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VOTING POWER IN THE EC DECISION MAKING AND THE CONSEQUENCES OF TWO DIFFERENT ENLARGEMENTS

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ABSTRACT: In this paper, we study the voting power in the Council of Ministers of the EC. The purpose of this paper is twofold: first, to evaluate the voting power for member states of today's Community and, second, to analyse the balance of power after two different enlargements of the Community. The analysis is based on the Shapley-Shubik and the Banzhaf power indices of simple cooperative games. The modified version of the Shapley-Shubik index is used to analyse how the sub-systems of the EC can change the distribution of power in the decision making process.

KEY WORDS: European Community, Game theory, Power indices

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1 Introduction

For the EFTA countries participation in the decision making process is one of the main differences between the would-be European Economic Area (EEA) accord and membership in the European Community. As noted in Hamilton (1990) there is a clash between the legal form and the economic substance of the EEA accord, which he sees as a significant reason for Nordic EFTA countries to apply for membership in the EC. The EEA agreement does not guarantee the EFTA countries proper influence on the decisions in the Community.

Discussion regarding EC membership has heated up in the most of the EFTA countries during the EEA negotiations. Austria already submitted its application in 1989 and Sweden followed it in July 1991. Finland has so far left the membership issue open but the government does not exclude the possibility that Finland will apply for full membership. Sweden's clear policy in favour of the EC membership has, on the other hand, been seen as a driving force for Finland and Norway towards the full membership in the European Community.

For the European Community the most signifigant issue in the near future will be the completion of the single market program by the end of 1992. The Community's attitude towards new members, especially from among the EFTA countries, is in principle positive and the negotiations with the new member candidates will start after the completion of the single market. Recently the rapid progress in the Eastern Europe has increased the number of countries interested in joining the European Community, like Poland, Czeckoslovakia and Hungary, but which lack the economic prerequisities for membership. Turkey has already applied for EC membership, but it is more likely that the next EC enlargement will be the one of EFTA countries'. It is important to keep in mind that every single expansion will change the structure and balance of power in the EC's decision making process.

As long as the governments of the member states have powers in the Community's decision making process, national aspects and the balance of national powers in the decision making play an important role. The analysis in this paper seeks to measure the voting power of the EC member states in the decision making which takes place in the Council of Ministers and the structural change of this balance of power after the EFTA enlargement. Two different expansions are presented; the one with four new member states: Austria, Finland, Norway and Sweden and the one with all the seven EFTA countries joining the EC. Particular attention has been paid to sub-systems within the Community which consist of two or more member states cooperating more likely than the others, see Schoutheete (1990). Since the analysis in this paper investigates the role of the member states in the decision making it disregards the role of the European Parliament, althrough the cooperation procedure in the Single European Act (SEA) gave it a stronger role in decision making than before, see Fitzmaurice (1988).

Voting power is here measured with the two best known power indices of game theory, the first one of which was inroduced by Shapley and Shubik (1954) and the second one by Banzhaf (1965). Their theoretical background lies in the cooperative game theory which does not model explicitely the coalition formation process but rather the possible pay-offs each alliance could obtain. In the voting games it is assumed that there are only two kinds of coalitions: losing ones and winning ones. These two best known indices measure the power in the abstract sense, i.e. they do not concentrate to any particular question of voting, and it is often argued, that the power indices analyse the voting body rather than the actual game played in it, see Straffin (1988). But since in the institutions where voting takes place, like the Council of Ministers of the EC, the voters and the Governments of the member states change and one can not know the issues to be voted in the future, the probabilistic approach offered by the power indices is rather effective. Although it does not model the players' behaviour, it does measure each player's potential abilities to change the result alone. The main difference between the two best known indices lies in the probability model behind them. When there is

information telling that some unions are more likely to cooperate than the others, it can be used to modify these probability models of voting, see Owen (1972).

The power indices have been mostly applied to political institutions or elections, which can be modelled as weighted voting games, e.g. regarding parliaments, see Holler (1981), the U.S. Senate, see Shapley and Shubik (1954), the U.N. Security Council, see Laakso (1977) or the presidential elections in the U.S. see Owen (1982). In the eighties the voting power of shareholders in large companies in the U.K. were analysed by Leech (1985), in Finland by Pohjola (1987) and in Sweden by Rydqvist (1987). One of the main results in these three studies was that the voting power tended to exceed the voting share for the largest shareholders, while for the minor ones the reverse seemed to be true. This is a rather common feature of the distributions of power in weighted voting games. For the game played in the Council of Ministers of today's EC this property does not, however, hold true, but it will be shown in section four that the relationship between the power and voting weight become monotonically increasing, although not very sharply, after the EFTA enlargement.

The rest of the paper is organized as follows. The EC decision making process is described in Section 2. The analysis is confined to the Council of Ministers. In section 3 the Shapley-Shubik and the Banzhaf power indices and their modified version of the former for games with a priori unions are defined and presented. The results obtained for today's Community and for one with two different EFTA enlargements are presented in Section 4. It is shown that power increases with respect to the population of the member state, but the growth is inelastic with elasticity 0.47 for today's Community and 0.40 and 0.31 for the EC of 16 and 19 respectively. It is also shown that there is no clear relation between the power voting weight ratio in the EC of 12 members, but after the entry of the small EFTA countries the power seems to increase faster than the voting weight. The blocking minorities are shown to be critical coalitions in the sense of power.

2 Decision Making Process in the EC

The Council of Ministers, where member countries' Ministers represent national Governments and interests, is the main decision making body in the European Community. According to the Treaty of Rome it has three possible voting rules for taking decisions: simple majorities, qualified majorities and unaminity. In majority votings the member countries' votes are related to their population as follows: Germany, Italy, the UK and France have 10 votes each; Spain 8 votes; the Netherlands, Portugal, Greece and Belgium 5 votes each; Denmark and Ireland 3 votes each and Luxembourg 2 votes. The relation between the voting weight and population is when estimated multiplicative rather than linear in accordance with the following regression equation:

$$\begin{aligned} LogW &= 0.00633 \cdot (LogP)^{2.465}, \quad R^2 = 0.972 \\ &\quad (0.00009) \end{aligned} \tag{1}$$

where W denotes the number of votes, P denotes population in thousands. The standard error of β-coefficient is shown in parenthesis. It is assumed in section four, that the new members will have votes according to this regression equation. When the qualified majority is required, 54 votes out of the total of 76 must be achieved in favour. In qualified majority voting absentions have the same effect as voting against but unaminity can be obtained with absentions.

The decision making process of the EC begins formally in the Commission, which consists of 17 Commissioners (two from each of the five largest countries and one from each of the other member states) appointed by the member governments, see Nicoll and Salmon (1990). The Council of Ministers doesn't have the direct right to initiate but as noted in Lodge (1989) the member governments do have certain indirect powers over the Commissioners and legislative proposals because they can refuse to reappoint a Commissioner if she/he is not 'loyal' enough for the national government. Theoretically the Commission is independent of the member states' Governments and it has been seen

as representative of the whole Community in the decision making. As the Commission speeds up the integration process, the Council of Ministers is portrayed as a delaying body.

Until the mid-eighties searching for unaminity was the rule rather than an exeption in the Council of Ministers. This was mainly due to the so-called Luxembourg Compromise, which was agreed in 1966. After this 'agreement to disagree' the decision making process was marked mainly by negotiations to amend the Commission proposals in the Council and its preparatory bodies until unaminity could be reached, see Nicoll and Salmon (1990). The SEA, which was signed in 1986 and which entered into force in 1987, changed the mechanism and raised the importance of coalition formation remarkably. The member countries' frustration at the old consensus-based system compounded with the Greek and Iberian enlargement and the plans for the single market program made it clear that decision making under the Luxembourg Compromise would not work and the role of qualified majority was strengthened, see Wallace (1990). Particularly the legislation related to the single market program was submitted to qualified majority rule. For very important matters such as taxation unaminity is, however, still required.

Under the SEA coalitions became one of the most important elements of the EC decision making process. As noted in Wallace (1990) what matters in the negotiations is not whether a vote is actually taken but the knowledge that a vote could be taken and this leads to active coalition formation during the preparatory work which consists of both formal and informal negotiations between government representatives. All this preparatory work rests on the understanding that the Council makes the final decisions and sums of voting weights of different coalitions play the key role when alliances are compared with each other.

An interesting dimension in coalition formation in the EC is permanent and predictable cooperation between two or more member states. It is clear that certain member states have more in common and cooperation between these countries is deeper than between

the others. In Schoutheete (1990) the concept of a sub-system is defined and analysed. The best known sub-systems in the EC of twelve are the Franco-German axis and the Benelux countries but also the Mediterranean countries, i.e. Spain, Portugal and Greece, are often considered as one. After the possible EFTA enlargement of the EC the Nordic countries would form an additional sub-system, see Stålvant (1990). It is interesting to note that this kind of close cooperation in the form of these sub-systems within the Community is fully accepted by the other member states, although it changes the conditions of coalition formation remarkably.

3 The Measures of Voting Power

Let N be the set of n government representatives in the Council of Ministers of the EC and $w = (w_1, w_2, \ldots, w_n)$ the vector of voting weights $p_i / \sum_{i=1}^{n} p_i$, where p_i is the number of votes belonging to member state i arranged in the order of size so that $p_i \geq p_{i+1}\ \forall i$. The decision making game in the Council of Ministers can be presented as a cooperative weighted majority game $u = [q; w_1, w_2, \ldots, w_n]$, where $q \in [0, 1]$ is the voting weight which is needed for majority. If we classify the coalitions in the power set of N, denoted by $\mathcal{P}(N)$, only on the basis of winning, u is *simple* and the *characteristic function* $v : \mathcal{P}(N) \mapsto R_+$ of the game will be *superadditive*, i.e. $v(S \cup T) \geq v(S) + v(T)\ \forall$ $S, T \subset N$ and $S \cap T = \emptyset$, with two possible values. Thus we can choose $v(S) = 1$ if $\sum_{i \in S} w_i \geq q$ and $v(S) = 0$ otherwise; for a textbook presentation of cooperative game theory, see Owen (1982).

When measuring the individual effect in certain voting body the most natural question to ask is , "What is the difference that one's vote will make?", see Straffin (1988). Player $i's$ individual effect for arbitary coalition S can be measured by the difference $\Delta_i v(S) = v(S \cup \{i\}) - v(S)$ if $i \notin S$ and $\Delta_i v(S) = v(S) - v(S - \{i\})$ if $i \in S$, which is often called the *marginal contribution* of player i to S. It can be easily seen that for simple games $\Delta_i v(S)$ is either 1, when i swings a coalition from losing to winning,

or 0 otherwise. To answer the question of individual effect generally to all coalitions in $\mathcal{P}(N)$, we need to specify a probability model for the voting process.

Let x_i be the probability that minister i favours a given Commission proposal and x a n-vector of these probabilities called *the acceptability vector* which characterizes a vote, see Straffin (1988). If we randomize the voting question, the acceptability vector defines the probabilities that player i belongs to an arbitary coalition $\mathcal{S}$, i.e. the probabilities that he/she will vote for a random bill. Supposing that each player votes 'yes' or 'no' independently of each other, we can write for any fixed $S \subset N$, the probability $P\{\mathcal{S} = S\} = \prod_{i \in S} x_i \prod_{i \notin S}(1 - x_i)$. If we take the sum of these probabilities multiplied by values of characteristic function over all possible coalitions, we will have the mathematical expectation for the value of function v. This expectation is often called the *multilinear extension* $f(x_1, \ldots, x_n)$ of v defined by Owen (1972). In particular for the voting games defined above the $v(S)$-terms will vanish, because the value of v is either 1 or 0, and the summation is taken over the class $\mathcal{W}$ of winning coalitions only. It can be shown, see Owen (1972), that the ith partial derivative of f is the expected value of the marginal contribution of player i for the coalition S, where the summation is taken over the class $\mathcal{M}_i$ of *minimum winning alliances* with respect to player i in voting games. Thus each $\mathcal{M}_i$ contains the coalitions in which i is crucial and hence

$$E[\Delta_i v(S)] = \sum_{S \in \mathcal{M}_i} \prod_{i \in S - \{i\}} x_i \prod_{j \in N - S} (1 - x_j), \tag{2}$$

which can be interpreted as the expectation of the individual effect in the simple voting game defined above.

For the calculation purposes we have to define the x_i probabilities explicitly. In the literature there are two following standard assumptions of the joint probability distribution for x_i:s:

- *Independence assumption* : Probabilities x_i are independently uniformly distributed on [0, 1].

- *Homogeneity assumption* : Each $x_i = t$ and t is uniformly distributed on [0, 1],

see Straffin (1988). The main difference between these assumptions is that under the homogeneity assumption there is a common standard by which the ministers evaluate the Commission proposal and thus the probabilities of the voters' decisions are correlated. It is worth noting that although the probabilities of the acceptability vector are correlated, the events A_i = { i will vote 'yes' } are not, because we have assumed that $P\{$ i votes 'yes' | j votes 'yes' $\} = P\{$ i votes 'yes' $\}$ $\forall\, i \neq j$. If we calculate the expectation of individual effect measured by one's marginal contribution, assuming independency we have

$$E_i\big[\Delta_i v(S)\big] = \sum_{S \in \mathcal{M}_i} (1/2)^{n-1} = \beta_i, \tag{3}$$

where $\mathcal{M}_i$ denotes the class of minimum winning coalitions with respect to player i and assuming homogeneity we have

$$E_i\big[\Delta_i v(S)\big] = \sum_{S \in \mathcal{M}_i} \frac{(n-s)! \cdot (s-1)!}{n!} = \Phi_i, \tag{4}$$

where n and s denote the cardinalities of sets N and S respectively. Equation (3) is usually referred to as the unnormalized Banzhaf index (BI) which is often normalized, although its probabilistic interpretation is then destroyed, see Straffin, Davis and Brams (1981). Equation (4) is referred to as the Shapley-Shubik power index (SSI), which is the best known special case of the Shapley value defined for cooperative games in Shapley (1953). It can be shown that Φ is the only probabilistic value for characteristic function games which has the consistency property, i.e. the sum of individual indices is always $v(N)$ and specially $\sum_{i=1}^{n} \Phi_i = 1$ for the voting games, see Dubey, Neyman and Weber (1981). The difference between the indices is often described in terms of permutations and combinations, since assuming homogeneity means that players' permutations are equally likely and assuming independency means that all coalitions are equally probable to form. According to Straffin (1988) this permutation-combination distinction is illusory, because both indices can be derived from a probability model in which the permutations of players play no role.

In standard analysis there are no constraints in coalition formation. It means that the size of the coalition measured by the sum of voting weights matters but not particularly who belongs to the alliance. Player i is equally likely to cooperate with players j and k $\forall\ j \neq k$. This assumption often serves as the first approximation, when the additional information of players' cooperation behaviour is not used or it is not available. If we take into account the possibility that some players may be more likely to cooperate than the others, the idea of coalition structures is useful, see Owen (1977, 1981).

Let N be the player set and $\mathcal{I} = \{M_1, \ldots, M_p\}$ a partition of N to a priori coalition structure, i.e. a collection of alliances which have made a prior commitment to pool their endowments in the game. For the union M_j the total power Φ_j can be easily calculated from the *quotient game* (u, P), where $P = \{1, 2, \ldots, p\}$ denotes the set of unions and $u(S) = v(\bigcup_{j \in S} M_j)\ \forall\ S \subset P$. There is no reason to assume that the union would lose the power it could obtain. Because of this efficiency requirement of sub-systems it seems natural to set the sum of individual power indices in each union to the total power of that union, see Schoutheete (1990). Hence we have $\sum_{i \in M_j} \Phi_i = \Phi_j$. For determining the distribution of power in coalition M_j we have to define a subgame w_j among the players in M_j which reflects the possibilities of different sub-unions when defecting from the sub-system M_j. Let K be a sub-union of M_j and K' its complement relative to M_j. The characteristic function of the game w_j played in the coalition M_j can be now defined, see Owen (1977), as power indices of sub-unions of M_j in the game $v_{M_j|K}$, where the coalition M_j is replaced by sub-union K in the quotient game, i.e. $u(S) = v(\bigcup_{j \in S} M_j - K')$ and $w_j(K) = \Phi_K[v_{M_j|K}]$. Owen (1977) suggests that the value for the individual players in the game with a priori unions should be calculated as a value in the game w_j. Hence we have

$$\Phi_i[u; \mathcal{I}] = \Phi_i[w_j]. \tag{5}$$

As it is shown in Owen (1977) the SSI for the games with coalition structures can be calculated as a weighted average of the terms $\Delta_i u(Q \cup K) = u(Q \cup K \cup \{i\}) - v(Q \cup K)$, where Q is an arbitary union of quotients M_j $(j \neq k)$, $K \subset M_k$, $i \in M_k$ and $i \notin K$. The

SSI for the game u with a coalition structure $\mathcal{I}$ (CSSI) can be now written

$$\Phi_i^{CS}[u;\mathcal{I}] = \sum_{S\subset P, j\notin S} \sum_{K\subset M_j, i\notin K} \frac{s!(p-s-1)!k!(m_j-k-1)!}{m_j!p!}\Delta_i u(Q\cup K), \qquad (6)$$

where p, s, k and m_j are the cardinalities of the sets P, S, K and M_j respectively. The marginal contribution term is more complicated than in the games without coalition structures, since although u is a simple game, w_j is not. Owen (1981) has also modified BI for the games with a priori unions, but this will not be analysed here.

These modified versions of power indices answer the question of the individual effect in voting games if a certain coalition structure exists and there is no cooperation between sub-unions across the union lines. In practice this approach often overestimates the powers of members in a priori unions, since the cooperation may not be permanent. Despite this overestimation, coalition structure indices (CSI) are useful measures, when one is approximating the effects of coalition formation both individually and structurally.

4 Results

In this study it is assumed that national interests in the EC's decision making are presented in the Council of Ministers, which is also the main decision making body in the EC. Since the monumental preparatory work done in working groups and committees and especially at the informal stage cannot be modelled, we instead choose a cooperative approach which does not model the negotiations of coalition formation but separates all possible alliances on the basis of pay-offs. The member states' influence on the decisions is approximated by each country's voting power in the simple majority voting game played in the Council of Ministers. Under the qualified majority rule the characteristic function of this game can be written

$$v(S) = \begin{cases} 1, & \text{if } \sum_{i\in S} p_i \geq 54 \\ 0, & \text{otherwise} \end{cases} \qquad (7)$$

where p_i denotes the quantity of votes of the member i. Equation (7) is essentially no more than a list of winning coalitions.

The multilinear extensions for simple games are easy to write for a game with 12 players, but every additional player doubles the size of the function. In the game of 19 players there are over half million coalitions and that is why the approximation methods are often used to calculate the power indices for larger games. In this paper the indices for the EC of 12 and 16 members are calculated by using the exact multilinear functions, but the indices for EC of 19 members in Table 6 are approximations. The best known method to approximate the power indices which is also used here is introduced by Owen (1982). The method is based on the asymptotic theory of the sum of uniformly distributed random variables, i.e. normal distribution. In the EC of 16 members there were no approximation errors larger than 0.001.

It is worth noting, that although the game defined in (7) stresses the winning coalitions, the SSI and the BI analyse this game on two sides. Let T be a coalition which is not winning but blocking in the sense that its complementary coalition with respect to the player set cannot win either. Such coalitions are usually called the *blocking minorities*. The *dual* game for v is defined as $v^* = v(N) - v(N - S)\ \forall\ S \subset N$, where it can be easily seen that $v^* = 1$ if S is a blocking minority or winning coalition. It is shown in Bolger (1979) that the SSI and the BI are identical in monotonic games and their duals and, since superadditive simple games are always monotonic, i.e. $v(S) \geq v(T)\ \forall\ T \subset S$, this also holds true here, see Weber (1988). In simple games the SSI and the BI measure the power to swing a coalition which is neither winning nor blocking to a blocking minority or the power to swing a coalition which is losing to a winning alliance.

The values of the SSI and the BI are presented in Table 1. The relationship between the power-vote ratio, i.e. power per voting weight, and voting weight which is often observed to be monotonically increasing in weighted voting games, see Pohjola (1987), is not very clear-cut in the EC decision making, but the ratio between power and population tends to grow increasingly while the population figures decrease. The relationship between power and population under the qualified majority rule is multiplicative in accordance

Table 1: **The SSIs and the BIs for the members of the EC12 under the qualified majority rule**

Country	Φ_i	Φ_i/cap $1/10^6$	Φ_i/Voting weight	β_i	β_i
GERMANY	0.134	1.720	1.018	0.139	0.129
ITALY	0.134	2.332	1.018	0.139	0.129
UNITED KINGDOM	0.134	2.347	1.018	0.139	0.129
FRANCE	0.134	2.397	1.018	0.139	0.129
SPAIN	0.111	2.842	1.055	0.118	0.109
NETHERLANDS	0.064	4.354	0.977	0.728	0.067
PORTUGAL	0.064	6.173	0.977	0.728	0.067
GREECE	0.064	6.417	0.977	0.728	0.067
BELGIUM	0.064	6.474	0.977	0.728	0.067
DENMARK	0.042	8.249	1.072	0.493	0.045
IRELAND	0.042	11.960	1.072	0.493	0.045
LUXEMBOURG	0.012	30.780	0.439	0.019	0.018
EC TOTAL	1.000	2.929	1.000	1.083	1.000

Table 2: **The influence of three different blocks to the SSIs under qualified majority rule assuming no counter blocks to be formed**

Member state	Franco-German axis		Benelux countries		Mediterranean countries	
	Φ_i	Φ_i/w_i	Φ_i	Φ_i/w_i	Φ_i	Φ_i/w_i
GERMANY	0.153	1.161	0.132	1.001	0.122	0.929
ITALY	0.125	0.947	0.132	1.001	0.122	0.929
UK	0.125	0.947	0.132	1.001	0.122	0.929
FRANCE	0.153	1.161	0.132	1.001	0.122	0.929
SPAIN	0.102	0.965	0.104	0.988	0.131	1.244
NETHERLANDS	0.062	0.936	0.066	1.001	0.059	0.899
PORTUGAL	0.062	0.936	0.068	1.038	0.069	1.050
GREECE	0.062	0.936	0.068	1.038	0.069	1.050
BELGIUM	0.062	0.936	0.066	1.001	0.059	0.899
DENMARK	0.042	1.067	0.044	1.126	0.051	1.297
IRELAND	0.042	1.067	0.044	1.126	0.051	1.297
LUXEMBOURG	0.013	0.499	0.012	0.452	0.021	0.814

with the following regression equation

$$Log\Phi = \underset{(0.0777)}{0.470114 \cdot LogP - 7.147}, \quad R^2 = 0.989 \tag{8}$$

where Φ denotes the SSI and P denotes population. In Figure 1 the fitted curves for the SSIs for qualified majority and unaminity voting with respect to population are presented. As we do not know the distribution of votes taken by each rule, i.e. the share of questions that can be solved by qualified majority and by unaminity, we can only say that the true voting power lies somewhere between these lines. The absolute majority game in the Council of Ministers leads to almost identical voting powers with qualified majority rule and that is why it is omitted.

The unification of Germany leads to interesting consequences to the balance of power, since the 'new' population of Germany moves the German point (GER) in Figure 1 away from the fitted curve to GER'. Having 12 votes which is the number of votes Germany would have according to the regression equation (1) instead of the current 10 would change the balance of power remarkably. If the qualified majority were 55 out of 78 votes Germany would gain 0.037 and Spain would lose 0.014 and Denmark and Ireland would lose 0.008 in terms of the SSIs. It is worth noting that in this game Luxembourg would gain 0.017. The gains and losses are however quite different if we set the qualified majority rule to 56 votes. This would decrease the gain for Germany to 0.013 and there would be no remarkable losers.

Under the unaminity rule there is only one winning coalition and the SSI and the normalized BI will be equal. In these unaminity games the essential difference between the probability models behind the indices can be seen. For the BI every coalition is equally likely to form and, since there is only one unanimous coalition the probability, that a certain player i will swing the alliance of 11 members to a winning one is very small. For the SSI it is equally likely that the coalition is of any size. Since there are only 13 possible sizes for coalitions in the EC of 12, the unaminity is over 300 times more pro-

Figure1. SSI and population in the EC12

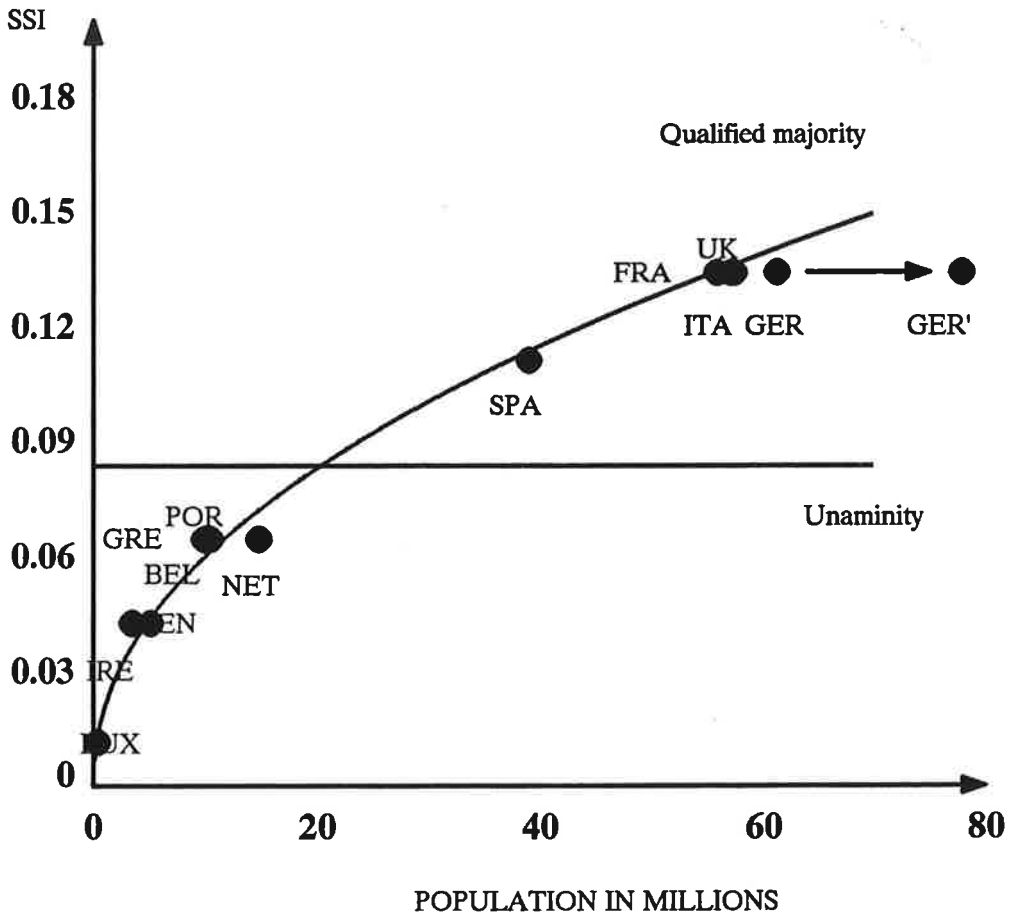

Table 3: **The SSIs and the BIs for the EC16 under the qualified majority rule**

Country	Φ_i	Φ_i/cap	Φ_i/Voting weight	β_i	β_i (Norm.)
GERMANY	0.116	1.493	1.046	0.121	0.109
ITALY	0.116	2.024	1.046	0.121	0.109
UNITED KINGDOM	0.116	2.036	1.046	0.121	0.109
FRANCE	0.116	2.080	1.046	0.121	0.109
SPAIN	0.090	2.322	1.017	0.099	0.090
NETHERLANDS	0.054	3.696	0.972	0.063	0.057
PORTUGAL	0.054	5.241	0.972	0.063	0.057
GREECE	0.054	5.448	0.972	0.063	0.057
BELGIUM	0.054	5.496	0.972	0.063	0.057
SWEDEN	0.043	5.097	0.968	0.048	0.043
AUSTRIA	0.043	5.661	0.968	0.048	0.043
DENMARK	0.032	6.234	0.959	0.039	0.035
FINLAND	0.032	6.466	0.959	0.039	0.035
NORWAY	0.032	7.598	0.959	0.039	0.035
IRELAND	0.032	9.039	0.959	0.039	0.035
LUXEMBOURG	0.020	53.251	0.898	0.025	0.023
EC TOTAL	1.000	2.727	1.000	1.108	1.000

bable under homogeneity than under independency. If we normalize the BI, the results presented in Table 1 are, however, very similar.

Table 2 summarizes the results obtained by applying the assumption of certain a priori unions, i.e. sub-systems, to form. It is assumed that no counter blocks are formed. The Mediterranean block includes Spain, Portugal and Greece. The results reveal that the total gain for the Franco-German axis and the Mediterranean countries will be approximately 3 percentage points, but only 0.3 percentage points for the Benelux countries. Larger sub-systems seem to gain more than the small ones. This is quite natural result, since the Franco-Geman axis and the Mediteranean block are closer to form a blocking minority than the Benelux countries. It seems to be a common feature for these a priori blocks that the large members outside these sub-systems lose more than the small ones. In particular small countries like Denmark and Ireland seem to gain when these

blocks are formed. Perhaps the most interesting result is that under the Mediterranean cooperation Spain will be the most powerful member in the decision making of the Community of 12 members assuming that no counter blocks are formed. This result does not, however, hold true in the EC of 16 members.

The Mediterranean countries form quite a strong alliance. If they join together with Ireland and the Benelux countries and the Franco-German axis form a coalition, i.e. the Schengen group, the power indices will be 0.45 for both the Schengen group and the Mediterranean countries with Ireland and 0.03 for UK, Italy and Denmark. Ireland's contribution would be 0.187 to the Mediterranean group, since if it plays alone the power indices would be 0.267 for the Mediterranean countries and 0.467 for the Schengen group. If this kind of coalition structure exists, it is an interesting stalemate, since the Schengen group needs all three remaining players to win, but the Mediterranean countries with Ireland need only one of these players to form a blocking minority.

Tables 3, 4 and 5 summarize the results obtained by applying the assumption of four new member states: Sweden, Austria, Finland and Norway and Table 6 when three additional countries: Switzerland, Iceland and Liechtenstein join the Community. It is assumed that the voting weights for each new member are determined according to the equation (1). Sweden, Austria and Switzerland would get four [1], Finland and Norway three, Iceland two votes and Liechtenstein would get one vote. The qualified majority is assumed to be 64 out of 90 votes in the EC of 16 and 69 out of 97 votes in the EC of 19 members.

The BIs have been omitted in the last three tables, since their message seems to be quite similar to the one of the SSI's. It has also been argued in Straffin (1988), that SSI is more applicable to voting bodies in which there is considerable communication among the voters and coalition formation is active. As it was noted earlier in this paper in the

[1] Hamilton (1990) assumes that Sweden will have five votes. In the EC of 16 members the qualified majority would then be 65. The gain for Scandinavian block would then increase to 0.018. The SSI for Sweden would be 0.054 and 0.031 for the other Nordic countries.

Table 4: **The gains of four different blocks to their members in terms of the SSIs assuming no counter blocks to be formed**

Member state	Franco-German axis	Benelux countries	Mediterranean countries	Nordic countries
	$\Delta\Phi_i$	$\Delta\Phi_i$	$\Delta\Phi_i$	$\Delta\Phi_i$
10 VOTE COUNTRIES	0.017			
8 VOTE COUNTRIES			0.011	
5 VOTE COUNTRIES		0.005	0.010	
4 VOTE COUNTRIES				0.005
3 VOTE COUNTRIES				0.004
2 VOTE COUNTRIES		0.004		
BLOCK TOTAL	0.034	0.014	0.031	0.017

EC active coalition formation plays an important role. The CSSIs are not presented in the case of the EC of 19, since the results were so similar to the ones presented for the EC of 16 members in Tables 4 and 5

It seems that the EC's enlargement containing these smaller countries turns the power voting weight ratio to be a monotonically increasing function of voting weight, see Tables 3 and 6. In the EC of 19 members the relationship is stricly increasing as can be seen in Figure 2 in accordance with the following regression equation:

$$r = 0.932 + 1.101 \cdot p \quad R^2 = 0.987, \tag{9}$$
$$(0.030)$$

where r denotes the power voting weight ratio and p voting weight which measures the size of the member state and the standard error of the β-coefficient is shown in the parenthesis. Large members tend to have little more power relative to their votes than the small ones. The relationship between the power and population in not as clear as it was in the EC of 12, since the power population ratio is not monotonically decreasing, see Tables 3 and 6. The relationship is, however, rather similar in accordance with the

Figure2. Power and voting weight in the EC19

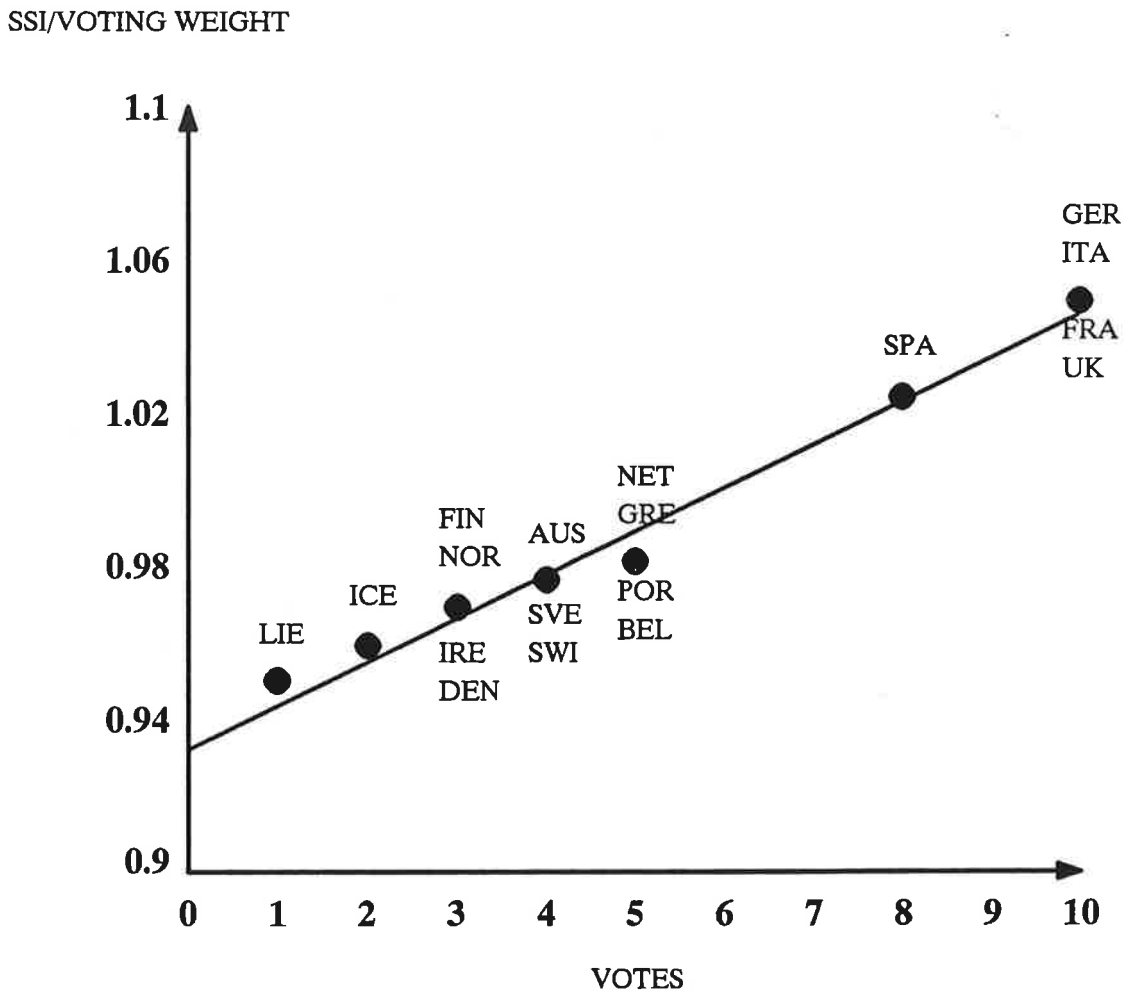

Table 5: **The gains for the sub-systems and for members outside these blocks in the EC12 and in the EC16 assuming that all sub-systems are formed**

Country/ Sub-system	Gain in the EC12	Gain in the EC16	Difference
FRANCO-GERMAN AXIS	0.010	0.010	0.000
MEDITERRANEAN COUNTRIES	-0.028	0.041	0.069
SCANDINAVIAN COUNTRIES	..	-0.002	..
BENELUX COUNTRIES	-0.012	0.002	0.014
SUB-SYSTEMS TOTAL	-0.030	0.051	..
ITALY	-0.005	-0.010	-0.005
UNITED KINGDOM	-0.005	-0.010	-0.005
AUSTRIA	..	-0.019	..
DENMARK	0.020	..	..
IRELAND	0.020	-0.012	-0.032
EC TOTAL	0.000	0.000	..

folowing regression equation:

$$Log\Phi = \underset{(0.031)}{0.404 \cdot LogP - 6.693}, \quad R^2 = 0.924 \tag{10}$$

for the EC of 16 members and

$$Log\Phi = \underset{(0.022)}{0.311 \cdot LogP - 5.860}, \quad R^2 = 0.920 \tag{11}$$

for the EC of 19 members, where Φ denotes the power measured by the SSI, P denotes population and the standard errors of β-coefficients are shown in the parenthesis.

It is assumed in Table 4 that no counter blocks are formed. It seems that large members within each block gain little more than the small ones. This is natural because of the definition of the quotient game in each sub-system, see Section 3. Also it seems that the total gain for these blocks increases with respect to the size likewise in the EC of 12 members. In Table 5 it is assumed that counter blocks are formed. The gain is measured

Table 6: **The SSIs for the EC19 and the difference between power indices in the EC12 and the EC19**

Country	Φ_i	Φ_i/cap	Φ_i/Voting weight	$\Delta\Phi_i$	$\Delta\Phi_i/\Delta w_i$
GERMANY	0.108	1.387	1.049	-0.026	0.913
ITALY	0.108	1.880	1.049	-0.026	0.913
UNITED KINGDOM	0.108	1.892	1.049	-0.026	0.913
FRANCE	0.108	1.933	1.049	-0.026	0.913
SPAIN	0.084	2.151	1.024	-0.027	1.185
NETHERLANDS	0.051	3.456	0.981	-0.013	0.913
PORTUGAL	0.051	4.900	0.981	-0.013	0.913
GREECE	0.051	5.093	0.981	-0.013	0.913
BELGIUM	0.051	5.139	0.981	-0.013	0.913
SWEDEN	0.040	4.742	0.976	..	..
AUSTRIA	0.040	5.267	0.976	..	..
SWITZERLAND	0.040	6.145	0.976	..	..
DENMARK	0.030	5.840	0.969	-0.012	1.404
FINLAND	0.030	6.057	0.969	..	..
NORWAY	0.030	7.118	0.969	..	..
IRELAND	0.030	8.468	0.969	-0.012	1.404
LUXEMBOURG	0.020	78.800	0.959	-0.002	0.351
ICELAND	0.020	52.533	0.959	..	..
LIECHTENSTEIN	0.010	391.600	0.950	..	..
EC TOTAL	1.000	2.689	1.000	-0.209	0.965

by the difference between the CSIs and the SSIs in Tables 1 and 3. It is interesting that in the EC of 12 the Franco-German axis would be the only sub-system to gain if the counter blocks are formed. In this game with coalition structures the Franco-German axis is the only player which forms a blocking minority with any of the rest of the players. In this kind of stalemate the sub-systems would gain only by forming larger coalitions with members outside the blocks or with each other. It is worth noting that in the EC of 16 members the situation is quite different and the total gain for the sub-systems would be 0.051. The Franco-German axis and specially the Mediterranean block are in the strong position and the small countries outside the blocks are the ones who would lose.

The marginal contributions in terms of the SSIs of possible additional members joining to these sub-systems are very high if they swing the coalition from losing one to a blocking minority. For example in the EC of 19 members the EFTA countries together with Denmark cannot block decision taken by qualified majority. The power for this extended EFTA coalition would be 0.301. If the UK joined this alliance it would swing the coalition from losing one to a blocking minority. The SSI would increase to 0.460 and thus the marginal contribution of the UK would be 0.159 which exceeds 0.108, the SSI for the UK in the EC of 19 members, remarkably, see Table 6.

The EFTA countries' share of the population in the EC of 19 members would be only 8.6 percent, but share of power 21 percent when measured by the SSI, see Table 6. As it was noted earlier the population elasticity of power would decrease after enlargements and the small countries' share of power would increase. Since the EFTA countries are small their weight in the EC's decision making would be very high relative to their population in the EC of 19 members presented in Table 6. The EFTA enlargement seems to in some sense equalize the power voting weight ratio, since the largest losses relative to decrease in voting weight are the ones of Spain, Denmark and Ireland. These three counties have the highest power voting weight ratios in the EC of 12 members.

5 Conclusions

Two explicit voting models were used to study the voting power in the EC. Since it is probable, that at least some of the EFTA countries will join the Community in this decade, two different enlargements were analysed. It seemed, that the relative loss of power of today's EC members would have been rather equal, but absolutely the largest countries would have lost more. There is no clear relationship between the power and voting right in the Community of 12, but the EFTA enlargement would change the situation. In the Community of 19 this relationship seemed to be monotonically increasing with the slope 1.1. This change is mainly due to the structure of the enlargement,

since the new members are small countries. Generally, it seems that the enlargements equalize the fluctuations in power voting weight ratio.

The modified versions of power indices were used to analyse the sub-systems in the Community. There were two main results. It seemed that the additional power an alliance could obtain increased with respect to the voting weight of the block when it was assumed that no counter blocks were formed. The gains and losses, however, seemed to change remarkably when counter blocks were allowed. The small countries seem to have an important role in the EC decision making in both the Community of 12 members and in the Community of 19 members. First, there are no blocking minorities among the known sub-systems of the EC and the small countries or other blocks are needed to form one. Second, although the power voting weight ratio tends to increase with respect of the size of the country, the determination of votes favours the small countries.

References

Banzhaf J. R. (1965): Weighted Voting Doesn't Work: A Mathematical Analysis. *Rutgers Law Review*, 317-343.

Bolger E. M. (1979): A Class of Power Indices for Voting Games. *International Journal of Game Theory 9*, 217-232.

Dubey P. & Neyman A. & Weber R. (1981): Value Theory without Efficiency. *Mathematics of Operations Research 6*, 122-128.

Fitzmaurice J. (1988): The Analysis of the European Community's Cooperation Procedure. *Journal of Common Market Studies XXVI*, 389-400.

Hamilton C.B. (1990): The Nordic EFTA Countries' Options: Community Membership or a Permanent EEA-accord. Paper presented at "EFTA Countries in a Changing Europe", 30 th Anniversary Round Table, Geneva 5th and 6th October, 1990.

Holler M. J. (1982): Party Power and Government Formation: A Case Study. In *Holler M. J. (ed.): Power Voting and Voting Power*, 273-282. Physica-Verlag.

Laakso M. (1977): The Distribution of power in the U.N. Security Council (in Finnish). Research Reports Ser. A No. 41. Institute of Political Science. University of Helsinki.

Leech D. (1988): The Relationship between Shareholding Concentration and shareholder voting power in British companies: A Study of the Application of Power Indices for Simple Games. *Management Science 34*, 509-527.

Lodge J. (1989): The European Community and the Challenge of the Future. Pinter.

Nicol W. & Salmon T.C. (1990): Understanding the European Communities. Philip Allan.

Owen G. (1972): Multilinear Extensions of Games. *Management Science 18*, 64-79.

Owen G. (1977): Values of Games with a priori Unions. In *Hein R. & Moeschlin O. (eds.): Essays in Mathematical Economics and Game Theory*, 76-88. Springer-Verlag.

Owen G. (1982): *Game Theory.* Academic Press.

Pohjola M. (1987): Shareholder voting power in Finnish industrial companies: applications of power indices for simple games (in Finnish), *Yearbook of Finnish Society for Economic Research.*

Rydqvist K. (1987): *The Pricing of Shares with Different voting power and the theory of oseanic games.* Stocholm.

de Schoutheete P. (1990): The European Community and its Sub-systems. In *Wallace W. (ed.): The Dynamics of European Integration*, 106-124. Pinter

Shapley L. (1953): A Value for N-person cooperative games. In Kuhn H. W. & Tucker A. W. (eds.): *Contributions to the Theory of games (Annals of Mathematical Study 28).* Princeton University Press.

Shapley L. & Shubik M. (1954): A Method for Evaluating the Distribution of Power in a Committee System. In *Shubik M. (ed.): Game Theory and Related Approaches to Social Behavior*, 141-150. Wiley.

Straffin P. D. & Davis M. D. & Brams S. J. (1982): Power and Satisfaction in an Ideologically Divided Voting Body. In *Holler M. J. (ed.): Power Voting and Voting Power*, 239-255. Physica-Verlag.

Straffin P. D. (1988): The Shapley-Shubik and Banzhaf power indices as probabilities. In Roth A. E. (ed.): *The Shapley value, essays in honor of Lloyd S. Shapley.* Cambridge University Press.

Stålvant C. (1990): Nordic Cooperation. In *Wallace W. (ed.): The Dynamics of European Integration*, 125-140. Pinter

Wallace H. (1990): Making multilateral negotiations work. In *Wallace W. (ed.): The Dynamics of European Integration*, 213-228. Pinter

Weber R. J. (1988): Probabilistic Values for Games. In Roth A. E. (ed.): *The Shapley value, essays in honor of Lloyd S. Shapley.* Cambridge University Press.

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