Economic Efficiency of EU Decision Making Process. Case Study: Measurement of Voting Power Indices of Romanian Parliament 1996-2004

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Abstract. *The power distribution of Member States of EU represents a problem of major importance concerning the future decisional structure. The article analyses the distribution of vote power in the CM, showing the influences of states over the decisional process as well as the modification that appears along with the enlargement. Within the organizations with vote decisions systems, an efficient decisional process supposes the knowledge of the possibilities that exists in formation of coalitions in case of a proposal. Starting from the analysis realized at EU level, the article presents a case study regarding the distribution of vote power and its influence over the decisional process in Romanian Parliament during 1996-2004.*

Key words: decisional making process; coalitions formation; voting game theory; Shapley-Shubik index; Banzhaf index.

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1. Measurement of voting power

Many organizations with systems of governance by voting have influence over decision making processes dependent on voting weight of each member. The decision rule, quota or vote threshold determines how many votes must be in favor of a proposal to guarantee simple majority or qualified majority and declare it a winning one. For example in the Finland for 200 seat of Eduskunta[(1)] three different majority rules are in in use: a simple majority=101/200, a 2/3 qualified majority =2/3x200 and in some case 5/6 majority=5/6x200=167/200. For some national parliaments a unanimous decision is required for important decisions such as constitutional amendments.

For the measure of voting power there is two classical index: the Shapley-Shubik power index and the Banzhaf power index. First index is calculated as base of pivotal or decisive voter and on all possible voter permutation, from which all the pivotal positions for a voter *i* is analyzed. The sum of all the pivotal positions is divided by all possible orderings (voter permutation) giving voter *i*'s share on all pivots (Paterson, 2007, pp. 3-4).

The Shapley-Shubik index for a player $i \in N$, for a game (N,v) is defined by

$$\phi_i(v) = \sum_{\{S \notin W; S \cup i \in W\}} \frac{s!(n-s-1)!}{n!}$$

where:

$n=|N|$, $s=|S|$.

If awe assume that all $n!$ are equiprobable, then $\phi_i(v)$ is the probability that player *i* be the pivotal member[(2)] of a winning coalition, that is, *S* is losing coalition and $S \cup i$ is winning. For every player *i* we obtain $\phi_i(v) = \sum_{j=0}^{n-1} \frac{j!(n-j-1)!}{n!} d_j^i$ where each d_j^i is the number of swings[(2)] of player *i* in coalitions of size *j*. When the game (N,v) is given by $v = v_1 \wedge v_2$, where $v_1 = [q; w_1......w_n]$ and $v_2 = [l; p_1....p_2]$, then we have the formula

$$d_j^i = \sum_{k=q-w_i}^{w(N\setminus i)} \sum_{r=l-p_i}^{p(N\setminus i)} a_{krj}^i - \sum_{k=q}^{w(N\setminus i)} \sum_{r=l}^{p(N\setminus i)} a_{krj}^i$$

where:

a_{krj}^i is the number of coalition such that $i \notin S$ with $w(S)=k$ and $p(S)=r$.

The (absolute) Banzhaf (or Penrose) Power Index β for a simple game (N,w) is defined without considering orderings, but in terms of swings it's:

$$\beta i = \frac{\sum_{S \subseteq N} [v(S) - v(S - \{i\})]}{2^{n-1}}$$

The summation is thus over all negative swings for player *i*. A simple voting game is an n-person game which can be defined as a pair (N,w) which satisfies cumulative conditions $\phi \in \omega, N \in \omega$, if $S \in \omega$ and $T \supseteq S$, then $T \in \omega$. A coalition *S* has a value of 0 (all losing coalitions). The characteristic function *v* for a coalition indicate the value of *S*: *v(S) = 1*, if *S* is winning, otherwise *v(S) = 0.*

The subset of all winning coalitions is denoted by *W* and using a shorthand notation and write $S \cup i$ for the set $S \cup \{i\}$, and $S \setminus i$ for $S \setminus \{i\}$we introduce a special class of simple games named weighted voting games. The set $[q, w_1,....w_n]$ will be used, where *q* si $w_1...w_n$ are positive integer with $w_i \le \sum_{i=1}^{n} wi$, for *i = 1,..n*. Here there are n player w_i is the number of votes of player *i,* and *q* is the quota needed for a coalition to win. A weighted majority game is the game $(N, v_1 \wedge .... \wedge v_m)$, where the games (N, v_t) are the weighted voting games represented by $\lfloor q^t; w_1^t ...., w_n^t \rfloor$ for $1 \le t \le m$. Then the characteristic function is given by $(v_1 \wedge ... \wedge v_m)(S) = 1$ if $w^t(S) \ge q^{t,}$ where $1 \le t \le m$ or 0 otherwise where $w^t(S) = \sum_{i \in S} w_i^t$. If *m=2* or *m=3* then we obtain weighted double or triple majority game, turn a coalition from losing to winning and it requires to know the number of swings for each player *i*. A swing for player *i* is a pair of coalitions $(S \cup i, S)$ such that $S \cup i$ is winning coalitions and *S* is a losing coalitions, that is, the number of winning coalitions in which player *i* is pivotal. For each $i \in N$, we denote by $\eta_i(v)$ the number of swings for *i* in game *v*, and the total number of swings is $\bar{\eta}(v) = \sum_{i \in N} \eta_i(v)$. The normalized Banzhaf index is the vector $\beta(v) = (\beta_1(v),...\beta_n(v))$ given by $\beta_i(v) = \frac{\eta_i(v)}{\bar{\eta}(v)}$, $1 \le i \le n$.

The power indices focus on different of winning coalition which have different definitions and restrictions and thus for example the number of winning coalitions may vary. In the largest possible group of winning coalitions *W* we define two subset: the set of minimal winning coalitions *MW*, and the set of strictly minimal winning coalitions *SMW*. Note that the names of these coalition types vary in the literature. To make a distinction between *W* and *MW* we use the notion of swing. In a *MW* at least one of the coalition members must be pivotal and thus have a swing. This does not imply that there could not exist any surplus members. There could as well be more than one decisive member in the same *MW*. The difference between a *MW* and a strictly minimal winning *SMW* is in the number of swings. Where in a *MW* at least one of the members must have a swing in a *SMW* each of the voters must have a swing, so no surplus members exist within the coalition and thus not even one of the voters can withdraw form the coalition in order to keep it winning. For a given voting game *v* on the voter set the set $N = \{1,2....n\}$ of *SMW* $M(v)$ is $M(v) = \{S \subseteq N / v(S) = 1 \wedge v(T) = 0 \forall T \subseteq S\}$. From this definition it follows that every *T* which is a subset of *S* is always non-winning: $v(S) \setminus \{i\} = 0 \forall i \in S$. The $S \setminus \{i\}$ is a strict subset of *S* given that $i \in S$.

2. Power distribution of EU–27 members

In the European Union, a measure of the decisional process, must predict how the EU members will be aligned in coalitions *yes* and *no* in case of a proposal. A specific indicator of efficiency of decisional process is the probability of passing. The probability of passing measure the way in which a majority can be obtained having specific rules of voting and it represents the number of all coalition possible winners divided to the number of all possible coalitions. We can calculate the number of possible coalitions between the EU members, having in mind an image over the combinations yes or no voted by the member states. The total number of EU coalitions 27 is 134217728 possible coalitions. The probability of passing is affected by the number of members, the distribution of votes and the majority bridge. The evolution dynamic of probability of passing was modified during the time. Once new states adhere, the member's votes were reallocated, changing the power of votes toward bigger states. Two new criteria were added, the criteria number of members (50%) and the population criteria (62%) from the population of EU. Starting from 2014 according with the Lisbon Treaty from 2007, in order to take a decision in the CM a majority of 55% of member states, representing at least 65% from the European population will be necessary. These regulations will be valid from 2014 if not a single member states will solicit the prolongation with another 3 years until 2017 the application of the actual regulations – the 17-th amendment at TUE, art 9c, alignment 3 and 4. Also until 2027, 75% from EU population will be entitled to invoke "*the compromise from Ioannina*". After 2017, this compromise will remain entitled, but with percents from the number of states, respectively from the European population decreased at 55%. These dispositions represent a concession made for Poland.

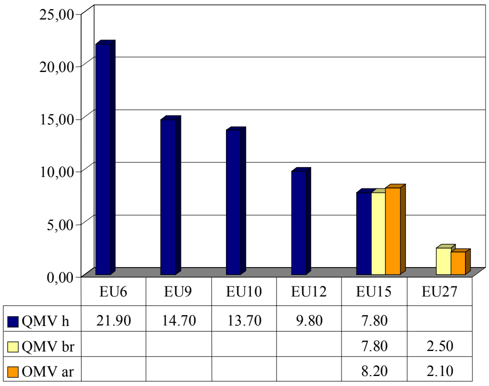

Figure 1. *Vote efficiency in EU enlargement*(3)

An important aspect of decisional process of EU is represented by the distribution of power between the members of EU, meaning the capacity to influence the decisions of EU by finding a position that should realise a winning coalition in the Council of Ministers. The most direct measure of power is the number of votes assigned to the country in the Council of Ministers. Thus for the 27 countries we have the following dates:

Distribution of votes and seats in CM and European Parliament(4)

Table 1

Country	Population	Index of Population	Proportional votes in CM	Nice - votes assign in CM	Seats in European Parliament		
					2007	Nice 2009	Lisbon 2009
Germany	82.038	0.170	58	29	99	99	96
UK	59.247	0.123	42	29	78	72	73
France	58.966	0.123	42	29	78	72	74
Italy	57.612	0.120	41	29	78	72	73
Spain	39.394	0.0819	28	27	54	50	54
Poland	38.667	0.0804	28	27	54	50	51
Romania	22.489	0.0467	16	14	35	33	33
Netherlands	15.760	0.0328	11	13	27	25	26
Greece	10.533	0.0219	7	12	24	22	22
Czech	10.290	0.0214	7	12	24	22	22
Belgium	10.213	0.0212	7	12	24	22	22
Hungary	10.092	0.0210	7	12	24	22	22
Portugal	9.980	0.0207	7	12	24	22	22
Sweden	8.854	0.0184	6	10	19	18	20
Austria	8.230	0.0171	6	10	18	17	19
Bulgaria	8.082	0.0168	6	10	18	17	18
Slovak	5.393	0.0112	4	7	14	13	13
Denmark	5.313	0.0110	4	7	14	13	13
Finland	5.160	0.0107	4	7	14	13	13
Ireland	3.744	0.00778	3	7	13	12	12
Lithuania	3.701	0.00769	3	7	13	12	12
Latvia	2.439	0.00507	2	4	9	8	9
Slovenia	1.978	0.00411	1	4	7	7	8
Estonia	1.446	0.00301	1	4	6	6	6
Cyprus	0.752	0.00156	1	4	6	6	6
Luxembourg	0.429	0.000892	0	4	6	6	6
Malta	0.379	0.000788	0	3	5	5	6

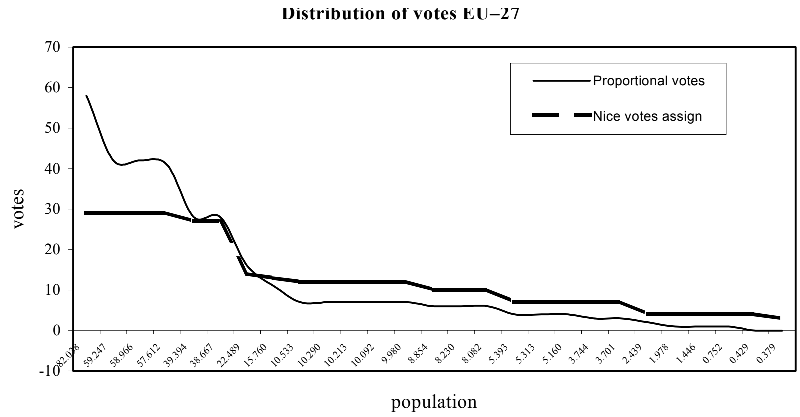

Figure 2. *Distribution of votes: proportional and assign according to Nice*

One of the most important consequences of power is referred to the budgetary allocation. The annual budgets must pass also over the Council of Ministers and the European Parliament. But in each case there are different threshold of majority. If in case of European Parliament, the majority bridge is of 50%, in the case of Council of Frontbench it is of 71%. Taking in consideration the fact that the allocation of members per states in PE is similar with the allocation of votes per states in the Council of Ministers, any winning coalition that can pass a budget through the Council of Ministers can pass it also through the European Parliament.

In Table 3 it may be observed that the redistribution of power toward large member states (an upward reform in terms of the power gradient) is moderate in the transition from the EU-15 to EU-25, but is dramatically increased in the transition from EU-25 to EU-27. We refer here to Shapley-Shubik index and also for the Banzhaf index. For example in EU-27 members, Germany, the largest EU member state, would have a power index of 16.27, only somewhat short of its share of EU population at 17.05%. Indeed the power gradient shows a very large increase from 56.2% at 86.1%. In contrast, Banzhaf calculations would indicate only a further moderate increase in power gradient due to the Treaty of Reform. Such a result runs contrary to the effects of the reform of qualified majority voting as perceived by various political commentators to the inter-governmental negotiations. The Banzhaf results may have certain difficulty in acceptance by interested parties.

Power indices changes in EU enlargement

Table 3

Country	EU–15	EU–25						EU–27				
	S-S			Shapley-Shubik		norm. Banzhaf index			Shapley-Shubik		norm. Banzhaf index	
		% pop.	SQ	Nice	Lisbon	Nice	Lisbon	% Pop.	Nice	Lisbon	Nice	Lisbon
Germany	11.67	18.16	8.30	9.49	15.76	8.56	10.42	17.05	8.73	16.27	7.78	11.87
UK	11.67	13.05	8.30	9.37	10.25	8.56	7.54	12.25	8.71	10.82	7.78	8.69
France	11.67	13.12	8.30	9.37	10.30	8.56	7.58	12.32	8.71	10.88	7.78	8.74
Italy	11.67	12.61	8.30	9.37	9.88	8.56	7.38	11.84	8.71	10.41	7.78	8.44
Spain	9.55	9.14	6.51	8.67	7.05	8.12	5.82	8.58	8.03	7.37	7.42	6.37
Poland		8.41	6.51	8.67	6.65	8.12	5.56	7.89	8.03	6.81	7.42	5.89
Romania								4.50	3.98	4.21	4.25	4.22
Netherlands	5.52	3.56	3.97	3.95	3.49	4.23	3.76	3.34	3.69	3.26	3.97	3.50
Greece	5.52	2.42	3.97	3.61	2.78	3.91	3.33	2.28	3.39	2.42	3.68	2.88

Country	EU–15	EU–25						EU–27				
	S-S			Shapley-Shubik		norm. Banzhaf index			Shapley-Shubik		norm. Banzhaf index	
		% pop.	SQ	Nice	Lisbon	Nice	Lisbon	% Pop.	Nice	Lisbon	Nice	Lisbon
Czech		2.25	3.97	3.61	2.67	3.91	3.25	2.11	3.39	2.29	3.68	2.78
Belgium	5.52	2.28	3.97	3.61	2.69	3.91	3.29	2.14	3.39	2.32	3.68	2.80
Hungary		2.23	3.97	3.61	2.66	3.91	3.25	2.10	3.39	2.28	3.68	2.77
Portugal	5.52	2.30	3.97	3.61	2.70	3.91	3.29	2.15	3.39	2.32	3.68	2.8
Sweden	4.54	1.97	3.25	2.99	2.50	3.27	3.18	1.85	2.82	2.09	3.09	2.63
Austria	4.54	1.78	3.25	2.99	2.38	3.27	3.10	1.67	2.82	1.95	3.09	2.52
Bulgaria								1.62	2.82	1.92	3.09	2.49
Slovak		1.18	2.34	2.07	2.00	2.31	2.88	1.11	1.95	1.52	2.18	2.19
Denmark	3.53	1.18	2.34	2.07	2.00	2.31	2.88	1.11	1.95	1.52	2.18	2.19
Finland	3.53	1.15	2.34	2.07	1.98	2.31	2.84	1.08	1.95	1.50	2.18	2.17
Ireland	3.53	0.87	2.34	2.07	1.82	2.31	2.76	0.82	1.95	1.31	2.18	2.02
Lithuania		0.76	2.34	2.07	1.75	2.31	2.73	0.72	1.95	1.23	2.18	1.96
Latvia		0.51	2.34	1.17	1.60	1.33	2.61	0.48	1.09	1.05	1.25	1.82
Slovenia		0.44	2.34	1.17	1.56	1.33	2.58	0.41	1.09	1.00	1.25	1.78
Estonia		0.30	2.34	1.17	1.47	1.33	2.54	0.28	1.09	0.90	1.25	1.70
Cyprus		0.16	1.57	1.17	1.38	1.33	2.50	0.15	1.09	0.80	1.25	1.62
Luxembourg	2.07	0.10	1.57	1.17	1.34	1.33	2.46	0.09	1.09	0.76	1.25	1.59
Malta		0.09	1.57	0.88	1.34	0.99	2.46	0.08	0.83	0.75	0.94	1.58
	47.0%		43.2 %	56.7 %	73.3%	49.1%	41.2%		56.2%	86.1%	47.5%	59%
	PG	Power Gradient						Power Gradient				

3. Measurement of power voting indices in Romanian Parliament 1996-2004

We will analyze the distribution of power by calculating the specific indicators in The Romanian Parliament during 1996-2004 period of time. Although the Romanian Parliament is constituted according with the Constitution from the Deputy Chamber and Senate, we will accomplish the calculation by considering all the mandates that are located in the common meetings, by the joining of the two forums, in the moment in which a series of important decisions are taken (for example the budget adoption) with simple majority.

We calculate Shapley-Shubik index SSI, the normalized Banzhaf index NBI. There are three modified Banzhaf power indices which we also examine: the Penrose index or absolute Banzhaf index ABI, which divides the number of swings for a voter only by the number of swings for all the other players. Two other indices are the power to prevent action PPA, which is the number of swings for an agent divided by the number of outcomes that lead to a decision and PIA power to initiate action. The purpose of PPA is to measure the power of an voter to block decisions. The PIA is the number of swings for an agent divided by the number of outcomes that do not lead to a decision. This measure the power of a voter to get a decision made. We also calculate the Baron-Ferejohn index which is specific of coalition's formation theory[(5)].

Indices calculation for Parliament, 1996

Table 4

Party	Seats CD+Senat	SSI	NBI	BF	ABI	PIA	PPA
CDR	175	0.395	0.37	0.316	0.627	0.351	2.916
PDSR	132	0.229	0.222	0.211	0.368	0.206	1.712
USD	76	0.229	0.222	0.211	0.358	0.201	1.666
UDMR	36	0.062	0.074	0.105	0.124	0.069	0.578
PRM	27	0.029	0.037	0.053	0.090	0.050	0.421
PUNR	25	0.029	0.037	0.053	0.083	0.046	0.387
Others	15	0.029	0.037	0.053	0.049	0.027	0.228

NMWC=9

Indices calculation for Parliament, 2000

Table 5

Party	Seats CD+Senat	SSI	NBI	BF	ABI	PIA	PPA
PDSR	220	0.60	0.636	0.429	0.906	0.587	1.986
PRM	121	0.10	0.091	0.143	0.093	0.060	0.204
PD	44	0.10	0.091	0.143	0.086	0.056	0.189
PNL	43	0.10	0.091	0.143	0.085	0.055	0.186
UDMR	39	0.10	0.091	0.143	0.079	0.051	0.173
Others	18	0	0	0	0.039	0.025	0.086

NMWC=5

Indices calculation for Parliament, 2004

Table 6

Party	Seats CD+Senat	SSI	NBI	BF	ABI	PIA	PPA
PSD+PUR	189	0.40	0.385	0.333	0.639	0.399	1.604
PNL-PD	161	0.233	0.231	0.222	0.360	0.224	0.902
PRM	69	0.233	0.231	0.222	0.431	0.269	0.820
UDMR	32	0.067	0.077	0.111	0.161	0.100	0.403
Others	18	0.067	0.007	0.111	0.087	0.054	0.218

NMWC=5

From the analysis of dates presented in tables 4, 5 and 6 we observe for example that in 1996 PDSR had almost twice mandates more than USD, but they had the same power of vote. The dates obtained demonstrate the fact the distribution of preferences expressed in function with the population votes is not a sufficient measure of a party power, but we should have in mind also the mandates obtained according with the elective algorithms and the calculated values of power indexes. Thus for the 3 cases the minimum number of wining coalition is 9, 5, 5 without taking in consideration the compatibility of ideologies or the pre-elective alliances.

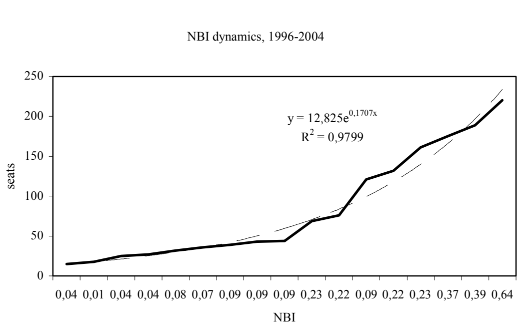

Figure 3. *NBI changes depending on seats share*

There is a exponential relationship between NBI, SSI and share of seat. In the first case these relationship is with $R^2 = 0,9799$ and in the second case with $R^2=0.9774$.

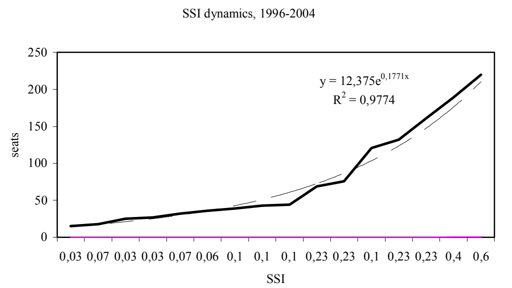

Figure 4. *SSI changes depending on seats share*

The power indices give values indicative of a player's voting power to involve himself in forming coalitions which can be an effective tool to understand decisions making processes in organizational systems based on voting games. The major goals of any power voting analyses is to assess relative power of a player or homogeneous groups of players which participate to decisions making, to evaluate the system itself in terms of fairness and maximizing voting power and to understand the benefits of coalitions and bloc voting.

Notes

(1) Finland Parliament.

(2) Swing (engl.) is an oscillation of a voter such as a withdrawing of his support can turn (swing) a winning coalition into a losing one or adding his support can turn a losing coalition into a winning one.

(3) QMV h = qualified majority voting historical, QMC br = qualified majority voting before reform, QMV ar qualified majority voting after reform (Baldwin, 2006: pp. 98-100).

(4) Dates from www.europarl.europa.eu

(5) All results are computed using the algorithms from http://www.warwick.ac.uk/~ecaae/ The number of minimum winning coalitions is calculated using algorithm Minimum Integer Weights in Java.

References

Acemoglu, D., Egorov, G., Sonin, K., „Coalition Formation in Political Games", *Centre for Economic and Financial Research,* 2006

Amer, R., Carreras, F. „Cooperation Indices and Weighted Shapley Values", *Mathematics of Operations Research* 1997, nr. 22, 1997, pp. 955-968

Baldwin, R., Wyplosz, C. (2006). *Economia Integrării Europene*, Editura Economică, București

Bilbao, J.M., Fernandez, J.R. „Voting Power in the European Union enlargement", *European Journal of Operational Research,* 2002, pp. 181-196

Felsenthal, D., Machover, M., „The Measurement of Voting Power: Theory and Practice, problems and Paradoxes", *Springer-Business and Economics,* vol. 102, nr. 3-4/2000

Gelman, A., Katz, J., Tuerlinckx, F., „The Matematics and Statistics of Voting Power", *Statistical Science,* vol. 17, nr. 4, 2002, pp. 420-435

Gibbard, A. „Manipulations of Voting Schemes: A General Result", *Econometrica*, nr. 41, 1973, pp. 587-601

Paterson, I., „Shedding Light on Contentious Issues of weighted Votes and The Constitutional Treaty", *Working Papers of Economic Policy Research Institutes,* nr. 50, 2007

Turnovec, F. „National, Political and Institutional Influence in European Union Decision Making", *Auco Czech Economic Review,* 2008, pp. 154-173