue of it’s concern\(^9\). Hence, it seems much more conceivable to us, that winning coalitions are formed within a process of social interaction among political actors prior to any voting in the council. Obviously, in this interactive process any relevant actor, national members in the council and the commission, have the equal chance to form a winning coalition. Hence, overall it seems realistic to assume that legislative decision-making under the consultation procedure matches conditions of the NLG, i.e. like assumed in the simple non-cooperative game winning coalitions are formed in an interactive social process anteceding final voting in the council and national members in the council and the commission have equal chances to formulate a proposal and try to form a winning coalition around this proposal\(^10\).

The second assumption regarding stable policy preferences is also important, since if it would not hold, our uncertainty argument would no more apply. At a first glance it is tentative to conclude that especially the CAP is a good example for stable preference outliers. It is well known that via the CAP welfare has been constantly transferred among national member states separating a subset of net-receivers from

\(8\) For the EU-12 the qualified majority required 54 out of 76 votes, where the national members have had the following weights: France, Germany, Italy, United Kingdom: 10; Spain: 8; Belgium, Greece, the Netherlands and Portugal: 5; Denmark, Ireland: 3, and Luxembourg: 2. We gave the weights for the EU-12 although since 1995 the EU includes 15 members, since our empirical example is taken from the EU-12.

\(9\) Moreover, for specific policy issues the council can directly formulate a proposal (see §205(2) EGV).

\(10\) Of course, given the specific voting rule of the consultation procedure, the commission is in every possible winning coalition, except the one formed by an unanimous council, hence the commission has an extraordinary position according to the consultation procedure when compared to national members in the council, but exactly this is reflected in the power indices.
a subset of net-payers. For example, Germany as well as the United Kingdom are both one of the biggest net-payers, while the Netherlands, Belgium and for many years France were constantly net-receivers of the CAP. Therefore, it seems straightforward to assume that one can identify stable and stylized policy preferences regarding the CAP, with net-receivers on the one side and net-payers on the other. However, in reality CAP is much more complicated than these simple calculations imply, i.e. for some commodities, e.g. milk, big net-payers like Germany are the strongest promoter of protectionism (see for example Koester 1976, 1996). Overall, empirical data on preferred policy positions of national council members clearly underlines that as long as real policy issues are concerned there hardly exists a stable preference formation (see Henning 2000, Henning/Wald 2000). Moreover, given our expositions above, even if some general pattern of preferred policy positions might persist, this would not be sufficient to avoid uncertainty. Although it would certainly change ex ante probabilities of coalition formation among political actors and hence application of classical power indices would be less appropriate. Nevertheless, the application of more generalized power indices as defined by eq. (8) still seems appropriate even under this conditions.

Given the expositions above, it is concluded that at least approximately legislative decision-making can be modeled within a political exchange approach. To compare the empirical fit of the political exchange model, we have additionally applied to alternative models. First, a random choice model has been used as a base run model. In particular, in the random choice decisions were forecasted by an independent random choice of policy positions for every policy dimension. Further, an agenda setter model (ASM) was applied. In particular, decision forecasts of the ASM correspond to the proposal that maximizes the commissions' spatial utility function subject to the constraint that the selected proposal is at least supported by a qualified majority in the council. In detail, models have been applied to forecast the so-called MacSharry reform from 1992. Altogether, the MacSharry reform of 1992
contained six regulations\textsuperscript{11}. Since main conclusion do not change we will only report estimation results for the milk regulation in the following\textsuperscript{12}.

Input data including actors ideal points $x$ and salience ($\theta$) for the different policy dimensions have been collected in personal interviews (see Pappi/Henning 1999, Pappi et al. 1998). Since the focus of our analysis lies on the empirical fit of the alternative models, we do not analyze estimation results in detail. Detailed estimation results\textsuperscript{13} and input data are reported in table 3 and 4 in the appendix, respectively.

According to table 1 the PEG delivers a much better prognosis when compared to the ASM. Overall, the best prognosis results for the Banzhaf-index, although differences in the goodness of fit are marginal for the different voting power-indices. Thus, given these results we clearly can conclude that the political exchange model is a much more realistic model for the legislative decision-making process than the agenda setting model suggested by Garett and Tsebelis.

This holds especially true, when we analyze decision prognoses for single policy dimension. For example, the reduction of intervention prices for milk (M1) is by far the most important policy dimension. Here, the commission has a clear outlier position demanding a reduction by -22.5 p.a., while the maximum reduction preferred by national members in the council is -10 p.a.. Assuming the commission has full agenda setter power would imply that the commission could almost realize her ideal position given a reduction of -19.6 p.a. for the ASM. In contrast, on the basis of PEG forecasts are much more realistic giving milk price reductions ranging from -11 p.a. to -9.3 p.a.\textsuperscript{14}

\textsuperscript{11} Regulation EWG No.: 1765-66/92 reforming cereals, oil seeds and protein plants; regulation EWG No.: 2071-74/92 reforming milk, regulation EWG No.: 2066-68/92 reforming the beef sector, regulation EWG No.: 2069-70/92 reforming sheep&goat; regulation EWG No.: 2075/92 reforming the tobacco sector and a regulation on supporting measures.

\textsuperscript{12} All estimation results are reported in Henning (2000). Note that estimations in Henning 2000 neglected external effects, while estimation results presented here do explicitly take external effects into account.

\textsuperscript{13} Political exchange equilibrium including external effects has been formulated as a mixed complementary programming problem that could be solved in GAMS using the path-solver (see Ferris/Munson 2000). I would like to thank Tom Rutherford and Michael Ferris who supported me writing a GAMS-program to calculate the political exchange equilibrium in GAMS.

\textsuperscript{14} Nevertheless, one has to admit that regarding the specific policy dimension of milk price reduction also the forecast of PEG does not fully match the real decision (see table 1). One reason for the relatively low fit follows from the fact that we calculate the political exchange equilibrium taking only
One more comment should be made regarding the goodness of fit of the PEG in comparison to the ASM. The low empirical fit of the ASM is a general result, e.g. applying the ASM to all 6 regulations of the MacSharry reform resulted in a total goodness of fit of only 6.7 p.a. (Henning 2000: 221). Note, that for specific single regulations, e.g. beef, even a negative goodness of fit was observed for the ASM. In contrast, goodness of fit remains high for the political exchange model, ranging from 44 p.a. for beef to 80 p.a. for sheep and goat. Overall, it is fair to say that empirical results convincingly supported the political exchange approach, while for the agenda setter model no satisfying empirical results could be observed.

Finally, a short comment on the empirically derived values of relative power and luck in the CAP should be made. Table 2 presents total shadow income, resource income and the shadow income corresponding to external effects of exchange for the different actors. According to the exposition above the relative resource income of an individual actor equals his assumed power index (which is the Banzhaf index in table 2). As has been discussed many times in the literature, for the consultation procedure the highest power is observed for the commission possessing roughly 15 p.a. of total political resource income, while power of the member states in the council varies from 1.6 p.a. for Luxembourg with only 2 votes to 10.9 p.a. of total resource income for the 10 vote members, namely France, Germany, Italy and the United Kingdom.

Interestingly, as Barry (1980) already argued power is not the most determining factor regarding actors’ satisfaction with the outcome of political decisions. As can be seen, luck is generally much more important. Given the values presented in table 2, the most lucky actors in milk policy are Luxembourg, Belgium and Denmark. Note that for example Luxembourg and Denmark would need an almost 30 times and 52
times higher resource income, respectively, to reach their utility levels derived in the present exchange equilibrium, if positive external effects of the control demand of other actors are neglected. In contrast, Italy and the commission, respectively, are less lucky needing only a 2.2 times higher income, if external effects would be neglected. The same holds true for Germany and the United Kingdom.

5 Summary

Stimulated by an on-going dispute on the application of political power indices to legislative-decision-making the EU in this paper a political exchange model of legislative decision-making has been derived based on non-cooperative game theory that allows for a derivation of political power indices. In particular, it has been demonstrate that this model can be applied empirically to the EU predicting pars pro toto real policy decision of the CAP. The political exchange approach has been derived in two steps. First, assuming policy preferences are private knowledge a non-cooperative legislative bargaining game (NLG) has been defined and the following results were proved: (i) The equilibrium outcome of the NLG corresponds to a lottery over legislators ideal points and the status quo; (ii) the probability that the ideal point of a legislator i is the final outcome of the game is determined by the constitutional rules of the legislature. The relative individual probability of a legislator can be interpreted as its political power and hence defines her political power index. (iii) on the basis of the NLG power can be systematically distinguish from luck the latter defined on the basis of individual expected utility corresponding with a lottery over the ideal points of other legislators’ and the status quo. (iv) under specific conditions political power in the NLG corresponds with the classical Banzhaf and Shapley-Shubik voting power index, respectively.

In a second step we demonstrate that there exists a political exchange game (PEG) that under specific assumptions dominates the NLG, i.e. leads to every legislator to a higher ex ante expected utility. According to the PEG legislator informally agree on a mean voter position that corresponds to the weighted mean of agent’s ideal points ands the status quo. In detail, the PEG corresponds with a centralized political

the CAP (see Henning 2000). Lobbying activities are generally neglected in the calculation presented
exchange mechanism, in which agent demand for individual weights regarding various dimensions of a multidimensional policy proposal. In equilibrium of the PEG legislators' ability to determine the final policy outcome can be subdivided into an institutionally determined political power component and a luck component corresponding to the externalities of political exchange of other legislators. Furthermore, it was argued that political power defined in the framework of the PEG generalized the power concept defined in the framework of the NLG. Beyond theoretical considerations empirical evidence for the PEG was delivered in section 4. In particular, empirical results imply a convincing support of the PEG, while for the agenda setter model, which has been suggested by Garrett and Tsebelis, only a poor empirical support was received.

References


here, while these are included in Henning 2000.


Appendix

Proof of Proposition 1:

(i) According to the structure of the game, a recognized legislator chooses a proposal \( x \in \mathbb{R}^m \) maximizing his expected payoff:

\[
EU_i = P_i(x_i)U_i(x_i) + (1 - P_i(x_i))v_i
\]

with:

\[
P_i(x_i) = \sum_{g \in G} \prod_{j \in g} f^g_i(x_i)p_{ij} \prod_{k \in G} \left( 1 - \int_0^1 f^k_i(x_i)p_{ik} \, dp_{ik} \right)
\]

As it holds for \( x \not\in H(s) \) that \( f^i(x_i) = 0 \) and for any \( x, x' \in H(s) \) \( f^i \) is a uniform distribution for all \( i,j \in \mathbb{N} \), thus it holds:

\[
P_{ij} = \int_0^1 p_{ij} \, dp_{ij} = 0.5
\]

Therefore, it follows: \( P_i(x) = P_i(x') = \sum_{g \in G} 0.5^g = 0.5^n g_i, \forall x \in H(s) \)

where, \( g_i, i \in \mathbb{N} \) denotes the number of winning coalitions, in which legislator \( i \) is a member. Hence, it follows directly that in every subgame each recognized legislator \( i \) will propose the maximand of his utility function over \( H(s) \), that is \( x_i \). To establish necessity notice that all subgames are identical. Let \( v_i \) denote the stationary continuation value for a legislator \( i = 1,\ldots,n \) for each subgame. Then it follows for the continuation values:

\[
v_i = \frac{1}{n} \sum_k P_k U_i(x_k) + v_i \frac{1}{n} \sum_k (1 - P_k) + (1 - p_T) \frac{1}{n} \sum_k (1 - P_k) U_i(s)
\]

\[
\iff
\]

\[
v_i = \frac{1}{1 - p_T + p_T \sum_k \sum_k P_k} \left( 1 - p_T \right) \left( \frac{1}{n} \sum_k P_k \right) \frac{1}{n} \sum_k (1 - P_k) U_i(s)
\]

(ii) The ex ante probability \( Q_s \) that the status quo will be the outcome of the legislative game is given by the following equation:

\[
Q_s = (1 - p_T) \frac{1}{n} \sum_k (1 - P_k) \left[ \frac{1}{n} \sum_k (1 - P_k) p_T \right] = \frac{(1 - p_T) \left( \frac{1}{n} \sum_k P_k \right)}{1 - p_T + p_T \frac{1}{n} \sum_k P_k}
\]

(iii) Accordingly, the ex ante probability that the proposal \( x_i \) will be the outcome of the legislative game is given by the following equation:

\[
Q_i = \frac{1}{n} \sum_{t=0}^\infty \left[ \frac{1}{n} \sum_k (1 - P_k) p_T \right] = (1 - Q_s) \frac{P_i}{\sum_k P_k} = (1 - Q_s) \frac{g_i}{\sum_k g_k} = (1 - Q_s) C_i
\]

(iv) Finally, it follows directly from (i) and (iii) that it holds for the values of the game:

\[
v_i = (1 - Q_s) \sum_k C_k U_i(x_k) + Q_s U_i(s).
\]

Q.E.D.
Proof of proposition 2

(i) According to the structure of the game NLG1, a recognized legislator chooses a proposal \( x \in \mathbb{R}^m \) maximizing his expected payoff:
\[
EU_i = P_i(x_i)U_i(x_i) + (1 - P_i(x_i))v_i
\]
with:
\[
P_i(x_i) = \sum_{j \in G} \prod_{j \neq i} \int f^j(x_i) p_{ij} \, dp_j \prod_{k \in G} \left( 1 - \int f^k(x_i) p_{ik} \, dp_k \right)
\]
As it holds analogously to NLG for \( x \notin H(s) \) that \( f^i(x_i) = 0 \) and for any \( x, x' \in H(s) \) \( f^i \) is a uniform distribution for all \( i, j \in \mathbb{N} \), thus it holds:
\[
P_{ij} = \int_0^1 p_{ij} \, dp_j = 0.5
\]
As by assumption legislators only approve winning coalitions in which the agenda setter is a decisive member it directly follows: \( P_i(x) = P_i(x') = \sum_{i \in G} 0.5^n = 0.5^g_i \quad \forall x \in H(s) \)
where, \( g_i \in \mathbb{N} \) denotes the number of winning coalitions, in which legislator \( i \) is a decisive member.
The residual statements in proposition 2 follow directly from the proof of proposition 1.
Q.E.D.

Proof of proposition 3:

We only have to be shown that under the homogeneity assumption the process of legislators’ belief formation results in the Shapley-Shubik values. According to the structure of the NLG1 a recognized legislator chooses a proposal \( x \in \mathbb{R}^m \) maximizing his expected payoff:
\[
EU_i = P_i(x_i)U_i(x_i) + (1 - P_i(x_i))v_i
\]
Now, under the homogeneity assumption it holds for \( P_i \):
\[
P_i(x) = \sum_{i \in G} \int \frac{1}{p} p^{r^i - 1} (1 - p)^{n-r^i} \, dp
\]
\[
= \sum_{i \in G} \frac{(r^i - 1)! (n - r^i)!}{n!} = \Phi_i
\]
where \( r^i \) denotes the number of members in the winning coalition \( g^i \). \( g^i \) denotes a winning coalition in which legislator \( i \) is a decisive member. Note that the last transformation results from the beta-function identity (see Straffin 1988: 76). The rest of proposition 3 follows directly from the proof of proposition 1. Note that the sum of the Shapley-Shubik indices of all legislators equals 1, therefore it can be substituted in eq. (13) of proposition 3.
Q.E.D.
Figure 1: Game-tree of the non-cooperative bargaining game

Table 1: Estimation results and goodness of fit* of PEG and ASM

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* defined as relative improvement of a random choice prognosis. Generally, the fit of a model prognosis is measured by the normalized Euclidian distance to the real decision.

** Policy Dimensions of the milk regulation EWG No.: 2071-74/91: M1 = Target price reduction in %, M2 = Quota reduction in %, M3 = Compensatory payment for quota reduction in ECU/100 kg quota, M4 = Additional levy in % of target price, M5 = Milk cow premium as a refund for target price reductions in ECU/cow, M6 = Limit for a premium for milk cows in number of cows.

Table 2: Power and luck in the CAP
## Table 3: Estimation results of the political exchange equilibrium based on the Banzhaf-index

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<th>Actors</th>
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<th>External effects $Luck$</th>
<th>Share $\text{power/luck}$</th>
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Source: own calculation

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Source: own calculation
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Source: Henning 2000

*Policy Dimensions of the milk regulation EWG No.: 2071-74/91: M1 = Target price reduction in %, M2 = Quota reduction in %, M3 = Compensatory payment for quota reduction in ECU/100 kg quota, M4 = Additional levy in % of target price, M5 = Milk cow premium as a refund for target price reductions in ECU/cow, M6 = Limit for a premium for milk cows in number of cows.