Institut für Höhere Studien (IHS), Wien
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Vote Weighting in the European Union

Confronting the Dilution of Representation?

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Abstract

The extent to which there is a regular relationship between the current voting weights in Council of European Union member states and their populations is investigated. It is shown that a model of alpha- or weak proportionality has a high explanatory power, with certain restrictions. Further desirable heuristic properties are considered. A particular proposal for extension of the current system to account for EU expansion to include Central and East European countries is evaluated in this light. However, even although this relationship between votes and population remains fixed, prior enlargements of the EU effectively changed the degree to which votes represent the Union's population. A methodology for calculating a Coefficient of Representation is introduced in this paper to measure this previously unquantified phenomenon. It is shown that a 'dilution of representation' has occurred and will continue unless a new voting system is introduced. Finally some alternative voting weights are presented as examples. These are constructed in such a manner as to preserve the basic principles found in the current system, but which raise the degree of representation moderately.

Keywords
Voting weight, European Union, coefficient (degree) of representation, power index, power envelope

JEL-Classifications
D71, D72, H77, C40

Comments

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Contents

1. Introduction

The European Union embarked on its Intergovernmental Conference (IGC) in 1996, a process whose purpose is to revise the Treaty of Maastricht. High on the agenda for this conference, which is due to be completed later in 1997, is a revision of the institutional and legislative arrangements which are to be the norms of the Union up to and beyond the next enlargement of the EU. Already the EU has 'association agreements' with several states of east and central Europe, e.g. Czech R., Hungary Poland, Slovakia and Slovenia among others, as well as with Malta and Cyprus, and it is widely expected that some such countries will be among the next group of states to which membership will be extended.

The EU (or EEC, EC) will thus have grown rapidly from a grouping of six to over twenty states within a forty year period. With such pace of development it is not surprising that institutional arrangements which were designed for a smaller community need to be revised to take account of the large number of members. It is thus an aim of the IGC to review the decision making procedures of the EU. This includes reconsidering some of the powers of proposal, resolution and adoption between the three major institutions, the Commission, the Council of Ministers and the European Parliament. Among the important questions which are being debated are the composition of the European Commission, and the voting system in the Council, where the ultimate responsibility for decisions rests. Quoting from the White Paper on the 1996 Intergovernmental Conference (1996) - *"The workings of the Council should be improved, and the IGC should consider the scope of majority voting, the weighting arrangements and the thresholds for decisions by qualified majority voting. The Conference will also have to study means of enabling the Commission to carry out its work more effectively, examining its membership and representativeness."*

Member states have a fixed allocation of votes in Council (or 'voting weight'); some decisions can be taken by a simple majority of these votes, most require a qualified majority, traditionally of more than two thirds (at present 62 out of a total of 87 votes, i.e. 71.3 %). Many of the member states, notably the larger states, have expressed the need to re-allocate the voting weights to reflect certain differences between states, particularly demographic differences, and with a eye on the future, differences in economic contribution. Among the relevant issues a list of *suggestions* for change put forward by member states includes:

- the allocation of votes to existing members and prospective candidates
- scope of application of unanimity, simple majority and qualified majority voting
- changing the threshold for qualified majority voting
- blocking minorities and the 'Ioannina compromise'
- 'codecison', i.e. rules regarding the approval in Council and Parliament

- introducing a double voting system (number of votes plus a certain percentage of total population, or number of votes plus a minimum number of Member States[1])
- introducing 'sectoral' blocking minorities, i.e. establishing different weighting arrangements in accordance with the subjects or policies voted on.

Since some states are in favour of replacing unanimous voting by qualified majority voting, or even simple majority voting becoming the norm, it is even easier to realise how central the issue of vote allocation becomes. There has also been a growing unease with the effect the inclusion of new smaller members has supposedly had, and in future will have on the relative distribution of votes. To quote one member state:

> "At present, the system gives one vote for every 200,000 Luxembourgers but only one vote for 8 million Germans or 6 million people in the United Kingdom, France or Italy. Without reform, the bias against the more populous Member States, which are also the largest net contributors to the EC Budget, will become even further pronounced with the accession of more, mainly small, states. Malta has only 400,000 inhabitants, Cyprus 700,000, and Estonia 1.5 million. An EU of 27 members, (i.e. containing all the current candidates for accession) would include 15 with populations of less than 10 million people (about the size of Greater London), and only six (including the UK) with populations of more than 30 million. The EU must decide how to weight votes in the Council to reflect such differences." [1]

We will refer to this perceived problem of an expanding EU, including more and more small states with relatively high voting weights, as 'dilution': a main aim of this paper is to establish whether and to what extent dilution exists. Further:

> "The simplest solution would be to change the numbers of votes accorded to each Member State within the system so that the weighting of votes is in better proportion to the population of each Member State."

It should be stressed here that some member states are opposed to such change and that political analysis is not the aim of this paper. However it would appear that there are certain questions to be addressed rigorously and conscientiously before informed judgement of any reform strategy can be considered, irrespective of whether the political consensus eventually rejects or accepts reform. Our approach in this paper is to put ourselves in the position of acting as an unbiased consultant on the research topic of *how* such a reform of voting allocations could be fairly and properly designed.

In particular there are some basic questions which we can pose:

Q1 *What kind of regularity does the existing allocation of votes exhibit?*

[1] F. Turnovec has considered double majorities which also involve voting weights based on GDP.

The current weighting patently is connected to the population of member states, but is this connection 'regular' enough that we can 'extrapolate' in order to determine votes of new entries to the EU?

Q2 *If we consider alternative schemes of voting weights which are linked to populations, can we distinguish objectively between those allocations which are more, and those which are less, a reflection of this feature?*

Can this effect indeed be quantified precisely? Having such a measure would enable us to make an evaluation of any reform proposal.

Q3 *How can we construct alternative vote allocations which are compatible with the constraints under which weighting of member states has been realised up till now?*

An answer to this question will utilise the insights gained from answering Q1 and our ability to make evaluations as implied by Q2.

The body of this paper follows closely the outline of these three questions. Section 2 deals with the formal aspects of the relation between votes and populations using data from the current fifteen member EU and an existing proposal for weighting the votes of new members. In Section 3 the concept of vote weighting implying an overall representation of population is introduced and a methodology for measuring it is described. A notable feature of this approach is that the data at each stage of EU development gives rise to a different degree of representation. Finally in Section 4 we consider whether some alternative vote allocations would raise the degree of population representation.

Executive Summary

There is a perhaps surprisingly high level of regularity in the current allocation of voting weights in Council to EU countries, to the extent that the link between vote and population can be captured by a plausible mathematical form: surprising, because the allocation is also constrained by the requirements which effectively take into account the natural demographic clusters of member states.

The only exceptions to this formula are for the member states with the very smallest and very largest populations, where the effect of an implicit compromise of establishing lower and upper bounds on votes can be hypothesised. An existing published proposal for weighting the votes of a long list of states, which are possible candidates for accession, is also shown to be fully compatible with the present allocation.

However, the problematical aspects of the current voting weights of member states in the Council of Ministers are less to do with determining these for new members, than with the fact that most of the new members will be 'smaller' states, as indeed have been most of the recently accessing states to the Union. In order to study this problem we have introduced an objective measure of the extent to which votes are an 'overall representation' of population across the entire European Union.

The vote allocation in the Council was reformed once previously - at the time of its first extension from six to nine members. The accession of smaller states has meant that the ***degree of representation of population*** has consistently decreased since EU 9 till the present EU of fifteen member states, as is shown in the box below:

Stage of Accession[2]	EU 6	EU 9	EU 10	EU 12	EU 12*	EU 15	EU 27
Degree of Representation	53%	56%	53%	50%	46%	45%	43%

The degree of representation shown in the table may take on a value between 0 and 100 percent, which correspond respectively to two extremes:

- nil for equal votes for each member state - *or 'one state one vote'*
- 100% for voting weights strictly proportional to population, which is equivalent to - *'one citizen one vote'*

In other words, although the existing voting allocation has in the past been applied consistently to new member states, the result of successive accessions has been a continuing drift of representation further and further away from the notion of 'one citizen one vote', which would correspond to full (proportional) representation.

Since the distribution of the number of inhabitants in countries of east, central and south Europe which are candidates for accession is also overwhelmingly skewed below the average, the degree of representation is bound to decrease further in future.

The degree of representation has fallen dramatically from over 50 percent to nearly 40 percent. To this extent we may objectively refer to the *dilution of representation* since the present vote allocation system was originally introduced. The term 'dilution' is chosen to underline the fact that the vote weighting system is the same, but the mix of countries (sizes)

[2] EU 12* refers to the situation since German unification; EU 27 refers to a hypothetical future grouping of twenty seven states (see body of report).

to which it is applied has changed, and the resulting effect is less overall representation of population.

Such levels of representation implied by votes in Council compares with degrees of representation of approximately 70 percent for seats per member state in the European Parliament and 30 percent for the number of commissioners from each member state in the European Commission.

Given the calls from some member states for reassessing voting weights, it is clear that any reform proposal which will be put forward will be an 'upward' reform strategy i.e. an allocation which increases the degree of representation. It is not clear however, just how high a degree such a proposal, if adopted, would be. In the boxes below two hypothetical alternative vote allocations are listed for the existing member states, both of which have degrees over 50 percent, that is, they are both propositions for *'modest reform'* which would return the degree of representation to its original level.

	Option B Votes
Luxembourg	2
Ireland	3
Finland	3
Denmark	3
Austria	4
Sweden	4
Portugal	5
Belgium	5
Greece	5
Netherlands	6
Spain	10
France	12
Italy	12
UK	12
Germany	12
Degree of Representation	52%

	Option C Votes
Luxembourg	2
Ireland	3
Finland	4
Denmark	4
Austria	5
Sweden	5
Portugal	6
Belgium	6
Greece	6
Netherlands	7
Spain	12
France	15
Italy	15
UK	15
Germany	15
Degree of Representation	53%

Both option B and option C are generated on a similar basis to the existing vote allocation: they are chosen to exhibit at least as much regularity conditions, and in such a way that no member receives less votes. The difference between the two proposals lies chiefly in the range of member states whose absolute vote changes: the largest six states in option B, and all but the smallest two states in option C.

There is, however, no binding requirement that any proposed alternative scheme of voting weights be constructed in this manner, but the possibility of, and mechanism for doing so exists, and may be taken advantage of, should there be a desire to generate options.

Likewise, should any other reform proposal of voting weights be put forward for consideration by EU member states, it would be advisable to evaluate its degree of population representation, in order to assess the extent to which the reform would redress the ongoing decline in representation. A proposal which produces a degree of representation above or around 60 percent could be considered a major reform.

2. Current and Past Vote Allocations - Regularity and Irregularities

Table 1 documents the development of vote allocations to member states of the European Union (EC, EEC or EU as appropriate) in the Council of Ministers. In the first two columns the population and GDP as of 1993 are given.[3]

Table 1: Voting Weight Allocations 1958 - present

Population (millions)	GDP (m. USD)	State	EU 6 Votes	EU 9 Votes	EU 10 Votes	EU 12 Votes	EU 12* Votes	EU 15 Votes
0.397	14233	Luxembourg	1	2	2	2	2	2
3.569	44906	Ireland		3	3	3	3	3
5.072	96220	Finland						3
5.191	137610	Denmark		3	3	3	3	3
7.937	183530	Austria						4
8.712	216294	Sweden						4
9.848	77749	Portugal				5	5	5
10.061	213435	Belgium	2	5	5	5	5	5
10.376	76698	Greece			5	5	5	5
15.277	316404	Netherlands	2	5	5	5	5	5
39.125	533986	Spain				8	8	8
57.650	1289235	France	4	10	10	10	10	10
57.840	1134980	Italy	4	10	10	10	10	10
58.040	1042700	UK		10	10	10	10	10
64.000		*Germany*	4	10	10	10		
80.769	1902995	Germany *					10	10
369.864	7280975	TOTAL	17	58	63	76	76	87
	Total	Population (in millions)	205.225	272.025	282.401	331.374	348.143	369.864
Ratio of	Total Votes	to Total Population since EU9		0.213	0.223	0.229	0.218	0.235

* since 1990

[3] In the analysis reported upon here, populations are considered fixed at the 1993 figures, using data from Turnovec (1996). There is no significant loss of accuracy in subsequent calculations. For pre-1990 Germany (former West Germany) a separate population figure is used.

It is quite evident that vote allocation has up till the present been determined by the population in each member state, a fact which is commonly accepted as part of the 'unwritten rules' of the EU institutional framework. Votes are non-decreasing with increasing population; more specifically, since votes take on integer values, it may be considered that there is an underlying increasing step function relating votes to population size. In contrast, despite the strong correlation between GDP and population in the current Union of 15 western European states, the positioning of Sweden is such that the entries in the GDP column are not everywhere increasing.

The vote allocation has an inbuilt and regular bias, as is shown in Tables 2a and 2b. This bias itself may be regarded as a deliberate political compromise between two extreme situations:

a) each state's share of votes is the same as its share of population - 'proportional votes'

b) each state's share of votes is the same regardless of population - 'equal votes'

Case (a) may alternatively be characterised as 'one citizen one vote (share)' and case (b) as 'one state one vote'.[4]

Tables 2a/b: Comparative data for EU 15; actual, and two extreme hypothetical cases

Table 2a: Vote- and Population shares

Population share %	State	Share of Votes in % Actual	Proportional	Equal
0.11%	L	2.30%	0.11%	6.67%
0.96%	IR	3.45%	0.96%	6.67%
1.37%	FI	3.45%	1.37%	6.67%
1.40%	D	3.45%	1.40%	6.67%
2.15%	A	4.60%	2.15%	6.67%
2.36%	SW	4.60%	2.36%	6.67%
2.66%	P	5.75%	2.66%	6.67%
2.72%	B	5.75%	2.72%	6.67%
2.81%	GR	5.75%	2.81%	6.67%
4.13%	N	5.75%	4.13%	6.67%
10.58%	SP	9.20%	10.58%	6.67%
15.59%	FR	11.49%	15.59%	6.67%
15.64%	IT	11.49%	15.64%	6.67%
15.69%	UK	11.49%	15.69%	6.67%
21.84%	G	11.49%	21.84%	6.67%

Table 2b: Ratio of Vote-share to Population- share

State	Actual	Proportional	Equal
L	21.417	1	62.110
IR	3.574	1	6.909
FI	2.515	1	4.862
D	2.457	1	4.750
A	2.143	1	3.107
SW	1.952	1	2.830
P	2.158	1	2.504
B	2.113	1	2.451
GR	2.049	1	2.376
N	1.391	1	1.614
SP	0.869	1	0.630
FR	0.737	1	0.428
IT	0.735	1	0.426
UK	0.732	1	0.425
G	0.526	1	0.305

[4] I am indebted to František Turnovec, Prague, for drawing attention to these points of reference.

For all the 'small' member states, i.e. with population less than average, the actual share of votes in Council is more than would be allocated by a proportional rule and would be improved upon by an 'equal' voting rule. The opposite is the case for the five 'large' states of above-average population, Spain, France, Italy, UK and Germany: the current allocation would be increased by a proportional rule, but is however more than an equal allocation would imply. Table 2b reinforces this distinction, and shows that the ratio of vote-share to population share ranges from over 20 (Luxembourg) to nearly one half (Germany), and decreases with population.

There has been one reform of the vote allocation, namely to coincide with the expansion of the EU to nine member states. In subsequent expansions new members have been allocated votes based on an 'interpolative' principle.

The changes introduced in EU 9 may be characterised as a reform from which only the smallest country, Luxembourg, incurred disbenefit. This may be seen by noting that the other five original member states all had their voting strength increased by a factor of 2.5, Luxembourg by a factor of two. Of the three new members, the UK's vote had to be the same as Italy's and Germany's (and thus France's) since its population lies between that of those two states. Ireland and Denmark were positioned in a new size category, receiving 3 votes apiece. Similarly there was no problem positioning Greece in EU 10 between Belgium and Netherlands. In EU 12 Spain falls into a new size category, and the allocation for Portugal with around ten million citizens was placed alongside Belgium and Greece. When Germany was unified its population increased overnight by over 25 percent, but its voting strength remained the same. Being already the largest member state, this fact did not upset the regularity of the increasing step function mentioned above, but it is handled as a defining event here (c.f. Table 1) and is important for the analysis. At the latest widening of the EU, to the current fifteen members, there was no problem placing Finland between Ireland and Denmark, but for Austria and Sweden a new category of members with four votes was created.

Figure 1 graphs the relationship between votes and member states' population currently in EU 15. It is worth noting that despite the 'steps' it is nearly always true that the ratio of votes to population (indicated by the slope of a radius from the origin to each point) is nearly everywhere decreasing - c.f. column 'Actual' in Table 2b. The only exceptions have been with the inclusion of Austria and Sweden in EU 15. This regularity may provide a 'second guess' as to how new members have in practice been placed in the vote allocation in the growing European Community.[5]

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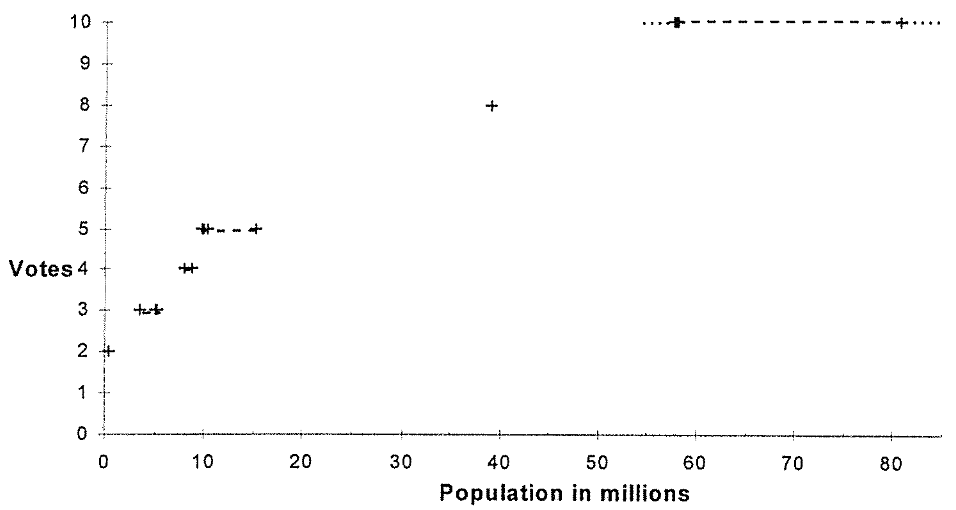
[5] See Paterson [1] (forthcoming).

Figure 1: Vote/Population relationship



2.1 Functional Form

Inasmuch as it can be reasonably assumed that the allocation of votes to member states up till the present was *not* determined by using a formula, it might seem paradoxical to pose the question of a suitable functional form for relating votes to population. What is to be gained by an approximate characterisation of this relationship? It is not merely in order to describe the past or present situation, but rather as a means of estimating how votes will be allocated to new member states in future, based on the previous evidence. Further, it should enable options for possible voting reforms to be generated which nevertheless preserve some of the notable regularities of the present allocation.

Widgrén (1993) proposed a relation between votes *V* and population *P* of the described by the regression equation:

$$\log V = 0.00633(\log P)^{2.465}$$

Certainly at least since the addition of Austria, Sweden and Finland this functional form, even when its parameters are re-estimated, does not provide a *constructive* characterisation of the relationship. By 'constructive' I consider not only the goodness-of-fit (as measured by R^2), but also that the relation is exact to within normal rounding. This latter requirement follows from the requirement that votes take on integer values only. That is to say, if a function $V(P)$ is a good-fit, $V: R^+ \rightarrow R^+$, then the function $f = r \circ V$ is adequate constructively if for each member state i

(1) $\quad V_i \equiv f(P_i), \forall i$, where $r: R^+ \rightarrow I^+$ is the integer rounding function.

It is not surprising that this rounding restriction makes it difficult to find any functional form by using regression which fits adequately. We restrict our attention even further to a particular functional form, the family of functions described by

(2) $V = cP^{\alpha}$ where α, $0 \leq \alpha \leq 1$, is a parameter which determines the 'curvature' of the relation and *c* is a constant.

This family of curves is interesting because of its simplicity and the fact that its extremes correspond to (a) and (b) above, i.e.

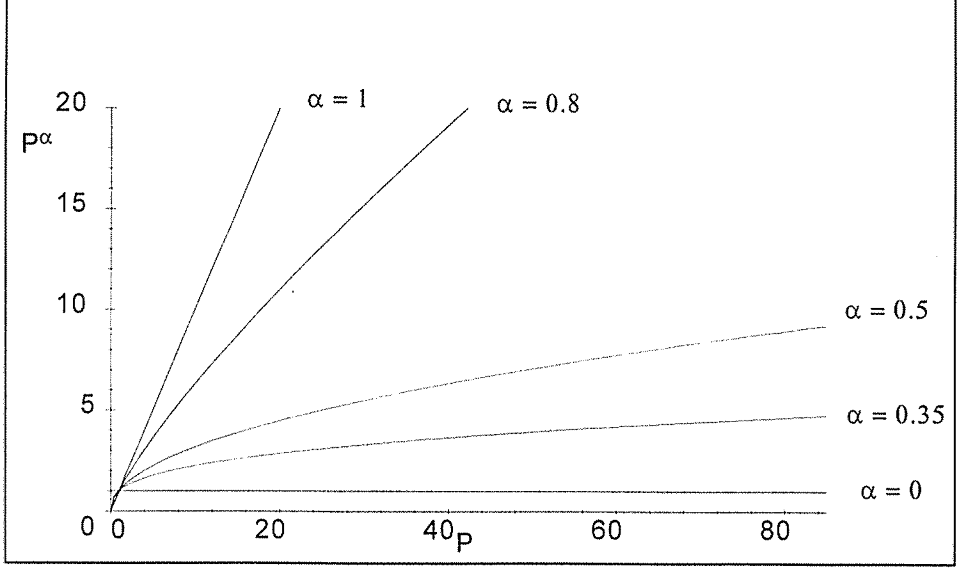
(3) $V_i = c$ $\forall i$ when $\alpha = 0$ - equality

and $V_i = cP_i$ $\forall i$ when $\alpha = 1$ - proportionality

(It is clear why c is described as a constant - multiplication of (2) by another constant $c' > 0$ produces a series of voting weights $cc'V_i$ which have identical vote-shares to (2) for the finite set of members *i*.)

Figure 2 illustrates some examples of "alpha-proportionality".[6]

Figure 2: Power Curves



Using the current data from EU 15, it turns out that requirements (1) and (2) are too restrictive when applied to the whole dataset. This is illustrated in Figure 3, by the upper and lower '*power envelopes*'.

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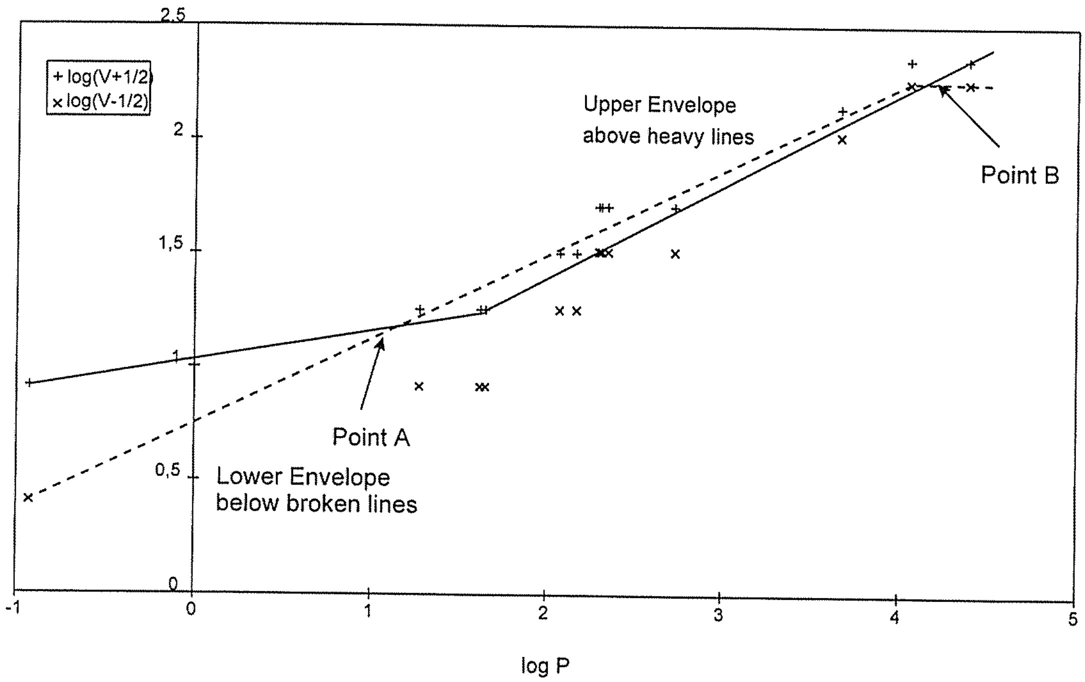
[6] Term coined by F. Turnovec.

For a relation (2) to hold we have $\log V = \log c + \alpha \log P$, i.e. α is the slope of a straight line in the logarithmic plots of votes against populations. For the rounding requirement (1) to hold we should have $\log(V_i - 0.5) \leq \log V_i <$ log $(V_i+0.5)$ for each data point *i*, which is equivalent to the requirement that the line should nowhere intersect the convex hull defined by the set of points $\{(x_i, y_i): x_i = \log P_i, y_i = \log(V_i - 0.5)\}$. Such a line would lie above the frontier of this lower (bound) power envelope (shown as broken line segments). Likewise it would of necessity have to lie below the upper envelope defined by the points $\{(x_i, y_i): x_i = \log P_i, y_i = \log(V_i + 0.5)\}$.

Figure 3: EU 15, Power Envelopes

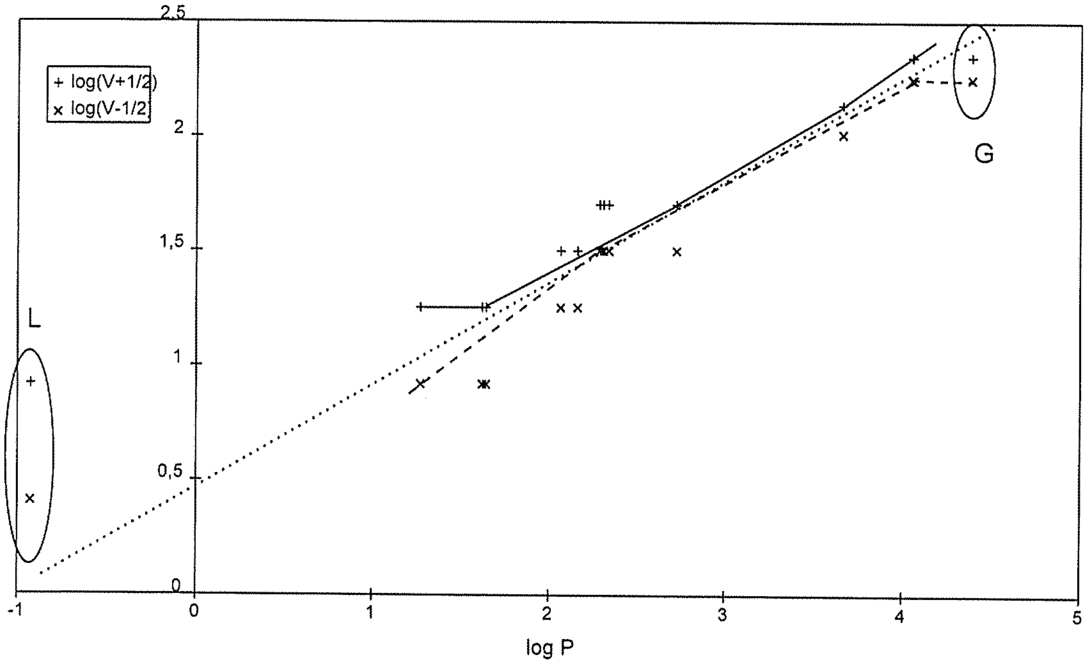


It is evident from Fig. 3 that no such line can fulfil both these requirements, as the upper and lower envelopes intersect at points A and B.[7]

[7] A line constructed between points A and B provides a useful alternative to regression for estimating the parameter α and the constant *c* for equation (2) which uses rounding information - see Paterson [1] - Both these methods, however do not capture the full picture of overall representation as the measure introduced in Section 3 does.

We may however speculate that the 'zone of overlap' is, loosely speaking, reasonably small, indicating that the deviations from the functional form (2) are not so great. Closer inspection of Figure 3 reveals indeed that the data for the two extremes of our set, namely Luxembourg and Germany, are the only exceptions to fitting a model of this form. We may remind ourselves of the extent of 'exceptionality' of the allocation for Luxembourg by referring to Table 2b above, and to the fact of Germany's vote remaining unchanged after unification. Figure 4 shows the revised situation, where the data for L and G are outwith the power envelopes as defined by the remaining data. The upper and lower envelopes now do not intersect, so that, within certain limits, there are lines which pass through without intersecting the envelopes, as does the long dotted line in the diagram.[8] This line has a slope of 0.42 and thus corresponds to a power curve of that degree.

Figure 4: EU 15, Envelopes without L and G



We can therefore obtain the votes for each state, V_i, from the relation

$$(4) \qquad V_i = \begin{cases} \min = 2, & \text{for } P_i < 712{,}000 \\ \langle 1.731 P_i^{0.42} \rangle & \text{for } 712{,}000 \leq P_i \leq 73 \text{ million} \\ \max = 10, & \text{for } P_i > 73\text{m} \end{cases}$$

where the brackets indicate integer rounding.

[8] It can be shown that the lower and upper limits for α are 0,419 and 0,457 respectively.

2.2 Constructing Alternative Vote Allocations

The regularity displayed by (4) above gives us a means to construct alternative vote systems, with more or less 'bias', by varying α and the range of population over which (2) applies. Not every such series, thus obtained, would be likely to be as acceptable, even if the range of votes, $V_i^{\min}$ to $V_i^{\max}$, itself was. The reason lies in the a-priori unknown effect of rounding, which determines the interval of a 'step' in the step-function starts and ends.

To help us in the selection of alternatives we introduce two additional criteria which we might reasonably want to apply to sets of n populations and votes, $\{P_i, V_i\}$,

where $P_i \le P_{i+1}$, $V_i \le V_{i+1}$, $i = 1, \ldots n-1$.

These criteria may be used to test the suitability of similar allocations. The first property[9], viz.

(5) V_i / P_i decreasing with increasing i

ensures a certain minimum difference in population between two countries where a 'step' occurs. As mentioned above, this criteria ceased to hold in the transition from EU 12 to EU 15, with the four votes allocated to both Austria and Sweden. However, the only plausible alternatives, Austria 4 votes, Sweden 5, or five votes for both states, also fail the criterion. Given the votes previously allocated to other countries, and the fact that both of these alternatives would also contradict the regularity revealed by (4) above, the choice made seems appropriate.

The second property demands a simple rule of 'clustering' states with similar populations on the same number of votes. Where P_i are increasing with i and,

(6) given $\{P_i, V_i\}$ and $\{P_{i+2}, V_i + 1\}$, then the weighting for a state of intermediary population should be given by

$$\begin{cases} \{P_{i+1}, V_i\} & \text{if } |P_{i+1} - P_i| < |P_{i+2} - P_{i+1}| \\ \{P_{i+1}, V_i + 1\} & \text{if } |P_{i+1} - P_i| > |P_{i+2} - P_{i+1}| \end{cases}$$

This criterion is met everywhere it applies for the current EU 15. If, say, Sweden had been allocated five votes and Austria four, the criterion would not have been met, as its population is closer to Austria's than it is to Portugal's population.

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[9] For continuous convex functions through the origin, it is equivalent to $\frac{dV}{dP} < \frac{V}{P}$.

There is obviously no binding necessity for alternative vote allocations to be proposed using a relation of the type (4), or indeed for the criteria (5) and (6), being 'rules of thumb', to be adhered to in any proposal - but taken individually or together they offer guidelines for assessing the appropriateness of any alternative.

2.3 Insights into a Proposal for Enlargement

There are already over eight states that have submitted applications to join the European Union, and it is widely expected that the first 'widening' to include some of the current transition economies will occur in the foreseeable future. It is possible indeed to draw up a long list of countries which could be candidates for membership. Based on this hypothetical situation, such a list, together with the number of votes each state would likely have in the Council of Ministers has been proposed at the Centre for European Policy Studies in Brussels (Ludlow 1994). In the light of the foregoing discussion, it seems reasonable to ask whether the proposal is a good extrapolation of current votes, on which it is based. The data for twelve countries together with EU 15 is shown in Table 3, and is referred to, for convenience as EU 27. As before, states are arranged in order of increasing population.

When data for the twelve additional countries is added to Figure 4 the scope for fitting a straight line between the revised upper and lower power envelopes is reduced by new constraints, but interestingly, still just possible. The feasible range for α is now only between 0.420 and 0.424, so that the model (4) still fits the data *constructively.*

Testing the data in Table 3 against criterion (5) reveals only one new infringement, which indicates that the allocation for Latvia is on the borderline between three (as proposed) and two votes; likewise for criterion (6). However if Latvia were to receive two votes some other changes in the allocation would also be required.[10]

[10] It should be noted that there are some other variations to the above proposal which would be consistent with the range of models feasible with respect to the new power envelopes. One such model, with maximum α, allocates Latvia 2 votes, but also Romania 7, and Cyprus 2 by default, the last being in that case outwith the domain of the function; another such model, corresponding to minimum α, allocates Slovakia 4 votes, but this would cause a clear violation of both the criteria (5) and (6).

Table 3: Populations and Votes of Extrapolation Proposal "EU 27"

State	Population (millions)	GDP (m. USD)	Population-share (%)	Votes	Vote-share or %weight
Malta	0.362	3120	0.08%	2	1.52%
Luxembourg	0.397	14233	0.08%	2	1.52%
Cyprus	0.726	7539	0.15%	2	1.52%
Estonia	1.546	4703	0.32%	2	1.52%
Slovenia	1.993	12566	0.42%	2	1.52%
Latvia	2.588	5257	0.54%	3	2.27%
Ireland	3.569	44906	0.75%	3	2.27%
Lithuania	3.747	4891	0.79%	3	2.27%
Finland	5.072	96220	1.06%	3	2.27%
Denmark	5.191	137610	1.09%	3	2.27%
Slovakia	5.345	10145	1.12%	3	2.27%
Austria	7.937	183530	1.67%	4	3.03%
Bulgaria	8.459	9773	1.78%	4	3.03%
Sweden	8.712	216294	1.83%	4	3.03%
Portugal	9.848	77749	2.07%	5	3.79%
Belgium	10.061	213435	2.11%	5	3.79%
Hungary	10.28	34254	2.16%	5	3.79%
Czech R	10.323	28192	2.17%	5	3.79%
Greece	10.376	76698	2.18%	5	3.79%
Netherlands	15.277	316404	3.21%	5	3.79%
Rumania	22.761	25427	4.78%	6	4.55%
Poland	38.446	87315	8.07%	8	6.06%
Spain	39.125	533986	8.21%	8	6.06%
France	57.65	1289235	12.10%	10	7.58%
Italy	57.84	1134980	12.14%	10	7.58%
UK	58.04	1042700	12.18%	10	7.58%
Germany	80.769	1902995	16.95%	10	7.58%
Totals	476.44	7514157	100.00%	132	100.00%

The conclusion is that the proposal is a consistent extension of the present vote allocation. Given that this allocation was originally drawn up for just nine member states, it is perhaps quite remarkable that the regularity implied by (4) can be maintained in this 'maximum' list of candidates,[11] with so few exceptions to the criteria (5) and (6).

[11] If Turkey is added to this list it would presumably be with the maximum of 10 votes, in accordance with population.

3. Measuring the Changing Degree of Representation in the Expanding European Union

The issue addressed in the pervious section deals with the static problem of vote allocation: static in the sense that, given a choice of votes for present member states (whether in accordance with the existing allocation or a revised weighting), new candidates for membership will be allocated votes by 'extrapolation' (rather interpolation). However, with every extension of the EU, the number of members increases, and the share of votes for each country of course decreases, *even although the static vote allocation rule remains the same.*

From the work of Turnovec (1996 and 1997) and Levínský and Silárszky (1997) on voting power, we know that the vote-shares in the Council of Ministers are highly indicative of the effective voting power of member states, as measured by Shapley-Shubik power indices.[12] As we have noted, there is a deliberate 'bias' in the ratio of vote-share to population-share away from strict proportionality in favour of smaller countries: and in general we can say that the smaller the member state, the higher is the ratio of votes to population (c.f. (5) above). Due to the size differences among states, the overall votes/population ratio changes with each extension of the EU.

[12] Among the methods used, the Shapley-Shubik Index (1954) is most widely used: in common with alternative measures, e.g. Banzhaf-Coleman (1965, 1971 and 1986) and Holler-Packel (1983), the index for each state is a function of the vote-shares (percentages/fraction of total votes) of the entire set of states and likewise is expressed as a percentage/fraction of the sum of all the indices. Formally, for an n-member set, whose *ith* member gets v_i votes, the vote-share v_i^s is given by

$$v_i^s = \frac{v_i}{\sum_{i=1}^{n} v_i}, \quad i = 1,\dots,n \qquad \text{so that} \qquad \sum_{i=1}^{n} v_i^s = 1$$

and the Power Indices P_i are determined by a multi-valued function f^p,

$$f^p : [0,1]^n \to [0,1]^n \quad \text{such that} \quad P_i = f^p(v_i^s) \text{ and } \sum_{i=1}^{n} P_i = 1 .$$

Without stating the conditions under which convergence may occur, it is evident from the calculations in Turnovec (1996) that as n increases, the Pi take on values close to the v_i^s for each i, i.e. $P_i \sim . v_i^s$.

The bottom row in Table 1 (Section 2) shows that this ratio has increased with every enlargement since the present voting allocation was adopted at EU 9 (the only exception is due to German unification.) This trend is also illustrated in Figure 5a where the growth in total votes is graphed against the corresponding growth in EU population; indeed as more and more states join an extended EU the trendline will advance even further into the upper half-quadrant since the candidate members are all 'smaller' countries with the exceptions of Rumania, Poland and Turkey.

Figure 5a: Trends since '73

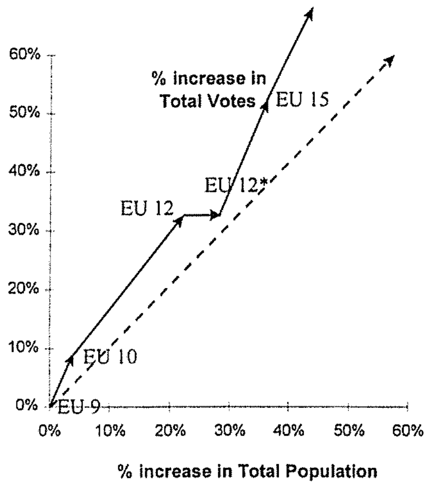
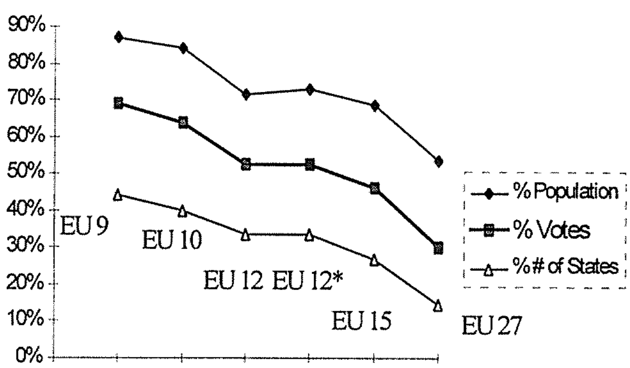


Figure 5b: Relative Shares of the 'Big Four'



There have been concerns expressed, notably emanating from the larger countries, that with extension, the influence of these larger countries is being decreased. And for sure, the population distribution of future candidates for membership has an even lower mean than that of the current EU 15 (c.f. Table 3). The question which is raised is whether these effects are occurring disproportionally. Figure 5b shows the falling share of the vote of the 'big four' states, France, Italy, UK and Germany. Their share of the population also indicates how vote-shares *would have changed* if these were proportional to population; likewise the line showing their percentage of the total number of member states indicates how vote-shares *would have changed* if each state had an equal number of votes allocated. (c.f. (3) above). It would appear that the trend is away from the former to the latter, but this evidence is incomplete.

Whereas Figure 5a does indicate the trend, it does not offers us a basis for comparing alternative voting allocations. And whereas Figure 5b does seem to indicate that the problem of dilution exists, it is not quantified and is partisan to the situation of particular countries. For this reason we introduce in this paper a measure which can be applied to any voting weight allocation, and which is non-partisan.

This section introduces the notion of ***overall representation*** for a given set of *n* member states and proposes an appropriate objective measure based on the data $\{P_i, V_i\}$, $i = 1, \ldots, n$. Once again we start our analysis using the two reference situations, strict proportionality and equality, introduced as (3) in Section 2. The calculation method is illustrated here for EU 6: a fuller treatment will be made available in a subsequent paper.[13] The data for member states is arranged in Table 4 in order of increasing population, which also gives of course non-decreasing votes.

Table 4: Cumulative data for EU 6

State	Populations (millions)	Votes	Population share P_i^S	Voting weight V_i^S	*Cumulative* P_i^S	*Cumulative* V_i^S	*Cumulative # of states*
L	0.397	1	0.002	0.059	0.002	0.059	1/6
B	10.061	2	0.049	0.118	0.051	0.176	1/3
N	15.277	2	0.074	0.118	0.125	0.294	1/2
FR	57.650	4	0.281	0.235	0.406	0.529	2/3
IT	57.840	4	0.282	0.235	0.688	0.765	5/6
G	64.000	4	0.312	0.235	1	1	1
TOTAL	205.225	17	1.000	1			

Three polygonal graphs of cumulative data are plotted in Figure 6 - y-axis data corresponding to cumulative vote-shares, population-shares, and share of the number of states - against cumulative population shares on the *x*-axis. The actual vote system of EU 6 is represented by the middle graph, cumulative vote-shares. If voting weights were instead distributed among states identically to population weights, then the lower graph would result - the line $y = x$. This line thus represents 'proportionality'. In this case, votes would fully be representative of the size of population of member states. On the other hand, were votes to be distributed equally among states, say one per country, then the upper graph - the cumulative no. of states, or 'equality' - would result. In this case the population size of a member state has no bearing whatsoever on the votes, in other words the votes allocated are a nil representation of population sizes. The extent of the upper area between 'equality' and 'actual' is thus strongly indicative of the representation of population size implied by the actual votes' weighting. We define[14] the ***Coefficient of Population Size Representation,*** $\mathbf{c}^R$:

(7) $\mathbf{c}^R$ = *Area between Votes and # of States Graphs /*

Area between Population and # of States Graphs

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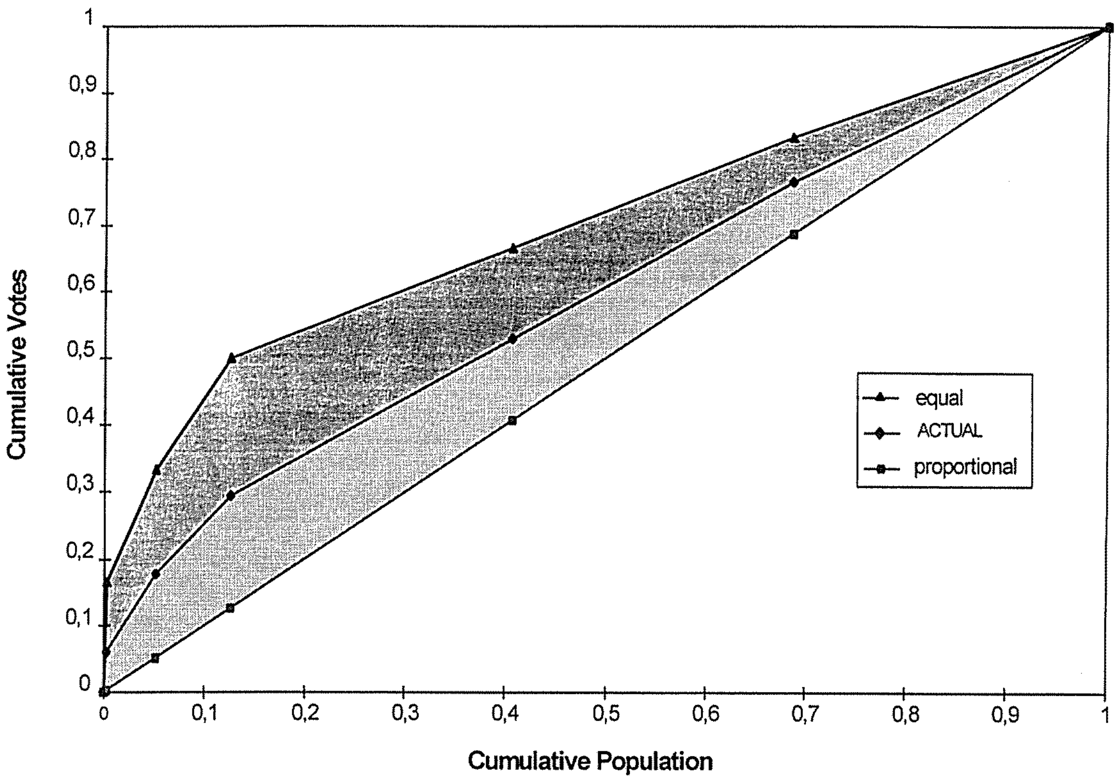
[13] See Paterson [2] (forthcoming).

[14] This definition is precise in terms of the data $\{P_i, V_i\}$ even although we state it in words. It is easy to state in mathematical terms - see Paterson [2] - but does not add here to our understanding.

Figure 6: EU 6 - Area Coeff = 0.53



In Figure 6, c^R is thus measured by the ratio of the area of the darker zone to that of the whole shaded area. Thus,

(8) $0 \leq c^R \leq 1$ and $c^R = 0$ iff votes are equal

$c^R = 1$ iff votes are proportional to population

In the case of EU 6, $c^R = 0.528$.

This measure has certain interesting properties: it is non-parametric, being independent of any particular functional form relating votes to population; it retains its validity even when the vote allocation system is reformed, as was the case in the transition from EU 6 to EU 9; and it responds as expected to the change in population occurring with German unification.[15]

The measure may be regarded as being based on the notion that each citizen of every state of the EU is accorded a share of the voting weight accruing to her/his state. States are ordered from 'richest' in vote-share to 'poorest'. The normed integration implied by using areas thus returns a *measure of overall representation* over the entire population of the EU.

[15] Budden and Monroe (1993) estimate an α coefficient using the power curve relationship of (2) which, in common with my own regression results - see Paterson [1]., does not exhibit as much explanatory power.

Alternatively, the coefficient may be said to be measuring the extent of proportional representation. And when presented in percentage terms we refer to the *'degree of representation'*.

The reader may be aware of some similarity in the construction of this coefficient and measures of concentration, notably the Gini Coefficient, as used, for example, by the World Bank to index the extent to which countries' income is less or more evenly distributed among individuals in their economies. (World Bank 1996). This connection should underscore the validity of our measure, but it should be noted that the Coefficient of Representation and the Gini Coefficient each measure significantly *different* phenomena.[16]

Figures 7a - 7b show the cumulative graphs for EU 9, ... ,EU 15 and also EU 27, as defined in the Section 2.

The upward shift in the coefficient to 0.559 from 0.528 in EU 6 indicates that the new voting allocation adopted for EU 9 was indeed a reform which benefited larger members. In fact only the allocation of Luxembourg, the smallest member, changed relatively - adversely for that country (Luxembourg's vote doubled from one to two, all others increased by a factor of 2.5). in the light of this, and as measured by the three percentage point increase in the coefficient, we may regard this new allocation as having been a minor reform. This increase in the degree of representation was indeed offset by the entry of Greece in EU 10, when the coefficient again reached 0.53. As we have seen in Section 2, a lasting justification of this reform has rather been that it has enabled a differentiation in votes allocated to other more recent members consistent with the original EU 9 scale.

Despite Spain belonging to the group of member states with above-average population, its accession together with Portugal also accompanied a net decrease in overall representation - c.f. Fig. 7c. (If this seems surprising, compare Fig. 5a above.) The increase in population of the EU's largest member, Germany, - shown in EU 12* - of course exacerbated the decline in representation. (Note that this fact is inadequately demonstrated by Fig. 5a.) Likewise the most recent extension, with smaller new members Austria, Finland and Sweden, has brought the coefficient to a new low value of 0.45.

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[16] The main difference in construction is that we are dealing essentially with two distributions, say populations and votes, related only by the requirement $P_i \leq P_j \Rightarrow V_i \leq V_j, \forall i, j$, whereas the Lorenz Curve is based on one, say income, distribution. Nevertheless, after a suitable reinterpretation of the variables, and by inverting the sense of the plot, we may calculate 'related' Gini Coefficients, c^G_V and c^G_E for actual and equal votes w.r.t. populations, respectively. (c.f. Bruckmann (1989), Piesch (1975)). We can show that $\boldsymbol{c}^R = 1 - c^G_V / c^G_E$. This relation is non-trivial: $\boldsymbol{c}^R$ and c^G_V yield different patterns of behaviour for our data! - see Paterson [2].

Cumulative Graphs of Representation

Fig. 7a: EU 9 - c^R = 0.559

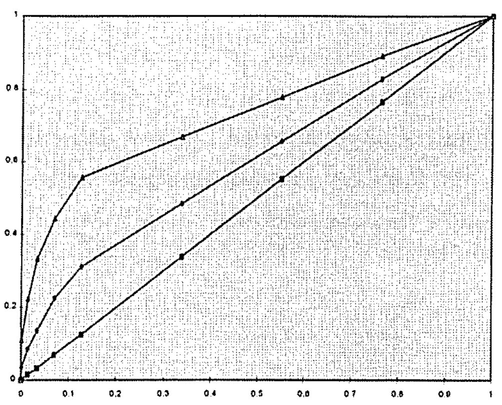


Fig. 7b: EU 10 - c^R = 0.525

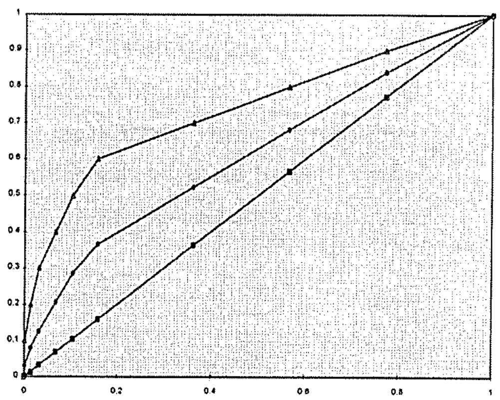


Fig. 7c: EU 12 - c^R = 0.504

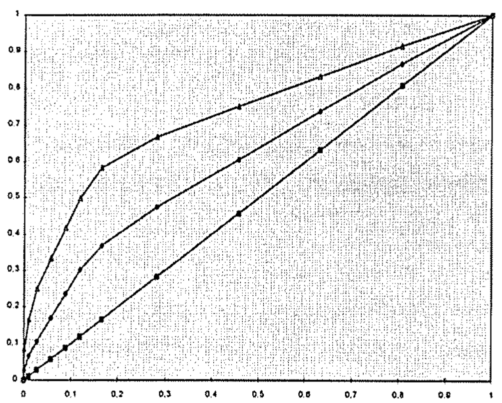


Fig. 7d: EU 12* - c^R = 0.464

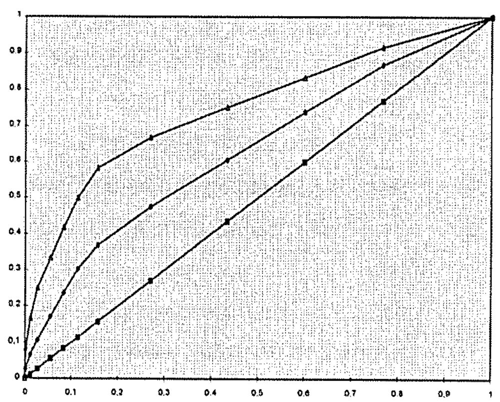


Fig. 7e: EU 15 - c^R = 0.450

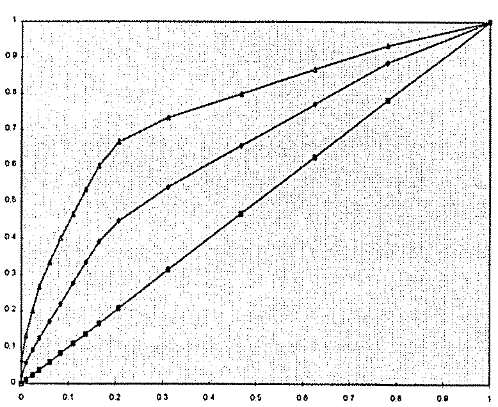
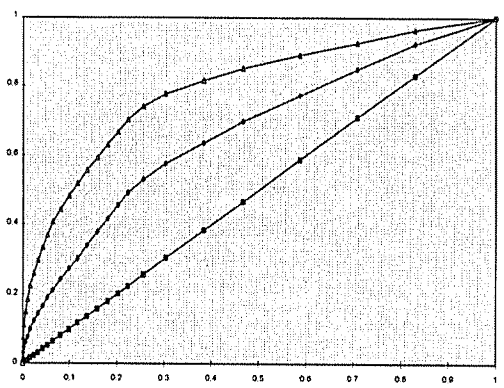


Fig. 7f: EU 27 - c^R = 0.428



Altogether, since the minor reform of EU 9, the accession of states of overwhelmingly below-average size (despite the falling average! [17]) has meant that the degree of representation has fallen by 19.4 percent to its present level, to the extent that we may objectively refer to a *dilution of representation*. This considerable decrease thus expresses quantitatively the extent to which the vote distribution among the present member states has become more akin to the extreme of 'one country one vote' than it was when this voting system was originally launched. And due to the fact that states which are likely candidates for future membership of the EU have also overwhelmingly smaller populations, the downward trend will continue in the future. The only redeeming feature is that the marginal effect of new entries on the coefficient is somewhat reduced: this can be concluded from Fig. 7f where the $\boldsymbol{c}^R$ is calculated as 0.428.

It is indeed a certainty that a new low degree of representation will be reached with the first extension of the EU into East Central Europe. Assuming, for example, that this group comprises Czech R., Hungary, Poland, Slovakia, and Slovenia, the coefficient of representation will be 0.441, i.e. 21.1 percent lower than EU 9. The only possibility of avoiding this scenario would be if the current Inter-governmental Conference should agree to an 'upward' reform of the vote allocation system, that is to say for example, relatively higher weighting for larger member states than is the case at present, leading to a higher degree of representation. Some possible options for reform are considered in the next section.

3.1 Other Uses of the Coefficient of Representation

The Coefficient of Size Representation is defined in a quite general way: it can be applied in other contexts. First of all we may consider two other institutions of the EU decision making process - the Commission and the European Parliament. In both of these organs votes may be identified with member states. We should bear in mind that the Commission is the supreme decision proposing body representing the entire Union, and that commissioners are generally 'Ministers' for an entire sector e.g. trade, agriculture etc. and are not first and foremost representatives of their country of origin. Nevertheless commissioners have until the present been selected from member states on the basis of a formula - one each for smaller states, two for larger states - and it is interesting for us to compare the degree of population representation as a whole for this institution with that of the European Council. Likewise we are aware that elections to the European Parliament are contested between the political parties in each member state, and that these parties have for the most part joined forces with kindred parties in the Parliament in Strassbourg to produce groupings of European conservatives, social democrats, liberals, etc. Nevertheless it is inevitable that some resolutions of the EP will be influenced by 'national' considerations, in which case it is instructive to compare its coefficient of representation with those of the Council and the

[17] It is a notable feature in itself that the population distribution of European countries is such that no country has a population between the mean of EU 6 (34.2 million) and EU 15 (24,7 million); of future candidates, only Rumania has a near average number of inhabitants.

Commission. After all, it is just as clear that the allocation of the total number of members of the EP to each member state has been set in a similar fashion to the Council, except that the discrepancy from proportionality is less marked. Using V_i to stand either for MEP's or commissioners, it still holds that

$$(9) \qquad P_i \leq P_j \Rightarrow V_i \leq V_j, \forall i,j$$

but, as can be seen from Table 5, the Parliament with $\boldsymbol{c}^R$ = 0.72 is considerably more, and the Commission with $\boldsymbol{c}^R$ = 0.30 considerably less, representative of states' population than is the Council.

Table 5: Coefficients of Representation for EU 15 Institutions

c^R based on...	Council	Parliament	Commission
Population	0.450	0.717	0.305
GDP	0.375	0.616	0.261

Another general aspect of our coefficient is that it can measure the vote representation with respect to other variables than population, even if the link with voting weight is less tenuous. Table 5 also shows the results of calculating coefficients of ***GDP representation***. Here it is *not* always the case that $GDP_i \leq GDP_j \Rightarrow V_i \leq V_j, \forall i,j$: GDP's may be highly correlated with populations of EU 15 countries, but the rank orderings differ somewhat. Nevertheless we obtain a consistent basis for calculating $\boldsymbol{c}^R$ by rank ordering the member states by increasing GDP.[18] It is not surprising therefore that the degree of representation of GDP for votes in all three institutions is less 'proportional' by between five and eight percentage points. Despite this observation, the 'closeness' of the results does reflect the correlation of GDP and population.[19]

Further, we may use the coefficient to measure the extent to which the power indices associated with a particular voting system are a representation of population. As mentioned above, these indices are near to relative vote-shares for both simple and qualified majority thresholds[20], but in general tend to be distributed with slightly more bias to larger countries. As an example we note here that the Shapley-Shubik power indices for EU 15 (i.e. voting power relative to a qualified majority of votes) yield a $\boldsymbol{c}^R$ of 0.50 (compared to 0.45 for the voting weights themselves).[21] A more dramatic change in the degree of representation may

[18] In this case the polygonal graph for equal votes still has a gradually decreasing slope.

[19] Coefficients of GDP representation drop much further, between 10 and 15 percentage points, when reasonable assumptions about votes for the commission and parliament for EU 27 are made.

[20] See Footnote 12 and Turnovec (1997a).

[21] We may even express the Power Indices as a representation of the voting weights. For the above data of EU 15 $\boldsymbol{c}^R$ in this case is calculated as 1.10 - Note that the concept can be extended to values greater than 1 - see Paterson [2].

be achieved by the use of double majorities[22]. In principle, however, we can achieve approximately this value of $\boldsymbol{c}^R$ merely by adjusting voting weights accordingly under a single majority system.

4. Evaluating Some Reform Options for European Council Voting

Having identified the extent of regularity in the present vote allocation to member states in the EU Council of Ministers in Section 2, and equipped with the measure of representation introduced in Section 3, we are now in a position to put forward some suggestions for possible change in allocation of voting weights, and to be able to evaluate these suggestions.

There are many political, not to mention economic, ramifications of any change in the voting system, and here is not the place to advocate any particular one. However it is undoubtedly the case that the EU finds itself currently, during the period of the IGC, and perhaps for many years after, undergoing the process of debate about this topic. This contribution should demonstrate that there are means of constructing and evaluating such change, should it be desired.

We consider three options for alternative vote allocations, and the impact of these changes on overall representation in the present EU of 15 members, and also the impact after a hypothetical wide extension to 27 members as presented in Section 2. All three options have been constructed on the basis of the regularity shown by the current vote allocation, as characterised by (4) above. To recall, for all countries in the population range between Ireland and UK a relation described by rounding values calculated from a power curve of the form (2) returns the exact voting weight; at the extremes of population, Malta and Luxembourg receive the minimum vote, and Germany the maximum. There is no ultimately compelling reason to construct alternatives in this manner, but doing so guarantees at least as much regularity in the vote allocation as exists at present.

Options A,B and C have been constructed in a similar manner to (4), with exponent, constant and range of countries in the range of the power function as denoted at the top of Table 6. On the left of the table, voting weights for A,B and C are listed for the present EU 15, together with the coefficient of representation $\boldsymbol{c}^R$ for each option. On the right of Table 6 the corresponding voting weights for the other fifteen candidate states which make up EU 27 are listed, together with $\boldsymbol{c}^R$, which is calculated for the entire EU 27. Voting weights which differ from the current vote allocation (or its extension EU 27) are denoted in bold italics. In all cases the absolute value of the weight increases or stays the same, so chosen for

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[22] We have measured the coefficient of representation of the vector of power indices as reported in Turnovec (1997a), where in this case a simple majority of both voting weights and population is required, as 0.78.

"psychological" reasons - i.e. no member state has votes 'taken away', at least in absolute terms.

Option A, as applied to the full range of 27 states, creates more differentiations by votes - notably a 'second smallest' grouping comprising Estonia, Slovenia and Latvia is introduced, Netherlands is differentiated from the group of countries with approximately ten million inhabitants, and Germany has uniquely the highest vote. At first it appears surprising that the coefficients of representation c^R of this option, both for the group of 15 and the group of 27 countries, barely differ from the existing system (0.45 and 0.43 resp.). However the exponent of option A is 0.4, comparable with that of the existing vote allocation (see Section 2) and this option may be regarded as an extension of the present system over an even wider range of populations and votes. But gains in voting weights for larger countries are offset in this option by gains for many smaller countries, so that the net effect on c^R is nil.

Table 6: Representation Coefficients for Some Selected Alternative Vote Allocations

Option	*A*	*B*	*C*
exponent	0.4	0.55	0.54
constant	2.3	1.29	1.64
range	*all*	*E - UK*	E - UK

EU 15	Option *A*	Option *B*	Option *C*
L	2	2	2
IR	4	3	3
FI	4	3	4
D	4	3	4
A	5	4	5
SW	5	4	5
P	6	5	6
B	6	5	6
GR	6	5	6
N	7	6	7
SP	10	10	12
FR	12	12	15
IT	12	12	15
UK	12	12	15
G	13	12	15
Total	108	98	120
c^R (EU 15)	**0.449**	**0.522**	**0.530**

Additional candidate members of EU 27	Option *A*	Option *B*	Option *C*
M	2	2	2
CY	2	2	2
E	3	2	2
SN	3	2	2
LA	3	2	3
LI	4	3	3
SK	4	3	4
BU	5	4	5
H	6	5	6
CZ	6	5	6
R	8	7	9
PO	10	10	12
	56	47	56
c^R (EU 27)	**0.427**	**0.509**	**0.532**

Option A therefore brings no benefit in terms of representation and presumably it would not be worthwhile implementing this alternative. Ideally we would prefer to construct an alternative vote allocation given a target value of representation: in the absence of prescribed target value for $\boldsymbol{c}^R$ we consider the possibility of changing the voting weights in such a way that the degree of representation returns to a level above 50% which the voting system initially exhibited, i.e. on its introduction in EU 6 or after the reform of EU 9.

Options B and C have been selected according to this criteria, in other words to counter the effects of 'dilution'.

We can see from Table 6 that the $\boldsymbol{c}^R$ for B and C would be around 0.53 if implemented in the present EU, and remain above 0.5 even in the case of EU 27: this compares with 0.43 if the present system is continued. In view of these results we may regard B and C as 'modest reforms'. A more radical upward reform would be needed to raise the coefficient of representation to, say, over 0.6 (c.f. $\boldsymbol{c}^R$ for European Parliament of approximately 0.7).

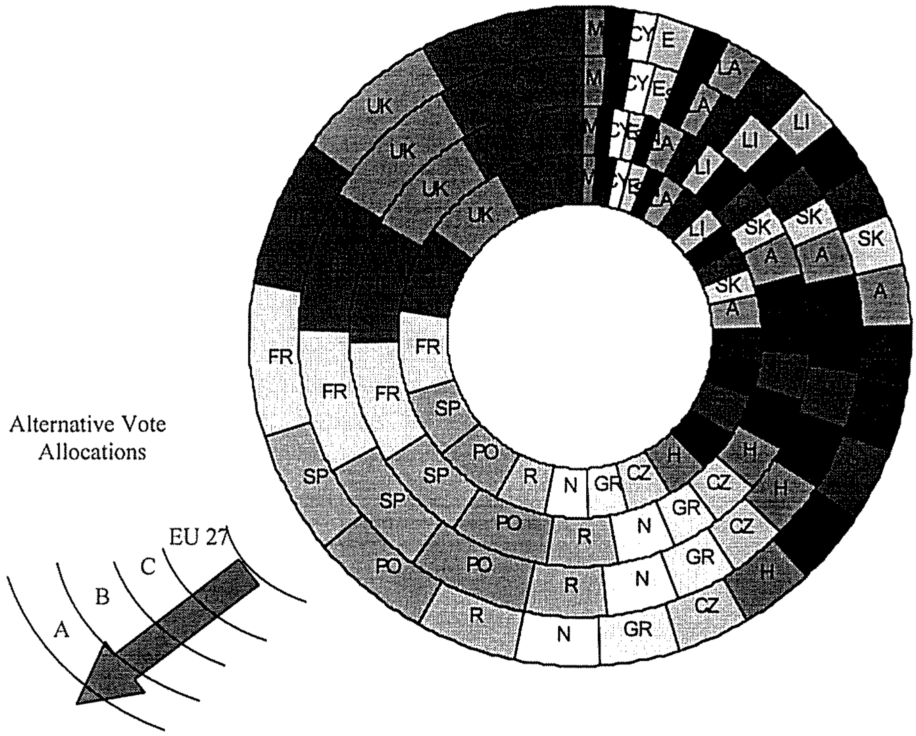
Option C differs from option B more 'psychologically' than in real terms: B increases the nominal vote for large countries only, whereas in C only countries at present having 3 or less votes remain unchanged. An illustration that option B is similar to option C, and option A to the current system, is provided graphically in Figure 8, where the outer and inner bands (A and current system) tend to 'move together', as do the middle bands, i.e. options B and C.

In both B and C, the vote of Germany is kept at the maximum reached by the other three large member states. It seems likely that this compromise, reached implicitly on German unification will be maintained. It is also noteworthy that the allocation for Netherlands is raised above that of Portugal, Belgium and Greece in all the options presented: in the current vote system it was *just* possible to fit a power curve to Netherlands' current voting weight, but in an upward reform a differentiation becomes unavoidable, if a relation of type (4) is to be maintained.

Options A, B and C have been chosen as examples also because of a high degree of regularity: there are no new exceptions to the criteria (5) and (6), in fact A shows improvements with respect to both criteria, and B improves w.r.t. criterion (6).

From the preceding discussion it would appear either of the modest reforms B and C could be implemented in order to raise the coefficient of representation above 0.5, the preference depending on the other considerations mentioned.

Figure 8: Vote - Shares in 27 member EU - Some Options



It is beyond the scope of this paper to consider the political background which would influence particular member states in their preferences for reform or indeed for no reform, but it is worth noting that the vote-shares of six members of the current EU would be increased under options B and C i.e. Netherlands, Spain, France, Italy, UK and Germany. For the other countries the largest drop in vote-share for option B is 0.65% and for option C, 0.95%. It seems unlikely that relative advantage/ disadvantage for member states on this issue alone would determine whether a particular reform will be adopted - for changes to the Treaty unanimity will after all be required.

Without attempting to analyse here the voting coalitions possible, it is noted in passing that whereas at present in EU 15 the combined votes of all members apart from the 'big four' - France, Italy UK and Germany total 47, more than the 44 votes needed for a simple majority in Council, for option B this possibility is only just feasible (the respective figures are 50 and 50), while for C this feature is no longer possible, the maximum amounting to 60, exactly half of the total votes and thus one less than required for a simple majority.

It is likely that the qualified majority voting (QMV) mode of decision making in Council will gain even more in importance i.e. it will be the norm for a wider range of decisions. More detailed analysis of the states and populations represented in possible majorities and blocking minorities in QMV is necessary in considering a particular option. If a suitable reform of voting weights can be found in the manner described in this paper which is acceptable for simple majorities and QMV, then the need to consider other changes may be obviated. Otherwise it is conceivable that alteration of the voting system could be achieved by changing the voting threshold of 71% and by the choice of an appropriate voting weight allocation.

To sum up, we have shown that we can generate options based on the regularities shown by the present allocation but which also imply a higher degree of representation of the whole population of the European Union. However any other suggestion for reforming voting weights can, and should, also be measured against this criterion, regardless of how the allocation is decided upon.

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Appendix:

Constructing and Evaluating Voting Weights as a Combination of Factors: e.g. Demography and Economic Contribution

The methodology used in the main sections of this paper can readily be generalized for cases in which it is desired to base vote allocations on weighted combinations of several factors. One possibility would be to take into consideration economic contribution in addition to demography. We present here a brief outline of the steps involved and illustrate using the population and GDP data for EU 27.

1. A new variable X is formed by choosing a weighting of population-shares P_i^s and GDP-shares G_i^s; for example, if we give twice as much importance to population as to GDP then

   $$X_i = 2/3^* P_i^s + 1/3^* G_i^s \text{ and } \sum X_i = \sum P_i^s = \sum G_i^s = 1$$

2. A suitable range of vote weightings is chosen: in the cases illustrated here a minimum of 1 and maximum of 15.
3. Using the relation $V_i = \langle cX_i^{\alpha} \rangle$ for all 27 states we can calculate upper and lower limits for α: in this case 0.599 and 0.396.
4. Values for α and c are chosen so as to determine voting weights V_i which are acceptable with respect to the criteria (5) and (6) of Section 2 - different values produce more or less cases where the criteria do not hold for some i.

The coefficient of representation with respect to the variable X can be calculated in an analogous manner as in Section 3 (in this case the data are ordered by increasing X) and compared to the usual population representation $\mathbf{c}^R$ and also to GDP representation $\mathbf{c}_G^R$ (ordered by increasing GDP).

It should be noted that the procedure outlined still involves certain discretionary choices - particularly in step 4 - within a general framework of regularity.

Two variants of voting weights based on X , Variant D and Variant E, are shown in the box below for comparison, with degrees of representation of around fifty percent and around sixty percent respectively. The values of the index X shown are percentages.

The values of α and *log c* used to generate Variant D are 0.495 and 3.48 respectively; Variant E uses the maximum values, 0.599 and 3.71 respectively. As is the case previously, a correspondence between the value of α and the coefficient of representation $\mathbf{c}_X^R$ may be observed. For some empirical results see Paterson [2] (forthcoming).

In such cases it is evident that $c_G^R < c_X^R < c^R$, which reflects the fact that X derives from a mix of population and GDP (and c.f. Table 5).

Two Variants Of Voting Weights Based On A Combination Of Population And GDP:
Variant D - Degree Of X Representation 52 - 54%
Variant E - Degree Of X Representation 61%

	Index in %	Voting Weights			Index in %	Voting Weights	
	X	Variant D	Variant E		X	Variant D	Variant E
L	0.12	1	1				
IR	0.70	3	2	M	0.06	1	1
FI	1.14	4	3	CY	0.14	1	1
D	1.34	4	3	E	0.24	2	1
P	1.72	4	4	SN	0.33	2	1
GR	1.79	4	4	LA	0.39	2	1
A	1.92	5	4	LI	0.55	2	2
SW	2.18	5	4	SK	0.79	3	2
B	2.35	5	4	BU	1.23	4	3
N	3.54	6	6	CZ	1.57	4	3
SP	7.84	9	9	H	1.59	4	3
UK	12.75	12	12	R	3.30	6	5
IT	13.13	12	12	PO	5.77	8	7
FR	13.79	12	12				
G	19.74	15	15				
EU 15	c_X^R	0.54	0.61	EU 27	c_X^R	0.52	0.61
	(c^R)	0.57	0.65		(c^R)	0.57	0.68
	(c_G^R)	0.49	0.56		(c_G^R)	0.39	0.47

Some comments on the above: The combination index X gives rise to a somewhat altered ordering of states, reflecting differences in GDP. The coefficient c_X^R measures representation of D and E in their own right, in terms of X, but these alternatives, if they were to be considered as an option for implementation, would be more radical (upward) reforms than Options B and C of Section 4, as instanced by comparison of respective coefficients c^R.

Methodological Conclusions

We have stressed that using a power function, as in (4), to generate alternatives generalizes on the existing vote allocation, but is essentially an arbitrary choice. However there is a very practical spin-off: by choosing values of α which is desired to design voting weights, alternatives with coefficients of representation near to α can readily be constructed.

The method can be extended to calculate coefficients of representation < 0 or > 1: the latter is the case for many election systems, where parliamentary seats gained by parties are disproportional to popular support.

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